# AVIATION AND THE ENVIRONMENT: EMMISSIONS

(110–125)

## HEARING

BEFORE THE

SUBCOMMITTEE ON AVIATION

OF THE

COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE

HOUSE OF REPRESENTATIVES

ONE HUNDRED TENTH CONGRESS

SECOND SESSION

MAY 6, 2008

Printed for the use of the
Committee on Transportation and Infrastructure

U.S. GOVERNMENT PRINTING OFFICE

42–305 PDF WASHINGTON : 2008

For sale by the Superintendent of Documents, U.S. Government Printing Office
Internet: bookstore.gpo.gov Phone: toll free (866) 512–1800; DC area (202) 512–1800
Fax: (202) 512–2104 Mail: Stop IDCC, Washington, DC 20402–0001

## COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE

JAMES L. OBERSTAR, Minnesota, *Chairman*

NICK J. RAHALL, II, West Virginia, *Vice Chair*
PETER A. DEFAZIO, Oregon
JERRY F. COSTELLO, Illinois
ELEANOR HOLMES NORTON, District of Columbia
JERROLD NADLER, New York
CORRINE BROWN, Florida
BOB FILNER, California
EDDIE BERNICE JOHNSON, Texas
GENE TAYLOR, Mississippi
ELIJAH E. CUMMINGS, Maryland
ELLEN O. TAUSCHER, California
LEONARD L. BOSWELL, Iowa
TIM HOLDEN, Pennsylvania
BRIAN BAIRD, Washington
RICK LARSEN, Washington
MICHAEL E. CAPUANO, Massachusetts
TIMOTHY H. BISHOP, New York
MICHAEL H. MICHAUD, Maine
BRIAN HIGGINS, New York
RUSS CARNAHAN, Missouri
JOHN T. SALAZAR, Colorado
GRACE F. NAPOLITANO, California
DANIEL LIPINSKI, Illinois
DORIS O. MATSUI, California
NICK LAMPSON, Texas
ZACHARY T. SPACE, Ohio
MAZIE K. HIRONO, Hawaii
BRUCE L. BRALEY, Iowa
JASON ALTMIRE, Pennsylvania
TIMOTHY J. WALZ, Minnesota
HEATH SHULER, North Carolina
MICHAEL A. ACURI, New York
HARRY E. MITCHELL, Arizona
CHRISTOPHER P. CARNEY, Pennsylvania
JOHN J. HALL, New York
STEVE KAGEN, Wisconsin
STEVE COHEN, Tennessee
JERRY MCNERNEY, California
LAURA A. RICHARDSON, California
ALBIO SIRES, New Jersey

JOHN L. MICA, Florida
DON YOUNG, Alaska
THOMAS E. PETRI, Wisconsin
HOWARD COBLE, North Carolina
JOHN J. DUNCAN, JR., Tennessee
WAYNE T. GILCHREST, Maryland
VERNON J. EHLERS, Michigan
STEVEN C. LATOURETTE, Ohio
FRANK A. LOBIONDO, New Jersey
JERRY MORAN, Kansas
GARY G. MILLER, California
ROBIN HAYES, North Carolina
HENRY E. BROWN, JR., South Carolina
TIMOTHY V. JOHNSON, Illinois
TODD RUSSELL PLATTS, Pennsylvania
SAM GRAVES, Missouri
BILL SHUSTER, Pennsylvania
JOHN BOOZMAN, Arkansas
SHELLEY MOORE CAPITO, West Virginia
JIM GERLACH, Pennsylvania
MARIO DIAZ-BALART, Florida
CHARLES W. DENT, Pennsylvania
TED POE, Texas
DAVID G. REICHERT, Washington
CONNIE MACK, Florida
JOHN R. 'RANDY' KUHL, JR., New York
LYNN A WESTMORELAND, Georgia
CHARLES W. BOUSTANY, JR., Louisiana
JEAN SCHMIDT, Ohio
CANDICE S. MILLER, Michigan
THELMA D. DRAKE, Virginia
MARY FALLIN, Oklahoma
VERN BUCHANAN, Florida
ROBERT E. LATTA, Ohio

## Subcommittee on Aviation

JERRY F. COSTELLO, Illinois, *Chairman*

BOB FILNER, California
LEONARD L. BOSWELL, Iowa
RICK LARSEN, Washington
RUSS CARNAHAN, Missouri
JOHN T. SALAZAR, Colorado
DANIEL LIPINSKI, Illinois
NICK LAMPSON, Texas
ZACHARY T. SPACE, Ohio
BRUCE L. BRALEY, Iowa
HARRY E. MITCHELL, Arizona
JOHN J. HALL, New York, *Vice Chair*
STEVE KAGEN, Wisconsin
STEVE COHEN, Tennessee
NICK J. RAHALL, II, West Virginia
PETER A. DEFAZIO, Oregon
ELEANOR HOLMES NORTON, District of Columbia
CORRINE BROWN, Florida
EDDIE BERNICE JOHNSON, Texas
ELLEN O. TAUSCHER, California
TIM HOLDEN, Pennsylvania
MICHAEL E. CAPUANO, Massachusetts
DORIS O. MATSUI, California
MAZIE K. HIRONO, Hawaii
LAURA A. RICHARDSON, California
JAMES L. OBERSTAR, Minnesota *(Ex Officio)*

THOMAS E. PETRI, Wisconsin
HOWARD COBLE, North Carolina
JOHN J. DUNCAN, JR., Tennessee
VERNON J. EHLERS, Michigan
STEVEN C. LATOURETTE, Ohio
FRANK A. LOBIONDO, New Jersey
JERRY MORAN, Kansas
ROBIN HAYES, North Carolina
SAM GRAVES, Missouri
JOHN BOOZMAN, Arkansas
SHELLEY MOORE CAPITO, West Virginia
JIM GERLACH, Pennsylvania
MARIO DIAZ-BALART, Florida
CHARLES W. DENT, Pennsylvania
TED POE, Texas
DAVID G. REICHERT, Washington
CONNIE MACK, Florida
JOHN R. 'RANDY' KUHL, JR., New York
LYNN A WESTMORELAND, Georgia
MARY FALLIN, Oklahoma
VERN BUCHANAN, Florida
JOHN L. MICA, Florida *(Ex Officio)*

# CONTENTS

**U.S. House of Representatives**
**Committee on Transportation and Infrastructure**
**Washington, DC 20515**

James L. Oberstar
Chairman

David Heymsfeld, Chief of Staff
Ward W. McCarragher, Chief Counsel

John L. Mica
Ranking Republican Member

James W. Coon II, Republican Chief of Staff

May 5, 2008

**SUMMARY OF SUBJECT MATTER**

**TO:** Members of the Subcommittee on Aviation

**FROM:** Subcommittee on Aviation Staff

**SUBJECT:** Hearing on "Aviation and the Environment: Emissions"

**PURPOSE OF HEARING**

The Subcommittee on Aviation will meet on Tuesday, May 6, 2008, at 2:00 p.m., in room 2167 of the Rayburn House Office Building, to receive testimony regarding aviation emission issues.

**BACKGROUND**

As demand for aviation services continues to grow, so too does aviation's possible impact on the environment. The Federal Aviation Administration ("FAA") forecasts that airlines are expected to carry more than 1 billion passengers by 2016, increasing from approximately 769 million in 2007. At the same time, fuel costs are rising, causing air carriers to actively search for increased fuel efficiencies, which would also have positive impacts on the environment. Currently, aviation accounts for about 3 percent of the world's greenhouse gas emissions ("GHG").[1] A small proportion (roughly two percent) of the atmosphere is composed of GHG (water vapor, carbon dioxide, ozone (nitrogen oxides ("NOx") and water vapor), and methane). According to the National Research Council ("NRC"), these gases change the earth's atmosphere to a temperature warm enough to support life. Water vapor is historically the most abundant GHG; other GHGs trap heat in the atmosphere at a greater rate than water vapor and together these GHGs increase the earth's temperature. The NRC found that "direct atmospheric measurements made over the past 50 years have documented steady growth in the atmospheric abundance of carbon dioxide ("$CO_2$") . . . $CO_2$ has increased by nearly 35 percent over the Industrial Era (since 1750)."[2] Once in, some GHGs reside in the atmosphere for potentially hundreds of years.[3]

---

[1] Intergovernmental Panel on Climate Change ("IPCC"), *Aviation and the Global Atmosphere* (1999).
[2] NRC, *Potential Impacts of Climate Change on U.S. Transportation* (March 11, 2008) at 27.
[3] Id. at 56.

In the last 40 years, aviation emissions per passenger mile have decreased by 70 percent.[4] According to the FAA, $CO_2$ emissions dropped in the United States by 4 percent between 2000 and 2006, at the same time, commercial aviation moved 12 percent more passengers and 22 percent more freight. Without further improvements to engine, airframe technology, or air traffic management, the preliminary computations in the Joint Planning Development Office's[5] ("JPDO") Next Generation Air Transportation System ("NextGen") plan show that aviation noise and emissions are likely to increase by 140-200 percent by 2025 under future aviation growth scenarios unless aggressive actions are taken to control and reduce aviation's environmental footprint. Environmental issues – unless forcefully addressed – could limit the ability to provide the growth in capacity and fully utilize the capabilities of the NextGen program. Along side the potential for growth, the industry has shown a history of self-help. According to the Air Transport Association ("ATA"), the airlines have achieved a 35 percent increase in fuel efficiency since 2001. Though jet fuel represents about thirteen percent of petroleum use, it represents only three percent of the total United States' energy consumption.

## I. U.S. Government Programs

### a. Research

Historically, most of the substantial aviation environmental gains have come from new technologies. The FAA's goal is to encourage a fleet of quieter, cleaner aircraft that operate more efficiently with less energy. The FAA states that solutions that involve technology improvements in engines and airframes in a foreseeable timeframe require successful maturation and certification of new technologies within the next 5-8 years.

In 2004, the National Aeronautics and Space Administration ("NASA") established a five-year goal to deliver technologies (at a near-commercial readiness level) to reduce $CO_2$ emissions of new aircraft by twenty-five percent. NASA aeronautic budgets have continued to decline since 2004 and, in early 2006, NASA's Aeronautic Mission Directorate realigned itself to focus on basic/fundamental research, leaving most of the proposal above underfunded. During this same time period, FAA planned to invest $10 million a year to develop a comprehensive framework of aviation environmental analytical tools and methodologies to assess interdependencies between noise, emissions, and economic performance to more effectively analyze the full costs and benefits of proposed actions.[6] This latter FAA work is ongoing.

NASA's focus on fundamental research leaves other agencies, including the FAA, the job of transitional and applied research, thereby impacting NextGen efforts, which includes several emission and fuel efficiency research and development items. Though NASA still plans to perform JPDO research, it will perform only fundamental research and not developmental work and demonstration projects.

---

[4] IPCC, *Aviation and the Global Atmosphere* (1999).
[5] In 2003, *Vision 100 – Century of Aviation Reauthorization Act* created the JPDO which is responsible for coordinating a public/private interagency partnership to bring the NextGen into use by 2025. The agencies involved include: the Departments of Transportation, Defense ("DOD"), Homeland Security, Commerce, FAA, NASA, and the White House Office of Science and Technology Policy.
[6] FAA, *National Aviation Research Plan, Report of the FAA to the United States*, Washington, DC, (February 2004).

**b. NextGen**

Under the current air traffic control system, controller workload, radio frequency voice-communication congestion, and the coverage and accuracy of ground-based navigational signals impose practical limitations on the capacity and throughput of aircraft in the system, particularly in busy terminal areas near major airports and around certain choke-points in the en route airway infrastructure where many flight paths converge. Both the FAA and independent experts have noted that increasing the national airspace capacity at the rates forecasted would be extremely difficult, if not impossible, using existing infrastructure, technologies and operational procedures.

The NextGen plan consists of new concepts and capabilities for air traffic management and communications, including: navigation and surveillance that rely on satellite-based capabilities; data communications; and enhanced automation. These technologies will allow adaptability by enabling aircraft to adjust more rapidly to unpredictable factors such as weather and traffic congestion. They will also allow for more precise and efficient flight route patterns.

Implementation of NextGen will have a dual impact of modernizing the aviation system while providing benefits to the environment. Among NextGen's goals are the capability to reduce the number of people exposed to significant noise levels; the significant health and welfare impacts of aviation on the population (from $CO_2$, NOx, water quality, particulates); and aircraft fuel consumption rates. Core elements of NextGen include improving operational procedures, introducing new technology in aircraft and engines, and developing alternative fuels. According to the FAA, conversion to a satellite-based, NextGen navigation system would cut emissions and delays by approximately 15 percent. For example, Automatic Dependent Surveillance-Broadcast ("ADS-B")[7] will enable more precise control of aircraft during flights to allow closer separations between aircraft and more direct routing. Continuous Descent Arrivals ("CDA") allows aircraft to remain at cruise altitude longer and avoid excess fuel burn associated with traditional landing procedures as it approaches an airport, therefore decreasing emissions and noise. Area Navigation ("RNAV") and Required Navigation Performance ("RNP") will descend on a precise route, avoiding populated areas and thereby decreasing noise and emissions.

According to the JPDO, an Environmental Management System will be fully integrated into all NextGen operations to ensure that the objective of environmental protection, which allows for sustained aviation growth, will be built into the system. In addition to enhanced air traffic procedures, NextGen will coordinate research into alternative fuels and cleaner/quieter engine and airframe technologies that will be inserted in a timely manner into the fleet and look at cost-effective market-based approaches to limiting GHGs (e.g., emission trading or carbon offsets).

The FAA is also participating in international efforts to accelerate environmentally friendly procedures. The Atlantic Interoperability Initiative to Reduce Emissions was formed in 2007 by the United States and the European Commission ("EC") to enhance air traffic procedure demonstration

[7] ADS-B uses global positioning system ("GPS") satellite signals, transponders aboard the aircraft, and a system of nearly 400 ground stations, to give pilots an unprecedented level of situational awareness. Since the ADS-B data is more accurate and refreshed at a far more rapid rate than is possible with radar, it will allow controllers to more closely sequence aircraft in high congestion areas.

projects. The United States also started a similar cooperative initiative with Australia and New Zealand in February 2008.

## III. Industry Efforts to Reduce Emissions

### a. Air Carriers/Manufacturers

There are significant incentives for airlines to reduce fuel use, especially as fuel costs today represent over 30-50 percent of airline operating costs in the United States. According to ATA, every penny of oil price increase adds $190-200 million a year to industry aviation fuel costs. Air carriers are employing a wide variety of procedures to reduce fuel consumption, including: single-engine taxi procedures and selective engine shutdown during ground delays; cruising longer at higher altitudes and employing shorter, steeper approaches and flying slower; optimizing flight planning for minimum fuel-burn routes and altitudes; investing in winglets to reduce aircraft drag and reduce fuel burn; using airport power rather than onboard auxiliary power units when at the gates; and experimenting with towing aircraft during some portion of travel to and from the gate. Another significant, though expensive way airlines have decreased emissions, is by using newer aircraft.

Innovation in environmental technologies to reduce noise and emissions has produced the bulk (90 percent) of the improvements in environmental performance in the U.S. aviation sector over the past few decades. Investing billions of dollars in research and development, U.S. manufacturers, with contributions by NASA, have made great strides in engine innovations and other technologies to save fuel and decrease emissions in the last three decades. The Boeing 787, for example, comprises a 20 percent decrease in fuel use and $CO_2$ emissions, 60 percent reduction of noise, and 28 percent less NOx over the airplane it replaces. However, manufacturers have expressed concerns that the United States risks losing its global leadership in aeronautics to Europe due to reduced NASA and FAA research and development programs.

### b. Alternative Fuels

Fuel costs are also motivating air carriers, airports and manufacturers to look at innovations in alternative fuels to decrease long-term cost and emissions. In partnership with airlines, airports, and manufacturers, FAA launched the Commercial Aviation Alternative Fuels Initiative ("CAAFI"). CAAFI is leading efforts to develop alternative fuels to ensure an affordable and stable supply of environmentally progressive aviation fuels. CAAFI seeks to promote the development of alternative fuels that offer equivalent levels of safety and compare favorably with petroleum-based jet fuel on cost and environmental bases.

Through CAAFI, participants from industry, government, universities, fuel suppliers, and over a half dozen U.S. government agencies share and collect needed data, and motivate and direct research on aviation alternative fuels. Within CAAFI, there are four teams that work on: fuel certification and qualification; research and development; environmental impact; and, economics and business cases. CAAFI's work to date includes:

- Creating roadmaps to communicate aviation needs and solutions;
- Disseminating flight-test information on synthetic fuels and bio-fuels;

- Supporting research and development on low carbon fuels sourced from plant oils, algae and biomass;
- Understanding life-cycle environmental impacts of production and use of alternative fuels;
- Planning for certification in 2008 of a 50 percent synthetic fuel, 2010 for 100 percent synthetic fuel, and 2013 for bio-fuels;
- Developing a handbook for calculating environmental and economic benefits and costs of alternative fuels for airports; and
- Educating public and private interests on the unique needs and practical solutions for aviation in the area of alternative fuels.

#### c. Airports

Increased flights and load factors challenge airports to increase capacity while mitigating the environmental impact on the local community. The majority of our nation's busiest airports fall in ozone non-attainment areas.[8] Air carriers and airports are working together to decrease emissions and fuel consumption. Electrifying the airport gates to provide preconditioned air and a ground power system improves air quality by eliminating the emissions resulting from the use of the aircraft's internal power generators that are run on jet fuel. Many airports are also putting resources into infrastructure for natural gas, electric, biofuels, and propane refueling stations that benefit the airport and also pubic users, including commercial vans, courtesy shuttles, and taxis. Airports are also participating in the U.S. Green Building Council's Leadership in Energy and Environmental Design program and using renewable energies such as solar and hydroelectric power to heat and cool their buildings. Many airports have recycling programs and high occupancy vehicle ground transportation programs for getting passengers to and from the airport. Since 2005, airports in Clean Air Act non-attainment areas have taken advantage of $6.6 million in FAA Airport Improvement Program funds for infrastructure improvements to reduce emissions through the Voluntary Airport Low Emissions ("VALE") program. The Airport Cooperative Research Program run by the National Academies of Science Transportation Research Board is funding a guidebook on preparing airport greenhouse gas inventories.

### IV. EU Emissions Trading Scheme

On December 20, 2006, the EC published a proposed directive to cover civil aviation under its Emissions Trading Scheme ("ETS"), which is intended to reduce $CO_2$ and other greenhouse gases. According to the European Union ("EU"), its aviation emissions have increased by 87 percent since 1990.[9] The proposed directive unilaterally includes the United States and other non-EU airlines and sidesteps the normal process for dealing with aircraft emissions through the International Civil Aviation Organization ("ICAO") and international air service agreements. Under the current EC proposal, air carriers landing in EU countries would be required to buy 10 percent of their 2004-6 average emissions starting in 2012. Under the rules being proposed by the EU, an airline would have to surrender emissions allowances for the entire duration of its trip. For example, an airline flying from Los Angeles to London, England would pay for the entire 6,000 miles and not just the portion flown in EU airspace. Additionally, not only would the airline be required to pay

---

[8] According to the Environmental Protection Agency, a nonattainment area is a locale that does not meet one or more of the National Ambient Air Quality Standards for the criteria pollutants designated in the Clean Air Act.
[9] EU's aviation emissions have increased dramatically in large part due to the increase of low cost carriers as well as the inefficiencies of 27 separate air traffic control systems.

the EU carbon allowances, joining the EU ETS offers no protection from additional fees put in place by EU member states. Great Britain doubled its air passenger duty fee last year based on an emissions justification. Other EU nations are considering the option of additional fees. The United States is opposed to the current EU scheme stating that it violates international aviation law, offers no protection to U.S. airlines from multiple charges, diverts revenue to subsidize EU industry and governments, and unilaterally mandates a single solution rather than negotiating with the United States and other countries to develop a performance-based approach that recognizes each country's sovereignty to implement appropriate measures.

At its September 2007 Assembly meeting, ICAO agreed that any type of ETS should only be applied **based on mutual consent** between countries. ICAO approved guidance for establishing the structural and legal basis for aviation's participation in an open trading system, and including key elements such as reporting, monitoring, and compliance, while providing flexibility. ICAO also chartered a Group on International Aviation and Climate Change (GIACC) to discuss an international plan to actively address aviation GHGs. Composed of political level officials from 15 key aviation states, the GIACC seeks to find multiple avenues for addressing aviation's climate change contributions. By fall 2009, it will develop a menu of measures from which states may choose to address emissions. These could include performance targets (e.g., fuel efficiency) and cost-beneficial market-based measures (e.g., charges or emissions trading). GIACC's goal is to maintain flexibility so that states choose what is appropriate for their particular market and industry situation.

Another international organization addressing emissions is the Air Transport Action Group (ATAG), which met in Geneva in April of 2008. The ATAG, primarily industry based, agreed on a declaration for commercial aviation to move towards carbon neutral growth and a vision of eventually achieving carbon free technology. ATAG plans to achieve this through focusing on a four-pillar approach to climate change: investment in new technology; increasing operational efficiency; air traffic and airport infrastructure improvements; and appropriate economic measures.

## V. H.R. 2881, the FAA Reauthorization Act

H.R. 2881, which passed the House on September 20, 2007, includes several provisions related to the environment, noise mitigation and land use initiatives. Section 132 allows airport operators to reinvest the proceeds from the sale of land that an airport acquired for a noise compatibility purpose, but no longer needs for that purpose -- giving priority, in descending order, to the following: reinvestment in another noise compatibility project at the airport; reinvestment in another environmentally-related project at the airport; reinvestment in another otherwise eligible AIP project at the airport; transfer to another public airport for a noise compatibility project; and finally, payment to the Airport and Airways Trust Fund.

Sections 503 and 504 allow the FAA to accept funds from airport sponsors to conduct special environmental studies for ongoing federally-funded airport projects, or studies to support approved airport noise compatibility measures or environmental mitigation commitments, or to hire staff or obtain services to provide environmental reviews for new flight procedures that have been approved for airport noise compatibility planning purposes.

Section 505, the CLEEN engine and airframe technology partnership, directs the FAA, in coordination with NASA, to enter into a 10-year cooperative agreement with an institution, entity, or eligible consortium to carry out the development, maturing, and certification of continuous lower energy, emissions and noise engine and airframe technology, including aircraft technology that reduces noise levels by 10 decibels at each of the three certification points relative to 1997 subsonic jet aircraft technology.

Section 506 phases out all civil subsonic jet stage 2 aircraft less than 75,000 pounds in the 48 contiguous states within five years. Section 507, the Environmental Mitigation Pilot Program, funds six projects at public-use airports to take promising environmental research concepts into the actual airport environment to demonstrate measurable reductions of aviation impacts on noise, air quality or water quality.

In addition, section 818, the Redevelopment of Airport Noise Properties Pilot Program, provides new tools to encourage airport compatible redevelopment of noise impacted properties adjacent to airports to ensure joint comprehensive land use planning.

## HEARING WITNESSES
## PANEL I

**Dr. David W. Fahey**
Research Physicist
National Oceanic and Atmospheric Administration

**Mr. Daniel K. Elwell**
Assistant Administrator
Aviation Policy, Planning, and Environment
Federal Aviation Administration

**Dr. Gerald Dillingham**
Director, Physical Infrastructure Issues
U.S. Government Accountability Office

## BRIEFING

**Ambassador John Bruton**
Head of the Delegation of the European Commission to
the United States of America

**<u>HEARING WITNESSES</u>**
**<u>PANEL II</u>**

**Mr. Bill Glover**
Managing Director, Environmental Strategy
The Boeing Company

**Mr. James C. May**
President and CEO
Air Transport Association

**Mr. Douglas E. Lavin**
Regional Vice President for North America
International Air Transport Association

**Mr. Richard L. Altman**
Executive Director
Commercial Aviation Alternative Fuels Initiative

**Mr. Mark Reis**
Managing Director
Seattle Tacoma International Airport

**Captain Mary Ann Schaffer**
Air Line Pilots Association

**The Honorable James Kitchenman Coyne, III**
President
National Air Transportation Association
Former Member of Congress (PA-08)

# HEARING ON AVIATION AND THE ENVIRONMENT: EMISSIONS

**Tuesday, May 6, 2008**

HOUSE OF REPRESENTATIVES,
COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE,
SUBCOMMITTEE ON AVIATION,
*Washington, DC.*

The Subcommittee met, pursuant to call, at 2:30 p.m., in Room 2167, Rayburn House Office Building, Hon. Jerry F. Costello [chairman of the Subcommittee] Presiding.

Mr. COSTELLO. The Subcommittee will come to order.

The Chair will ask all Members and staff and everyone to turn electronic devices off or on vibrate.

The Subcommittee is meeting today to hear testimony on aviation and on the environment emissions. Today, after the first panel, the Aviation Subcommittee will recess while we hear a briefing from Ambassador John Bruton. The briefing is open to the public, and Members can ask questions. After the ambassador's briefing, we will then reconvene the hearing and will hear from the second panel. I will give a brief opening statement. Then I will call on the Ranking Member, Mr. Petri, for any statement that he may have, and then we will recognize our witnesses.

I welcome everyone to the Subcommittee hearing today on aviation and the environment, in particular, emissions. Globally, commercial aviation accounts for about 3 percent of emissions, and with 1 billion passengers expected to fly in the United States by 2016, we need to responsibly manage aircraft emissions. Here at home and across the globe, more is being done to reduce energy consumption and emissions. Airlines, airports, manufacturers, and the Air Force are at the forefront of developing better planes, technology and operating procedures to conserve fuel and to reduce emissions.

They are an example of how improvements are driven by necessity as fuel costs are the largest single expenditure for the airlines, accounting for about 40 percent or more of their total expenditures. In the last month, fuel has greatly affected the aviation industry, causing four carriers to file bankruptcy and other carriers to reduce capacity. Every penny increase in the price of jet fuel results in an additional $195 million in annual fuel costs for the U.S. airline industry.

To combat this, aircraft fuel efficiency has improved by almost 31 percent since 1990. On April 22nd, 2008, the ATA committed to work towards an additional 30 percent fuel efficiency improvements by the year 2025. Research also continues in engine efficiency, airframe aerodynamics and in the use of lighter materials like the composites currently being used by Boeing on the 787. The implementation of NextGen will also have a positive impact on the environment, including fuel-efficient operation procedures, the introduction of new airframe and engine technologies and in developing alternative fuels.

This is another reason why we need to move forward on modernizing our air traffic control system and in continuing to urge the FAA to produce and meet its timelines for modernizing our system.

I am pleased to see that Boeing completed its first biofuels flight with Virgin Atlantic early this year and that it is working on fuel cells for future aircraft. I am also interested in hearing more about coal to liquids—CTL—coal to liquids technology and the benefits that it may bring to this discussion. I have been a long supporter of clean coal technologies. The United States has at least a 250-year supply of coal. Given that CTL fuels can be used in existing planes and engines and that they can help reduce our reliance on foreign sources of oil, I believe that CTL production should be pursued.

Further, airports are facing a significant challenge to increase capacity while also managing the environmental impacts on local communities. Many airports are putting resources into infrastructure for natural gas, solar, electric, biofuels, and propane refueling stations that benefit the airports and many public users such as commercial vans, courtesy shuttles and taxis.

I am interested in hearing more from SeaTac on its recycling program and on its greenhouse gas emissions inventory. Under H.R. 2881, the FAA Reauthorization Act of 2007, which passed the House on September 20th of last year, we provided historic levels of funding to upgrade our air traffic control system, to improve efficiency and to invest in aviation research. Other programs to reduce our carbon footprint in H.R. 2881 include the Clean Engine and Airframe Technology Partnership and the Green Towers Program, which was modeled after what is currently being done at O'Hare International Airport in Chicago. We continue to wait on our friends in the other body, in the Senate, to act on legislation to reauthorize the FAA so that we can move forward to going into conference and in producing a bill that can be sent to the White House.

Finally, the European Union has proposed an emissions trading scheme to reduce emissions. Due to the global nature of aviation, I strongly believe that any effort to reduce emissions should be done by consensus through ICAO and must maintain economic growth while we are reducing emissions.

I, again, welcome all of our witnesses today. I look forward to hearing your testimony.

Before I recognize the Ranking Member, Mr. Petri, for his opening statement or remarks, I ask unanimous consent to allow 2 weeks for all Members to revise and extend their remarks and to submit any additional statements and materials for the record. Without objection, so ordered.

At this time, the Chair recognizes the Ranking Member, Mr. Petri.

Mr. PETRI. Thank you very much, Mr. Chairman, and thank you for calling this timely and important hearing today.

As you pointed out, aviation is essential to the healthy economy and the free flow of travel and commerce worldwide, but as we all know, airplanes are currently solely dependent on petroleum-based fuels that emit greenhouse gasses. According to the FAA, the transportation sector is responsible for about one-quarter of greenhouse gas emissions, but to put things into perspective, aviation is responsible for only 3 percent of U.S. greenhouse gas emissions.

Historically, the aviation industry has taken a leading role in the effort to reduce emissions. Emissions are directly tied to fuel consumption. With the soaring cost of jet fuel, airlines and operators have a clear incentive to reduce the fuel burden. Significant and environmental benefits have come along with the business incentive to conserve fuel.

Multi-billion dollar research and development investments by industry are yielding more efficient, quieter engines as well as lighter, more aerodynamic frames.

It is my understanding that for aircraft of the 70- to 150-passenger size, Pratt and Whitney's newly developed, geared thermal fan engine will increase aircraft fuel efficiency of upwards of 12 percent. Boeing's groundbreaking new 787 Dreamliner design will require 20 percent less fuel, will be 60 percent quieter and will produce 28 percent less noxious oxide emissions than the plane it replaces. I think, on a per-passenger basis, this is about as fuel efficient as a mini automobile on a per mile basis.

Realizing that aviation, like all other industries, is a contributor to greenhouse gas emissions, it is important to note that in the last 35 years the U.S. air transportation system has experienced a sixfold increase in mobility. However, even with that growth in travel, aviation fuel efficiency has seen a 60 percent improvement.

Aviation emissions have been and remain a controversial issue. Aviation's contribution to greenhouse gas emissions has recently received growing attention in our country and even greater attention overseas.

The European Commission has proposed to regulate aircraft emissions in a proposal to add the aviation industry to the European Union's emissions trading scheme. Some have raised the concern that the proposal violates several bilateral agreements, including the recently signed U.S.-EU Open Skies agreement. There are also concerns that it ignores recognized international civil aviation laws.

While the second phase of the EU's emission trading scheme is a vast improvement over the first phase, it is important that proposals to regulate aircraft emissions not unfairly burden an industry that has done so much to reduce its impact on the environment, an industry that we rely on to bring together the world community.

In the U.S., the FAA and this Committee have undertaken several initiatives to address the impact aviation has on the environment. For instance, in this Committee's current FAA reauthorization proposal that passed the House last September, we included no less than eleven programs to lower aviation's impact on the environment.

In coordination with the airline industry's emission reduction efforts, the voluntary airport low-emission and continuous low-energy emissions and noise programs have proven themselves successful. It is reauthorized in the House FAA reauthorization proposal. We are committed to continue to advance these programs going forward.

Government has also had a responsibility to continue to invest in fundamental aviation research and development. In fact, for budget year 2009, the FAA plans to invest more than $336 million in research and development.

According to U.S. Government sources, the number of commercial air carriers has doubled since the late 1970s. The number of U.S.-scheduled passenger enplanements has jumped by about 175 percent. Domestic enplanements are projected to grow to over 1 billion by 2016.

As aviation grows, it is critical that it continues to do so in an environmentally responsible manner.

The aviation industry has proven that lessening aviation's impact on the environment can be achieved without strict government regulations. As scrutiny over the aviation industry is on the rise around the world, we must be sure not to hamper productive efforts that have proven effective at reducing emissions. We must also continue our work on developing cleaner-burning, alternative jet fuels.

Clearly, aviation emissions is a complicated issue, requiring a complex and multi-faceted approach, utilizing the expertise and knowledge of the FAA, NASA and of the aviation industry.

In conclusion, I would like to thank all of our witnesses and Ambassador Bruton for coming, and I look forward to your testimony and to the discussion this afternoon.

Thank you, Mr. Chairman.

Mr. COSTELLO. The Chair thanks the Ranking Member.

Before I recognize Members for statements, opening statements or for comments, I want to make sure that Members and everyone are mindful that we are going to have a number of procedural votes on the floor, and we do have nine witnesses who will be testifying at this hearing today.

So, with that, the Chair will now recognize the gentlelady from Texas, Ms. Johnson.

Ms. JOHNSON. Mr. Chairman, thank you very much.

I will just ask unanimous consent to file my statement to save some time. Thank you.

Mr. COSTELLO. The Chair thanks the gentlelady and now recognizes the gentleman from New York, Mr. Hall.

Mr. HALL. Mr. Chairman, I will follow the gentlelady's example and ask that my statement be entered in the record.

I yield back.

Mr. COSTELLO. The Chair thanks the gentleman.

Does any other Member wish to make a statement or a comment?

If not, the Chair at this time will introduce our first panel of witnesses: Mr. David Fahey, who is a Research Physicist with NOAA; Mr. Daniel Elwell, who is the Assistant Administrator over at the FAA for Aviation Policy Planning and the Environment; and Dr.

Gerald Dillingham, who is the Director of Physical Infrastructure Issues with the U.S. Government Accountability Office. Mr. Dillingham has testified here many times before.

So we welcome all of you. The Chair will recognize you, Dr. Fahey, for your opening comments and for your testimony.

We would remind the witnesses that you will be recognized for 5 minutes. Your entire statements will be entered into the record, and then, of course, Members will have questions after the three of you present your testimony.

With that, Dr. Fahey.

**TESTIMONY OF DR. DAVID W. FAHEY, RESEARCH PHYSICIST, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION; DANIEL K. ELWELL, ASSISTANT ADMINISTRATOR, AVIATION POLICY, PLANNING AND ENVIRONMENT, FEDERAL AVIATION ADMINISTRATION; AND DR. GERALD DILLINGHAM, DIRECTOR, PHYSICAL INFRASTRUCTURE ISSUES, U.S. GOVERNMENT ACCOUNTABILITY OFFICE**

Mr. FAHEY. Good afternoon, Mr. Chairman and Members of the Committee.

I am Dr. David Fahey, a Research Physicist with NOAA, the National Oceanic and Atmospheric Administration. Thank you for inviting me to be a witness at this hearing.

I have spent my career studying the atmosphere, with particular emphasis on ozone depletion and climate change, and have been involved with aviation issues in a number of research studies and policy-relevant scientific assessments.

My written testimony addresses the basic aspects by which global aviation affects climate and discusses key uncertainties and knowledge gaps and the understanding of those effects. The results in my testimony are derived from the scientific assessments of the Intergovernmental Panel on Climate Change, or ″IPCC″ as it is commonly known. The IPCC completed an aviation assessment in 1999 and partially updated it in 2007. Here, I will highlight several key points from my testimony.

First, aviation is one of several human activities that contribute to climate change by altering the natural amounts of greenhouse gasses, small particles or cloudiness in the Earth's atmosphere. These activities create what scientists call ″radiative forces″ of climate which can be thought of as pushing the climate away from its current state. Scientists know that if it is pushed too hard the climate state will change, altering basic parameters such as temperature and precipitation.

My next point is that there are three aspects of aviation operations which, when taken together, distinguish aviation from other human activities that contribute to climate change.

The first of these is the aviation burns fossil fuels, releasing a variety of gases and particles into the atmosphere. A number of these emissions contribute to climate change.

Secondly, most aviation emissions occur at aircraft cruise altitudes, well above the Earth's surface, which allows some of those emissions to have a greater effect in the atmosphere and on climate than they otherwise would if the emissions occurred near the Earth's surface.

Thirdly, aviation operations often increase cloudiness along and near aircraft flight tracks. Aircraft contrails shown in my Figure 1, here displayed, are the most familiar form. This is actually a picture over Washington, D.C. This increase in cloudiness contributes to climate change.

So, to recap, aviation has a unique role in climate change because it burns fossil fuels high in the atmosphere and increases cloudiness.

My next point is that the aviation climate impact is a sum of several component effects. A summary is shown in my Chart 1 where the unit of measure is radiative forcing. Current best estimate values are shown there as the bars for the emissions of carbon dioxide, nitrogen oxides, water vapor, sulfate, and soot particles and for cloudiness from contrails. This list reflects the complexity of the aviation climate impact. The total of these terms is positive, the bottom bar there, which means aviation leads to a warming of climate. For perspective, the aviation total is about 3 percent of the total climate forcing from all human activities.

My fourth and final point is that uncertainties and knowledge gaps are associated with aviation's climate impact. Computer models of the atmosphere are required to quantify aviation effects because of the complexity of the processes involved. Model estimates are associated with varying uncertainties because our representation of atmospheric processes and models is incomplete.

Concerning knowledge gaps, two are worth noting here; namely, the lack of best estimates for the impact of contrails as they spread out to form more extensive cirrus clouds and the potential role of aviation particles in modifying cloud formation.

So, in summary, aviation emits gases and particles high in the atmosphere and increases cloudiness. The emissions and cloudiness cause radiative forcings which lead to climate change. Currently, the overall impact of aviation is a positive radiative forcing, which leads to a warming of climate. Uncertainties remain when it comes to quantifying the separate impact of various aviation emissions, and some gaps exist in our knowledge of key processes involving those effects.

So thank you again, Mr. Chairman, for inviting me to testify. I am happy to answer any questions that you might have.

Mr. COSTELLO. Dr. Fahey, we thank you, and we will have some questions for you.

The Chair now recognizes, under the 5-minute rule, Mr. Elwell.

Mr. ELWELL. Chairman Costello, Mr. Petri and Members of the Committee, thank you for the opportunity to testify today.

Given the amount of misinformation circulating today about aviation emissions and climate change, I thought I might try to correct some misperceptions.

Myth: Aviation is the fastest-growing source of greenhouse gas emissions. Fact: Aviation currently represents, as we have heard several times, less than 3 percent of greenhouse gas emissions worldwide. While that number may grow to 5 percent by 2050, the largest aviation market in the world—the U.S.—is burning less fuel today than in 2000.

Myth 2: Aviation emissions have four to five times the impact on climate change because of the altitude where they occur. Fact:

There is nothing unique about emissions from aircraft engines. Just like your automobile, aircraft emissions are about 70 percent C02, 29 percent water and 1 percent other products, including NOx and particulate matter. It does not matter where CO2 is emitted. The climate impact of C02 is well-understood, and it is the same at altitude as it is on the ground.

As my colleague just said, our knowledge of the impacts from the other products is not very good, both as to intensity and, in some cases, even whether there is a net warming or cooling effect.

Myth 3: Other forms of transport are out-performing aviation in fuel-efficiency improvement. Fact: the fuel efficiency of aircraft has improved by 70 percent in the last 40 years. Even over the 20-year period, 1985 to 2005, improvements in U.S. aviation far outpaced the emission intensity improvements in other methods of transport, including automobiles, trains and rail.

Myth 4: European aviation is doing better than U.S. aviation with respect to emissions performance. Fact: between 1990 and 2005, the greenhouse gas emissions of commercial aviation in the European Union grew about three times as fast as those of the U.S. aviation sector. Further, since 2000, while EU aviation emissions rose over 30 percent, U.S. commercial aviation actually burned 4 percent less fuel even though it carried 12 percent more passengers and 22 percent more cargo.

Myth 5: The U.S. opposes the use of market-based measures to address aviation emissions. Fact: During last year's ICAO assembly, the U.S. and most of the world endorsed the utility of market-based measures in general and emissions trading in particular, as long as those measures are implemented for international emissions through mutual consent. Europe disagreed with the mutual consent part of that resolution.

Finally, myth 6: The U.S. has no plan to address aviation's greenhouse gas impacts on climate. Fact: We have placed environmental stewardship at the heart of our efforts to transform the U.S. aviation system through NextGen. We are addressing the challenge of aviation emissions via a five-pillar plan.

Number one: Improve our scientific understanding of the impacts of aviation emissions. As Patrick Moore, cofounder and former leader of Greenpeace, recently noted, "We all have a responsibility to be environmental stewards, but that stewardship requires that science, not political agendas, drive our public policy."

Two: Accelerate air traffic management improvements and efficiencies to reduce fuel burn. We are putting about a billion less tons of CO2 in the atmosphere per year since we implemented the reduced vertical separation minimum in 2005, and we are accelerating the use of enhanced navigation procedures like RNP and CDA to further improve fuel efficiency.

Three: Hasten the development of promising environmental improvements in aircraft technology. The President's budget funds, and this Committee's authorization bill authorizes, a research consortium called CLEEN, which will accelerate the maturation of technology that will lower energy emissions and noise.

Four: Explore the potential of alternative fuels for aviation. The FAA helped form and is an active participant in the Commercial Aviation Fuels Initiative. You will hear from Rich Altman later, the

CAAFI Director, about progress we are making in this area. Alternative fuels will be the game-changer technology that gets us closer to carbon neutrality.

Five: Market-based measures and emissions trading may be useful to reduce emissions if technological operational and procedural improvements are not enough.

Aviation succeeded in its first century because it constantly met the challenge of innovation—flying safer, faster, quieter, and cleaner. Going forward, climate change could be the most significant long-term challenge facing aviation. I am confident NextGen and our five-pillar plan will provide a science-based, technology-driven approach that focuses on performance.

Thank you, Mr. Chairman. I would be happy to answer any questions.

Mr. COSTELLO. Thank you, Mr. Elwell.

The Chair now recognizes Dr. Dillingham.

Mr. DILLINGHAM. Thank you, Chairman Costello, Mr. Petri and Members of the Subcommittee.

In my testimony today, I will address three questions: First, what is the nature and scope of aviation emissions? Second, what is the status of key Federal efforts to reduce emissions? What are some other steps that could be taken to reduce emissions?

Regarding the nature and scope of emissions: Aviation emissions can have adverse health and environmental effects. They contribute to local air pollution on the ground and to greenhouse gases in the atmosphere. Over the last 30 years there has been a steady reduction in aircraft emissions. However, the increased number of flights, coupled with system congestion and delays, has partially offset these reductions. The forecast is for continued growth in air traffic for the coming decades. Some experts have argued that it will be difficult for the technology needed to mitigate emissions to keep up with the forecasted growth in traffic.

Regarding key Federal efforts for reducing emissions: In the near term, the technologies and procedures that are being developed as part of the NextGen to improve the efficiency of flight operations can also reduce aircraft emissions. According to FAA, implementing NextGen technologies and procedures will allow for the more direct routing of flights, which will also improve fuel efficiency and will reduce greenhouse gases between 10 and 15 percent. In the long term, emissions controls are going to be derived from research and development that is focused on increasing fuel efficiency and in mitigating the effects of emissions and noise.

The national plan for aeronautics R&D supports the integrated R&D goals for increasing fuel efficiency and for reducing emissions and noise. One of the goals of this plan is to better understand the nature and impact of aviation emissions. The results of this work are expected to support the development of lower emitting alternative fuels, more efficient air traffic management technologies and procedures and more fuel-efficient aircraft engines. Both the FAA and NASA have developed strategic plans for work that could help to achieve these national goals.

Turning now to next steps going forward: As mentioned, NextGen has the potential to help reduce emissions. Therefore, a first step going forward is that FAA should expedite the moving of

NextGen from planning to implementation. In taking this step, the FAA might consider establishing a single office that would have the authority to implement NextGen and that would be accountable to the FAA Administrator.

Another step for FAA is to deploy and demonstrate as soon as possible an integrated suite of NextGen technologies and procedures that are currently available. Such a deployment could demonstrate the benefits of NextGen, including greater system efficiency and lower emissions. These benefits could also incentivize airlines to equip for operating in the NextGen environment.

A next step for Congress is addressing the decline in Federal funding for aeronautical research. One way that this can be accomplished is by reauthorizing FAA. The House FAA reauthorization bill includes funding for the CLEEN Initiative that could lead to the early maturation of certain emission-reduction technologies. Additionally, FAA is requesting a threefold increase in its budget for R&D, including $688 million for NextGen.

Another step for Congress is to continue considering proposals to address climate change, including market-based mechanisms and other incentives for technological change. These considerations should include the global nature of aviation and the potential unintended consequences of the various proposals.

Mr. Chairman and Members of the Subcommittee, although FAA and the aviation industry have exceptional environmental records, the issue is not past performance but future achievements. Adequately addressing emissions and other environmental concerns must be an integral part of efforts to improve the efficiency, safety and capacity of the national airspace system.

Thank you, Mr. Chairman.

Mr. COSTELLO. Thank you, Dr. Dillingham.

Again, we thank all three of our witnesses on the first panel for your testimony.

Dr. Fahey, talking about research and policy, what discussions need to take place to improve the scientific knowledge of aviation's impact on the atmosphere?

Mr. FAHEY. Thank you, Mr. Chairman.

I think it is very clear that the science is not exactly where you would want it to be if the objective is to evaluate the need for regulation and to follow through with some regulation.

First of all, I think a way to improve the science is to consider updating the IPCC 1999 assessment of aviation. This was an international scientific exercise, much like the climate change assessments that they do, that brought together scientists along with stakeholders, both the industry and policymakers, to consider what was the impact of aviation. Back in 1999, no one really could put a number on it. So a decade hence we are not where we would like to be in terms of having updated that assessment because things have changed. Models have gotten better; the problem has shifted a bit. So that is one thing that could be done.

The second—and it has come up here just in this testimony—is that any assessment of aviation's climate impact and any assessment of whether regulation is appropriate needs to have a scenario of what the future of aviation is going to be, meaning I can speak very clearly today as I did about what aviation has done to date, but I cannot speak nearly as well about what the future is. That is because no one necessarily knows the future.

So, again, scientists could come together with policymakers, aircraft, airline industry representatives, and their stakeholders to develop those scenarios, and those scenarios would address not only expected but also desirable changes in the technology in the operations, in the fuels, and traffic growth. Again, they are things that have already come up here this afternoon.

So, from a scientific point of view, scientists need to know what is most likely going to happen or need to know a range of things so that they can evaluate those scenarios, rather than all possible scenarios, for the climate impacts and then hand those over to the policymakers. Well, first of all, they must finish an international assessment that says what we think those scenarios mean, and then that provides the basis for policymakers.

Then the final thing that could improve the science is simply to strengthen the commitment of U.S. science and regulatory agencies to actually spend quality time carrying through with these things. Again, we have heard that there are ongoing programs that are trying to address these problems, but I think, again, we should strengthen that, and we should, probably more importantly, coordinate that so we do not reinvent the wheel and that we share resources and efforts to bring to bear on this.

Mr. COSTELLO. Thank you.

Dr. Dillingham, in your testimony, you identify a potential research gap for emissions reduction technologies. I wonder if you might talk a little bit about the implications of this gap.

Mr. DILLINGHAM. Yes, Mr. Chairman.

What we are referring to is, prior to, I think, about 2005, NASA, which conducts a significant part of the aeronautical research for the U.S., restructured its portfolio in terms of the kind of research it would do and the level to which it would develop that research. Prior to that time, NASA was developing research to, let us say, the technology readiness level of five or six, which meant that this level was closer to where the industry would pick it up and move it further into the potential for something to be used in the development of a new product design.

Since that time, not only has NASA restructured its research portfolio, but it has seen a significant decline in the amount of money that is available for aeronautical research. Part of what was scheduled for that budget was research that was going to support NextGen technologies and environmental issues for NextGen. So that all had to be reevaluated, reshuffled, and so you had a gap between where NASA was able to take the technology and where industry would pick it up. So that is the gap we are talking about. The proposal that you mentioned in your opening statement—the CLEEN proposal—as well as other provisions within the House reauthorization bill are efforts to close that gap. FAA is also, as I said, trying to close the gap. It has the potential to slow down NextGen if FAA is not able to get that research done that will allow it to move forward with NextGen and emission and noise reduction technologies.

Mr. COSTELLO. Thank you, Dr. Dillingham.

Mr. Elwell, I think we are all very familiar with the FAA's view of the EU legislation, which of course would include U.S. carriers and its emissions trading scheme.

What actions or measures would the FAA or the U.S. Government be prepared to take if, in fact, the EU adopts and applies the legislation to U.S. carriers?

Mr. ELWELL. Mr. Chairman——

Mr. COSTELLO. First, you might, for the record, state the FAA's view of the EU legislation.

Mr. ELWELL. Regarding the EU legislation in its current state, the Administration is against. I want to highlight, obviously, the Administration is not against the effort to reduce emissions. Clearly, we have had pretty good success in recent years.

Right now, the state of the EU legislation is such that its unilateral nature is unacceptable to the U.S., and I would say it is so for quite a number of countries. That is why we have right now the Group on International Aviation and Climate Change which came out of the 36th Assembly last year, which is where this impasse sort of came to a head.

We do not know the final state of the legislation, because it is still being worked on. In fact, it is probably having a little more difficulty between the EU Commission and the Parliament now than it had several months ago. We cannot really make a statement on the legislation. It has not reached its final form.

Mr. COSTELLO. But in its current form, clearly the administration opposes it?

Mr. ELWELL. Clearly.

Mr. COSTELLO. The Chair now recognizes the Ranking Member, Mr. Petri, for any questions he may have.

Mr. PETRI. Thank you.

I really wanted to follow up on the questions you were just asking and maybe lay a little, or help you lay a little foundation for the briefing we are going to be receiving from Ambassador Bruton.

I understand you were over in Brussels some time ago and had considerable discussions. The issue of carbon-based emissions is not an EU problem or an American problem; it is a problem that we feel that needs to be addressed by China and India and Europe and the United States, and so on.

So are there opportunities rather than arguing? What is someone to do? The Europeans are trying to move forward. There are a number of issues when you get beyond the borders of international that are impacting people outside in their own countries, and aviation clearly raises almost all of those issues. Is there some way we can switch this into a positive discussion? Do you have hope that that is going to be possible or are we here in a sort of tit-for-tat facedown?

Mr. ELWELL. Well, certainly, there is hope to come to an agreement. I agree with you, Mr. Petri. This is a global problem, for international aviation as well as maritime. Maritime emissions have unique problems. Because so much of the emissions are emitted internationally, aviation is in a unique position in that, unlike ground-based sources of C02, we have currently—aviation has no alternative propulsion source.

As far as the question of, is there a way to get past this, I think absolutely. I think, Mr. Chairman—Chairman Costello—mentioned phase 2 of the US-EU open aviation negotiations. I think that is an excellent opportunity, and I believe it will be on the agenda to try to figure out a way. The rest of the world believes ICAO still has the mandate to lay out a global framework. To that end, the GIACC, the Group on International Aviation and Climate Change, will be working hard, very hard, over the next 18 months or so to come up with that framework in time to help inform the U.N. process in general.

So, I am a strong proponent, the U.S. is a strong proponent for allowing individual states—respecting sovereignty, for allowing individual states to work with a suite of measures. There are a number of measures that can be used, not just ETS, to achieve set goals. I do believe that we need to set some goals going forward and then allow states the discretion to use this suite of measures necessary to achieve those goals.

Mr. PETRI. Are there opportunities—I should know more about the enforcement mechanism or whatever, but are there opportunities for sort of a carrot approach as well as for a stick approach? We have a relatively older air fleet which can be made much more efficient. I know California, as an example, some years ago discovered the most efficient thing they could do to reduce emissions was to have a bounty on old cars. If we could come up with some system like that as part of this, it would be a great benefit to a leader in industry that I think wants to modernize its fleet but that is really behind the eight ball for a variety of reasons in doing that right now. Most of the sales of these wonderful new composite planes are going to airlines around the world rather than to our domestic fleet because of the financial situation. Are there any ideas of that sort?

Mr. ELWELL. I do not want to answer a sort of "carrot" question with a "stick" answer. I think right now, clearly, the biggest carrot out there is getting the most modern fleet mix. For any user of the aviation system, whether it is a commercial airline or an individual, private owner, getting the most fuel-efficient and modern airframe as soon as possible to reduce this cost of fuel burden is the clearest approach. But I do think—and I noted—there are a number of States that want to incorporate, for instance, an affordable loan program for NextGen equipage. I think that it is innovative, and I think it is a great idea.

Mr. COSTELLO. The Chair thanks the Ranking Member and now recognizes the gentleman from Wisconsin, Mr. Kagen.

Mr. KAGEN. Thank you, Mr. Chairman, for holding this important hearing. Thank you to Ranking Member Petri for leading the way on some of these questions.

Dr. Fahey, am I correct in reading your testimony that there is no other means of propelling our aircraft today other than by using fossil fuels from some source?

Mr. FAHEY. I did not really address that in my testimony. In terms of what we have done so far, that is certainly the case. So I am mostly addressing it in terms of the climate impact of aviation. Looking backwards in time, what has aviation done to date? That ties in with my comment about the need for scenarios where, if you want a scientific assessment of the future of aviation, we first have to discuss what the scenario is of that. The scientists do not define that. We should be handed that, so to speak.

Mr. KAGEN. Right. All of the fossil fuels used in transporting people and goods in aircraft are giving out emissions, as you have stated. There are nitrogen oxide components. There are respiratory irritants in sulfates.

So, as far as you are aware, all of the fossil fuels are not healthy for people, right? You would agree with that?

Mr. FAHEY. Well, certainly, as to some of the byproducts of fossil fuels, that is correct.

Mr. KAGEN. Yet, it is a very small component of what might affect human health?

Mr. FAHEY. That I cannot speak to, but I would guess that is the case.

Mr. KAGEN. With regard to the cap and trade that you mentioned, Mr. Elwell, has there been any consideration on the part of the administration to include the pollution that comes our way from China? As you know, China has developed its economy largely at the expense of the sacrifice of its environment, and their pollutants do not remain in their airspace; they travel over to the United States, to the West Coast. What measures have you taken to include China into any possible cap and trade that moves forward?

Mr. ELWELL. Well, the cap and trade—again, in the aviation context for the U.S., for U.S. aviation's contribution to climate change, the U.S. does not believe cap and trade is appropriate for us. Again, this goes right back to every nation is in a different place. China is a country that is part of the Group on International Aviation and Climate Change. They plan to grow their aviation system 15 percent a year going forward. They see possibly mitigating that by 5 percent with NextGen-like technology. Clearly, they are in a completely different, very robust growth state.

We currently do not have a plan for walling off a cap-and-trade system for other countries' emissions. Again, that is what the global framework is designed to address. It is intended to take into account the different socioeconomic conditions vis-a-vis aviation that other countries are in but still getting to an overall global reduction. I think that is the goal globally, to get a global reduction even while allowing growth where you can allow growth.

Mr. KAGEN. Has the administration at all considered generating or synthesizing fossil fuels by extracting carbon dioxide from the atmosphere and then synthesizing jet fuels much as the Fischer-Tropsch reaction has been shown to do?

Is that beyond your area of expertise?

Mr. ELWELL. That would be beyond my area of expertise.

Mr. KAGEN. That is the safest answer on that one.

I will not ask Dr. Dillingham.

Mr. DILLINGHAM. Thank you.

Mr. KAGEN. Back to you, Dr. Fahey.

Mr. FAHEY. I am aware of that process. It is not clear to me that it is carbon neutral or sufficiently carbon neutral, and I do not know that it has been discussed for aviation.

Mr. KAGEN. Very good.

I yield back my time. Thank you.

Mr. COSTELLO. The Chair thanks the gentleman.

There may be other Members who will have questions to submit in writing, but at this time, we would recognize Mr. Ehlers, the gentleman from Michigan. I understand he may have a few questions.

Mr. EHLERS. Thank you, Mr. Chairman. I have just one fairly brief one for Dr. Fahey.

What can you tell me about the emissions problem at the various altitude levels? Obviously, we have piston aircraft from 0 to 10, maybe 15, and you have jets at varying altitudes. What is the interaction of the emissions with the atmosphere at the different levels? Which are worse and which are better?

Mr. FAHEY. Which altitudes are better?

Mr. EHLERS. Well, I am just wondering what is the byproduct of the emissions. Does it depend on the altitude? Does the interaction of the emissions with the atmosphere vary with altitude? Which is the problem area? Which is less important?

Mr. FAHEY. Well, the short answer is, yes, the effect of emissions is certainly a function of altitude. That is part of its complexity.

As I mentioned in my oral testimony, one of the key distinguishing factors for aviation is the fact that it is up in the atmosphere, well above the Earth's surface. What I did not say is why. The reason why is that the emissions' lifetime or the time before they are actually removed from the atmosphere—as to some of the emissions—increases the higher you put them in the atmosphere. So, if an emission is going to have a deleterious effect, you enhance it by emitting it high in the atmosphere.

This is not true for C02, as you probably well know, because its lifetime exceeds any other one that we are considering, so that is not the issue. The nitrogen oxide is probably one of the more interesting ones. Nitrogen oxides are emitted at the Earth's surface, also in fossil fuel burning, but at altitude nitrogen oxides linger around, so to speak. They interfere or they contribute to ozone production in a way that they do not on the surface of the Earth, meaning they are producing that ozone at the same altitude, and they have an effect on methane, which you may know is a principal greenhouse gas. So that aspect of aviation is one that stands out, for example, that no other sector really is noted for having this dependency. Again, it depends on altitude. So if all aviation—I will conjecture—you know, never flew above 3,000 feet, we probably would not have the NOx—or the nitrogen oxide—ozone methane problem, but the fact that they are more at 30,000 feet, 40,000 feet now, you do.

Then there is another example. A small component is water vapor, that fossil fuel burning releases water vapor. At the Earth's surface that is completely inconsequential, but if you are at the high altitudes and in the troposphere and into the lower stratosphere, now that water is consequential because nature removes most of the water from air as it moves. It circulates in the atmosphere, so the stratosphere is significantly drier by orders of magnitude than the Earth's surface. So if you put in water, even if it looks like it is a small amount, it can have a disproportionate effect. Water vapor, in the case of aviation, is not the largest impact, as you can see from my charts, but it is there; it is measurable; it is quantifiable.

Then of course there are sensitivities, that if you increase the altitude of all aviation you would increase that term where you may reduce other terms.

Then another important example is contrails. As you may know, contrails require cooperation from the atmosphere, that the atmosphere has to be cold enough for a contrail to form and it has to have high enough relative humidity, and that does not happen in the lower regions of the atmosphere. It is too warm. And so you need to go up into the colder troposphere, the lower region of the atmosphere before a contrail is likely to form given current aviation technology. And so if you were to fly all aircraft, I will conjecture, below 3,000 feet you would not have contrails. So, if you look at the chart, contrails are a significant component of the overall contribution to aviation.

So, you see those kinds of trade-offs. It really does matter. For example, the over-the-pole routes that have become popular as a way of shaving distance off of aviation, those flights operate a greater fraction of the time in the stratosphere because the stratosphere is lower in the polar regions. And so an aircraft flying at a constant altitude, which they tend to do, will spend more of its time in the stratosphere as it goes over the poles than it would if it went across the continental U.S. or across the equator. So you can even bring it down to not only does it depend on altitude—well, it does depend on altitude, but it also depends where you are in the latitude-longitude space when you make those emissions.

Mr. EHLERS. Thank you very much. That is very interesting. I apologize. I was detained and could not be here, but I will have to peruse your written statement because I find this very intriguing. Thank you very much.

Mr. COSTELLO. The Chair thanks the gentleman from Michigan and thanks our first panel of witnesses for being here and for your valuable testimony. You are dismissed.

I might ask Ambassador Bruton his time schedule. We have just been called to the floor for votes, and timing is everything around here. There are 10 votes that have been called for, which means that we will recess, and it will be about an hour and 20 minutes. You have one or two options, Mr. Ambassador, depending on your schedule. We could take your briefing, your 5-minute briefing, and if you cannot remain here, we will submit questions to you in writing. We are respectful of your time. In an hour and 20 minutes, we will come back and get to our next panel of witnesses.

So I am giving you the option depending on your time. Do you want to go forward with your briefing? Yes.

The Chair thanks our first panel and will call Ambassador Bruton to the witness table, please.

Now that we have concluded the first panel of the Subcommittee hearing, we will recess the hearing and will proceed to an open briefing by the head of the delegation of the European Commission to the United States, Ambassador John Bruton. During this time, the official reporter will take a break and will rejoin us when we reconvene with the second panel of the hearing.

I welcome Ambassador Bruton. Ambassador, I thank you for being here today, and the Subcommittee appreciates your participation and recognizes that neither this Subcommittee nor the House has jurisdiction over the ambassador.

Ambassador Bruton was the Prime Minister of Ireland from 1993 to 1997. He also had a leading role in the Constitutional Convention of the European Union. He was appointed as a commission head of the delegation in the United States in November of 2004. I have worked, through the Friends of Ireland, with the ambassador in his years as the Prime Minister of Ireland.

Ambassador, we welcome you. We thank you for being here, and we look forward to your briefing.

[Whereupon, at 3:25 p.m., the Subcommittee was recessed, to reconvene at approximately 4:45 p.m., this same day.]

Mr. COSTELLO. The Subcommittee will come to order. The Chair will announce that we hope that we are finished voting for an hour, but we had 10 or more votes but we are hoping that we have a little bit of time we can go to your testimony immediately. And we appreciate your patience.

The second panel, let me introduce quickly Mr. Bill Glover who is the managing director, Environmental Strategy for the Boeing Company. Mr. James C. May, president and CEO of the Air Transport Association. Mr. Douglas Lavin, the regional vice president for North America, International Air Transport Association. Mr. Richard Altman, the executive director, Commercial Aviation Alternative Fuels Initiative. Mr. Mark Reis who is the managing director of the Seattle Tacoma International Airport. Captain Mary Ann Schaffer, the Air Line Pilots Association. And the Honorable James Coyne, the president of the National Air Transportation Association and a former Member of this body.

**TESTIMONIES OF BILL GLOVER, MANAGING DIRECTOR, ENVIRONMENTAL STRATEGY, THE BOEING COMPANY; JAMES C. MAY, PRESIDENT AND CEO, AIR TRANSPORT ASSOCIATION; DOUGLAS LAVIN, REGIONAL VICE PRESIDENT, NORTH AMERICA INTERNATIONAL AIR TRANSPORT ASSOCIATION; RICHARD ALTMAN, EXECUTIVE DIRECTOR, COMMERCIAL AVIATION ALTERNATIVE FUELS INITIATIVE; MARK REIS, MANAGING DIRECTOR, SEATTLE TACOMA INTERNATIONAL AIRPORT; MARY ANN SCHAFFER, AIR LINE PILOTS ASSOCIATION; HON. JAMES COYNE, PRESIDENT, NATIONAL AIR TRANSPORTATION ASSOCIATION, FORMER MEMBER OF CONGRESS**

Mr. COSTELLO. The Chair now recognizes Mr. Glover under the 5-minute rule.

Mr. GLOVER. Thank you, Mr. Chairman, Ranking Member Petri. Members of the Subcommittee, thank you for the opportunity to testify. In view of the hour, I will keep my remarks very short. Recently, the environment has been page 1 news all over the world. At Boeing, we have spent 50 years making environmental performance of our products a cornerstone of our business.

Today, the Boeing Company produces a family of 18 different aircraft, all quieter and more fuel efficient than earlier generations of aircraft. Through ICAO, the industry has reduced the noise footprint around airports and driven down aircraft-specific emissions, carbon monoxide, soot and nitrogen oxides on a world-wide basis. As aircraft are a uniquely mobile asset, designed to fly and be acceptable anywhere in the world, ICAO feels a key role in developing clear global standards. This is critical for Boeing, as 80 percent of our commercial airplanes are delivered outside the United States. We urge Congress to allow ICAO to continue its historic role of regulating aircraft emissions.

Improving aircraft is, of course, only part of the problem—part of the solution I should say. In order to reduce CO2, air traffic management, biofuels and other types of new solutions are equally important. Sustainable alternative fuels can also help reduce aviation environmental footprint. We are focused on second-generation biofuels that do not compete with food sources or require large quantities of land or water. For example, we completed the first-ever biofuel trial with Virgin Atlantic and G.E. earlier this year on a Boeing 747. We are planning a similar demonstration with Continental Airlines in 2009.

Boeing recognizes we must do our part to improve the footprint of aviation. Government must also do its part. Specifically, we urge Congress to foster policies that will enable NextGen to become a reality. We also need to accelerate air traffic management practices and projects that can provide improvements to capacity and reduce emissions. And finally, ICAO should be allowed to fulfill its well-established role of regulating aircraft noise and emissions. Mr. Chairman, thank you for the opportunity to testify.

Mr. COSTELLO. The Chair thanks you, Mr. Glover.

And we now recognize Mr. May.

Mr. MAY. Thank you, Mr. Chairman. I will also be brief. I would like to emphasize three key points. First, that commercial airlines are extremely greenhouse gas efficient; secondly, that we are proactively committed to further limiting our emissions footprint and are aggressively pursuing a plan to achieve that outcome; and third, there is a critical role for the Federal Government to play. Commercial aviation in the United States has a decidedly strong track record that is often overlooked, or, in fact, even misstated. We contribute just 2 percent of domestic greenhouse gas emissions compared to 25 percent for the balance of the transportation industry. This is no small achievement considering the commercial aviation is essential to our economy and supports nearly 9 percent of U.S. employment. Today's airplanes, thanks to Billy and the folks at Boeing and Airbus, are not just smarter. They are quieter, cleaner, use less fuel than ever before, and we fly them smarter. U.S. airlines have been able to deliver more value by constantly improving fuel efficiency. We have improved 110 percent since 1978, resulting in 2.5 billion metric tons of carbon dioxide savings which is roughly equivalent to taking more than 18.7 million cars off the road in each of those years. What is even more amazing is that we burn 4 percent less fuel in 2006 than 2000 yet carried 12 percent more passengers, 22 percent more cargo. So we are delivering the payloads with less fuel and more carbon efficiently.

Today our planes are as fuel efficient as compact cars, carry more goods and people more than six times faster, and our jets are five or six times more fuel efficient than corporate aviation.

U.S. airlines are highly motivated to continue this trend. And this may be one of the most important points I can make. Fuel is our largest cost center, averaging 30 to 50 percent of operating expenses. 2007 the bill was $41.7 billion. Projected 2008 $60 billion and climbing. The market is sending commercial airlines an overwhelming price signal. As demand for air services grows, some growth in aviation services are predicted but that is not a bad thing because we drive more environmentally efficient economy optimizing global value change, creating greater social and economic opportunities. IPCC has estimated that by 2050, we will grow a whopping 1 percent in terms of total greenhouse gas emissions. That is, worldwide we will go from 2 percent to 3 percent.

Now we have got a commitment, ATA carriers, to improve fuel efficiency an additional 30 percent by 2025. That means another 13 million cars coming off the road each of those years. But we are going to have to invest over $730 million in new equipment and airplanes. We have got $20 to $30 billion—and I said million. I meant billion. $730 billion in aircraft. We have a big bill for Next Generation coming up and that recognizing carbon's fuel supply—carbon-based fuel supply can only take us so far, you are going to hear from our friends at CAAFI who are talking about all the great things they are doing for alternative fuels. So Congress can make all the difference.

Four areas I would like to suggest, first, update our outdated air traffic control system, something that you have been leaders on and we have talked about many times. It shows us that we can add 10 to 15 percent on top of the already 30 percent goal that we have got. That is a big, big number. We urge Congress to reinvigorate NASA and FAA environmental aeronautics R&D programs, ask you to spur further commercial development of alternative fuels, and most importantly, we ask Congress to forbear from imposing climate change-related legislation that would work against our efforts.

If we continue our fuel efficiency and other advances, we have got to have the capital to invest. Punitive economic measures that siphon funds out of our industry would severely threaten that progress. If you enact a Lieberman-Warner kind of legislation with cap and trade, it is going to cost us $100 billion over the foreseeable near-term future. And that is money we could use to spend on air traffic control, new planes, avionics, all sorts of things to remain green and as green as any industry in the world. We ask for your help and we appreciate your time.

Mr. COSTELLO. The Chair thanks the gentleman.

And now recognizes Mr. Lavin.

Mr. LAVIN. Thank you, Mr. Chairman, distinguished Members of the Subcommittee. Thank you for the opportunity to brief you on the steps the commercial aviation industry is taking to reduce our environmental footprint. IATA is made up of 235 carriers from some 140 countries that together represent approximately 94 percent of scheduled international traffic.

My colleague, Jim May, has provided you an excellent summary of commercial aviation's impressive environmental record to date and our industry's commitment to further reduce our carbon footprint. For IATA's part, our members have committed to improve our fuel efficiency by 25 percent by 2020. As part of that effort, this year IATA is developing an industry-wide passenger carbon offset program. In the medium term, we will implement a strategy to reach carbon-neutral growth. And over the longer term, IATA has a vision of a zero emissions commercial aviation industry. Significant reductions in carbon emissions will require strong cooperation among air carriers, air frame and engine manufacturers and alternative fuel suppliers. However, the aviation industry cannot achieve these critical targets on our own. We must rely on the support of governments around the world if we are going to reach carbon neutrality. First, as Jim May already stated, we need this Congress to put the right economic incentives in place for the development of radically new green technologies. Second, we need you to take the steps necessary to address the global infrastructure shortage. We need accelerated funding for NextGen and to encourage Europe to deliver on their long-promised Single Sky project. In operations, we need the Congress to promote the optimization of U.S. and global air routes and the FAA's deployment of key capabilities like RNP, RNF, and ADS-B. Third, we need this Congress to set an example for the world by refusing to implement barriers to the airline industry's effort to reduce its carbon footprint. We are strongly opposed to negative economic measures that do nothing to support the environment. Some examples of these negative measures may be useful.

As the Chairman noted previously, the U.K. recently announced its intention to require aviation to pay more of its environmental cost by replacing an already onerous air passenger duty tax with a duty payable based on the size of the aircraft and the distance it is travelling. This extraterritorial scheme violates international law and is simply using the environment as a cover for an effort to address a budgetary shortfall. Likewise, we cannot tolerate including aviation in flawed emissions trading schemes. IATA believes that a properly designed global ETS may help close the gap between growth in aviation and emissions as long as it is accompanied with investments in technology, improved operations and better infrastructure. Unfortunately Europe is proposing to include aviation in an ETS that is anything but properly designed. It is a unilateral regional measure when our mobile industry needs global solutions.

It is extraterritorial to the point that it proposes to control emissions by U.S. carriers while operating in U.S. airspace and over international waters. It would require airlines to buy permits for all of our emissions by 2020, thereby ignoring the progress we have made and our aggressive carbon reduction targets. It is also important to note that the European Commission is now studying how to impose controls on NOx emissions despite existing IKO global controls of these emissions.

Here in the United States, we share Mr. May's concern about the structure of the Lieberman-Warner climate change bill. It proposes to control aviation emissions by requiring fuel producers to acquire allowances to cover the greenhouse gas content of the fuel they sell to the transportation sector. The cost of these allowances would be passed on directly to airlines, thereby serving as a tax on airline operations and ultimately our passengers. To make matters worse, unlike other dirtier and less progressive industries, the producers would not be granted any allowances for the progress we have made to date on fuel efficiency.

We urge the House to oppose the Senate climate tax that only hinders industry's efforts to address this global problem. In closing, IATA and its member airlines are proud of their environmental record and are committed to further aggressively reduce our carbon footprint. We look forward to working with this Subcommittee to promote solutions that allow us to reach our shared green goals. Thank you.

Mr. COSTELLO. The Chair thanks you, Mr. Lavin and now recognizes Mr. Altman.

Mr. ALTMAN. Mr. Chairman, in your April 8 op-ed for The Hill you stated that aviation is leading the way in research in alternative fuels. In testifying today as a representative of that effort, my goal is to provide new information and overall progress on alternative fuel efforts since we last spoke. For those not familiar with CAAFI, the Commercial Aviation Alternative Fuels Initiative is a data gathering communications collaboration that seeks to increase both the quantity and the quality of dialogue amongst airline, airport, manufacturer and FAA sponsors. CAAFI engages multiple government, industry and university stakeholders. Over 20 energy suppliers are now stakeholders in CAAFI. We are global in reach with stakeholders on four continents. CAAFI now sees our catalyst for informed and expedited solutions that serve all components of the supply chain. The goal is to make our relatively small sector of transportation a customer of choice for introducing alternative fuels.

I will focus on three specific areas. First is to make sure that alternative fuels are certified. Second are the environmental considerations for both greenhouse gases and local air quality. Third is establishing an opportunity for buyer-supplier dialogue that can result in aviation being an early buyer for alternative supplies.

The first 4 months of 2008 have seen unprecedented level of activity in all these areas. Regarding certification, on April 11 the Air Force Certification Office approved the new JP8 Mil Spec embracing 50/50 blends of Synthetic Paraffinic Kerosene. These include coal, gas and biomass. This quantification is the first critical break from the long-term certification approach which qualified fuels on an individual producer/individual plant basis. In February, the CAAFI certification team provided a similar proposal for commercial approvals. Taken together, these investments form critical signposts to investors that aviation fuel plan investment is viable. These include plants in Illinois and Ohio with candidates from Rentech, American Clean Coal Fuels and Baard Energy. If initial approvals for these projects are granted this year, initial production will occur as early as 2012.

Promising developments do not stop there. CAAFI's R&D and certification teams are working together to achieve long-term goals of approving sustainable biofuels. Such progress involves fuels from hydrogenated plant oils. Recognizing that just CAAFI having a goal of 2013 for sustainable aviation biofuel is inadequate, we have a roadmap that our R&D team lead and our certification team lead in concert with what the Air Force has put together.

Ultimately, fuel from algae may have the greatest yield of all energy crops, as much as 100 times the yield of current biofuel crops. Commercial aviation's effort and the environment have taken a similar large stride.

The MIT-led PARTNER Center of Excellence's precedent setting Well to Wake environmental life cycle models co-2 outputs for over a dozen candidates fuel types. The first phase of the FAA-funded project is complete. The second iteration is planned.

Work to date on these models suggests that there are a wide range of options that have the potential to outperform current oil refineries in greenhouse gas production. The key characteristics of alternative fuels is that they are extremely low in sulfur and result in small soot parcels, now identified in EPA-issued standards. With over half the airports in the U.S. identified nonattainment areas under the standard use of emerging alternative fuels may be one of the best tools to control growth in PM2.5 exposure that could ultimately limit the growth of commercial aviation.

To ease new fuels introduction to airport markets, CAAFI recommended a project to combine these tools via development of an airport handbook calculation procedure. The TRB Airport Cooperative Research Program initiated that program last year.

The last piece of the puzzle is to have buyers for these new fuels. And I would like to thank Jim for his action on Earth Day to put together a policy on which we can base that dialogue.

Now to ensure that this process is substantive the ATA Energy Council and the CAAFI business and economic team will bring suppliers and airline users together in the September and October time period here in Washington to initiate dialogue.

In closing, I would like to thank you, Mr. Chairman, for your support of CAAFI and I would like to thank publicly the approximately 150 largely volunteer members of the CAAFI coalition for their contributions to these efforts. For most including our team leaders, this is not their day job.

So thank you also to FAA and Dan Elwell for supporting the effort and for recognizing immediately that was a very important part of the puzzle.

Mr. COSTELLO. Thank you, Mr. Altman.

And the Chair, now recognizes Mr. Reis.

Mr. REIS. Mr. Chairman, thank you for the opportunity to testify today about airport efforts to reduce greenhouse gas emissions. While I serve as the managing director of SeaTac Airport, I am also on the board of directors of Airports Council International North America. So, while my testimony today will focus on the progress we have made at SeaTac, but I also represent the broader airport community here today.

Environmental protection has for decades been an integral part of airports' responsibilities. As the public face of the aviation industry in our communities, airports play a leadership role in demonstrating environmental stewardship to the local and global communities we serve. Airports' contribution to aviation's global greenhouse gas emissions is relatively small. And airports have little or no control over some of the larger contributors such as aircraft and private vehicles. But in spite of that limited role, we recognize that everyone has a responsibility to reduce their contribution to climate change, and airports are committed to doing everything appropriate.

Last year, SeaTac Airport prepared a greenhouse gas emissions inventory. Not surprisingly, aircraft were found to be the largest contributor to the 4.7 million tons of CO2 at SeaTac, about 90 percent of the total. Public movement to and from the airport accounted for about 8 percent of that number. And airport-controlled emissions were only 1.4 percent.

The value of the inventory of course is that it allows us to identify opportunities to reduce greenhouse gas emissions and measure our progress. However, we did not wait for the inventory to initiate our focus on emission reductions. For the past several years, we have purchased green power to serve 25 percent of our electric load. We have initiated energy conservation investments that have reduced our electrical energy consumption by 25 percent despite expanding our terminal facilities by 20 percent and have transitioned to many CNG vehicles.

Price signals are a key component to reducing our footprint. Like every other airport, we used to mask the real cost of some of the utilities—power, water, sewer—by including those costs in the airline landing fees.

In 2001, however, we established a utility system using the same rate-making methodology that regulated utility would use to charge airlines, concessionaires and other customers for their actual utility usage. Instantly, these clearer price signals allowed us to demonstrate to our customers the cost effectiveness of conservation measures. We have recently used a similar system to change the economics of waste hauling at SeaTac as well.

Mr. Chairman, we have also found that we can cut greenhouse gases even as we pursue operational and customer service enhancements. For example, our parking pay on foot system and space count systems, our underground fuel hydrant system and the future consolidated hotel shuttle system will all enhance customer service, decrease operating costs for us and our customers, improve local air quality and cut greenhouse gas emissions.

We are working closely with our airline partners in a variety of initiatives to reduce fuel burn and emissions on the ground. In 2006, we opened a ramp tower that has significantly improved the efficiency and safety of ramp operations, saving the airlines 800,000 gallons of fuel each year and reducing emissions by 8,500 tons per year. We also provide airlines the option to power aircraft electrical needs with gate-side electricity, which reduces the need to run auxiliary power units and will soon be providing chargers so the airlines can transition to electric ground service equipment fleets.

We are now designing a centralized preconditioned air system that will save approximately 5 million gallons of aircraft fuel each year, and we are working very closely with Alaska Airlines and the FAA to explore accelerated implementation of an offset RNP approach that could further reduce fuel burn and greenhouse gas emissions.

Mr. Chairman, while airports are quite focused on reducing greenhouse gas emissions, some irports, especially smaller airports with fewer financial resources, could do more. My written testimony includes some suggestions for changes in AIP provisions, over and above those the Committee has already included in the reauthorization bill, that could help airports pursue additional initiatives.

In closing, let me reiterate the greenhouse gas emissions are just one of many important environmental challenges that airports and aviation face each day. We must carefully balance the need to reduce greenhouse gas emissions with a need to reduce impacts from noise and local air quality. In doing so, airports must continue to, and pledge that we will continue to, lead the environmental stewardship role within our communities.

Thank you, Mr. Chairman.

Mr. COSTELLO. The Chair thanks you, Mr. Reis, and now recognizes Captain Schaffer.

Ms. SCHAFFER. Good afternoon Chairman Costello, Ranking Member Petri. I am Captain Mary Ann Schaffer, chairperson of the Air Line Pilots Association's Task Force on Aviation Sustainability and the Environment. I have been an airline pilot for a major network carrier for more than 19 years and certainly serve as an A320 captain. Thank you for the opportunity to represent ALPA's 56,000 pilot members and to present an airline perspective on aviation and the environment.

Airline pilots work at the nexus of air traffic technology, aircraft capability and operational limitation. We bear the ultimate responsibility for the safety of our passengers, cargo and crew.

In our view, any change to regulations, laws or operational initiatives must be based on maintaining or improving aviation safety. To be more direct, pilots must be fully engaged to ensure that ALPA's top priority, safety, remains paramount. That said, pilots fly airplanes powered by engines that burn fuel.

Members of this Committee may remember the thundering noise and plumes of exhaust of a first-generation jet laboring down a runway for takeoff. Thankfully, the noise of today's jets are mere whispers in comparison. In fact, today's aircraft carries 6 times more payload and use 60 percent less fuel.

ALPA pilots' jobs and careers rely on a financially strong and stable airline industry. The current challenges we face are unprecedented. Record high fuel prices, industry consolidation and an aging airspace system that requires complete overhaul. On environmental policy, we also have the added challenge of a patchwork of local, State, national and international environmental regulations or proposed initiatives that add taxes and charges.

So challenges certainly exist but real solutions do too. ALPA is now fully engaged in many initiatives to further decrease greenhouse gas emissions and reduce fuel burn. Let me give you an example. RNP and RNF procedures use satellite-based technology. We can track a shorter lateral path with a more efficient descent profile to a runway. The same techniques are applied to departure paths, allowing for precise ground tracks to minimize noise and provide more efficient climbs to higher fuel-saving altitudes. These procedures have already proven increased efficiency, reduced noise and emissions and lowered pilot and controller workload. Last week, a controller had to issue 10 different heading and speed changes to me as I approached San Francisco. The controller, clearly skilled, timed our arrival onto the landing runway while clearing crossing runway traffic for takeoff between each landing. The skill of the controller maximized runway use, but our approach was far from fuel efficient.

So what can industry and government do to make rapid progress to cut emissions, save fuel and reduce noise?

First, we need a national energy policy that promotes innovation and provides robust funding for energy research and development to find a reasonable alternative to jet fuel. Second, we need to support modernization of the air traffic control system in every way possible, including accelerating NextGen. As an example of inefficiencies in the current ATC system, last month in San Juan, I delayed starting the second engine on my airliner to save fuel on taxi out. Based on my experience operating in and out of San Juan, I elected to start the second engine with three aircraft in front of me for takeoff.

My judgment proved incomplete. We sat for an additional 45 minutes waiting for a significant number of inbound aircraft to land. If I had had all the traffic information available, I would have made a different decision. Current NextGen plans will provide such information sharing.

We also need to back infrastructure improvements like new runways and taxiways such as at O'Hare, Atlanta and Washington Dulles. All of these critical improvements can and must be implemented without imposing new economic burdens on the struggling airline industry. The U.S. airline industry has already made enormous strides in improving its environmental impact without instituting market-based measures. ALPA is committed to helping establish international emissions standards and standard operating procedures to protect the environment, promote the economic health of our industry, and maintain safety. After all, with oil hitting $121 a barrel, our industry already has the economic incentive to save fuel and reduce emissions.

Thank you again for the opportunity to present our view from the cockpit.

Mr. COSTELLO. The Chair thanks you, Captain Schaffer and now recognizes our former colleague, Mr. Coyne.

Mr. COYNE. Thank you very much, Mr. Chairman, and Mr. Ranking Member Petri. As you know, NATA represents some nearly 2,000 aviation businesses at airports across the country from Cahokia, Illinois, to Oshkosh, Wisconsin, and everywhere in between. And at each of those airports there are aviation businesses that are just as committed as some of our larger colleagues in the industry to reducing greenhouse gas emissions. Fundamentally, of course, greenhouse gas emission reduction is a function of aircraft size, engine efficiency and the operational route and procedures that aircraft follows. Small airplanes have the same opportunity to reduce greenhouse gas emissions as larger airplanes.

In fact, as you may know, both of you may know, some of the most efficient aircraft in the world are some of our smallest aircraft. And I am pleased to report that in the last 10 or 15 years, there has been tremendous research advances in both the engine efficiency of small aircraft and the efficiency of the aircraft themselves as the aircraft become lighter, able to make a more efficient use of their time and the engine activity that they have.

We strongly encourage all of the other things that have been said here, especially with regard to airspace redesign and NextGen development. NextGen is going to be one of the most important elements of reducing our greenhouse gases because the tremendous waste that we have already heard from my colleagues at ALPA and IATA and ATA.

But I might point out that smaller aircraft, especially private aircraft and charter aircraft, are uniquely victimized by air traffic control rules that oftentimes lead these aircraft to operate at a much, much lower altitude than is operationally efficient. They are also subject to far more involved routing departures, arrivals many times. Many of the small aircraft pay what amounts to a 50 percent premium in inefficient fuel and waste for a typical flight.

So we strongly support the development of NextGen and hope that we can see Congress in the new FAA reauthorization accelerate the NextGen implementation.

I remember testifying before this Committee in 1994 when the first proposals were advanced from the FAA for NextGen. That was 14 years ago. At that time somebody asked—one of the Members of the Committee asked the FAA experts how long would it take to implement advances in ADS-B and satellite navigation, all of the things that are now part of NextGen. And back in 1994 the answer was: it would take 20 years. Everyone in the room at that time almost laughed, thinking, how could it take 20 years to implement something like that? Well, here we are 14 years later and many would say that we are really not that much closer to implementing the NextGen advances that we need to move forward.

It is up to this Committee to set the timetable I think for NextGen development and I hope that you will take very seriously the opportunity that is now provided by the added fuel cost to make it even more imperative that we bring NextGen to a reality.

NATA and our member firms very much want to be a part of that development, that research. And you will have an opportunity on Monday to see two of the more innovative companies in our industry out at Dulles Airport. We are going to be bringing the Eclipse aircraft and DayJet, and an operational firm down in Florida will be there as well, along with several other small charter operators to demonstrate how small aircraft can be especially efficient in these high fuel cost days.

One of the things to be mindful of is that the entire carbon footprint of a traveller is the sum of all of his travel to the airport, then in the aircraft and then back once he lands. And so for you to get from eastern Illinois up to Oshkosh, Wisconsin, to meet your Ranking Member on an occasion, I submit that taking a private plane may be the most efficient way with the least carbon footprint to get from that point A to point B rather than trying to get to an airline and get on an airplane and then onto a car and so on and so forth.

So please bear in mind that small aircraft are a very important part of the solution, a very important part of working together with government and industry to make this happen. And we hope that some of you can come out to Dulles Airport and see some of these new aircraft next Monday.

Thank you very much.

Mr. COSTELLO. The Chair thanks you, Mr. Coyne.

You can hear the bells. We are being called for additional votes. I have one quick question. I am going to yield to the Ranking Member to ask a question, and then he and I have agreed that we will submit written questions to you. I have some for Mr. Glover, Mr. Lavin and Mr. Altman.

Let me ask you, Mr. Altman, your organization and the Air Force, you have been working on a joint roadmap to achieve full certification of sustainable aviation biofuels. Where are you in the process?

Mr. ALTMAN. Where we are in that process. DARPA, in particular, has completed early research on three different hydrogenated plant oils. In addition, they have programs Centrolium and Tyson Food on a separate item from animal oil.

There may be some additional fuels that Boeing will supply to that process. So we will have about a half dozen different samples by the end of the year that we can put through the certification protocols for what they call fit-for-purpose testing. With that in mind, we have the opportunity then to certify—from what the experts have told me, it will take quite some time to do that. But it would appear with all the engine tests and the component tests that need to be done that this could be accomplished on a generic basis with pure sustainable biojet fuel by 2013.

It will require—the big linchpin in this is, can we get adequate investment to produce 250,000 to 500,000 gallons of biofuel for those tests? That is what the energy companies have told us they need. To do that would require a good $100 million in investment. The way we have approached that is to start a dialogue to incorporate EER&E, the renewable side of DOE and USDA in our dialogue. Perhaps they can be helpful within the environment to get some sustainable biofuel production going along to match up with our efforts in the certification area.

Mr. COSTELLO. I thank you, Mr. Altman. As I said, I have some other questions that I will submit in writing. And the Chair now recognizes the Ranking Member, Mr. Petri.

Mr. PETRI. Well, I would just like to thank you all for your indulgence. Our schedule, as you know, some of you have been here many times before know that we just can't control it. We are doing the best we can under the circumstances. We appreciate your rolling with the punches, so to speak. I just will submit additional questions. But Mr. Coyne, I think in your written testimony, you referred to a kind of a rule of thumb that air transport flights have three times the greenhouse gas effect of surface transportation flights. Is that sustainable? Is that in dispute? That would make quite a difference in all of these discussions.

Mr. COYNE. Well, at altitudes, the consumption of fuel is much, much lower than it is at sea level for the same engine. And because the air—you have a couple of combined effects. The air is, of course, less dense, so you don't need as much force to get through the air. And the efficiency of the engines increases as well. So we—all of us, whether we are flying an Airbus or a Cherokee prefer to be flying as high as we can most of the time. And this is one of the reasons that the continuous ascent approach, the RNP approaches that the NextGen is talking about and especially the ability to get up to altitude as quickly as you can and to stay there as long as you can. And there is a lot of research that needs to be done.

There is mid-level altitudes at the 20,000-foot level we don't know as much about. Because the troposphere there doesn't lead— we don't have the contrails typically developing around 20,000 feet. So we have some of the newer jets which—especially the smaller jets, the DayJet-type aircraft that can operate efficiently at 26,000, 27,000, 28,000 feet may find that it is more from a footprint issue better to operate at that level without the contrails being developed even though the engines aren't quite as efficient as they might be up at 41,000. But we need research because we don't have easy answers. And one of the things we are doing with DayJet and others is get aircraft involved in testing these different issues of altitudes height and, of course, improved approaches into and from airports.

Mr. COSTELLO. The Chair, again, thanks all of you not only for your testimony, but your patience. I know some of you have been here 4 hours. So we do appreciate your testimony and your patience. And we look forward to continuing to work with you and this important issue. With that, the Chair now adjourns. I am so used to recessing today. The Chair now adjourns the Subcommittee.

[Whereupon, at 6:05 p.m., the Subcommittee was adjourned.]

**OPENING STATEMENT OF**
**THE HONORALBE RUSS CARNAHAN (MO-3)**
**TRANSPORTATION AND INFRASTRUCTURE COMMITTEE**
**AVIATION SUBCOMMITTEE**

**Hearing on**
Aviation and the Environment: Emissions

**Tuesday, May 6, 2008**

#####

Chairman Costello and Ranking Member Petri, thank you for calling this important hearing on the impact emissions from aviation operations have on the environment.

Aviation emission's contribution to climate change is well-known, it is now time to make corrective measures, both reactive and proactive to diminish this effect. There is great potential within the aviation industry to ensure our airplanes improve their emissions standards. It is projected that by 2016 airlines are expected to carry more than one billion passengers, which is an increase from seven-hundred-sixty-nine million in 2007. We must take into account future growth of the aviation industry as we work toward improving aviation emission standards.

The passage of the FAA Reauthorization Act last year by the House was an important step in improving emissions standards, as it included provisions related to the environment, noise mitigation and land use initiatives. I was especially happy to see the inclusion of the Environmental Mitigation Pilot Program, which will fund projects to take promising environmental research concepts into the actual airport environment to demonstrate measurable reductions of aviation impacts on noise, air quality or water quality.

Vast improvements have been made to the fuel efficiency of airplanes over the past several decades. That is why I confident if we make a concerted effort we can improve the emissions standards worldwide, and further help the aviation industry, to reduce its effect on climate change.

In closing I would like to thank all our witnesses for joining us today and look forward to hearing their prospective on what we can do to reduce the impact of the aviation industry on the environment.

#####

**STATEMENT OF**
**THE HONORABLE JERRY F. COSTELLO**
**AVIATION AND THE ENVIRONMENT: EMISSIONS**
**MAY 6, 2008**

- I want to welcome everyone to our Subcommittee hearing on Aviation and the Environment: Emissions.

- Globally, commercial aviation accounts for almost 3 percent of emissions. And with one billion passengers expected to fly in the U.S. by 2016, we need to responsibly manage aircraft emissions.

- Here at home and across the globe, more is being done to reduce energy consumption and emissions. Airlines, airports, manufacturers and the Air Force are at the forefront of developing better planes, technology and operating procedures to conserve fuel and reduce emissions.

- They are a perfect example of how improvements are driven by necessity, as fuel costs are the largest single expenditure for the airlines, accounting for 40% or more of their total expenditures.

- In the last month, fuel has greatly affected the aviation industry, causing four carriers to file bankruptcy and other carriers reducing capacity. Every penny in the price of a gallon of jet fuel results in an additional $195 million in annual fuel costs for the US airline industry.

- To combat this, aircraft fuel efficiency has improved by almost 31 percent since 1990. On April 22, 2008, ATA committed to work towards an additional 30 percent fuel efficiency improvement by 2025.

- Research also continues in engine efficiency, airframe aerodynamics, and the use of lighter materials, like composites currently used on the Boeing 787.

- Implementation of NextGen will also have positive impacts on the environment including fuel efficient operating procedures, the introduction of new airframe and engine technologies and developing alternative fuels. This is another reason why I am supportive of moving forward on modernizing our air traffic control system and continue to urge the FAA to produce and meet its timeline and milestones for modernizing our system.

- I am pleased to see that Boeing completed its first biofuels flight with Virgin America earlier this year and is working on fuel cells for future aircraft.

- I am also interested in hearing more about coal to liquids (CTL) technology and the benefits it brings to this discussion. I have long been a supporter of clean coal technologies. The state of Illinois is rich in coal and the United States has a 250-year supply of coal in the ground that we continue to use for half of our electricity production.

- Given that CTL fuels can be used in existing planes and engines without degradation in performance, and that they can help reduce our reliance on foreign sources of oil, I believe that CTL production should be pursued.

- Further, airports are facing significant challenges to increase capacity while also managing the environmental impacts on local communities. Many airports are putting resources into infrastructure for natural gas, solar, electric, biofuels and propane refueling stations that benefit the airport and many public users such as commercial vans, courtesy shuttles and taxis. I am interested in hearing more from SEA-TAC on its recycling program and its greenhouse gas emissions inventory.

- Under H.R. 2881, the FAA Reauthorization Act of 2007, which passed the House of Representatives September 20, 2007, we provide historic levels of funding to upgrade our air traffic control system to improve efficiency and invest in aviation research. Other programs to reduce our carbon footprint in H.R. 2881 include the CLEEN Engine and Airframe Technology Partnership and the Green Towers Program which was modeled after what is currently being done at O'Hare International Airport.

- We continue to wait on Senate action on this legislation so we can proceed to conference.

- Finally, the European Union has proposed an Emissions Trading Scheme to reduce emissions. Due to the global nature of aviation, I strongly believe any effort to reduce emissions should be done by consensus through ICAO and must maintain economic growth while reducing emissions.

- With that, again I welcome our witnesses and look forward to their testimony.

- Before I recognize Mr. Petri for his opening statement, I ask unanimous consent to allow 2 weeks for all Members to revise and extend their remarks and to permit the submission of additional statements and materials by Members and witnesses. Without objection, so ordered.

Opening Statement of the Honorable Eddie Bernice Johnson
House Aviation Subcommittee
Hearing on "Aviation and the Environment: Emissions."
Tuesday, May 6, 2008 – 2167 RHOB

EB Johnson

**Thank you Mr. Chairman.**

**I want to thank you and Ranking Member Petri for holding today's hearing on the implications of aviation operations on our environment, particularly air quality.**

**While much of the committee's attention regarding greenhouse gases has focused primarily on the regulation and progress of over the road transportation sources in reducing their carbon footprint, I feel we should also keep the pressure on other transportation modes as well.**

**It is important to note that airport ground operations, as well as aircraft produce the same harmful emissions as motor vehicles, such as: carbon dioxide, nitrogen oxides, carbon monoxide, and other particulates that adversely impact our environment and the air we breathe.**

**According to the Environmental Protection Agency (EPA) and the Federal Aviation Administration (FAA), greenhouse gas emissions have grown over the past ten years and will increase sixty-percent by 2025.**

**While emissions from airport operations and aircraft represent a relatively small portion of overall local air quality concerns, air pollution from the aviation sector should not and can not be taken lightly.**

**In 2005, the Dallas-Fort Worth region, a region deemed in "non-attainment" by the EPA, airport contribution to area nitrogen oxide represents 6.1%, and aircraft contribution to non-road nitrogen oxide represents 19.9%.**

**While these numbers represent a minimal overall percentage, it underscores the importance of partnership between our airports and air carriers in doing all they can to help minimize greenhouse gases.**

**Dallas-Fort Worth (DFW) International Airport, the world's 3rd busiest airport sitting on 18,000 acres, has made tremendous strides in this area.**

**DFW International Airport recently became the first airport in Texas to achieve the highest level of recognition awarded by the Texas Commission on**

**Environmental Quality (TCEQ) for its continued environmental achievement with acceptance into the Clean Texas Program. This state recognition comes less than a year after DFW earned a place on the U.S. Environmental Protection Agency's National Environmental Performance Track program for Environmental Leadership.**

**Some of the recent environmental accomplishments include: reducing air emissions from operations by 95% due to electric and natural gas conversions; replacing aging boilers and chillers with state of the art technology, reducing nitrogen oxide emissions by 39 tons per year; replacement of aging operational fleets reducing nitrogen oxide emissions by 557 tons per year; and reducing airport's overall energy footprint by 25 million British thermal units.**

**DFW has demonstrated a steadfast commitment to environmental leadership and has been recognized as a role model by the air transportation industry, the Environmental Protection Agency and the Texas Commission on Environmental Quality.**

**While these achievements are certainly commendable, this type of community leadership must be exercised and realized all across the country and throughout the aviation sector in order to obtain meaningful, national progress.**

**As I close I want to thank our witnesses that have come before us to testify this afternoon. I look forward to learning more about what technology-driven initiatives are currently underway to reduce emissions at airports and within the overall aviation system.**

**Thank you Mr. Chairman and I yield back the balance of my time.**

Harry E. Mitchell

Statement of Rep. Harry Mitchell
House Transportation and Infrastructure Committee
Subcommittee on Aviation
5/6/08

Thank you, Mr. Chairman.

As demand for air travel continues to grow, we must be mindful of the impact flying so many aircraft has on our environment.

Like many large metropolitan areas around the country, Phoenix is not new to aviation emissions and noise issues. Sky Harbor is currently the nation's 8th busiest airport.

However, unlike many other metropolitan areas, which are forced to choose between improved capacity and improved noise mitigation, our rapid growth provides us with a unique opportunity to plan ahead, and build for a better future.

Sky Harbor has made a genuine commitment to noise abatement, and that is an important first step.

Innovation in new technologies to reduce noise and emissions has led to significant improvements in environmental performance in the U.S. aviation sector, and we must continue to focus on producing new technologies to ensure that we continue to improve our aircraft and airports.

I look forward to hearing more from our witnesses.

I yield back.

STATEMENT OF
THE HONORABLE JAMES L. OBERSTAR
SUBCOMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE
HEARING ON "AVIATION AND THE ENVIRONMENT: EMISSIONS"
MAY 6, 2008

Global climate change is a result of the tremendous build-up of greenhouse gases - such as carbon dioxide and methane - in the atmosphere. These gases are currently present at far higher levels than they have been in over 10,000 years. These gases are very good at capturing heat energy. As a result, the more that carbon dioxide or methane is emitted into the atmosphere, the more heat energy that is trapped – and the warmer the planet becomes. The world's top atmospheric scientists say that the evidence that the climate has warmed is "unequivocal".

The lion's share of the increase of these greenhouse gases is due to man-made causes: whether it is power-plants, vehicles, or other activities that consume fossil fuels. As to aviation's impact on global warming, however, the Intergovernmental Panel on Climate Change ("IPCC") states that it only accounts for about 3 percent of the world's greenhouse gas emissions ("GHG"). At the same time, fuel costs are rising, causing air carriers to actively search for increased fuel efficiencies, which would also have positive impacts on the environment. In the last 40 years, aviation emissions per passenger mile have decreased by 70 percent. According to the Federal Aviation Administration ("FAA"), $CO_2$ emissions dropped in the United States by 4 percent between 2000 and 2006, at the same time, commercial aviation moved 12 percent more passengers and 22 percent more freight.

The FAA forecasts that airlines are expected to carry more than 1 billion passengers by 2016, increasing from approximately 769 million in 2007. Despite the progress the aviation industry has achieved, an increase of this magnitude, unless aggressively mitigated for the environment, has the potential to limit enhanced capacity throughout the national airspace. As I have stated before, the environment is the third leg of a three-part capacity enhancement initiative – the other two are air traffic control modernization and increased physical capacity at airports. If we succeed in increasing air traffic control modernization and expanding the physical capacity of airports to accommodate more aircraft – and aviation emissions cause public concern, then the other two advances will be nullified. The FAA is working on establishing aviation environmental analytical tools and methodologies to assess interdependencies between noise, emissions, and economic performance to more effectively analyze the full costs and benefits of proposed actions.

One of these proposed actions is the Next Generation Air Transportation System ("NextGen"). The implementation of NextGen will have a dual impact of modernizing the aviation system while providing benefits to the environment. Among NextGen's goals are the capability to reduce the number of people exposed to significant noise levels; the significant health and welfare impacts of aviation on the population (from $CO_2$, NOx, water quality, particulates); and aircraft fuel consumption rates.

Aviation Emissions not only has the potential to limit capacity domestically, it also has an impact internationally. According to the European Union ("EU"), its aviation emissions have increased by 87 percent since 1990. As a result, the European Commission ("EC") proposed emissions trading scheme that would unilaterally include the United States and other non-EU airlines and sidesteps the normal process for dealing with aircraft emissions through the International Civil Aviation Organization ("ICAO") and international air service agreements. Under the current EC proposal, air carriers landing in EU countries would be required to buy 10 percent of their 2004-6 average emissions starting in 2012.

I am opposed to the EU emissions trading scheme because it violates international aviation law, offers no protection to U.S. airlines from multiple charges, diverts revenue to subsidize EU industry and governments, and unilaterally mandates a single solution rather than negotiating with the United States and other countries to develop a performance-based approach. I am concerned about any unilateral approach to dealing with aviation emissions, and believe that any efforts to reduce emissions should be done by consensus through ICAO.

So hopefully today's hearing will identify the role aviation plays in green house gases, what the U.S. government is doing to mitigate these emissions, identify industry efforts, and determine what others are doing around the world.

I look forward to the testimony of our witnesses.

**TESTIMONY TO THE HOUSE TRANSPORTATION COMMITTEE**

**AVIATION SUBCOMMITTEE**

**HEARING ON AVIATION AND THE ENVIRONMENT: EMISSIONS**

**Richard L. Altman**

**Executive Director,**
**Commercial Aviation Alternative Fuels Initiative (CAAFI)**

**May 6, 2008**

Thank you Mr. Chairman and members of the Subcommittee for providing the Commercial Aviation Alternative Fuels Initiative with the opportunity to testify on the compelling issues of Aviation and the Environment: Emissions.

Mr. Chairman thank you as well for acknowledging Aviation's efforts in alternative fuels in particular. In your April 8 Op-ed for "The Hill" you stated that "the (aviation industry) is leading the way in research on alternative fuels. Besides the positive impact on the bottom line, there are obvious positive environmental impacts from these efforts, with lessons for the rest of the country". It is particularly gratifying to us in the Aviation sector that our positive efforts are being recognized including, but not limited to, the efforts of the CAAFI collaboration. CAAFI is solely an instrument that Commercial Aviation is using to bring together the full scope of subjects needed to speed the introduction of alternative fuels. In testifying today as a representative of the CAAFI my goal is to provide new information to the committee on our progress since we last spoke to you one year ago. With progress there also comes added insight to the challenges that are being faced. Those will be addressed as well.

For those not familiar with CAAFI, the Commercial Aviation Alternative Fuels Initiative is a data gathering and communications collaboration that seeks to increase both the quantity and the quality of dialogue among its Airline, Airport, Manufacturer and FAA sponsors and between sponsors and the numerous stakeholders that are engaged with us. CAAFI engages multiple government, industry and university contributors. Over 20

Energy suppliers are now stakeholders in CAAFI. We are global in reach with multiple stakeholders on four contents. The fundamental belief of the sponsors in forming the CAAFI collaboration is that the aviation industry is data driven and relatively small in size allowing it to benefit from such an approach. CAAFI's sponsors and stakeholders recognize that data they develop and collect needs to be placed in the hands of key analysts and decision makers. In such matters as safety, security, and the environment such analysis will be a catalyst for informed and expedited solutions that serves all components of the supply chain well. Uniform understanding of solutions and clarity of message, it is believed, will spur suppliers to invest in solutions suitable for Commercial Aviation. The goal is to make our relatively small sector of transportation a "customer of choice" for introducing alternative fuels.

With this goal in mind this testimony focuses on two areas. First, progress we have been made in each of CAAFI's four functional areas (Certification, R&D, Environmental and Business/Economics) since we met last year with the committee will be laid out. Second, the main challenges that we face to strengthen and continue our leadership roles in alternative fuels will be highlighted.

As indicated last year the input provided is very much a snapshot of unfolding events. New results arrive and new ideas are conceived almost daily in this rapidly developing area – just as fuel price went up $10 per barrel crude since you authored the Op-ed piece on April 8.

The first four months of 2008 have seen an unprecedented level of activity in the Certification and R&D developments globally. Obviously there are many headline developments you cited in your comments on highly visible Flight programs. Those occurred both at Boeing and at Airbus. Many more are planned.

Most important, in my view, is the spadework being done in three areas. These efforts do not typically draw headlines but will result in turning these headlines into actual fuel production that will affect both producers and users. Accordingly this testimony addresses the efforts of CAAFI teams seeking to

- Execute R&D and certify new fuels;
- Define their environmental benefits and costs of these fuels as well as to establish tools to ease the assessment of the benefits of introducing these fuels to new location using a full life cycle (well to wake analysis);
- Establish efforts to facilitate dialogue between new suppliers and buyers to ensure that the needed discussions take place. This dialogue is critical to ensure potential investors that projects that supply alternative fuels via the unique airport fuel distribution infrastructure will find ready buyers.

Last year CAAFI identified broad time frames when key R&D and certification events would occur. That promise is becoming reality with several truly key developments having occurred in the last few months.

On April 11 the Air Force Certification Office approved a new JP8 Mil Spec (8133) embracing 50/50 blends of Synthetic Paraffinic Kerosene (SPK) from all forms of feed stocks including coal (CTL), gas (GTL), and biomass (BTL). This qualification is the first critical break from the long-term certification approach which qualified fuels on an individual producer/individual fuel basis. This "generic approval" does much to strengthen the opportunities for new Suppliers.

In February the CAAFI Certification and Qualification team was a driving force behind the submittal of a ballot to the ASTM proposing a modification to the fuel specification ASTM D-1655 to include 50/50 SPK based blends. In a meeting just last week in Alexandria, VA the team mapped out its plans to achieve a positive outcome that is expected to parallel the Air Force process and targets completion by yearend.

Taken together these developments form critical signposts to investors in synthetic jet fuel plants. Aviation fuels can comprise up to 70% of the output from plants like those in the planning stages for construction Illinois and Ohio by Rentech, American Clean Coal

Fuels and BAARD Energy. If initial approvals for these projects are granted this year, construction can start early next year and initial production is possible in the 2012 time period.

Promising developments do not stop there. Also in April the UK certification panel provided its approval (via DefStan 9191) for 100% Sasol CTL from Sasol's South African facility. That approval marks a notable success for the Engine manufacturers GE, Honeywell, Pratt & Whitney and Rolls Royce as well as Sasol. Together they were able to run all tests required by a new set of engine company protocols and become certified in about 3 years time. Certification was achieved less than 15 months after the completion of the last test at P&W in January 2007. This is a great sign that we will be able to achieve CAAFI's goal of approving 100% FT fuel by year end 2010. It should signal to the investment community that time to certification is no longer a barrier to investment. CAAFI's R&D and Certification teams are working together to achieve longer term goals of approving sustainable aviation biofuels from sources that may prove to be less capital intensive in the long term. One such process involves fuels from hydrogenated plant oils.

Recognizing that just having a goal of 2013 for sustainable aviation biofuel certification is not nearly enough to realize the CAAFI's goals, its certification and R&D team leaders are working with the Air Force to formulate a joint roadmap co-owned by CAAFI and the Air Force to achieve full certification of new sustainable aviation biofuels identified through the soon to be completed Defense Advance Research Project Agency (DARPA) program..

Ultimately fuel from algae may have the greatest yield of all energy crops, as much as 100 times the yield of current biofuel crops. DARPA and Algae Fuel interests are working closely with industry to launch new projects to head down the road of researching and subsequent commercialization of this promising source.

While Certification of Fuels is a pre-requisite to enabling alternative fuel use in aviation, such alternatives must pass the test of providing significant environmental gains. CAAFI's environmental team has several initiatives launched through the FAA Office of Environment and Energy and the Transportation Research Board's Airport Cooperative Research Program (ACRP) designed to achieve this end. Several key milestones have been met on those projects over the last year. Taken together they place aviation in a position not only of achieving environmental gains but of documenting those gains in ways that are quantifiable. CAAFI is dedicated to making these approaches acceptable to all stakeholders willing to provide input to and consider data based analysis.

The MIT led Partnership for AiR Transportation Noise and Emissions Reduction (PARTNER) Center of Excellence's precedent setting "Well to Wake" environmental life cycle model provides CO2 outputs for over a dozen candidate fuel types. The first phase of the FAA funded project is complete. A second iteration on the study is planned and upgrades to the model to better account for Jet fuel production specifics are planned. It will use "world class" models to assess indirect land use effects in the production of aviation biofuels. Work to date using these models suggest that there are a wide range of fuel options that have the potential to outperform current oil refineries in "well to wake" greenhouse gas production.

Based upon the model and the information that has been provided by those planning the projects in Illinois and Ohio a positive outcome may include mixed coal and biomass to liquid fuel (CBTL) projects now in the planning phase. Those facilities offer the most efficient means to capture CO2 and can use it for enhanced oil recovery. Princeton researchers have indicated that for every barrel of fuel produced, two barrels of oil are obtained from enhanced oil recovery. The mixing of coal and biomass may offer significant improvements in carbon footprint compared to coal to liquid (CTL) plant and oil refineries. Analyses by Princeton and Noblis suggest that carbon neutral synfuel production with as little as 21% biomass content may be possible when by-products are fully utilized.

A key characteristic of the alternative synthetic paraffinic kerosene Alternative fuels currently being brought to market, or in the research phase, is that they are extremely low in sulfur. Sulfur is a precursor to the small soot particles (PM 2.5) that are now identified in EPA issued National Ambient Air Quality Standards (NAAQS). With over half the airports in the U.S. in identified non-attainment areas under the NAAQS, use of emerging alternative fuels may be one of the best tools to control growth in PM2.5 exposure that could ultimately limit the growth of commercial aviation in the U.S.

This past week CAAFI introduced a proposal to the Coordinating Research Council (CRC) of the fuels approval agency American Society for Materials and Testing (ASTM) to study the costs and benefits of ultra low sulfur (ULS) fuel in aircraft. Initial studies from MIT show that that control of PM2.5 in jet fuel via ULS fuels (including 100% SPK) could have very sizable public health benefits. Benefits can be double that of the benefits of currently mandated NOX reduction in local airport environments. The study requests an examination balancing health effect benefits with potential maintenance costs and addresses any airworthiness concerns with results by the end of 2009.

With this data in hand, future approvals of pure synthetic fuels post 2009 will be expedited. To ease new fuels introduction to airport markets CAAFI recommended a project to combine these tools via development of an Airport handbook calculation procedure. The Transportation Research Board, Airport Cooperative Research Program (ACRP) initiated that program late last year. The project (ACRP project 02-07) is currently in its first phase surveying different sized airports to in part establish databases needed to create the handbook and to execute test cases of handbook use.

One economic key to introduction of alternative fuels could be the degree to which ULS jet fuels can be used in diesel powered ground vehicles if 100% SPK fuel can meet the ULS limits now applied to diesel equipment. In airports planning the ability to use one, rather than two fuel types provides potential efficiencies. In addition, those airports confronting PM2.5 non attainment could be the best place to introduce synthetics.

Identification of those locations could provide valuable data to fuel producers in identifying early customers.

Recognizing this, CAAFI participants proposed two new projects to ACRP last week. The first project enhances ACRP 02-07 fidelity by proposing the development of added emissions data for ground support equipment (GSE) from a variety of alternative fuels. The second project proposes a project to prioritize airports that would benefit from the introduction of low PM2.5 fuels non-attainment areas as these areas have been identified in EPA issued National Ambient Air Quality Standards and quantifying what gains are possible.

While action is not complete on FAA Reauthorization it should be noted that the Aviation Committee's actions to initiate the CLEEN program and to make ACRP permanent and with a part of the funding directed to environmental projects are already serving to make approval of alternative fuels more likely.. Thanks to the Aviation Subcommittee and Transportation Committee for helping to enable these initiatives.

With certified fuel candidates available and needed environmental tools elements in hand the last key needed to launch the aviation alternative fuels in the U.S. are buyers. The Air Force with its visible goal of 50% use of 50/50 synthetic fuels by 2016 has long been the leader in the US in this area. I am pleased to report that the commercial airline industry is now taking important steps to join the Air Force as potential early customers for Synthetic Fuels.

On Earth Day April 22nd, the Air Transport Association (ATA)– a CAAFI sponsor and the representative of a majority of U.S Airlines provided its policy on synthetic fuels. A link to that statement is provided in this testimony:
http://www.airlines.org/economics/energy/altfuelsprinciples.htm

The comprehensive statement dedicates the U.S Airlines to work with potential future suppliers to "integrate alternative fuels into their operations." It seeks only alternative fuels that have "a reduced emissions profile relative to traditional fuels on a life cycle basis." The tools that it commits to use to demonstrate that performance are the ones being developed by CAAFI and the FAA Office of Environment and Energy and being used by the ACRP as described above.

To ensure that this process is substantive, the ATA Energy Council representing the Airline's fuel purchasers, and the CAAFI business/economic team now plan to bring suppliers and airline users together in a Department of Commerce hosted meeting in the fall here in Washington. The meeting will introduce a potential new fuel supply base to an aviation industry with unique distribution and fuel quality needs.

These recent developments are extremely important and should signal to potential suppliers and investors that with competitive business terms for fuels that meet the stated environmental criteria, and a distribution system which is compatible with transport and airport infrastructure, the airline industry is prepared to be a key component in helping to launch new fuel production projects.

I am please to note that the fuel industry is responding to the message that aviation (both commercial and military) has sent. In particular parties planning projects in Illinois (Rentech and American Clean Coal Fuels) and Ohio (BAARD Energy) have indicated in public forums that they are willing to dedicate up to 70% of facility production to jet fuel. This amount is far above current Fischer Tropsch facility production volumes which average less than 30% jet fuel production.

Another indication that suppliers are responding to aviation's call is that, increasingly, aviation and CAAFI are being invited to address Energy forums regarding our plans. Just next week CAAFI will be the only transportation mode addressing the 8th GTL/XTL Summit in London at the invitation of Air Force gas to liquid (GTL) supplier Shell Aviation.

In November, Boeing was a co-sponsor of the first Algae summit held in San Francisco. Aviation interests from several CAAFI sponsors and suppliers were present. It was at this meeting that DARPA announced its multi-million dollar project to enable algae fuels.

With all this excellent progress, much of it over the last year, the obvious question is what issues remain as gaps for CAAFI and which gaps can government agencies address. First, we must acknowledge that the current round of projects offers only a small contribution. If all the supply of the proposed plants was dedicated to aviation it could only provide the 80,000 barrels a day fuel needs of Chicago's O'Hare airport. Second, as we all know, large capital flows are needed to build plants and equipment. Consequently these projects cannot escape the issues of capital formation currently plaguing the investment community. Clearly these issues are well beyond CAAFI's area of influence. We can however ensure that solutions are available when conditions allow more investment.

CAAFI has identified the following gaps as areas we can influence with the help of the Congress, the Administration and the private sector:

- One barrier to sustainable aviation biofuel introduction is the need to produce significant quantities just so that the fuel can be certified for aircraft use. For example it is recognized that the engine industry alone (as cited publicly by DARPA) will need up to 250,000 to 500,000 gallons of biofuels from new processes (e.g. hydrogenated plant oils) to achieve certification. CAAFI and the airline industry are addressing that issue by adding USDA and the Department of Energy renewables office (EERE) as stakeholders in our process. It is our hope that recognizing the potential for renewable energy suppliers we can find solutions to work this problem. Interest and support from the Aviation subcommittee and other Congressional committees can certainly provide assistance.
- There are technical concerns with transport of some bio sourced fuel types should they become available to airport facilities. CAAFI has included concerns of facility compatibility into its definition of a qualified fuel. We know that efforts

are underway through such efforts as the Biomass Research and Development Initiative to explore those problems. That said airport suppliers and pipelines needs to be fully engaged to ensure that our unique needs are addressed.

- At present there is no domestic supplier of technology for the gasification of biomass to create liquid fuels . With limited options we lack optimal technical solutions. Part of the CAAFI business team's goal is to engage its highly competent systems level-manufacturers in the pursuit of these technologies. Companies such as UTC, GE, Honeywell, Raytheon and Boeing can potentially help in that quest.
- There is significant concern about water use and that there will not be sufficient quality and quantity of water--particularly in western states--for the cooling of FT plants and for the production of biomass feed stocks in many areas. Solutions may involve the use of degraded (dirty, salty water). Again Aerospace manufacturer technologists can help solve the issues which in themselves may be profitable businesses and in the margin help their core aviation business.
- Lastly we do need to ensure that there is a complete and thorough national dialogue and common understanding on the quantification of environmental solutions. International harmonization of tools and solutions developed using those tools is a priority for CAAFI sponsor FAA office of Environment and Energy (AEE). For its part CAAFI along with FAA AEE is placing the highest priority on including the best indirect land use change emissions impacts, and fuel production emissions models in future iterations of its aviation specific lifecycle analysis tools. We need a true international cooperative effort and are increasing our dialogue to include more international partners to approach this goal.

In closing I would like to thank you Mr. Chairman for your support of the CAAFI coalition by providing us with an opportunity to represent our sponsors before the committee.

I would also like to publicly thank the approximately 150, largely volunteer, members of the Commercial Aviation Alternative Fuels Initiative for their contributions to these efforts. For most–including our team leads--CAAFI is not their "day job" but an additional effort based on the importance to them of the issue. I would also like to thank the members of all the stakeholder government agencies from DOE, NASA, USAF, DOD, DARPA, USDA, DOC, and EPA who have crossed organizational stovepipes to cooperate in ways I have not seen in my 41 years in working with government from the vantage of the private sector. Without contributions from all of those mentioned above the progress we have reported would not have been possible and prospects for future progress remote.

That concludes my prepared statement. Thank you.

The Voice of Aviation Business

4226 King Street
Alexandria, VA
22302

P 703-845-9000
F 703-845-8176
www.nata.aero

NATA
National Air Transportation Association

**Statement**

**of the**

**National Air Transportation Association**

**before the**

**Subcommittee on Aviation,**

**Committee on Transportation and Infrastructure,**

**U.S. House of Representatives:**

**Hearing on**

**Aviation and the Environment: Emissions**

**May 6, 2008**

**2167 Rayburn House Office Building**
**Washington, DC**

**Appearing for NATA:**
James K. Coyne, President
National Air Transportation Association
4226 King Street
Alexandria, Virginia 22302
(703) 845-9000

Chairman Costello, Ranking Member Petri, and Members of the Subcommittee:

Thank you for this opportunity to appear before you to discuss our members' efforts to minimize the impact our industry has on the environment.

My name is James K. Coyne, and I am president of the National Air Transportation Association (NATA). NATA, the voice of aviation business, is the public policy group representing the interests of aviation businesses before the Congress, federal agencies and state governments. NATA's over 2,000 member companies own, operate and service aircraft and provide for the needs of the traveling public by offering services and products to aircraft operators and others such as fuel sales, aircraft maintenance, parts sales, storage, rental, airline servicing, flight training, Part 135 on-demand air charter, fractional aircraft program management and scheduled commuter operations in smaller aircraft. NATA members are a vital link in the aviation industry providing services to the general public, airlines, general aviation and the military.

## Background

Climate change is an important topic and one that includes all of U.S. industry. The aviation industry is one of the fastest growing sectors of the economy, and attention has been focused on carbon dioxide emissions from aircraft. The industry has adopted an environmental agenda that also supports aviation's continued growth. This agenda includes testing alternative fuels to be used in aircraft, participation in carbon offset programs, and encouraging "green airports." It is important to highlight the facts on emissions concerning aviation:

- **Aviation accounts for only 3% of greenhouse gas emissions worldwide,** according to data from the Intergovernmental Panel on Climate Change (IPCC).

- **Aviation gasoline and jet fuel account for 12% of all petroleum products.** According to data from the U.S. Department of Energy, aviation gasoline and jet fuel supply account for 1,624,000 barrels per day compared to 20,588,000 barrels of all petroleum products used per day.

- **Alternative fuels programs exist within aviation.** Virgin fuels, Boeing, and GE Aviation have joined forces to develop an alternative fuel that includes a biofuel blend composed of babassu oil and a mixture of jet fuel and coconut oil. Additionally, the University of North Dakota received a $5 million grant to develop a cold weather sustainable biofuel to be used by the military.

- **New aviation technology is producing cleaner and more efficient aircraft.** Advances in aerodynamics offer more efficient wings and designs with less drag. The Cirrus and Columbia aircraft are examples of more efficient general aviation aircraft. New composite materials are making aircraft lighter in weight, which results in increased fuel efficiency.

## NATA Climate Initiative

NATA's members have been very active in addressing ongoing concerns with the general aviation industry's impact on the environment. Late last year, NATA established its

Environmental Committee to develop programs designed to assist member companies in minimizing their impact on the environment including the development of a new Climate Initiative that would provide NATA members with the opportunity to purchase carbon offsets for their aircraft operations. Below is a brief description of the new *NATA Climate Initiative*:

➢ ***Carbon Offsets:***
Carbon offsetting involves reducing emissions by investment in projects that save energy, such as investment in technology that allows industry to be more efficient and increasing the generation of renewable energy. NATA is establishing a program to make carbon offsets available to member companies. This includes a 3- to 4-cent per gallon carbon offset based on the Chicago Climate Exchange, the only voluntary, legally binding integrated trading system to reduce emissions of all six major greenhouse gases (GHGs), with offset projects worldwide.

➢ ***Green Aviation Facilities:***
NATA encourages its member companies to meet proper environmental compliance standards including a Spill Prevention Control and Countermeasure (SPCC) plan, if fuel is stored above ground in tankers. The association is currently undertaking the development of best management practices that will allow aviation businesses to capitalize on becoming more energy efficient and minimizing their company's impact on the environment. To date, NATA has crafted best management practices for the following topics *(note: each topic has a white paper that is attached at the back of this testimony)*:

- **Spill Prevention Control and Countermeasures (SPCC)**
- **Hazardous Waste**
- **Storm Water**
- **Used Batteries**
- **Used Oil**
- **Used Fluorescent Lamps**

**Public Relations Campaign**

NATA is currently developing a public relations campaign to provide the facts about aviation's impact on the environment and what the association's members are doing to ensure the protection of the world's environment.

First, let's review the magnitude of carbon emissions for aviation as compared to other modes of transportation. The U.S. Department of Energy (DOE) has issued a publication titled *Transportation Energy Data Book: Edition 26* (June 1, 2007). In this publication, the DOE provides an annual statistical compendium designed to characterize transportation activity and explore data on other factors that influence transportation energy use. Much of this publication is just the numbers, but an analysis of this data can provide some very interesting insights. In order to obtain a relative comparison of the magnitude of carbon emissions for different modes of transportation, an analysis of fuel consumption is used. Because different types of fuel (gasoline, diesel fuel, jet fuel to name a few) provide different energy values, the data is normalized by looking at the energy use in British Thermal Units (BTUs). This provides a better comparison than actual gallons of fuel consumed. The table below shows the energy use for aviation and several other modes of transportation.

| Mode of Transportation | BTUs Used (Trillions) in 2005 | Percent of Total |
|---|---|---|
| | | |
| **Aviation** | **2,477** | **9.0%** |
| Cars | 9,140 | 33.4% |
| Light Trucks | 8,108 | 29.6% |
| Medium/Heavy Trucks | 4,577 | 16.7% |
| Water | 1,366 | 5.0% |
| Pipeline | 842 | 3.1% |
| Rail | 657 | 2.4% |

The table shows that aviation accounts for only 9% of the total transportation energy use. Cars and light trucks each use more than three times the energy as the aviation industry, and medium/heavy trucks account for about twice that of aviation. Highway transportation (cars, light trucks, and medium/heavy trucks) combine for almost 80% of the transportation energy and thus contribute a similar level of greenhouse gases. Aviation, on the other hand is a much smaller contributor to energy use and greenhouse gas emissions.

Further analysis within the aviation group shows the relative contribution of commercial aviation versus general aviation. The table below shows this comparison.

| Mode of Transportation | BTUs Used (Trillions) in 2005 | Percent of Total Transportation |
|---|---|---|
| | | |
| **Aviation** | **2,477** | **9.0%** |
| Domestic Carriers | 1,861 | 6.8% |
| International Carriers | 373 | 1.4% |
| General Aviation | 242 | 0.9% |

General aviation accounts for less than one percent of the total transportation energy use in the United States and its fuel use is about one seventh that of the domestic air carriers.

The analysis of the relative efficiency of fuel use for different modes of transportation includes several additional factors. This analysis includes normalizing the data using the BTU content as did the previous analysis, but also includes the average passengers per vehicle, and provides a conversion into an equivalent miles per gallon (MPGe) based on the BTU content of gasoline (115,000 BTU per gallon). For example, automobiles have an average passenger use of 1.57 passengers per car. Using the DOE data, we find that cars use on average 3,496 BTUs per passenger mile and this corresponds to approximately 33 MPGe. The table below shows several modes of transportation and their corresponding MPGe.

| Mode of Transportation | Average Passengers per Vehicle | BTUs per Passenger Mile 2005 | MPG Equivalent |
|---|---|---|---|
| | | | |
| **Aviation** | **90.4** | **3,959** | **29 MPGe** |
| Cars | 1.57 | 3,496 | 33 MPGe |
| Light Trucks | 1.72 | 4,329 | 27 MPGe |
| Rail (Commuter) | 32.9 | 2,569 | 45 MPGe |
| Rail (Intercity- Amtrak) | 17.9 | 2,760 | 42 MPGe |
| Bus (Transit) | 8.7 | 4,318 | 27 MPGe |

This table shows that aviation provides the greatest average passengers per vehicle and the resulting MPGe of 29 is roughly the same as cars and light trucks. With the vast advantage of moving large numbers of people quickly over many miles, the aviation industry is a very efficient mode of transportation.

In summary, this analysis of transportation modes shows that aviation provides a very efficient mode of transportation and compares similarly to typical highway transportation (cars and light trucks) in per passenger equivalent miles per gallon. Additionally, the aviation industry contributes a much smaller percentage (about 9%) of the total energy use and thus contributes a much smaller percentage of greenhouse gas emissions as compared to highway transportation (about 80% for cars, light trucks and medium/heavy trucks).

**Industry Actions**

Two prime examples of NATA members being proactive on the environmental front are NetJets Inc. and DayJet Corporation.

**NetJets Inc.**

On September 13, 2007, NetJets Inc. Chairman & CEO Richard Santulli announced the company's new multifaceted program to address the impact of its flight operations on the environment.

The initiative, which will be expanded in the coming months, includes a focus on offsetting carbon emissions from NetJets' flights, while at the same time it begins to reduce the carbon footprint of NetJets' operations worldwide. It also includes a substantial investment in leading-edge technology research with the goal of creating an ultra-low emission jet fuel.

The following core elements of the initiative are the results of a detailed environmental review process undertaken by NetJets beginning in early 2006:

1. Improving Energy Efficiency and Reducing Greenhouse Gas Emissions – NetJets U.S. has established a goal of improving its energy efficiency, cutting waste, and reducing carbon emissions from its internal operations by 10% over the next two years. It has established Director of Environmental Management positions, reporting to the Office of the Chairman, in both the United States and Europe. These senior executives will manage, monitor, and report regularly on NetJets' progress and any

ongoing challenges, as well as helping to identify new opportunities to do more in the coming months and years.

2. *Driving Technological Transformation* – NetJets is investing in cutting-edge research to identify more environmentally friendly aviation technologies through sponsoring The Next Generation Jet Fuel Project at Princeton University with the University of California, Davis to develop an ultra-low emission jet fuel.

3. *Offsetting Unavoidable Impacts* – NetJets is investing in a set of carefully reviewed and closely monitored carbon offset projects that will provide verified greenhouse gas reductions. These projects will allow the company to offset fully the carbon footprint of its internal operations. The offset portfolio will also be available to NetJets Owners so they can offset their flights. Additionally, Marquis Jet Partners will make the NetJets carbon offset portfolio available to Marquis Jet Card Owners.

4. *Leveraging World Class Expertise* – To ensure that NetJets remains a leader on climate issues, the company has established both U.S. and European advisory boards – each consisting of environmental experts who can help NetJets apply best-in-class practices and provide guidance to the company at every step along the way. The U.S. Advisory Board consists of Fred Dryer, Professor of Mechanical and Aerospace Engineering at Princeton University; Ashok Gupta, Director of the Air and Energy Program at the Natural Resources Defense Council; Terry Tamminen, former Secretary of the California Environmental Protection Agency; Bonnie Reiss, Operating Advisor to Pegasus Capital and founder of the Earth Communications Office; and George Favaloro, Managing Partner at Esty Environmental Partners.

NetJets realizes that its responsibilities also extend to the communities in which it operates. With this in mind, it will build on these four areas of immediate commitment by launching a community-based Solar Schools Project. Beginning in California and drawing on Governor Arnold Schwarzenegger's environmental leadership, this innovative public-private partnership will fund the placement of photovoltaic cells on school roofs – while in the process educating school children about environmental issues.

**DayJet Corporation**

Dayjet Corporation has produced a Very Light Jet Footprint Analysis Concept Paper to ensure that it maximizes its operations by using state-of-the art technology while minimizing its impact on the environment. A description of this concept paper can be reviewed below:

Introduction

DayJet Corporation is a technology-driven company, pioneering the creation of the on-demand, per-seat air, regional transportation market. In spearheading the use of the new generation of very light jets (VLJs) in air carrier service, DayJet is committed to building on the inherent efficiencies and favorable footprint of the Eclipse 500 aircraft, toward the long range goal of sustainable air transportation. DayJet's strategies are informed and motivated by the emerging understandings of the epochal challenges of managing carbon dioxide and other greenhouse gas effects on climate dynamics. DayJet strives to translate the understanding from the climate science community to applications on how the company manages the effects of its aviation activities. DayJet works to apply these understandings to its company strategies for technology, for operations, and for business practices.

DayJet's strategic framework for moving toward a sustainable business in on-demand air transportation includes three major phases of technology implementation over the near term (two to four years), mid-term (four to six years), and longer term (more than six years).

1. Near Term: This phase of the strategy focuses on reducing carbon emissions through airspace efficiencies. With the Federal Aviation Administration, DayJet plans the early implementation of certain of the operating capabilities envisioned in the U.S. Joint Planning and Development Office (JPDO) vision for the Next Generation air transportation system (NextGen). This vision underpins transformation of the national airspace toward a performance-based air traffic management system. This system incorporates performance-based navigation, surveillance and communications technologies. The technologies associated with this transformation include Required Navigation Performance (RNP), Area Navigation (RNAV), and Automatic Dependent Surveillance-Broadcast (ADS-B). These technologies let DayJet optimize its flight routes for savings in energy, carbon and noise. When implemented, these optimized routes will reduce fuel consumption for the company's networked fleet operation by an estimated 15 percent and more. These fuel savings translate directly into emissions reductions. DayJet's business model operates effectively using the second- and third-tier airports serving the nation's smaller suburban, rural and remote communities. These airports are largely underutilized national assets, with virtually none of the congestion and delays issues that would add unacceptable costs to DayJet's operations. At these smaller airports, as a consequence, DayJet is able to operate with greatly reduced ground times from engine start to takeoff and from landing to engine shutdown. The effect is to reduce emissions that would affect local air quality around airports.

2. Mid Term: This phase of the strategy focuses on alternative fuels that reduce carbon and other emissions. DayJet supports fuel strategies that enable movement toward carbon neutral practices across the company's industrial sector. Because DayJet's business model calls for approximately a five-year life cycle for its aircraft, the company will be in a position to provide aircraft and engines coming out of its fleet for testing of new fuels.

3. Longer Term: This phase of the strategy focuses on being early adopters of advancing aircraft and propulsion systems that do not add carbon and other greenhouse gases to the environment.

Based on this framework, DayJet is undertaking action in five arenas:

Engines- DayJet works with the aircraft and engine manufacturers toward continual improvement in the efficiencies and emissions from flight operations, for the current and future generations of equipment.

Fuel- DayJet collaborates with the university research community on modeling, analysis, and strategies for continual improvement of the footprint for on-demand air transport operations using VLJs and other technologically advanced aircraft. DayJet is engaged in planning dialogue with Embry Riddle Aeronautical University

(ERAU), Florida Institute of Technology (FIT), Florida Atlantic University, and the University of Central Florida (UCF) to establish relationship strategies leading to creation and adoption of new technologies.

NextGen Airspace Efficiencies- DayJet partners with other on-demand air transportation service providers to accelerate the early adoption of the operating capabilities envisioned in the U.S. Joint Planning and Development Office (JPDO) Next Generation Air Transportation System (NextGen). NextGen technologies reduce the footprint of DayJet's fleet operations.

Neutralizing Carbons- The DayJet service model is conceived to offer regional business travelers an alternative to highway travel. This means that the aggregation of travelers on a DayJet trip can be carbon-competitive with highway transport alternatives in certain specific cases. In the nearest term, DayJet will implement strategies for airspace efficiencies with the goal of advancing toward carbon-competitive effects of on-demand air travel, relative to highway alternatives.

Sustainable Business Practices- DayJet manages unavoidable carbon emissions through careful assessment of total company operations with the aim of achieving verified greenhouse gas reductions. The goal is to reduce where possible and to otherwise offset the carbon footprint of the company's internal operations.

Tropospheric Flight

The questions regarding potential fuel efficiencies (and therefore carbon sourcing) of on-demand, networked fleet operations of VLJs include the effects of flight in the troposphere versus the stratosphere. The initial assessments by the International Panel on Climate Change (IPCC) regarding the effects of aviation on the environment focused on flight in the stratosphere. These past studies published first in 1999[i] and then reviewed in 2006[ii] summarize the three most important ways that aviation affects the climate:

1. Direct emissions of greenhouse gases specifically $CO_2$ and water vapor
2. Nitrogen oxide emissions interacting with ozone and methane
3. Contrail-induced cirrus cloud formation

A new generation of aircraft referred to as very light jets (VLJs), and a new generation of on-demand air transportation service business models are now emerging in regions of the United States, as well as in Europe and other continents. These new business models influence the characteristics of fleet operations using these new VLJs. These operations will share common characteristics in flying relatively shorter segments and in making effective use of mid-altitudes that are not extensively used by larger air carrier transports. In particular, because the average flight segment length in these regional transportation services is approximately 300 miles, and because of airspace utilization and traffic flow considerations, the typical flight levels for these fleet operations are below 26,000 feet, well below the stratosphere, and within the troposphere.

Based on these operational realities, we plan to support research focused on the following four topics:

- Comparative greenhouse effect of water vapor emitted by VLJs between 18,000 and 26,000 feet, versus in the stratosphere
- Comparative effect of nitrogen oxide emitted by VLJs between 18,000 and 26,000 feet on atmospheric ozone versus emissions in the stratosphere
- Implications of the effect of NOx-induced depletion of methane for NOx emissions in the troposphere
- Reduced effect of cloud formation due to absence of contrails by VLJs flown in the troposphere
- Effect of lowered propulsive efficiency in the troposphere versus higher propulsive efficiency in the stratosphere on overall carbon dioxide emissions, for VLJs. The results of this analysis will lead to engine design requirements for operating turbofans such as the Geared Turbofan[iii] in the mid altitudes.

The state of the art in climate modeling is limited in terms of providing reliable estimates for the specific aviation-induced radiative forcing effects. Even so, perhaps the relative effects of stratospheric and tropospheric flight can be considered. A rule of thumb in climate science estimates that each unit of fuel burned by stratospheric air transport flights has the greenhouse effect of three times that of ground transport[iv]. Further, it is estimated that the radiative forcing from persistent contrails and contrail-induced cirrus clouds (PCC) exceeds the contributions from all other aviation-induced RF combined[v]. However, quantitative analysis is absent regarding the effect of flying in the troposphere specifically by VLJs. We plan to support analysis to provide quantitative information regarding this distinction.

## Legislative Actions

Clearly Congress will have a vital role in outlining the next steps necessary to mitigate aviation's footprint on the environment. The U.S. House of Representatives' FAA Reauthorization bill, H.R. 2881, provides an outstanding blueprint for the aviation industry to utilize new technologies through the legislation's support of the Next Generation Air Transportation System.

Since last year, NATA members have been strongly encouraged to support H.R. 2881, a bill approved by the U.S. House of Representatives that would provide historic funding levels, nearly $13 billion, for the FAA's Facilities and Equipment (F&E) account that will accelerate implementation of the Next Generation Air Transportation System (NextGen). NextGen is the FAA's national plan to transform the air traffic control system from a ground-based navigation system using radar to a satellite-based system. This legislation will enable the FAA to make needed repairs and upgrades to existing facilities and equipment, and provide for high-priority safety-related systems.

By utilizing new technologies, airspace routes can be better defined, allowing more aircraft and more routes to be determined within the airspace. And most importantly, utilizing new technologies to improve airspace usage, aircraft will be able to fly routes more directly, thereby minimizing noise and the impact on the environment.

The demand for air travel is increasing steadily. The FAA projects that by 2025 the number of domestic enplanements will have doubled to 1,482 million per year. The environmental impact of air travel is increasingly important to consumers, which is why the aviation industry is collaborating to address this important issue.

Thank you for the opportunity to testify, and I will be happy to answer your questions.

---

[i] International Panel on Climate Change Special Report: Aviation and the Global Atmosphere – Summary for Policy Makers, 1999.
[ii] Workshop on the Impacts of Aviation on Climate Change: A Report of Findings and Recommendations. June 7-9, 2006 Cambridge, MA, August 2006.
[iii] Pratt & Whitney reference TBD
[iv] Noppel, F.; and Singh, R.: Overview of Contrail and Cirrus Cloud Avoidance Technology. Journal of Aircraft, Vol. 44, No. 5, Sept-Oct 2007, pp. 1721-1726.
[v] Sausen, R., Isaksen, I., Grewe, V., Hauglustaine, D., Lee, D., Gunnar, M., Kohler, M. O., Pitari, G., Schumann, U., Stordal, F., and Zerefos, C.: "Aviation Radiative Forcing in 2000: An Update on IPCC (1999)," Meteorologische Zeitschrift; Acta Scientiarium Naturalium Universtatis Normalis Hunanensis, Vol. 14, No. 4, Aug. 2005, pp. 555-561.

NATA
National Air Transportation Association
The Voice of Aviation Business

*(prepared by George S. Gamble, 2G Environmental, LLC)*

## Environmental Health and Safety (EHS) Policy

## Spill Prevention Control and Countermeasures (SPCC)

---

**Regulatory Reference:** 40 CFR 112, Oil Pollution Prevention.

**Purpose:** The purpose of this Spill Prevention Control and Countermeasures (SPCC) Program is to establish a framework for each Fixed Base Operation (FBO) to become and remain compliant with the Federal Environmental Protection Agency (EPA) rules for above ground tank systems (ASTs) and oil pollution prevention.

Each facility that owns or operates above ground tank systems (including refueler trucks) that contain an aggregate storage capacity of 1,320 gallons or higher must prepare a SPCC Plan. The plan includes requirements for secondary containment, loading/unloading of fuel and oil, discharge of accumulated rainwater, inspections, training, updates to the plan, and other miscellaneous items.

**General Requirements:**

The purpose of the SPCC Rule is to prevent spills of fuel and oil into the navigable waters of the United States. The regulations are in place to encourage facilities to build structures and perform actions that will prevent spills from occurring. If a spill occurs, systems are required to contain the spill such as secondary containment systems and thus prevent potential spills from advancing into the navigable waters. Finally, if a spill does advance off-site, the SPCC Plan includes procedures for making the initial response to a spill and to provide proper reporting to the regulatory agencies.

Each facility is required to prepare a site specific SPCC Plan. This EHS Policy provides the general framework and guidance for following the SPCC requirements, but each facility must follow the specific requirements set forth in the site specific SPCC Plan. If there are any discrepancies between this EHS Policy and the site specific SPCC Plan, the SPCC Plan shall prevail.

The site specific SPCC Plan must include the following requirements.

- Properly transferring fuel.
- Properly transferring accumulated rain water from containment areas.
- Performing training.
- Conducting routine inspections.
- Properly responding if a spill should occur.

**Spill Reporting Requirements:**

A spill of fuel or oil must be reported to the EPA and the state if 25 gallons of fuel or oil is spilled on the soil (quantities may be less in some states) or if any fuel or oil gets into the storm sewer system and creates a sheen on the water. Contact information for reporting is located in the site specific SPCC Plan. A person reporting a spill should be prepared to provide the following information.

- Date, time, and duration of the release.
- Source and total volume of the release.
- Spill clean-up procedures.
- Personnel who discovered and/or participated in the spill clean-up.
- Equipment used during the clean-up.
- Waste disposal methods.
- Any unusual events, injuries or agency inspections.

In addition to this reporting, a written report is required by the EPA if either of the following quantities is spilled. Written report requirements are included in the site specific SPCC Plan.

- Any single discharge more than 1,000 gallons.
- Any two discharges more than 42 gallons each within a 12-month period.

Spills must be reported to the EHS/Safety Department.

**Responsibilities:**

1. Employees:

Employees are required to perform routine work activities in an environmentally responsible manner. Sensitive activities include the following fuel transfers.

- From the fuel delivery company into the bulk fuel tanks.
- From the bulk fuel tank into the refueler truck.
- From the refueler truck into the aircraft.
- Transfers of used oil and used fuel.

Employees commonly make transfers of accumulated rain water from containment areas. When these transfers are made, a notation must be made in the facility log book documenting the estimated amount of water released, the date, the time, a statement that the water contained no fuel (even a sheen), and a statement that the valve was closed and secured after the transfer.

Employees should know where potential spills will flow. This can be accomplished by watching the flow of rain water during a rain event. Employees should know where to build dams with booms or absorbent materials if a spill occurs. Employees must know where spill equipment is kept and how to properly employ the spill equipment.

Employees are required to make an initial response to a spill if it occurs, however, formal clean-up activities are to be performed by trained and certified response contractors. Employees should make an effort to stop the flow of fuel (close valve, shut down pump, etc.) and should employ booms or absorbent materials to prevent a spill from advancing into storm sewer inlets or drainage ditches. Employees should notify supervision of any spill, regardless of size, and allow supervision to make appropriate reports to the regulatory agencies. Proper clean-up of absorbent materials must be included in the employee activities.

All employees that handle fuel or oil must participate in initial and annual training to refresh their understanding of the EPA rules and the SPCC Plan. The training must include the items shown in the General Requirements section of this Policy.

Employees often perform routine monthly inspections of the fuel handling equipment and spill response equipment. Inspections must follow the checklist provided in the site specific SPCC Plan and be kept with the SPCC Plan once complete. Any malfunctioning equipment or missing spill equipment should be reported to supervision immediately.

2. Managers/Supervisors:

Managers/Supervisors should ensure that employees are performing their work activities in a proper manner including fuel transfers and transfers of accumulated rain water.

Managers/Supervisors should ensure that employees respond appropriately to spills. Managers/Supervisors should make notifications to Federal, State, and Local environmental regulatory agencies in event of a spill as required by the site specific SPCC Plan. Managers/Supervisors should coordinate activities of environmental response contractors that may be assisting in the clean-up activities after a spill.

Managers/Supervisors should ensure employees participate in the required training and perform inspections.

Managers/Supervisors should ensure the SPCC Plan is up-to-date and sign off for the 5-year reviews if no significant changes have occurred at the facility. Managers/Supervisors should also ensure that a professional engineer be contracted to modify the SPCC Plan within 6 months of any significant change occurring such as adding new tanks or new refueler trucks. Managers/Supervisors should make the SPCC Plan available to regulatory agencies during an inspection of the facility.

3. EHS/Safety Department:

The Environmental Health and Safety (EHS) Department/Safety Department is responsible for ensuring that each facility has a current SPCC Plan. EHS can assist FBOs in locating professional engineers (as required by the regulation) that can assist in creating or modifying SPCC Plans as needed.

EHS will assist FBOs in setting up initial "train the trainer" sessions and can assist in any environmental questions that may arise.

EHS must be notified of any reportable spill event and will properly document in the company tracking system.

**Training:**

The site specific SPCC Plan must include initial and annual training requirements for all employees that handle fuel or oil. EHS has provided a training video and Power Point slides to each FBO to be used for training. Training activities must include the following items.

- General facility operations.
- Procedures for oil handling.
- Operation and maintenance of equipment used to prevent discharges.
- Requirements for reporting a discharge.
- Pollution control laws, rules and regulations.
- Contents of the facility SPCC Plan.
- Discussion of previous discharges, malfunctioning components, and new precautions.

**Recordkeeping:**

Documentation of the following SPCC activities must be maintained.

- Transfers of accumulated rain water must be documented in the facility log book or documented on a checklist. These documents must be maintained for a period of three (3) years.
- Facility inspections must follow the checklist provided in the site specific SPCC Plan and should be maintained for a period of three (3) years.
- Training records must document who received SPCC training, the dates of the training, and the topics covered. These documents must be maintained for a period of three (3) years.

National Air Transportation Association

The Voice of Aviation Business

*(prepared by George S. Gamble, 2G Environmental, LLC)*

# Environmental Health and Safety (EHS) Policy

## Hazardous Waste

---

**Regulatory Reference:** 40 CFR 261, Identification and Listing of Hazardous Waste; State specific hazardous waste rules.

**Purpose:** The purpose of this Hazardous Waste Program is to establish a framework for each Fixed Base Operation (FBO) to become and remain compliant with the Federal Environmental Protection Agency (EPA) rules as well as state specific rules for hazardous waste.

This procedure will help FBOs to recognize what is considered a hazardous waste and how to properly handle and dispose of hazardous waste. The EPA defines three different levels of waste generators:

- Large quantity generators (more than 2,200 pounds per month).
- Small quantity generators (between 220 pounds and 2,200 pounds per month).
- Conditionally exempt small quantity generators (less than 220 pounds per month).

**General Requirements:**

The federal EPA has set forth rules for proper handling, storage, and disposal of hazardous waste under 40 CFR 261. Hazardous waste is defined as listed wastes (typically a specific waste item or waste from a specific process stream) or characteristic wastes (flammable, reactive, corrosive, or toxic). Examples of hazardous wastes that may be generated at an FBO operation include oil based paint wastes, acids, Alodine wastes, solvents (that aren't recycled), batteries (that aren't recycled), and fluorescent lamps (that aren't recycled).

There are several guidelines that facilities should follow to avoid the requirements in the hazardous waste rules as shown below.

- Properly recycle all spent solvents.
- Properly recycle all used batteries.
- Properly recycle all used fluorescent lamps.
- Properly recycle all used oil.
- Dispose of all sumped AVGAS and jet fuel as a product to be burned for its BTU content. (Typically the used oil contractor will handle used AVGAS and used jet fuel as well as used oil.)
- Minimize hazardous wastes to remain under the limit of 220 pounds per month for the conditionally exempt small generator status.

If a General Manager is not sure if a waste is hazardous, he or she should contact the EHS/Safety office for assistance. If a facility exceeds the limit of 220 pounds of hazardous waste in any given month, he or she should contact the EHS/Safety office for assistance as the facility must obtain an EPA Identification Number and follow strict handling and shipping requirements.

Employees must not transport hazardous waste and must use only an approved transporter.

Storage of hazardous waste must include proper labeling (including the EPA Waste Code and date waste was generated), proper containers, and proper secondary containment. The facility should have access to spill response equipment if needed for a spill.

If a leak or spill of hazardous waste occurs, the leak must be immediately controlled (stop flow from valve or container if possible) and contained with available spill response equipment. Any clean-up activities must be conducted using an outside contractor trained and certified to handle hazardous waste.

**Responsibilities:**

1. Employees:

Employees must be aware of the requirements for identifying and handling hazardous waste, and proper response to a spill.

Employees must properly store hazardous waste and label containers properly (including the EPA Waste Code and date waste was generated).

Employees must wear proper personal protective equipment when handling hazardous waste. Each type of waste typically requires a different set of protective equipment, so if there are any questions, please call the EHS/Safety office. Equipment should include safety glasses, chemical resistant gloves, and possibly protective clothing.

Employees must not dispose of hazardous waste in any drains or dumpsters – no exceptions.

2. Managers/Supervisors:

Managers/Supervisors should ensure that employees are performing their work activities in a proper manner including handling, storage, recycling, and spill response.

Managers/Supervisors should ensure that employees respond appropriately to spills. Managers/Supervisors should make notifications to Federal, State, and Local environmental regulatory agencies if required.

Managers/Supervisors should ensure that hazardous waste is properly labeled (including EPA Waste Code and date waste was generated).

Managers/Supervisors should ensure that employees were proper protective equipment while handling hazardous waste.

Managers/Supervisors should ensure employees never dispose of hazardous waste in any drains or dumpsters.

3. EHS/Safety:

The Environmental Health and Safety (EHS)/Safety Department will monitor compliance with all environmental regulations including the hazardous waste regulations.

The EHS/Safety Department will assist in any environmental questions that may arise such as proper identification of waste items, proper storage, proper protective equipment, and response to spills.

The EHS/Safety Department must be notified of any reportable spill event and will properly document in the company tracking system.

**Training:**

If facilities remain under the limit for conditionally exempt small quantity generators (generate less than 220 pounds of waste in a month and store less than 2,200 pounds at any time) then no specific training requirements are required. If a facility exceeds these limits, they should contact the EHS/Safety office for training assistance.

**Recordkeeping:**

No shipping records or manifests are required if facilities remain under the limit for conditionally exempt small quantity generators (generate less than 220 pounds of waste in a month and store less than 2,200 pounds at any time).

National Air Transportation Association

The Voice of Aviation Business

*(prepared by George S. Gamble, 2G Environmental, LLC)*

## Environmental Health and Safety (EHS) Policy

## Storm Water Pollution Prevention Plans (SWPPP)

---

**Regulatory Reference:** 40 CFR 122, EPA Administered Permit Programs: The National Pollutant Discharge Elimination System (NPDES); 40 CFR 123, State Program Requirements; and State Specific Storm Water Regulations.

**Purpose:** The purpose of this Storm Water Pollution Prevention Plan (SWPPP) Program is to establish a framework for each Fixed Base Operation (FBO) to become and remain compliant with Federal Environmental Protection Agency (EPA) rules as well as state specific rules for storm water discharge permitting and control.

Airports typically have an airport wide storm water permit obtained from the state environmental regulatory agency. This permit typically includes sampling requirements (usually managed by the airport authority), storm water pollution prevention team members (may or may not include tenant facilities), inspection requirements (may or may not include tenant facilities), training requirements, and requirements for the preparation of a SWPPP.

**General Requirements:**

As described above, airports typically have an airport wide storm water permit and may or may not have provisions for tenants. Each FBO should have a copy of the airport's permit and also the site specific SWPPP to ensure they are aware of all local requirements. The SWPPP should include a description of site specific Best Management Practices.

Typical Best Management Practices for airport facilities include the following.

- Good Housekeeping.
- Proper fuel transfer activities.
- Proper management of refueler trucks.
- Proper vehicle and equipment maintenance.
- Proper outside storage of materials.
- Proper handling of sumped fuel from aircraft.

Spills must be reported to the EHS/Safety Department. Spill reporting to regulatory agencies should follow the requirements in the site specific Spill Prevention Control and Countermeasures (SPCC) Plan.

**Responsibilities:**

1. Employees:

Employees are required to perform routine work activities in an environmentally responsible manner. Sensitive activities include the following.

- Fuel and chemical storage.
- Fuel transfers.
- De-icing operations.
- Maintenance activities outside.
- Vehicle storage outside.
- Material storage outside.
- Sumping activities from aircraft.

Employees commonly make transfers of accumulated rain water from secondary containment areas. When these transfers are made, a notation must be made in the facility log book documenting the estimated amount of water released, the date, the time, a statement that the water contained no fuel (even a sheen), and a statement that the valve was closed and secured after the transfer.

Employees are required to maintain proper housekeeping in all work areas. Keeping work areas neat and clean is an important first step in maintaining good storm water control.

Employees must follow the Best Management Practices (BMPs) as defined in the Storm Water Pollution Prevention Plan and also as presented in the training. Examples of BMPs are provided in the General Requirements section of this procedure.

Employees are required to make an initial response to a spill if it occurs as defined in the SPCC Plan.

All employees that perform activities that may impact storm water quality must participate in initial and annual training to refresh their understanding of the EPA rules, the state rules, and the Storm Water Pollution Prevention Plan. The training must include the items shown in the Training section of this procedure.

Employees often perform routine monthly or quarterly inspections of areas that may impact storm water quality. Inspections must follow the checklist provided in the site specific SWPPP and maintained per the Recordkeeping section of this procedure.

2. Managers/Supervisors:

Managers/Supervisors must ensure that employees are performing their work activities in a proper manner including housekeeping, Best Management Practices, and general storm water control.

Managers/Supervisors must ensure that employees respond appropriately to spills. Managers/ Supervisors must notify the EHS/Safety Department and must make notifications to Federal, State, and Local environmental regulatory agencies in event of a spill as required by the site specific SPCC Plan. Managers/Supervisors must coordinate activities of environmental response contractors that may be assisting in the clean-up activities after a spill.

Managers/Supervisors must ensure employees participate in the required training and perform inspections.

3. EHS/Safety Department:

The Environmental Health and Safety (EHS)/Safety Department will provide assistance for ensuring that each facility is compliant with the Airport's storm water permit and SWPPP.

The EHS/Safety Department will assist FBOs in setting up initial "train the trainer" sessions and can assist in any environmental questions that may arise.

The EHS/Safety Department must be notified of any reportable spill event and will properly document in the company tracking system.

**Training:**

The company has developed a general training program that assists the FBOs with the general compliance with the storm water regulations. This training includes a discussion of the regulatory framework, impacts of airport facilities, housekeeping, Best Management Practices, and also utilizes a video.

The EHS/Safety Department has provided assistance to the FBOs in conducting a train the trainer session and provided necessary training documents. Each FBO is responsible for conducting subsequent training for all employees that could impact storm water quality.

The site specific SWPPP should include initial and annual training requirements for all employees that could impact storm water quality. Training activities should include the following items.

- Pollution control laws, rules, and regulations.
- General facility operations
- Housekeeping practices.
- Best Management Practices (BMPs).
- Materials management.
- Spill response.
- Discussion of previous discharges, malfunctioning components, and new precautions

**Recordkeeping:**

Documentation of the following SWPPP activities must be maintained.

- Transfers of accumulated rain water must be documented in the facility log book or documented on a checklist. These documents must be maintained for a period of three (3) years.
- Facility inspections must follow the checklist provided in the site specific SWPPP and typically must be maintained for a period of three (3) years.
- Training records must document who received SWPPP training, the dates of the training, and the topics covered. These documents typically must be maintained for a period of three (3) years.

National Air Transportation Association

The Voice of Aviation Business

*(prepared by George S. Gamble, 2G Environmental, LLC)*

## Environmental Health and Safety (EHS) Policy

## Used Batteries

---

**Regulatory Reference:** 40 CFR 273, Standards for Universal Waste Management, State specific battery recycling rules.

**Purpose:** The purpose of this Used Battery Program is to establish a framework for each Fixed Base Operation (FBO) to become and remain compliant with the Federal Environmental Protection Agency (EPA) rules as well as state specific rules for Used Batteries and Universal Waste.

The EPA Universal Waste regulations came about in the early 1990s to allow generators of certain common waste items to properly recycle these items and streamline the requirements for these items. Items regulated in the Universal Waste rules include the following.

- Used Batteries.
- Used Florescent Lamps.
- Pesticides.
- Mercury containing equipment.

**General Requirements:**

The FBO handles a variety of batteries from large lead acid batteries to small nickel cadmium rechargeable batteries. Most of these batteries contain hazardous materials and thus must be handled properly to ensure no damage to the environment occurs.

The Federal EPA has set forth rules for proper handling and recycling of used batteries under the Universal Waste Rules and the requirements for handling these items are simpler than the rules governing hazardous waste. A significant part of these rules includes the proper recycling of the used batteries. Recycling batteries keeps them out of the landfills and thus protects the environment from potentially hazardous waste. The regulations include recordkeeping requirements for Large Quantity Handlers (greater than 5,000 KG stored at any one time), but all FBO operations should fall below this limit and thus should not be required to maintain specific records.

Proper handling of used batteries includes proper labeling. Each battery or each storage location must be labeled as "Used Batteries" and the storage area needs to be labeled with the date accumulation began (date of last shipment) as batteries can be stored no more than one year.

Employees must not transport used batteries to recycling center. Use only an approved transporter (usually the company that recycles the batteries).

If a leak occurs on any battery, the leak must be immediately contained. Use absorbent materials to capture the leak and place the battery in a pan or other container that will contain any residual leaking fluid. Handle all clean-up wastes per EPA Hazardous Waste rules.

**Responsibilities:**

1. Employees:

Employees must be aware of the requirements for the handling of used batteries, properly recycling used batteries, and proper response to a spill.

Employees must properly store and label used batteries and must mark the storage area with the date that batteries were accumulated (date of last shipment to the recycler). Batteries must be accumulated for a period of less than one year before they are sent to a recycler.

Employees must know the proper method to respond to a leaking battery and how to contain any leaking fluid.

Employees must participate in a training session to discuss proper handling and proper spill response. Training only needs to be completed initially and no refresher training is required.

2. Managers/Supervisors:

Managers/Supervisors should ensure that employees are performing their work activities in a proper manner including handling, recycling, and spill response.

Managers/Supervisors should ensure that employees respond appropriately to spills. Managers/Supervisors should make notifications to Federal, State, and Local environmental regulatory agencies if required.

Managers/Supervisors should ensure batteries are stored for less than one year before they are shipped to a recycler.

Managers/Supervisors should ensure that used batteries are properly labeled.

Managers/Supervisors should ensure employees participate in the required training.

3. EHS/Safety Department:

The Environmental Health and Safety (EHS)/Safety Department will monitor compliance with all environmental regulations including Universal Waste and used batteries.

The EHS/Safety Department will assist FBOs in setting up initial "train the trainer" sessions and can assist in any environmental questions that may arise.

The EHS/Safety Department must be notified of any reportable spill event and will properly document in the company tracking system.

**Training:**

Employees must be trained to include proper handling and emergency procedures. This training is only required initially and no refresher training is required. EHS/Safety is planning to develop training materials and make them available to each FBO.

**Recordkeeping:**

No shipping records or manifests are required.

Documentation of the training activities must be maintained and must include the person's name, date of training, and topics covered.

NATA
National Air Transportation Association
The Voice of Aviation Business

*(prepared by George S. Gamble, 2G Environmental, LLC)*

## Environmental Health and Safety (EHS) Policy

## Used Oil

---

**Regulatory Reference:** 40 CFR 279, Standards for the Management of Used Oil, State specific used oil rules.

**Purpose:** The purpose of this Used Oil Program is to establish a framework for each Fixed Base Operation (FBO) to become and remain compliant with the Federal Environmental Protection Agency (EPA) rules as well as state specific rules for Used Oil.

The EPA Used Oil regulations came about in the early 1990s to allow generators, transporters, and recyclers of used oil to properly recycle these items and streamline the requirements for this material.

**General Requirements:**

The Federal EPA has set forth rules for proper handling and recycling of used oil under the Standards for the Management of Used Oil regulations and the requirements for handling these items are simpler than the rules governing hazardous waste. A significant part of these rules includes the proper recycling of the used oil. Used oil may contain hazardous impurities such as heavy metals and must be protected from entering the environment. Recycling oil keeps it out of the landfills and thus protects the environment from potentially hazardous waste.

Proper handling of used oil includes proper labeling. Each used oil storage location must be labeled as "Used Oil" and the fill port for any used oil stored in underground storage tanks (USTs) must also be labeled as "Used Oil." Keep containers in good condition and free of leaks. If a leak occurs, it must be repaired immediately and any contaminated soil must be removed. Containers must follow the requirements of 40 CFR 112, Spill Prevention Control and Countermeasures, if the facility aggregate tank capacity exceeds 1,320 gallons.

Employees must not transport used oil. An approved transporter must be used (typically the company that recycles the oil).

Do not mix used oil with any other products such as waste jet fuel or waste AVGAS.

Any spills of used oil must be handled per the site specific SPCC Plan. The Manger/Supervisor should make any notifications to Federal, State, and Local environmental regulatory agencies and keep the EHS/Safety department informed along the way.

Many FBOs already have a used oil recycling company in place, however, if a used oil recycler is needed, companies can be located with the assistance of the Coordinating Committee for Automotive Repair (CCAR) on their web site at www.ccar-greenlink.org.

**Responsibilities:**

1. Employees:

Employees must be aware of the requirements for the handling of used oil, properly recycling used oil, and the proper response to spills of used oil.

Employees must properly store and label all containers with a "Used Oil" label.

Employees must know the proper method to respond to a spill of used oil and how to dispose of clean-up materials.

Employees must participate in a training session to discuss proper handling and proper response to spills of used oil. This training in incorporated into the Spill Prevention Control and Countermeasures (SPCC) training and needs to be completed annually.

2. Managers/Supervisors:

Managers/Supervisors should ensure that employees are performing their work activities in a proper manner including handling, recycling, and responding to spills of used oil.

Managers/Supervisors should ensure that employees respond appropriately to used oil spills. Managers/Supervisors should make notifications to Federal, State, and Local environmental regulatory agencies if required as identified in the facility SPCC Plan.

Managers/Supervisors should ensure that used oil containers are properly labeled.

Managers/Supervisors should ensure employees participate in the required training.

3. EHS/Safety:

The Environmental Health and Safety (EHS)/Safety Department will monitor compliance with all environmental regulations including used oil regulations.

The EHS/Safety Department will assist FBOs in setting up initial "train the trainer" sessions and can assist in any environmental questions that may arise.

The EHS/Safety Department must be notified of any reportable spill event and will properly document in the company tracking system.

**Training:**

Employees must participate in a training session to discuss proper handling and proper response to spills of used oil. This training is incorporated into the SPCC training and must be completed annually. EHS/Safety is planning to develop used oil specific training materials and make them available to each FBO.

**Recordkeeping:**

No shipping records or manifests are required.

Documentation of the training activities must be maintained as defined in the SPCC Program.

National Air Transportation Association

The Voice of Aviation Business

*(prepared by George S. Gamble, 2G Environmental, LLC)*

## Environmental Health and Safety (EHS) Policy

## Used Fluorescent Lamps

---

**Regulatory Reference:** 40 CFR 273, Standards for Universal Waste Management, State specific recycling rules.

**Purpose:** The purpose of this Used Fluorescent Lamp Program is to establish a framework for each Fixed Base Operation (FBO) to become and remain compliant with the Federal Environmental Protection Agency (EPA) rules as well as state specific rules for Used Fluorescent Lamps and Universal Waste.

The EPA Universal Waste regulations came about in the early 1990s to allow generators of certain common waste items to properly recycle these items and streamline the requirements for these items. Items regulated in the Universal Waste rules include the following.

- Used Batteries.
- Used Florescent Lamps.
- Pesticides.
- Mercury containing equipment.

**General Requirements:**

The Federal EPA has set forth rules for proper handling and recycling of used fluorescent lamps under the Universal Waste Rules and the requirements for handling these items are simpler than the rules governing hazardous waste. A significant part of these rules includes the proper recycling of the used fluorescent lamps. Fluorescent lamps contain mercury and are therefore hazardous to the environment. Recycling fluorescent lamps keeps them out of the landfills and thus protects the environment from potentially hazardous waste. The regulations include recordkeeping requirements for Large Quantity Handlers (greater than 5,000 KG stored at any one time), but all FBO operations should fall below this limit and thus should not be required to maintain specific records.

Proper handling of used fluorescent lamps includes proper labeling. Each Fluorescent Lamp or each storage location must be labeled as "Used Fluorescent Lamps" and the storage area needs to be labeled with the date accumulation began (date of last shipment) as fluorescent lamps can be stored no more than one year.

When florescent lamps are replaced, the used lamps must be placed in containers or packages that are structurally sound, adequate to prevent breakage and compatible with the contents of the lamps. It is recommended to use one of the boxes that the new lamps were delivered in, but be sure to label the used lamps with a "Used Fluorescent Lamps" label.

Broken lamps must be placed in a closed, structurally sound container that is compatible with the contents of the lamp and must keep any releases of mercury inside the package. Broken lamps should be placed in a closed plastic container and the lid should be taped closed. These containers should be labeled as "Broken Fluorescent Lamps."

Many FBOs already have a recycling company in place, however, if a recycler is needed, companies can be located with the assistance of the Association of Lighting & Mercury Recyclers on their web site at www.almr.org.

Employees must not transport used fluorescent lamps to recycling center. Use only an approved transporter (usually the company that recycles the fluorescent lamps).

**Responsibilities:**

1. Employees:

Employees must be aware of the requirements for the handling of used fluorescent lamps, properly recycling used fluorescent lamps, and proper response to broken lamps.

Employees must properly store and label used fluorescent lamps and must mark the storage area with the date that fluorescent lamps were accumulated (date of last shipment to the recycler).

Fluorescent lamps may be accumulated for a period of no more than one year before they are sent to a recycler.

Employees must know the proper method to respond to a broken fluorescent lamp and how to properly package it for shipment.

Employees must participate in a training session to discuss proper handling and proper response to broken lamps. Training only needs to be completed initially and no refresher training is required.

2. Managers/Supervisors:

Managers/Supervisors should ensure that employees are performing their work activities in a proper manner including handling, recycling, and response to broken lamps.

Managers/Supervisors should ensure that employees respond appropriately to broken lamps. Managers/Supervisors should make notifications to Federal, State, and Local environmental regulatory agencies if required.

Managers/Supervisors should ensure fluorescent lamps are stored for less than one year before they are shipped to a recycler.

Managers/Supervisors should ensure that used fluorescent lamps are properly labeled.

Managers/Supervisors should ensure employees participate in the required training.

3. EHS/Safety:

The Environmental Health and Safety (EHS)/Safety Department will monitor compliance with all environmental regulations including Universal Waste and used fluorescent lamps.

The EHS/Safety Department will assist FBOs in setting up initial "train the trainer" sessions and can assist in any environmental questions that may arise.

The EHS/Safety Department must be notified of any reportable spill event and will properly document in the company tracking system.

**Training:**

Employees must be trained to include proper handling and emergency procedures. This training is only required initially and no refresher training is required. EHS/Safety is planning to develop training materials and make them available to each FBO.

**Recordkeeping:**

No shipping records or manifests are required.

Documentation of the training activities must be maintained and must include the person's name, date of training, and topics covered.

United States Government Accountability Office

GAO

Testimony

Before the Subcommittee on Aviation, Committee on Transportation and Infrastructure, House of Representatives

For Release on Delivery
Expected at 2:00 p.m. EDT
Tuesday, May 6, 2008

# AVIATION AND THE ENVIRONMENT

## NextGen and Research and Development Are Keys to Reducing Emissions and Their Impact on Health and Climate

Statement of Gerald L. Dillingham, Ph.D.
Director, Physical Infrastructure Issues

GAO
Accountability * Integrity * Reliability

GAO-08-706T

May 6, 2008

# AVIATION AND THE ENVIRONMENT

## NextGen and Research and Development Are Keys to Reducing Emissions and Their Impact on Health and Climate

GAO
Accountability • Integrity • Reliability

# Highlights

Highlights of GAO-08-706T, a testimony before the Subcommittee on Aviation, Committee on Transportation and Infrastructure, House of Representatives

### Why GAO Did This Study

Collaboration between the federal government and the aviation industry has led to reductions in aviation emissions, but growing air traffic has partially offset these reductions. The Federal Aviation Administration (FAA), together with the National Aeronautics and Space Administration (NASA), the Environmental Protection Agency (EPA), and others, is working to increase the efficiency, safety, and capacity of the national airspace system and at the same time reduce aviation emissions, in part, by transforming the current air traffic control system to the Next Generation Air Transportation System (NextGen). This effort involves new technologies and air traffic procedures that can reduce aviation emissions and incorporates research and development (R&D) on emissions-reduction technologies. Reducing aviation emissions is important both to minimize their adverse health and environmental effects and to alleviate public concerns about them that could constrain the expansion of airport infrastructure and aviation operations needed to meet demand.

This testimony addresses (1) the scope and nature of aviation emissions, (2) the status of selected key federal efforts to reduce aviation emissions, and (3) next steps and challenges in reducing aviation emissions. The testimony updates prior GAO work with FAA data, literature reviews, and interviews with agency officials, industry and environmental stakeholders, and selected experts.

To view the full product, including the scope and methodology, click on GAO-08-706T. For more information, contact Gerald L. Dillingham at (202) 512-2834 or dillinghamg@gao.gov.

### What GAO Found

Aviation contributes a modest but growing proportion of total U.S. emissions, and these emissions contribute to adverse health and environmental effects. Aircraft and airport operations, including those of service and passenger vehicles, emit ozone and other substances that contribute to local air pollution, as well as carbon dioxide and other greenhouse gases that contribute to climate change. EPA estimates that aviation emissions account for less than 1 percent of local air pollution nationwide and about 2.7 percent of U.S. greenhouse gas emissions, but these emissions are expected to grow as air traffic increases.

Two key federal efforts, if implemented effectively, can help to reduce aviation emissions—NextGen initiatives in the near term and research and development over the longer term. For example, NextGen technologies and procedures, such as satellite-based navigation systems, should allow for more direct routing, which could improve fuel efficiency and reduce carbon dioxide emissions. Federal research and development efforts—led by FAA and NASA in collaboration with industry and academia—have achieved significant reductions in aircraft emissions through improved aircraft and engine technologies, and federal officials and aviation experts agree that such efforts are the most effective means of achieving further reductions in the longer term. Federal R&D on aviation emissions also focuses on improving the scientific understanding of aviation emissions and developing lower-emitting aviation fuels.

Next steps in reducing aviation emissions include managing NextGen initiatives efficiently; deploying NextGen technologies and procedures as soon as practicable to realize their benefits, including lower emissions levels; and managing a decline in R&D funding, in part, by setting priorities for R&D on NextGen and emissions-reduction technologies. Challenges in reducing aviation emissions include designing aircraft that can simultaneously reduce noise and emissions of air pollutants and greenhouse gases; encouraging financially stressed airlines to purchase more fuel-efficient aircraft and emissions-reduction technologies; addressing the impact on airport expansion of more stringent EPA air quality standards and growing public concerns about the effects of aviation emissions; and responding to proposed domestic and international measures for reducing greenhouse gases that could affect the financial solvency and competitiveness of U.S. airlines.

Sources of Aviation Emissions

Source: FAA.

Mr. Chairman and Members of the Subcommittee:

I appreciate the opportunity to testify before you on aviation emissions, one of the key sources of concern about the environmental effects of aviation. Over the past 30 years, the federal government, the aviation industry, and other private parties have worked collaboratively to achieve steady reductions in aircraft emissions.[1] Nevertheless, increases in air traffic, which have enhanced the nation's productivity and mobility, have partially offset these reductions, as more flights have produced more emissions and congestion has led to flight delays. According to the Federal Aviation Administration (FAA), this growth in air traffic will continue, with the number of flights increasing 20 percent by 2015 and 60 percent by 2030.[2] In light of these developments, concerns about the environmental effects of aviation emissions have persisted. Moreover, better scientific understanding of the potential health effects of certain aviation emissions and their contribution to climate change has intensified the public's concerns.

To accommodate the expected growth in air traffic, FAA is leading a multipronged, multiagency effort to increase the efficiency, safety, and capacity of the national airspace system. This effort includes transforming the current air traffic control system into the Next Generation Air Transportation System (NextGen)[3] and will require airport and runway expansion. The NextGen initiative incorporates research and development (R&D) on emissions-reduction technologies, alternative fuels, and cleaner and quieter air traffic management procedures. This R&D is necessary both to meet anticipated domestic and international environmental standards and to reduce the environmental impact of aviation. Meeting environmental standards can limit the adverse effects of aviation emissions on air quality and climate, and addressing public concerns about aviation emissions is necessary to avoid constraints on the expansion of aviation operations and airport infrastructure planned under NextGen.[4]

Under the National Environmental Policy Act of 1969, agencies evaluate the likely environmental effects of projects they are proposing using an environmental assessment or, if the projects likely would significantly affect the environment, a more detailed environmental impact statement.[5] FAA typically carries out one of these evaluations for federally financed airport construction projects, including the construction of federally

[1]These emissions include airborne pollutants, which affect air quality, and greenhouse gases, primarily carbon dioxide, which are produced by the combustion of fossil fuel, and contribute to climate change.

[2]These figures are based on a long-range FAA forecast using 2006 as the baseline.

[3]See the list of related products at the end of this statement, especially GAO, *Next Generation Air Transportation System: Progress and Challenges in Planning and Implementing the Transformation of the National Airspace System*, GAO-07-649T (Washington, D.C.: Mar. 22, 2007.)

[4]As we noted in our recent testimony before this Subcommittee, aviation noise has been a greater constraint on airport expansion efforts than aviation emissions, but we are limiting our discussion in this testimony to aviation emissions.

[5]42 U.S.C. §4332(2)(C).

subsidized runways. In addition, under the Clean Air Act's conformity provision, no federal agency may approve or provide financial assistance for any activity that does not conform to an applicable state implementation plan.[6] Therefore, FAA must evaluate whether a proposed federal action associated with an airport project conforms with the applicable state implementation plan before approving or funding the project.[7] In addition, the Clean Air Act mandates standards for mobile sources of emission, such as aircraft and the equipment that service them at airports. EPA sets emissions standards for aircraft and has chosen to adopt international emissions standards for aircraft set by the International Civil Aviation Organization (ICAO).[8]

As requested, my testimony today focuses on aviation emissions. It will address the following questions: (1) What are the scope and nature of aviation emissions? (2) What is the status of selected key federal efforts to address aviation emissions? and (3) What are some next steps and major challenges for the federal government, the aviation industry, and Congress related to aviation emissions? My statement is based on previous GAO reports[9] updated with a synthesis of recent empirical literature and interviews with officials from FAA, the National Aeronautics and Space Administration (NASA), and the U.S. Environmental Protection Agency (EPA); representatives of aviation industry and environmental associations, and selected aviation emissions experts.[10] We balanced the selection of these experts to capture the views of the many different groups involved in aviation emissions reduction efforts and NextGen. We conducted our work from March to May 2008 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the study to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our study objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our study objectives.

---

[6]States are required to submit implementation plans to EPA for reducing emissions in areas that fail to meet the National Ambient Air Quality Standards set by EPA under the Clean Air Act for common air pollutants with health and environmental effects (known as criteria pollutants). Geographic areas that have levels of a criteria pollutant above those allowed by the standard are called nonattainment areas.

[7]42 U.S.C. §7506(c)(1) (The Conformity Provision).

[8]ICAO is an organization affiliated with the United Nations that aims to promote the establishment of international civilian aviation standards and recommended practices and procedures. FAA, as the U.S. representative to ICAO, in consultation with EPA, works with representatives from other countries to formulate aircraft emissions standards.

[9]See the list of related GAO products at the end of this statement, especially GAO, *Aviation and the Environment: Strategic Framework Needed to Address Challenges Posed by Aircraft Emissions,* GAO-03-252 (Washington, D.C.; Feb. 28, 2003).

[10]We are currently undertaking a study on aviation environmental trends, efforts, and challenges for this Subcommittee and the Subcommittee on Space and Aeronautics, Committee on Science and Technology, House of Representatives.

**Summary**

Currently, aviation contributes a modest proportion of total emissions in the United States, but its share could increase in the future, and aviation emissions can have a detrimental effect on health and the environment. Aircraft are the primary source of aviation emissions, but airport operations, including those of service and passenger vehicles, also produce emissions. Together, aircraft operations in the vicinity of the airport and other airport sources emit nitrogen oxides, which lead to the formation of ground-level ozone (also known as smog), and other substances that contribute to local air pollution, as well as carbon dioxide and other greenhouse gases that rise into the atmosphere and contribute to climate change. Aircraft operations in the upper atmosphere are, however, the primary aviation-related source of greenhouse gas emissions. Currently, according to EPA estimates, aviation emissions account for less than 1 percent of local air pollution nationwide and about 3.6 percent of U.S. greenhouse gas emissions. This proportion is, however, expected to grow with projected increases in air traffic, despite expected improvements in fuel efficiency. Notably, according to FAA, emissions of nitrogen oxides from aviation sources will increase by over 90 percent by 2025 if not addressed. This increase is likely to increase ozone, which aggravates respiratory ailments. Increases in air traffic also mean increases in carbon dioxide emissions and increases in aviation's contribution to climate change, according to the International Panel on Climate Change (IPCC).

Two key federal efforts, if implemented effectively, can help to reduce aviation emissions—near term NextGen initiatives and R&D over the longer term to fully enable NextGen and reduce aircraft emissions. Some NextGen technologies and procedures, such as satellite-based navigation systems, should allow for more direct routing, which could improve fuel efficiency and reduce carbon dioxide emissions. According to FAA, the full implementation of NextGen could reduce greenhouse gas emissions from aircraft by up to 12 percent by 2025. Federal R&D efforts—led primarily by FAA and NASA and often conducted in collaboration with industry and academia—have achieved significant reductions in aircraft emissions over the last 30 years, and FAA and NASA officials and aviation experts agree that such efforts are the most effective means of achieving further reductions in the longer term. As part of the a national plan for aeronautics R&D, issued by the White House Office of Science and Technology Policy, the federal government supports a comprehensive approach to R&D on aviation emissions involving FAA, NASA, and other federal agencies that is intended both to improve scientific understanding of the impact of aviation emissions and to develop new technologies, fuels, and air traffic management approaches. Better understanding of the nature and impact of aviation emissions can inform the development of lower-emitting alternative fuels, more efficient air traffic management technologies and procedures, and more fuel-efficient aircraft engines.

Reducing aviation emissions includes steps that FAA and others can take to move the implementation of NextGen forward and to support R&D on NextGen and emissions-reduction technologies, as well as technical, financial, and regulatory challenges facing the federal government, the aviation industry, and Congress. One step for FAA is to ensure the efficiency of NextGen's management by, for example, addressing

congressional leaders' and stakeholders' concerns about the program's management structure and authority. Another step for FAA is to further deploy, as soon as practicable, NextGen technologies and procedures, such as the more efficient takeoff and landing procedures now in use at a few airports, to realize their benefits and lower emissions levels. A third step, for FAA and NASA, is managing a decline in federal funding for aeronautics research, the research category that includes work on aviation emissions, new aircraft and engine technologies, and alternative fuels. As a result of this decline, NASA is now sometimes developing technologies to a lower maturity level than in the past, and the technologies are less ready for manufacturers to adopt them. The administration's reauthorization bill for FAA seeks some additional funding for an initiative that could lead to the earlier maturation of certain emissions-reduction technologies, but according to some experts, increased funding of the initiative could increase the probability of success and decrease the time needed to achieve that success. Challenges in reducing aviation emissions for the federal government, the aviation industry, and Congress include designing aircraft that can simultaneously reduce noise and emissions of air pollutants and greenhouse gases; encouraging financially stressed airlines to purchase more fuel-efficient aircraft and emissions-reduction technologies; addressing the impact on airport expansion of more stringent EPA air quality standards and growing public concerns about effects of aviation emissions; and responding to proposed domestic and international measures for reducing greenhouse gases that could affect the financial solvency and competitiveness of U.S. airlines.

**Aviation's Small but Growing Proportion of Total Emissions Contributes to Health and Environmental Effects**

Aviation-related activities contribute to local air pollution and produce greenhouse gases that cause climate change. Aircraft account for about 70 to 80 percent of aviation emissions, producing emissions that mainly affect air quality below 3,000 feet and increase greenhouse gases at higher altitudes. At ground level, airport operations, including those of motor vehicles[11] traveling to and from the airport, ground service equipment,[12] and stationary sources such as incinerators and boilers, also produce emissions. Together, aircraft operations in the vicinity of the airport and other airport sources produce emissions such as carbon monoxide, sulfur oxides, particulate matter, nitrogen oxides, unburned hydrocarbons, hazardous air pollutants,[13] and ozone[14] that contribute to air pollution. In addition, these sources emit carbon dioxide and other greenhouse gases that contribute to climate change, but aircraft operations in the upper atmosphere are the primary source of aviation-related greenhouse gases. Carbon dioxide

[11]Motor vehicles include cars and buses for airport operations and passenger, employee, and rental agency vehicles.

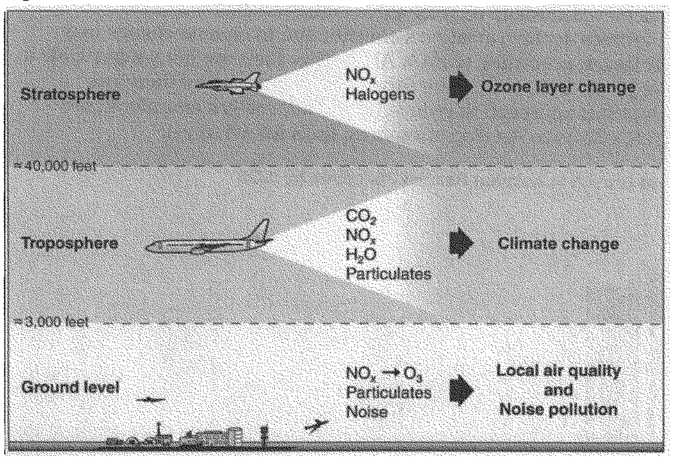
[12]Ground service equipment includes aircraft tugs, baggage and belt loaders, generators, lawn mowers, snow plows, loaders, tractors, air-conditioning units, and cargo moving equipment.

[13]Hazardous air pollutants from aviation activities include benzene and formaldehyde.

[14]Ground-level ozone is formed when nitrogen oxides and volatile organic compounds as well as other gases and substances are mixed and heated in the atmosphere.

is both the primary aircraft emission and the primary contributor to climate change. It survives in the atmosphere for over 100 years. Furthermore, other gases and particles emitted by aircraft—including water vapor, nitrogen oxides, soot, contrails,[15] and sulfate—can also have an impact on climate, but the magnitude of this impact is unknown, according to FAA. Figure 1 illustrates aviation's impact on air quality and climate.

**Figure 1: Environmental Effects of Aviation Emissions and Noise**




Source: GAO.

Currently, aviation accounts for a small portion of air pollutants and greenhouse gas emissions. Specifically, aviation emissions represent less than 1 percent of air pollution nationwide, but their impact on air quality could be higher in the vicinity of airports. In addition, aviation accounts for about 2.7 percent of the total U.S. contribution of greenhouse gas emissions, according to the Department of Transportation's Center for Climate Change and Environment. A 1999 study by the United Nations' Intergovernmental Panel on Climate Change (IPCC) estimated that global aircraft emissions generally accounted for approximately 3.5 percent of the warming generated by human activity.[16]

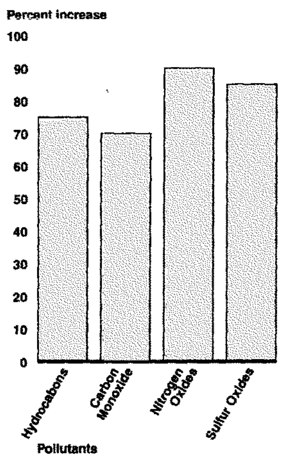
As air traffic increases, aviation's contribution to air pollution and climate change could also grow, despite ongoing improvements in fuel efficiency, particularly if other sectors achieve significant reductions. In addition, aviation's impact on air quality is changing as more fuel-efficient, quieter aircraft engines are placed in service. While new aircraft

[15]Contrails are clouds and condensation trails that form when water vapor condenses and freezes around small particles (aerosols) in aircraft exhaust.

[16]Intergovernmental Panel on Climate Change, *Aviation and the Global Atmosphere* (1999).

engine technologies have reduced fuel consumption, noise, and emissions of most pollutants, they have not achieved the same level of reductions in nitrogen oxide emissions, which contribute to ozone formation. According to FAA, nitrogen oxide emissions from aviation will increase by over 90 percent by 2025 without improvements in aircraft emissions technologies and air traffic management, and emissions of other air pollutants will also increase, as shown in figure 2. Additionally, aviation's greenhouse gas emissions and potential contribution to climate change is expected to increase. IPCC has estimated that aircraft emissions are likely to grow by 3 percent per year, outpacing the emissions reductions achieved through technological improvements. Furthermore, as emissions from other sources decline, aviation's contribution to climate change may become proportionally larger, according to FAA. Alternative fuels are not yet available in sufficient quantities for jet aircraft, as they are for some other uses, and therefore aviation cannot yet adopt this approach to reduce its greenhouse gas emissions (see discussion below on U.S. efforts to develop alternative fuels for aviation).

**Figure 2: FAA Analysis of Growth in Aviation Related Pollutants by 2025**



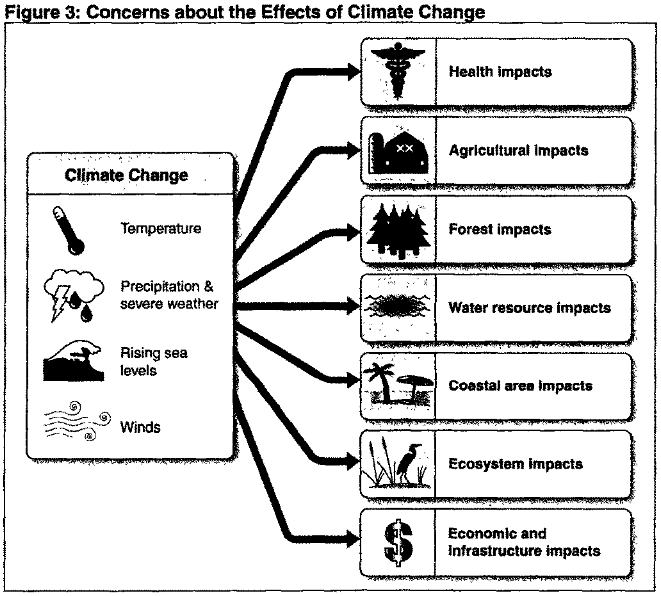

Source: FAA.

Note: According to FAA, the increases in aviation-related pollutants are baseline forecasts that do not account for potential improvements in aircraft technology and air traffic management.

Aviation emissions, like other combustible emissions, include pollutants that affect health. While it is difficult to determine the health effects of pollution from any one source, the nitrogen oxides produced by aircraft engines contribute to the formation of ozone, the air pollutant of most concern in the United States and other industrialized countries. Ozone has been shown to aggravate respiratory ailments. A National Research Council panel recently concluded that there is strong evidence that even short-term exposure to ozone is likely to contribute to premature deaths of people with asthma, heart disease, and other preexisting conditions. With improvements in aircraft fuel efficiency and the expected resulting increases in nitrogen oxide emissions, aviation's contribution to ozone formation may increase. In addition, aviation is associated with other air pollutants, such as hazardous air pollutants, including benzene and formaldehyde, and particulate matter, all of which can adversely affect health. Data on emissions of hazardous air pollutants in the vicinity of airports are limited, but EPA estimates that aviation's production of these pollutants is small relative to other sources, such as on-road vehicles. Nevertheless, according to EPA, there is growing public concern about the health effects of the hazardous air pollutants and particulate matter associated with aviation emissions. See appendix I for more detailed information on the health and environmental effects of aviation emissions.

Carbon dioxide and other greenhouse gas emissions from aircraft operations in the atmosphere, together with ground-level aviation emissions that gradually rise into the atmosphere, contribute to global warming and climate change. IPCC's most recent report[17] documents mounting evidence of global warming and projects the potential catastrophic effects of climate change. As figure 6 shows, climate change affects precipitation, sea levels, and winds as well as temperature, and these changes in turn will increasingly affect economies and infrastructure around the world.

**Figure 3: Concerns about the Effects of Climate Change**




Source: EPA and FAA.

[17] Intergovernmental Panel on Climate Change, Fourth Assessment Report, *Summary for Policy Makers,* Cambridge University Press, Cambridge, UK, November 2007.

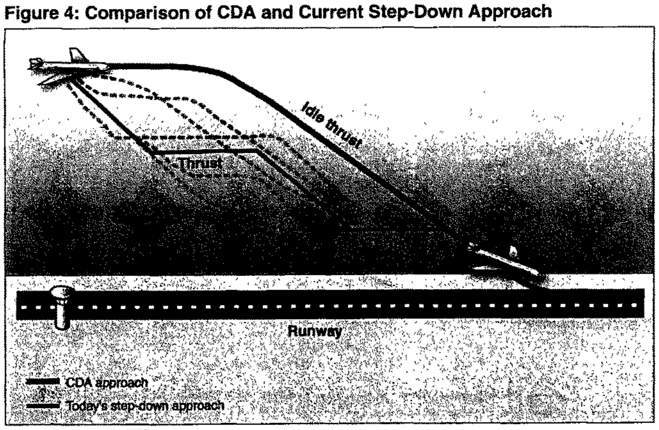
**Key Federal Efforts to Address Aviation Emissions Include Near-Term Operational Changes and Longer-Term R&D Initiatives**

Two key federal efforts, if implemented effectively, can help to reduce aviation emissions—near-term NextGen initiatives and an array of R&D programs over the longer term to fully enable NextGen and to reduce aircraft emissions. The NextGen initiatives are primarily intended to improve the efficiency of the aviation system so that it can handle expected increases in air traffic, but these initiatives can also help reduce aviation emissions. In addition, the federal government, led by FAA and NASA, has longer-term R&D programs in place to improve the scientific understanding of the impact of aviation emissions in order to inform decisions about emissions-reduction strategies, explore potential emissions-reducing alternative fuels, and develop NextGen and aircraft emissions-reduction technologies.

NextGen Initiatives Have the Potential to Help Reduce Emissions

Technologies and procedures that are being developed as part of NextGen to improve the efficiency of flight operations can also reduce aircraft emissions. According to FAA, the implementation of NextGen could reduce greenhouse gas emissions from aircraft by up to 12 percent. One NextGen technology, considered a centerpiece of NextGen, is the Automatic Dependent Surveillance-Broadcast (ADS-B) satellite aircraft navigation system. ADS-B is designed, along with other navigation technologies, to enable more precise control of aircraft during en route flight, approach, and descent. ADS-B will allow for closer and safer separations between aircraft and more direct routing, which will improve fuel efficiency and reduce carbon dioxide emissions. This improved control will also facilitate the use of air traffic control procedures that will reduce communities' exposure to aviation emissions and noise. One such procedure, Continuous Descent Arrivals (CDA), allows aircraft to remain at cruise altitudes longer as they approach destination airports, use lower power levels, and thereby lower emissions and noise during landings. Figure 3 shows how CDA compares with the current step-down approach to landing, in which aircraft make alternate short descents and forward thrusts, which produce more emissions and noise than continuous descents. A limited number of airports have already incorporated CDA into their operations. For example, according to officials from Los Angeles International Airport, nearly 25 percent of landings at their airport use CDA procedures in one of the airport's standard terminal approaches. In addition, United Parcel Service plans to begin using a nighttime CDA procedure, designed and tested at the Louisville International Airport, for its hub operations.

**Figure 4: Comparison of CDA and Current Step-Down Approach**



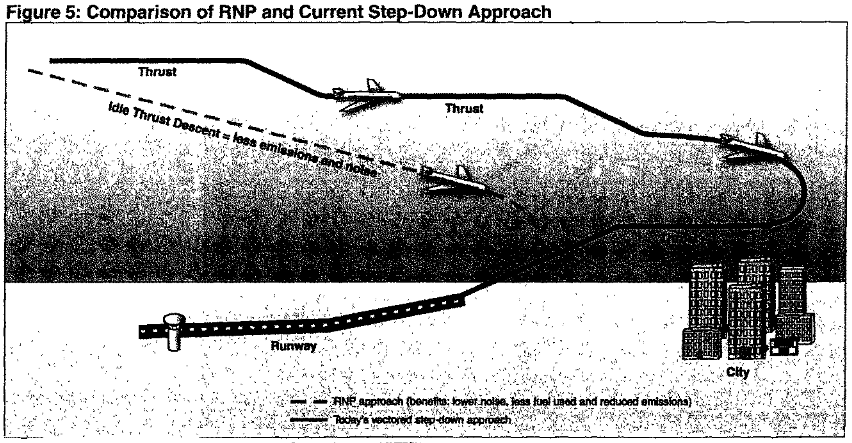

Sources: Naverus and AVTECH.

Note: Continuous Descent Arrivals keep aircraft higher for longer and have them descend at near-idle power to touchdown. Optimal profiles are not always possible, especially at busy airports.

Two closely associated NextGen initiatives, Area Navigation (RNAV) and Required Navigation Performance (RNP), have the potential to modify the environmental impact of aviation by providing enhanced navigational capability to the pilot. RNAV equipment can compute an airplane's position, actual track, and ground speed, and then provide meaningful information on the route of flight selected by the pilot. RNP will permit the airplane to descend on a precise route that will allow it to avoid populated areas, reduce its consumption of fuel, and lower its emissions of carbon dioxide and nitrogen oxides.[18] See figure 4. Currently, over 350 RNAV/RNP procedures are available at 54 airports, including Dallas/Fort Worth, Miami International, Washington Dulles, and Atlanta Hartsfield.

[18]A critical component of RNP is the ability of the navigation system to monitor its achieved navigation performance and to identify for the pilot if an operational requirement is or is not being met during an operation.

**Figure 5: Comparison of RNP and Current Step-Down Approach**




Sources: Naverus and AVTECH

Note: An RNP approach and path allows for idle-thrust, continuous descent instead of today's step-down approaches with vectors. RNP precision and curved-approach flexibility can shift flight paths to avoid populated areas.

Still another NextGen initiative, High-Density Terminal and Airport Operations, is intended to improve the efficiency of aircraft operations at busy airports, and, in the process, reduce emissions. At high-density airports, the demand for access to runways is high, and arrivals and departures take place on multiple runways. The combination of arrivals, departures, and taxiing operations may result in congestion, which in turn produces delays, emissions, and noise as aircraft wait to take off and land. Under the High-Density Terminal and Airport Operations initiative, which FAA has just begun to implement, aircraft arriving and departing from different directions would be assigned to multiple runways and safely merged into continuous flows despite bad weather and low visibility. To guarantee safe separation, these airports would need enhanced navigation capabilities and controllers with access to increased automation. Under this initiative, aircraft would also move more efficiently on the ground, using procedures that are under development to reduce spacing and separation requirements and improve the flow of air traffic into and out of busy metropolitan airspace. More efficient aircraft movement would increase fuel efficiency and reduce emissions and noise. Although the implementation of this initiative is in the early stages, FAA has identified the R&D needed to move it forward.

Technologies and procedures planned for NextGen should also help improve the efficiency of flights between the United States and other nations, further reducing emissions, particularly of greenhouse gases. A test program scheduled to begin in the fall of 2008, known as the Atlantic Interoperability Initiative to Reduce Emissions (AIRE), sponsored by FAA and the European Commission, Boeing, and Airbus, will involve gate-to-gate testing of improved procedures on the airport surface, during departures and arrivals, and while cruising over the ocean. Some of the procedures to be tested will use technologies such as ADS-B. A similar effort—the Asia and South Pacific Initiative to Reduce Emissions (ASPIRE)—was launched earlier this year, involving the United States, Australia, and New Zealand.

Federal R&D Focuses on Long-Term Approaches to Addressing Aviation Emissions

We have previously reported[19] that the federal government and industry have achieved significant reductions in some aircraft emissions, such as carbon dioxide, through past R&D efforts, and federal officials and aviation experts agree that such efforts are the most effective means of achieving further reductions in the longer term[20]. As part of the a national plan for aeronautics R&D, issued by the White House Office of Science and Technology Policy, the federal government supports a comprehensive approach to R&D on aviation emissions that involves FAA, NASA, and other federal agencies. According to FAA, this approach includes efforts to improve the scientific understanding of the nature and impact of aviation emissions and thereby inform the development of more fuel-efficient aircraft, of alternative fuels that can reduce aircraft emissions, and of air traffic management technologies that further improve the efficiency of aviation operations. NASA, industry, and academia are important partners in these efforts. Notably, however, the development of breakthrough technologies, such as highly fuel-efficient aircraft engines that emit fewer greenhouse gases and air pollutants, is expensive and can take a long time, both to conduct the research and to implement the new technologies in new aircraft designs and introduce these new aircraft into the fleet. Successfully developing these technologies also requires the support and cooperation of stakeholders throughout the aviation industry.

FAA Supports Research on Improving the Scientific Understanding of Aviation Emissions and on Alternative Fuels

Improving the scientific understanding of aviation emissions can help guide the development of approaches to reducing emissions by improving aircraft manufacturers' and operators' and policy makers' ability to assess the environmental benefits and costs of alternative policy measures. Such an assessment can then lead to the selection of the alternative that will achieve the greatest net environmental benefits. For example, one technology might greatly increase fuel efficiency, but produce higher nitrogen oxide emissions than another, somewhat less fuel-efficient technology. Overall, a cost benefit analysis might indicate that the less fuel-efficient technology would produce greater net benefits for the environment.

FAA currently supports several recent federal efforts to better quantify aviation emissions and their impact through improvements in emissions measurement techniques and modeling capability. One of these efforts is FAA's Partnership for Air Transportation

[19]GAO-03-252.

[20]Alternatively, some scientists studying options for addressing climate change believe that a price on emissions would represent the most effective means of achieving reductions overall.

and Emissions Reduction (PARTNER) Center of Excellence.[21] Created in 2003, PARTNER carries on what representatives of airlines, aircraft and engine manufacturers, and experts in aviation environmental research have described as a robust research portfolio. This portfolio includes efforts to measure aircraft emissions and to assess the human health and welfare risks of aviation emissions and noise. For example, researchers are developing an integrated suite of three analytical tools—the Environmental Design Space, the Aviation Environmental Design Tool, and the Aviation Environmental Portfolio Management Tool – that can be used to identify interrelationships between noise and emissions. Data from these three tools, together with the Aviation Environmental Design tool being developed by the Volpe National Transportation Systems Center and others, will allow for assessing the benefits and costs of aviation environmental policy options. Another R&D initiative, the Airport Cooperative Research Program (ACRP),[22] conducts applied research on aviation emissions and other environmental issues facing airports. The program is managed by the National Academies of Science through its Transportation Research Board under a contract with FAA, which provided $10 million for the program in both 2007 and 2008 and is seeking to increase these investments through its reauthorization to specifically focus on aviation environmental issues. Several of the emissions-related projects undertaken through ACRP have concentrated on developing methods to measure particulate matter and hazardous air pollutants at airports in order to identify the sources of these pollutants and determine whether their levels could have adverse health effects. FAA has also developed an Aviation Emissions Characterization roadmap to provide a systematic process to enhance understanding of aviation's air quality emissions, most notably particulate matter and hazardous air pollutants. In addition, FAA, in conjunction with NASA and the National Oceanic and Atmospheric Administration, launched the Aviation Climate Change Research Initiative to develop the scientific understanding necessary for informing efforts to limit or reduce aviation greenhouse gas emissions.

Another effort, the Commercial Aviation Alternative Fuels Initiative (CAAFI),[23] led by FAA, together with airlines, airports, and manufacturers, is intended to identify and eventually develop alternative fuels for aviation that could lower emissions of greenhouse gases, and other pollutants; increase fuel efficiency; and reduce U.S.

[21]FAA Centers of Excellence are FAA partnerships with universities and affiliated industry associations and businesses throughout the country that conduct aviation research in a number of areas, including advanced materials, aircraft noise, and aircraft emissions. PARTNER is a cooperative research organization that includes 10 collaborating universities and approximately 50 advisory board members who represent aerospace manufacturers, airlines, airports, state and local governments, and professional and community groups. NASA, FAA, and Transport Canada are sponsors of PARTNER. The collaborating universities and organizations represented on the advisory board provide equal matches for federal funds for research and other activities.

[22]ACRP was authorized in 2003 as part of Vision 100—Century of Aviation Reauthorization Act, Pub. L. 108-176, Section 712 (Dec 12, 2003).

[23]CAAFI, established in October 2006, is sponsored by the Air Transport Association, the Aerospace Industries Association, and the Airports Council International-North America under the direction of FAA, and involves stakeholders from industry, universities, and other federal agencies, including NASA.

dependence on foreign oil. CAAFI supports research on low-carbon fuel from sources such as plant oils, algae, and biomass that are as safe as petroleum-based fuel and compare favorably in terms of environmental impact. Part of the research will involve assessing the environmental impact of alternative fuels to determine whether their use could reduce emissions of pollutants that affect climate and air quality. The research will also assess the impact of producing these fuels on the overall carbon footprint. The CAAFI sponsors have set goals for certifying a 50 percent synthetic fuel for aviation use in 2008, a 100 percent synthetic fuel for use by 2010, and a biofuel made from renewable resources such as palm, soy, or algae oils. As part of CAAFI, Virgin Atlantic Airlines, together with Boeing, has tested a blend of kerosene (normal jet fuel) and biofuels in a flight from London to Amsterdam, and Continental, in association with Boeing and jet engine manufacturer General Electric, is planning a similar test in 2009.

### NASA Conducts Fundamental Aeronautics R&D in Support of NextGen, Including Efforts That Can Help Lower Emissions

NASA has devoted a substantial portion of its aeronautical R&D program to the development of technologies critical to the implementation of NextGen, as well as new aircraft and engine technologies, both of which can help reduce aviation emissions.

NASA has three main aeronautics research programs – Fundamental Aeronautics, Aviation Safety, and Airspace Systems – each of which contributes directly and substantially to NextGen. For example, the Airspace Systems program supports research on air traffic management technologies for NextGen, and the Fundamental Aeronautics program focuses on removing environmental and performance barriers, such as noise and emissions, that could constrain the capacity enhancements needed to accommodate projected air traffic increases. Appendix II describes in more detail how NASA's aeronautics R&D programs support the implementation of NextGen.

NASA also works with aircraft and aircraft engine manufacturers to increase fuel efficiency and reduce emissions. Their efforts have contributed to a number of advancements in aircraft engine and airframe technology, and NASA's R&D on emissions-reduction technologies continues. NASA has set technology-level goals for reducing greenhouse gases, nitrogen oxides, and noise, which have become part of the U.S. National Aeronautics Plan. For example, the plan includes a goal for developing technologies that could reduce nitrogen oxide emissions during landings and takeoffs by 70 percent[24] below the ICAO current standard. The plan also sets a goal of increasing fuel efficiency (and thereby decreasing greenhouse gases emissions) by 33 percent. These technologies would be incorporated in the next generation of aircraft, which NASA refers to as N+1,[25] by 2015. However, as NASA officials note, these goals must be viewed

[24]This goal is at a pressure ratio of 30, over the ICAO standard adopted at the Committee on Aviation Environmental Protection's sixth meeting (CAEP 6), with commensurate reductions over the full pressure ratio range.

[25]"N" refers to the current generation of tube-and-wing aircraft entering service in 2008, such as the Boeing 787.

within the context that each of the goals can be fully met only if it is the only goal. For example, the goal for reducing nitrogen oxides can be fully achieved only at the expense of the goals for lowering greenhouse gas emissions and noise, because it is technologically challenging to design aircraft that can simultaneously reduce all of these environmental impacts.

For the longer term (2020), NASA is focusing on developing tools and technologies for use in the design of advanced hybrid-wing body aircraft, the following generation of aircraft, or N+2. Emissions from these aircraft would be in the range of 80 percent below the ICAO standard for nitrogen oxide emissions during landings and takeoffs, and fuel consumption would be 40 percent less than for current aircraft. The U.S. aircraft and engine manufacturing industry has also set goals for reducing aircraft emissions in the engines the industry plans to produce. According to the Aerospace Industries Association, which represents this industry, its members have set a goal of reducing carbon dioxide emissions by 15 percent in the next generation of aircraft while continuing to significantly reduce nitrogen oxide emissions and noise.

The development of aircraft technologies such as those that NASA is currently working on to reduce emissions can take a long time, and it may be years before the technologies are ready to be incorporated into new aircraft designs. According to FAA, the development process generally takes 12 to 20 years. For example, the latest Pratt and Whitney engine, the geared turbofan, which is expected to achieve significant emissions and noise reductions, took 20 years to develop.

**Several Steps Can Be Taken to Help Reduce Aviation Emissions, but Challenges Remain to Be Addressed**

Reducing aviation emissions includes steps that FAA and others can take to move the implementation of NextGen forward and support R&D on NextGen and emissions-reduction technologies, as well as technical, financial, regulatory challenges facing the federal government, the aviation industry, and Congress.

<u>Expediting the Implementation of NextGen Can Help Reduce Aviation Emissions</u>

Implementing NextGen expeditiously is essential to handle the projected growth in air traffic efficiently and safely, and in so doing, help to reduce aircraft emissions. Steps to advance NextGen's implementation include management improvements and the deployment of available NextGen components.

Management Improvements Can Move NextGen Forward More Efficiently

Several management actions are important to advance the implementation of NextGen. One such action is to establish a governance structure within FAA that will move NextGen initiatives forward efficiently and effectively. FAA has begun to establish a governance structure for NextGen, but it may not be designed to give NextGen initiatives sufficient priority to ensure the system's full implementation by 2025. Specifically, FAA's implementation plan for NextGen is called the Operational Evolution Partnership (OEP).

The manager responsible for OEP is one of nine Vice Presidents who report to the Chief Operating Officer (COO) of FAA's Air Traffic Organization (ATO), who reports directly to the FAA Administrator. While the manager responsible for OEP is primarily responsible for implementing NextGen, other Vice Presidents are responsible for NextGen-related activities in their designated areas. In addition, the FAA managers responsible for airports and aviation safety issues are Associate Administrators who report through the Deputy FAA Administrator to the FAA Administrator. Some of the activities for which these Associate Administrators are responsible are critical to NextGen's implementation, yet there is no direct line of authority between the OEP manager and these activities.

Some congressional leaders and other stakeholders, including aviation industry representatives and aviation experts, view FAA's management structure for NextGen as too diffuse. Some of the stakeholders have called for the establishment of a position or NextGen program office that reports directly to the FAA Administrator to ensure accountability for NextGen results. These stakeholders have expressed frustration that a program as large and important as NextGen does not follow the industry practice of having one person with the authority to make key decisions. They point out that although the COO is nominally in charge of NextGen, the COO must also manage FAA's day-to-day air traffic operations and may therefore not be able to devote enough time and attention to managing NextGen. In addition, these stakeholders note that many of NextGen's capabilities span FAA operational units whose heads are on the same organizational level as the head of OEP or are outside ATO, and they believe that an office above OEP and these operational units is needed. In prior work, we have found that programs can be implemented most efficiently when managers are empowered to make critical decisions and are held accountable for results.[26]

Another management action is needed to help ensure that FAA acquires the skills required for implementation, such as contract management and systems integration skills. Because of the scope and complexity of the NextGen implementation effort, FAA may not have the in-house expertise to manage it without assistance. In November 2006, we recommended that FAA examine its strengths and weaknesses and determine whether it has the technical expertise and contract management expertise that will be needed to define, implement, and integrate the numerous complex programs inherent in the transition to NextGen.[27] In response to our recommendation, FAA has contracted with the National Academy of Public Administration (NAPA) to determine the mix of skills and number of skilled persons, such as technical personnel and program managers, needed to implement the new OEP and to compare those requirements with FAA's current staff resources. In December 2007, NAPA provided FAA with its report on the

[26]See GAO, *Best Practices: Better Support of Weapon System Program Managers Needed to Improve Outcomes*, GAO-06-110 (Washington, D.C.: Nov. 30, 2005). In this study of private-sector best practices that could be applied to federal programs,[26] we found that program managers at highly successful companies were empowered to decide whether programs were ready to move forward and to resolve problems and implement solutions. In addition, program managers were held accountable for their choices.

[27]GAO, *Next Generation Air Transportation System: Progress and Challenges Associated with the Transformation of the National Airspace System*, GAO-07-25 (Washington, D.C.: Nov. 13, 2006).

types of skills FAA will require to implement NextGen, and it has undertaken a second part of the study that focuses on identifying any skill gaps between FAA's current staff and the staff that would be required to implement NextGen.[28] NAPA officials told us that they expect to publish the findings of the second part of the study in the summer of 2008. We believe this is a reasonable approach that should help FAA begin to address this challenge as soon as possible. It may take considerable time to select, hire, train, and integrate into the NextGen initiative what could be a large number of staff.

We have also identified potential approaches for supplementing FAA's capabilities, such as having FAA contract with a lead systems integrator (LSI)–that is, a prime contractor who would help to ensure that the discrete systems used in NextGen will operate together and whose responsibilities may include designing system solutions, developing requirements, and selecting major system and subsystem contractors.[29] However, this approach would require careful oversight to ensure that the government's interests are protected and could pose significant project management and oversight challenges for the Joint Planning and Development Office (JPDO), the organization within FAA responsible for planning NextGen, and for FAA.

### Deploying Available NextGen Components Can Demonstrate Their Ability to Operate Together and Achieve Anticipated Efficiencies

Moving from planning to implementing some components of NextGen can begin to demonstrate the potential of the system as well as reduce congestion in some areas of the country, thereby also reducing emissions. Many of the technologies and procedures planned for NextGen are already available, and a few have been implemented individually, such as the CDA procedures in use in Los Angeles and Louisville and ADS-B in Alaska. However, the available technologies and procedures have not yet been deployed simultaneously to demonstrate that they can be operated safely as an integrated suite of technologies and procedures in the national airspace system. Several stakeholders have suggested that FAA consider a gradual rollout of NextGen technologies and procedures in a particular area. For example ADS-B technologies, CDA and RNAV/RNP procedures, and high-density airport operations could be deployed in a defined area of the current system, possibly in sequence over time, to test their combined use and demonstrate the safety of an integrated suite of NextGen advancements. Such a graduated rollout is sometimes referred to as "NextGen Lite." FAA is currently considering a demonstration project in Florida and Georgia, in which it, together with aviation equipment manufacturers and municipalities, would use the NextGen capabilities of ADS-B, RNAV, and RNP for on-demand air taxi fleet[30] operations.

[28]NAPA, *Workforce Needs Analysis for the Next Generation Air Transportation System (NEXTGEN): Preliminary Findings and Observations* (Washington, D.C.: December 2007).

[29]GAO-07-25.

[30]Air taxis are small aircraft that can be hired to carry passengers or cargo and are regulated under Part 135 of the Federal Aviation Regulations.

As other NextGen capabilities, such as System-Wide Information Management (SWIM )[31] are deployed and as air taxi fleet operations move to other airports and regions, the demonstration will be expanded to include those new capabilities and other airports and regions. According to the airlines and other stakeholders we interviewed, a demonstration of the successful integration of NextGen capabilities and of efficiencies resulting from their use would give the airlines an incentive to equip their aircraft with NextGen technologies. They could then lower their costs by reducing their fuel consumption and decrease the impact of their operations on the environment. The findings from our research indicate that such regional or targeted demonstrations could accelerate the delivery of NextGen benefits while helping to ensure safe operations within the current system. In addition, demonstrations can increase stakeholders' confidence in the overall NextGen initiative.

### Resolving Aeronautics R&D Funding Issues Is a Further Step in Addressing Aviation Emissions

Federal funding for aeronautics research, the category that includes work on aviation emissions, has declined over the past decade, particularly for NASA, which historically provided most of the funding for this type of research. NASA's current aeronautics research budget is about half of what it was in the mid-1990s. Moreover, the budget request for aeronautics R&D for fiscal year 2009 is $447 million, or about 25 percent less than the $594 million provided in fiscal year 2007. (See table 1.) According to NASA, about $280 million of the proposed $447 million would contribute to NextGen. In addition, according to NASA officials, a significant portion of the funding for subsonic fixed-wing aircraft is directed toward emissions-related research, and many other research efforts contribute directly or indirectly to potential emissions-reduction technologies.

[31]SWIM is information-management architecture for the national airspace system, acting as its "World-Wide Web." SWIM will manage surveillance, weather, and flight data, as well as aeronautical and system status information and will provide the information securely to users.

**Table 1: The President's Budget for NASA's Aeronautics Programs for Fiscal Years 2007 and 2008 and Budget Projections for Fiscal Years 2009 through 2013**

**(Dollars in millions)**

| | Fiscal year | | | | | | |
|---|---|---|---|---|---|---|---|
| | Enacted | | Requested | Proposed | | | |
| **Program** | **2007** | **2008** | **2009** | **2010** | **2011** | **20112** | **2013** |
| Aviation Safety | | | | | | | |
| Integrated Vehicle Health Management | 30.7 | 22.2 | 19.7 | 19.9 | 18.8 | 18.6 | 19.2 |
| Aging Aircraft | 14.9 | 10.0 | 10.6 | 11.3 | 11.2 | 12.0 | 12.4 |
| Integrated Resilient Aircraft Control | 22.2 | 15.3 | 17.1 | 18.5 | 19.0 | 18.2 | 18.8 |
| Integrated Intelligent Flight Deck Technologies | 19.5 | 19.3 | 15.2 | 16.3 | 16.0 | 15.7 | 16.1 |
| **Subtotal** | **87.3** | **66.5** | **62.6** | **65.9** | **65.0** | **64.5** | **66.5** |
| Airspace Systems | | | | | | | |
| NextGen – Airspace | 85.1 | 83.3 | 61.3 | 56.0 | 57.3 | 58.5 | 60.8 |
| NextGen – Airportal | 17.4 | 16.8 | 13.3 | 16.7 | 16.9 | 16.9 | 17.5 |
| **Subtotal** | **102.5** | **100.1** | **74.6** | **72.7** | **74.2** | **75.4** | **78.4** |
| Fundamental Aeronautics | | | | | | | |
| Subsonic – Rotary Wing | 36.1 | 30.8 | 25.8 | 26.6 | 26.7 | 26.9 | 28.0 |
| Subsonic – Fixed Wing | 133.9 | 119.9 | 108.4 | 105.3 | 107.6 | 109.1 | 111.5 |
| Supersonics | 67.7 | 53.0 | 44.0 | 44.9 | 44.3 | 45.2 | 46.6 |
| Hypersonics | 92.8 | 66.2 | 57.3 | 56.4 | 56.5 | 57.4 | 58.4 |
| **Subtotal** | **330.4** | **269.9** | **235.4** | **233.2** | **235.2** | **238.6** | **244.6** |
| Aeronautics Test Program | | | | | | | |
| Aero Ground Test Facilities | 48.5 | 50.0 | 48.2 | 49.4 | 50.8 | 51.0 | 51.0 |
| Flight Operations and Test Infrastructure | 25.0 | 25.1 | 25.6 | 26.4 | 27.2 | 27.2 | 27.2 |
| **Subtotal** | **73.5** | **75.1** | **73.9** | **75.8** | **78.0** | **78.2** | **78.2** |
| **Total** | **593.8** | **511.7** | **446.5** | **447.5** | **452.4** | **456.7** | **467.7** |

Source: NASA.

Note: Most of the research on aircraft emissions reductions that NASA performs is funded through the Fundamental Aeronautics – Fixed Wing program.

As its funding for aeronautics R&D has declined, NASA has emphasized fundamental research, which serves as the basis for developing technologies and tools that can later be integrated into aviation systems, and has focused less on developmental and demonstration work. As a result, NASA is now sometimes developing technologies to a lower maturity level than in the past, and the technologies are less ready for manufacturers to adopt them, resulting in a gap in the research needed to bring technologies to a level where they can be transferred to industry for further development. Failure to address this gap could postpone the development of emissions-reduction technologies.

As a partial response to the gap, the administration has proposed some additional funding for FAA that could be used to further develop NASA's and others' emissions- and noise reduction technologies. Specifically, FAA's reauthorization proposal seeks $111 million through fiscal year 2011 for the CLEEN Engine and Airframe Technology Partnership,[32] which FAA officials said is intended to provide for earlier maturation of emissions and noise technologies while NASA focuses on longer-term fundamental research on noise and emissions. The CLEEN partnership, which is also contained in the House's FAA reauthorization bill,[33] would create a program for the development and maturation of certifiable engine and airframe technologies for aircraft over the next 10 years which would reduce aviation noise and emissions. The legislation would require the FAA Administrator, in coordination with the NASA Administrator, to establish objectives for developing aircraft technology outlined in the legislation. The technology requested to be developed would increase aircraft fuel efficiency enough to reduce greenhouse gas emissions by 25 percent relative to 1997 subsonic jet aircraft technology, and, without increasing other gaseous or particle emissions, reduce takeoff-cycle nitrogen oxide emissions by 50 percent relative to ICAO's standard. Although FAA's reauthorization bill has not yet been enacted, the administration's proposed fiscal year 2009 budget includes $10 million for the CLEEN program.

The CLEEN program would be a first step toward further maturing emissions and noise reduction technologies, but experts agree that the proposed funding is insufficient to achieve needed emissions reductions. While acknowledging that CLEEN would help bridge the gap between NASA's R&D and manufacturers' eventual incorporation of technologies into aircraft designs, aeronautics industry representatives and experts we consulted said that the program's funding levels may not be sufficient to attain the goals specified in the proposal. According to these experts, the proposed funding levels would allow for the further development of one or possibly two projects. Moreover, in one expert's view, the funding for these projects may be sufficient only to develop the technology to the level that achieves an emissions-reduction goal in testing, not to the level required for the technology to be incorporated into a new engine design. Nevertheless, according to FAA and some experts we consulted, the CLEEN program amounts to a pilot project, and if it results in the development of emissions-reduction

[32]CLEEN stands for continuous lower energy emissions and noise.

[33]H.R. 2881.

technologies that can be introduced into aircraft in the near future, it could lead to additional funding from the government or industry for such efforts.

FAA and NASA have identified the R&D that is needed for NextGen, but have not determined what needs to be done first, at what cost, to demonstrate and integrate NextGen technologies into the national airspace system. Completing this prioritization is critical to avoid spending limited funds on lower-priority efforts or conducting work out of sequence. Once the identified R&D has been prioritized and scheduled, cost estimates can be developed and funds budgeted. Prioritizing research needs is an essential step in identifying the resources required to undertake the research.

The European Union is investing substantially in R&D that can lead to fuel-efficient, environmentally friendly aircraft. In February 2008, the European Union announced the launch of the Clean Sky Joint Technology Initiative, with total funding of $2.4 billion over 7 years—the European Union's largest-ever research program. The initiative establishes a Europe-wide partnership between industry, universities, and research centers and aims to reduce aircraft emissions of carbon dioxide and nitrogen oxides by up to 40 percent and aircraft noise levels by 20 decibels. According to FAA, it is difficult to compare funding levels for U.S. and European R&D efforts because of differences in program structures and funding mechanisms, Nevertheless, foreign government investments of such magnitude in R &D on environmentally beneficial technologies could reduce the competitiveness of the U.S. aircraft manufacturing industry, since greater investments are likely to lead to greater improvements in fuel efficiency and keep U.S. aircraft manufacturers competitive in the global economy as well as reducing aviation's impact on the environment.

## Reducing the Impact of Aviation Emissions Poses Technical, Financial, and Regulatory Challenges

Reducing aviation emissions will require technological advances, the integration of lower-emitting aircraft and NextGen technologies into airline fleets, and strengthened or possibly new regulations to improve air quality and limit greenhouse gas emissions. Fulfilling these requirements will pose challenges to aviation because of the technical difficulties involved in developing technologies that can simultaneously address air pollutants, greenhouse gases, and noise; constraints on the airline industry's resources to invest in new aircraft and technologies needed to reduce emissions and remain competitive; and the impact that emissions regulations can have on the aviation system's expansion and the financial health of the aviation industry.

### Simultaneously Addressing Air Pollutants, Greenhouse Gases, and Noise from Aircraft Presents Technical Challenges

Although the aviation industry has made strides in lowering emissions, more reductions are needed to keep pace with the projected growth in aviation, and achieving these reductions will be technically challenging. NASA's efforts to improve jet engine designs illustrate this challenge: While new designs have increased fuel efficiency, reduced most emissions, and lowered noise, they have not achieved comparable reductions in nitrogen oxide emissions. Nitrogen oxide emissions have increased because new aircraft engines operate at higher temperatures, producing more power with less fuel and lower carbon dioxide and carbon monoxide emissions, but also producing higher nitrogen oxide emissions, particularly during landings and takeoffs, when engine power settings are at their highest. It is during the landing/takeoff cycle that nitrogen oxide emissions also have the greatest impact on air quality. As discussed, nitrogen oxides contribute to ground-level ozone formation. Similarly, as we noted in a report on NASA's and FAA's aviation noise research earlier this year,[34] it is technologically challenging to design aircraft engines that simultaneously produce less noise and fewer greenhouse gas and other emissions. Although it is possible to design such engines, the reductions in greenhouse gases could be limited in engines that produce substantially less noise. NASA and industry are working on technologies to address these environmental trade-offs. For example, the Pratt & Whitney geared turbo fan engine that we mentioned earlier is expected to cut nitrogen oxide emissions in half while also improving fuel efficiency and thereby lowering carbon dioxide emissions. Nevertheless, it remains technologically challenging to design aircraft that can reduce one environmental concern without increasing another.

In a 2004 report to Congress on aviation and the environment,[35] FAA noted that the interdependencies between various policy, technological, and operational options for addressing the environmental impacts of aviation and the full economic consequences of these options had not been appropriately assessed. However, in recent years, FAA has made progress in this area, including its sponsorship of the previously mentioned PARTNER study on the interrelationships between noise and emissions. This study can be used to assess the costs and benefits of aviation environmental policy options.

### The Financial Condition of the Airline Industry Creates a Challenge to Implementing Emissions-Reduction Technologies

Most U.S. airlines have stated that they plan to invest in aircraft and technologies that can increase fuel efficiency and lower emissions, but in the near term, integrating new aircraft into the fleet, or retrofitting aircraft with technologies that can improve their operational efficiency, poses financial challenges to the airline industry. Aircraft have an average lifespan of about 30 years, and the airlines can take almost that entire period to pay for an aircraft. The current fleet is, on average, about half as many years old—11 years for wide-body aircraft, and 14 years for narrow-body aircraft—and therefore is expected to be in operation for many years to come. In addition, the financial pressures facing many airlines make it difficult for them to upgrade their fleets with new, state-of-the-art aircraft, such as the Boeing 787 and Airbus A380, which are quieter and more fuel

[34]GAO, *Aviation and the Environment: Impact of Aviation Noise on Communities Presents Challenges for Airport Operations and Future Growth of the National Airspace System,* GAO-08-216T (Washington, D.C.: Oct. 24, 2007).

[35]FAA, *Aviation and the Environment: A National Vision Statement, Framework for Goals and Recommended Actions* (Washington, D.C.: December 2004).

efficient, emitting lower levels of greenhouse gases.[36] Currently, U.S. carriers have placed a small proportion (40, or less than 6 percent) of the over 700 orders that Boeing officials say the company has received for its 787 model. Furthermore, no U.S. carriers have placed orders for the new Airbus 380. These financial pressures also limit the airlines' ability to equip new and existing aircraft with NextGen technologies such as ADS-B that can enable more efficient approaches and descents, resulting in lower emissions levels. FAA estimates that it will cost the industry about $14 billion to equip aircraft to take full advantage of NextGen.

Delays by airlines in introducing more fuel-efficient, lower-emitting aircraft into the U.S. fleet and in equipping or retrofitting the fleet with the technologies necessary to operate NextGen could limit FAA's ability to efficiently manage the forecasted growth in air traffic. Without significant reductions in emissions and noise around the nation's airports, efforts to expand their capacity could be stalled and the implementation of NextGen delayed because of concerns about the impact of aviation emissions. As we previously reported,[37] offering operational advantages, such as preferred takeoff and landing slots, to fuel-efficient, lower-emitting aircraft or aircraft equipped with ADS B could create incentives for the airlines to invest in the necessary technologies. Similarly, as noted, deploying an integrated suite of NextGen technologies and procedures in a particular region could create incentives for carriers to equip their aircraft with NextGen technologies.

### More Stringent Regulatory Standards Pose Challenges for Airport Expansion Projects

Concerns about the health effects of air pollutants have led to more stringent air quality standards that could increase the costs or delay the implementation of airport expansion projects. In recent years, EPA has been implementing a more stringent standard for ozone emissions to better protect the health of people exposed to it, and this standard could require more airports to tighten controls on nitrogen oxides and some types of volatile organic compounds that also contribute to ozone formation. Under the current standard,[38] 122 airports are located in areas that are designated as nonattainment areas. This number includes 43 of the 50 busiest U.S. commercial service airports. In March 2008, EPA further revised the ozone standard, because new evidence demonstrated that exposure to ozone at levels below the level of the current standard are associated with a

[36]We are currently undertaking a study for this Subcommittee and the House Committee on Transportation and Infrastructure that, among other things, will assess the financial condition of the airlines.

[37]GAO, *Aviation and the Environment: FAA'S and NASA's Research and Development Plan's for Noise Reduction Are Aligned, but the Prospects of Achieving Noise Reduction Goals Are Uncertain,* GAO-08-384 (Washington, D.C.: Feb. 15, 2008).

[38]In 2003, EPA began implementing a new standard that called for concentrations of ozone not to exceed 0.08 parts per million over an 8-hour period. The former standard required concentrations not to exceed 0.12 parts per million over a 1-hour period. The more stringent standard resulted in the designation of more nonattainment areas for ozone. These areas contained 12 airports.

broad array of adverse health effects.[39] This recent revision to the ozone standard will increase the number of U.S. counties, and hence airports, that will be in nonattainment. EPA estimated that the number of affected counties could potentially grow from 104 to 345 nationwide. While the exact number of airports that will be affected has not been officially determined at this time, FAA estimates that a modest number of commercial service airports in California, Arizona, Utah, Texas, Oklahoma, Arkansas, and along the gulf coast to Florida will be in nonattainment for the revised 8-hour ozone standard. According to EPA, any development project beginning in 2011 at these airports would have to conform to the state implementation plan.

As communities gain more awareness of the health and environmental effects of aviation emissions, opposition to airport expansion projects, which has thus far focused primarily on aviation noise, could broaden to include emissions. According to a California air quality official, many of the same communities that have interacted with airports over aviation noise have more recently recognized that they could also be affected by emissions from airport sources. In Europe, concerns about the impact of aviation on air quality and climate change have led to public demands for tighter control over aircraft emissions, and these demands have hindered efforts to expand airports in Birmingham, and London (Heathrow). Moreover, a plan to expand London's Stansted Airport was rejected because of concerns about climate change that could result from additional emissions.

To minimize constraints on the future expansion of airport capacity stemming from concerns about the health and environmental effects of aviation emissions, it will be important for airports; the federal and state governments; and the airline industry to work together to accurately characterize and address these concerns and to take early action to mitigate emissions. As noted, constraints on efforts to expand airports or aviation operations could affect the future of aviation because the national airspace system cannot expand as planned without a significant increase in airport capacity. The doubling or tripling of air traffic that FAA expects in the coming decades cannot occur without additional airports and runways.

### Market-Based Initiatives to Reduce Aviation Emissions of Greenhouse Gases Could Pose Challenges for U.S. Airlines by Increasing Their Costs

Concerns about the environmental effects of greenhouse gas emissions have grown steadily over the years, leading to national and international efforts to limit them. In the

[39] 73 Fed. Reg. 16436 (Mar. 27, 2008). The new standard would lower the allowed concentrations of ozone from 0.08 parts per million in an 8-hour period to 0.075 parts per million during that period.

United States, EPA has not regulated greenhouse gas emissions;[40] however, Congress is taking steps to deal with climate change, some of which could include market-based measures that would affect the aviation industry. For example, several bills were introduced in the 110th Congress to initiate cap and trade[41] programs for greenhouse gas emissions[42] None of these bills would include aviation directly in a cap and trade program. However, some could have indirect consequences for the aviation industry by, for example, requiring fuel producers to purchase allowances through the system to cover the greenhouse gas content of the fuel they sell to the aviation sector. The cost of purchasing these allowances could be passed on to fuel consumers, including airlines, raising the cost of jet fuel. Fuel is already the airline industry's largest cost. According to the Air Transport Association, cap and trade programs that significantly increase airline fuel costs could have significant consequences for the industry and such programs could make it more difficult for carriers to pay for aircraft or technologies that would reduce greenhouse gas emissions. As we have previously noted,[43] cap and trade programs can cost-effectively reduce emissions of greenhouse gases such as carbon dioxide, especially when compared with other regulatory programs. However, it is important that the impact of such measures on various sectors of the economy, such as the aviation industry, be thoroughly considered.

[40]Recently, however, the Supreme Court ruled that greenhouse gases meet the Clean Air Act's definition of an air pollutant and that EPA has the statutory authority to regulate greenhouse gas emissions from new motor vehicles under the Clean Air Act. *Massachusetts v. Environmental Protection Agency*, 127 S.Ct. 1438, 1459-62 (2008). As a result of this opinion, EPA must take one of three actions: (1) issue a finding that greenhouse gas emissions cause or contribute to air pollution that may endanger public heath or welfare; (2) issue a finding that greenhouse gases do not endanger public health or welfare; or (3) provide a reasonable explanation as to why it cannot or will not exercise its discretion to issue a finding. If EPA makes an endangerment finding, the Clean Air Act requires EPA to regulate greenhouse gas emissions from new motor vehicles. In response to this case, EPA has announced that it will issue an Advance Notice of Proposed Rulemaking on "specific effects of climate change and potential regulation of greenhouse gas emissions from stationary and mobile sources under the Clean Air Act.

[41]Cap and trade programs combine a regulatory limit or cap on the amount of a substance—in this case a greenhouse gas such as carbon dioxide—that can be emitted into the atmosphere with market elements like credit trading to give industries flexibility in meeting this cap. A current example is the cap and trade program for sulfur dioxide under the Clean Air Act. This program includes electric utilities, which are the primary emitters of sulfur dioxide, and established a cap on the utilities' emissions. Sulfur dioxide allowances were primarily given (rather than auctioned) to companies.

[42]S. 28, S, 309, S. 317, S. 485, S. 1168, S. 1177, S. 1201, S. 1554, S. 1766, S. 2191,H.R. 620, H.R. 1590, H.R. 3989, H.R. 4226.

[43]GAO, *Vehicle fuel Economy: Reforming Fuel Economy Standards Could Help Reduce Oil Consumption by Cars and Light Trucks, and Other Options Could Complement These Standards,* GAO-07-921 (Washington, D.C.: Aug. 2, 2007).

Internationally, ICAO has not set standards for aircraft carbon dioxide emissions,[44] but it has been working, with the support of FAA, other government aviation authorities, and the aviation industry, to develop a strategy for addressing the impact of aviation on climate change, among several efforts to address climate change. For example, ICAO published a manual for countries, *Operational Opportunities to Minimize Fuel Use and Reduce Emissions.* In 2004, ICAO endorsed the development of an open emissions trading system as one option countries might use and endorsed draft guidance for member states on establishing the structural and legal basis for aviation's participation in a voluntary open trading system. The guidance includes information on key elements of a trading system, such as reporting, monitoring, and compliance, while encouraging flexibility to the maximum extent possible. In adopting the guidance last fall at the ICAO Assembly, all 190 Contracting States—with the exception of those in the European Union—agreed that the inclusion of one country's airlines in another country's emissions trading system should be based on mutual consent between governments.

Consistent with the requirement to pursue reductions of greenhouse gas emissions from international aviation through ICAO, some countries that have included the aviation sector in their emissions trading systems or other emissions-reduction efforts have, excluded international flights. Consequently, these countries' efforts will not affect U.S. airlines that fly into their airports. The European Union (EU), however, is developing legislation, which has not been finalized, that would include both domestic and international aviation in an emissions trading scheme.[45] As proposed, the EU's scheme would apply to air carriers flying within the EU and to carriers, including U.S. carriers, flying into and out of EU airports in 2012. For example, under the EU proposal, a U.S. airline's emissions in domestic airspace as well as over the high seas would require permits if a flight landed or departed from an EU airport. Airlines whose aircraft emit carbon dioxide at levels exceeding prescribed allowances would be required to reduce their emissions or to purchase additional allowances. Although the legislation seeks to include U.S. airlines within the emissions trading scheme, FAA and industry stakeholders have argued that U.S. carriers would not legally be subject to the legislation.

While the EU's proposal to include international aviation in its emissions trading system is intended to help forestall the potential catastrophic effects of climate change, according to FAA and airlines, it will also affect the aviation industry's financial health. In particular, according to FAA and airline and aircraft and engine manufacturing industry representatives, the EU's proposal could disadvantage U.S. airlines, which have older, less fuel-efficient fleets than their European competitors. Paying for emissions

---

[44] According to FAA, the last extensive discussion within ICAO on carbon dioxide emissions from aircraft occurred several years ago. At that time, ICAO's experts agreed that the cost of fuel provided sufficient incentive to minimize fuel consumption – hence carbon dioxide emissions. There was some technical work around 2001 on the development of an aircraft efficiency parameter, which might have been used to target carbon dioxide reductions. However, it failed to identify a parameter that would be able to assess aircraft fleets in their multiple operational environments in an equitable manner.

[45] The emissions trading scheme involves a cap and trade system that sets allowances for greenhouse gas emission for industries and other sources. Parties that pollute below their allowance receive emissions credits, which they can trade in a market to other parties that have exceeded their allowance.

credits could, according to U.S. airlines, also leave them with less money for other purposes, including investing in newer, more fuel-efficient aircraft and technologies to improve flight efficiency and reduce fuel usage. Furthermore, according to U.S. carriers, the proposed trading scheme unfairly penalizes the aviation sector because it lacks a readily available non-carbon-based alternative fuel, whereas other sectors can use alternative fuels to reduce their emissions.

The governments of many nations, including the United States, oppose the European Union's proposal to unilaterally include international aviation in its emissions trading system because the proposed approach is not consistent with ICAO guidance. Furthermore, such an approach could be inconsistent with international aviation agreements and may not be enforceable. According to FAA, the EU's inclusion of aviation in its emissions trading scheme violates the Chicago Convention on International Civil Aviation[46] and other international agreements. FAA further notes that the EU proposal ignores differences in the U.S. and EU aviation systems[47] and ignores a performance-based approach in which countries decide which measures are most appropriate for goals on emissions. We are currently undertaking for this Subcommittee a study of the EU emissions trading system and its potential impact on U.S. airlines, and other issues relating to aviation and climate change.[48]

Mr. Chairman, this concludes my prepared statement. I would be pleased to respond to any questions that you or other Members of the Subcommittee may have.

### Contacts and Acknowledgments

For further information on this testimony, please contact Dr. Gerald L. Dillingham at (202) 512-2834 or by email at dillinghamg@gao.gov. Individuals making key contributions to this testimony include Ed Laughlin, Lauren Calhoun, Bess Eisenstadt, Jim Geibel, Rosa Leung, Josh Ormond, Richard Scott, and Larry Thomas.

[46]The Chicago Convention on International Civil Aviation of 1944 organized global aviation. According to the Convention, no state may condition the right of transit over or entry into or exit from its territory of any aircraft of another state on their operator's payment of fees, dues, or other charges.

[47]For example, FAA notes that there are considerable differences in the air traffic system efficiencies across the Atlantic, that the United States has a domestic fuel tax while nearly all EU states have none, and that the cost of fuel is about 50 percent more expensive for U.S. airlines because of the dollar's weakness in recent years.

[48]This ongoing work was jointly requested by the Committee on Transportation and Infrastructure, House of Representatives, and the Subcommittee on Space and Aeronautics, Committee on Science and Technology, House of Representatives.

**Appendix I**

**Federal Agency Views on Health and Environmental Effects of Air Pollution**

| Pollutant | Heath effects | Environmental effects |
|---|---|---|
| Ozone | Lung function impairment, effects on exercise performance, increased airway responsiveness, increased susceptibility to respiratory infection, increased hospital admissions and emergency room visits, pulmonary inflammation, and lung structure damage (long term). | Results from animal studies indicate that repeated exposure to high levels of ozone for several months or more can produce permanent structural damage in the lungs. Ozone is also responsible for several billion dollars of agricultural crop yield loss in the United States each year. |
| Carbon monoxide | Most serious for those who suffer from cardiovascular disease. Healthy individuals are also affected, but only at higher levels of exposure. Exposure to elevated carbon monoxide levels is associated with visual impairment, reduced work capacity, reduced manual dexterity, poor learning ability, and difficulty in performing complex tasks. | Adverse health effects on animals similar to effects on humans. |
| Nitrogen oxides | Lung irritation and lower resistance to respiratory infections. | Acid rain, visibility degradation, particle formation. Contributes toward ozone formation, and acts as a greenhouse gas in the atmosphere and, therefore, may contribute to climate change. |
| Particulate matter | Effects on breathing and respiratory systems, damage to lung tissue, cancer, and premature death. The elderly, children, and people with chronic lung disease, influenza, or asthma, tend to be especially sensitive to the effects of particulate matter. | Visibility degradation, damage to monuments and buildings, safety concerns for aircraft from reduced visibility. . |
| Volatile organic compounds | Eye and respiratory tract irritation, headaches, dizziness, visual disorders, and memory impairment. | Contribute to ozone formation, odors, and have some damaging effect on buildings and plants. |
| Carbon dioxide, water vapor, and contrails | None. | Act as greenhouse gases in the atmosphere and, therefore, may contribute to climate change. Contrails and contrail-induced clouds produce warming effect regionally where aircraft fly. |
| Sulfur dioxide | Breathing, respiratory illness, alterations in pulmonary defenses, and aggravation of existing cardiovascular disease. | Together, sulfur dioxide and nitrogen oxides are the major precursors to acid rain, which is associated with the acidification of lakes and streams, accelerated corrosion of buildings and monuments, and reduced visibility. |

Sources: EPA and FAA.

**Appendix II**

## Examples of the National Aeronautics and Space Administration's Research and Development Programs Supporting NextGen

| NextGen research and development (R&D) needs | NextGen capabilities from the National Aeronautics and Space Administration's (NASA) R&D programs |
|---|---|
| Safety management procedures that can predict, rather than respond to, safety risks, in a high density, complex operating environment; research to support safety analysis, development of advanced materials for continued airworthiness of aircraft, aircraft system and equipage management; and adaptive aircraft control systems to allow the crew and aircraft to recover from unsafe conditions. | Under its Aviation Safety program, NASA research supports development of Safety Management Systems to provide a systematic approach to manage safety risks; integrates prediction and mitigation of risks prior to aircraft accidents or incidents; and shares safety-related information through programs such as the Aviation Safety Analysis and Information Sharing program. |
| Improved air traffic management technologies to manage airspace configuration, support increases in volume and complexity of traffic demands, mitigate weather impacts, and maintain safe and efficient operations at airports, decrease runway incursions, and address wake vortex issues. | Under its Airspace Systems program, NASA research supports development of variable separation standards based on aircraft performance levels in the en route environment; trajectory-based operations, traffic spacing, merging, metering, flexible terminal airspace, and expanded airport access; technologies and procedures for safe runway procedures in low-visibility conditions; coordinated arrival/departure management; and mitigation of weather and wake vortex issues. |
| Management of aviation growth to meet the complexity of operations within the NextGen environment, regulation and certification of new manned and unmanned aircraft, and management of operations in an environmentally sound manner. | Under its Fundamental Aeronautics program, NASA research supports development of improved performance for the next generation of conventional subsonic aircraft, rotorcraft and supersonic aircraft and develops methods for environmental management system to measure and assess reductions in air quality impact, noise, and emissions. |

Source: GAO analysis of Joint Planning and Development Office and NASA information.

**Related GAO Products**

*Aviation and the Environment: FAA's and NASA's Research and Development Plans for Noise Reduction Are Aligned, but the Prospects of Achieving Noise Reduction Goals Are Uncertain.* GAO-08-384. Washington, D.C.: February 15, 2008.

*Aviation and the Environment: Impact of Aviation Noise on Communities Presents Challenges for Airport Operations and Future Growth of the National Airspace System.* GAO-08-216T. Washington, D.C.: October 24, 2007.

*Climate Change: Agencies Should Develop Guidance for Addressing the Effects on Federal Land and Water Resources.* GAO-07-863. Washington, D.C.: August 7, 2007.

*Responses to Questions for the Record; Hearing on the Future of Air Traffic Control Modernization.* GAO-07-928R. Washington, D.C.: May 30, 2007.

*Responses to Questions for the Record; Hearing on JPDO and the Next Generation Air Transportation System: Status and Issues.* GAO-07-918R. Washington, D.C.: May 29, 2007.

*Next Generation Air Transportation System: Status of the Transition to the Future Air Traffic Control System.* GAO-07-748T. Washington, D.C.: May 9, 2007.

*Joint Planning and Development Office: Progress and Key Issues in Planning the Transition to the Next Generation Air Transportation System.* GAO-07-693T. Washington, D.C.: March 29, 2007.

*Next Generation Air Transportation System: Progress and Challenges in Planning and Implementing the Transformation of the National Airspace System.* GAO-07-649T. Washington, D.C.: March 22, 2007.

*Next Generation Air Transportation System: Progress and Challenges Associated with the Transformation of the National Airspace System.* GAO-07-25. Washington, D.C.: November 13, 2006.

*Aviation and the Environment: Strategic Framework Needed to Address Challenges Posed by Aircraft Emissions.* GAO-03-252. Washington, D.C.: February 28, 2003.

*Aviation and the Environment: Transition to Quieter Aircraft Occurred as Planned, but Concerns about Noise Persist.* GAO-01-1053. Washington, D.C.: September 28, 2001.

*Aviation and the Environment: Aviation's Effects on the Global Atmosphere Are Potentially Significant and Expected to Grow.* GAO/RCED-00-57. Washington, D.C.: February 18, 2000.

*Aviation and the Environment: Results from a Survey of the Nation's 50 Busiest Airports,* GAO/RCED-00-222. Washington, D.C.: August 30, 2000.

*Aviation and the Environment: Airport Operations and Future Growth Present Environmental Challenges.* GAO/RCED-00-153. Washington, D.C.: August 30, 2000.

(540172)

STATEMENT OF DANIEL K. ELWELL, ASSISTANT ADMINISTRATOR, OFFICE OF AVIATION POLICY, PLANNING AND ENVIRONMENT, FEDERAL AVIATION ADMINISTRATION, BEFORE THE HOUSE TRANSPORTATION AND INFRASTRUCTURE COMMITTEE, SUBCOMITTEE ON AVIATION, ON AVIATION EMISSIONS. MAY 6, 2008

Chairman Costello, Congressman Petri, Members of the Subcommittee:

I am pleased to appear before you this morning to address an issue that is central to any discussion of aviation and the environment, aviation emissions. Today I will provide a brief overview of the Federal Aviation Administration's (FAA) activities that help to minimize the environmental impacts associated with aviation emissions, some observations on the current international discussion on emissions trading for aviation, and how Congress can help in moving forward our efforts to address aviation greenhouse gas (GHG) emissions. What should be clear is there is a strong commitment at the very heart of the Next Generation Air Transportation System (NextGen) plan that we have developed--a commitment to provide a systematic, well-informed and performance-based approach to tackling aviation emissions and other environmental issues.

The aviation industry is experiencing record growth globally. It is moving the equivalent of 1/3rd of the world's population each year across the world. Airbus and Boeing have record sales, and two of the fastest growing economies in the world--China and India--are on track to build 100 new airports in the next decade to meet demand.

At the same time, just as aviation is knitting together the world, redefining what opportunity and what neighbor means, concern has grown about its contribution to greenhouse gas emissions and potential impacts on climate change. Aircraft emissions remain a central environmental concern and challenge as they contribute to global climate change and impact the local air quality near airports, and thus could slow the growth of aviation and the benefits it brings to our nation. While we do not have all the answers at this point, what we do have in the NextGen plan is a commitment to provide a systematic, well-informed and performance-based approach to tackling aviation emissions and other environmental issues.

There appears to be a disconnect between perception and performance on aviation emissions, at least in the United States. In some quarters there is a perception that aviation greenhouse gas emissions are growing out of control and that it needs to be reined in by emissions caps and taxes. But consider the facts that we know about performance of the sector and our plans for continued improvement.

Worldwide, aviation represents less than 3% of total man made greenhouse gas emissions. And in the U.S., how have we been doing? The Environmental Protection Agency (EPA) has measured domestic aviation emissions at approximately 3% of GHG emissions. And there is a very positive trend. When you compare today to 2000, U.S. commercial aviation is moving 12% more passengers and 22% more freight while burning less fuel, reducing our carbon output by a million tons. This compares favorably with the U.S. economy overall and aviation has clearly outperformed passenger vehicles in improving its energy efficiency in the past few decades (see Chart 1).

Now let's give these numbers some context. Consider, for example, the performance of the other major aviation market in the world: the European Union. Between 2000 and 2006, aviation $CO_2$ emissions in the U.S. declined by about 4%. During the same period in Europe, emissions increased by around 30%! In part, this explains our different perceptions of the problem across the Atlantic (see Chart 2).

The fastest means of reducing aviation emissions is to reduce the amount of fuel that is burned. The aviation industry has made and continues to make significant improvements in fuel efficiency. Commercial jet aircraft fuel efficiency has improved 70% [1]over the last 40 years and continues to get better. On a per passenger mile basis, Boeing's new 787 will be as fuel efficient as today's subcompact hybrid car. Also, according to the Air Transport Association (ATA), U.S. commercial airlines have committed to a 30% improvement in fuel efficiency over 2005 by 2025.

FAA tracks commercial aviation fuel efficiency and encourages fuel efficiency by U.S. airlines. In just the past four years (2003-2007), U.S. airlines have improved their fuel efficiency 11% (see Chart 3). Since 2000, the restructuring of U.S. airline fleets in the aftermath of September 11th, the rise in fuel costs, utilization of fuel efficient operational procedures, and improvements in air traffic management have all contributed to these savings. With oil now over $100 dollars per barrel and fuel at about a third of operating cost, you can imagine the incentive U.S. airlines have to reduce fuel consumption.

[1] Intergovernmental Panel on Climate Change (IPCC) special report entitled, *Aviation and the Global Atmosphere*, 1999.

Further, given the weakness of the dollar, the price of fuel for U.S. airlines is about 50% higher than their European counterparts (see Chart 4).

I noted the contribution FAA has made in improving the emissions efficiency of air transport in the United States. Some efforts, like the introduction of Reduced Vertical Separation Minimum (RVSM), have been very successful, saving about 3 million tons of $CO_2$ annually. RVSM is an International Civil Aviation Organization (ICAO) approved concept that reduces the aircraft separation standard at certain high altitudes, allowing aircraft to safely fly more optimum profiles, gain fuel savings and increase airspace capacity. Other efforts, like the redesign of the Northeast airspace, are more difficult to put in place, but no less important to our overall goal of increasing capacity while minimizing emissions.

So, the good news is we are starting from a record of exceptional performance historically as we move ahead. So what is our program as we go forward?

First, we must improve our scientific understanding of the impacts of aviation emissions. While $CO_2$'s impacts are well known, our understanding of impacts from other emissions--especially at altitude--ranges from fair to poor (see Chart 5). We must ensure that we identify the harmful emissions, accurately measure their impact and design appropriate technologies, or procedures to mitigate or eliminate their effects. This is especially true given the interdependencies that exist—for example, strategies to increase fuel efficiency (and therefore reduce $CO_2$ emissions) can make it more difficult to reduce emissions of nitrogen oxides. As part of our NextGen effort to advance our understanding in this area, we recently launched the Aviation Climate Change Research Initiative (ACCRI) in partnership with the National Aeronautics and Space Administration (NASA) and other agencies. This initiative will help accelerate our scientific understanding to inform policy decisions in this area.

Second, we must accelerate air traffic management improvements and efficiencies to reduce fuel burn. Improving energy efficiency has the dual benefit of improving both environmental and operational performance of the aviation sector. As I said before, we have saved millions of tons of carbon emissions over the past couple of years by putting RVSM in place. We are accelerating implementation of other enhanced air traffic control navigation and other procedures to further improve the fuel efficiency of the system. Through the use of Required Area Navigation (RNAV) and Required Navigation Performance (RNP) technology, aircraft will be able to use descent procedures that burn less fuel and result in quieter operations. In addition, satellite-based air traffic control paired with Automatic Dependent Surveillance-Broadcast (ADS-B) technology on aircraft allow for safer but closer separations between aircraft and more direct routing, which will improve fuel efficiency and also reduce carbon dioxide emissions. In essence, NextGen itself will improve environmental performance. We are already achieving early gains at a test program at Dallas-Fort Worth International Airport, where American Airlines' use of NextGen-related procedures is reducing carbon dioxide emissions by levels equivalent to removing 15,000 cars from the road for a year.

A good example of emissions reductions from aviation operational improvements is Continuous Descent Arrival or CDA. CDA allows an airplane to fly a continuous descent path to land at an airport, rather than the traditional "step downs" or intermediate level flight operations. The airplane initiates descent from a high altitude in a near "idle" engine (low power) condition until reaching a stabilization point prior to touch down on the runway. Trials in Louisville, KY have shown a fuel savings (and thus GHG savings) averaging about 12% for the arrival portion of the flight. And testing at Atlanta Hartsfield International Airport of continuous descent arrivals shows savings of 1,300 pounds of carbon dioxide for each and every flight.

CDA is one of those win-win strategies, having environmental and operational benefits that can reduce noise, emissions, and fuel burn, as well as flight time. The cumulative impact of measures like this throughout the system can have a real impact. As additional advanced aircraft and air navigation procedures planned for the NextGen system are developed and deployed, we will see an even greater reduction in greenhouse gas emissions impacts from aviation.

Third, we must hasten the development of promising environmental improvements in aircraft technology. This builds upon the fact that the vast majority of improvements in environmental performance over the last three decades have come from enhancements in engine and airframe design. Both the House and Senate have included a number of our environmental proposals in their pending aviation reauthorization bills (H.R. 2881 and S. 1300) including a proposal to create a research consortium, to be called CLEEN--

Continuous, Low Energy, Emissions, and Noise--focused on accelerating the maturation of lower energy, emissions and noise technology for aircraft. While action on that legislation is not completed, we already have in place a cooperative working relationship with NASA and broad participation of outside stakeholders through our research advisory committee, the Partnership for AiR Transportation Noise and Emissions Reduction (PARTNER) Center of Excellence advisory board, and our NextGen Environmental Working Group.

Fourth, it is imperative to explore the potential of alternative fuels for aviation--fuels that could have benefits for energy security as well as emissions performance, depending on the fuel's lifecycle greenhouse gas emissions profile. The FAA is a major partner in the Commercial Aviation Alternative Fuels Initiative, or CAAFI. CAAFI's participants, which include a cross-section of airlines, manufacturers, airports, fuel producers, federal agencies and international players, are implementing a road-map to explore the use of alternative fuels for commercial aviation. Let me emphasize this is not "pie in the sky". CAAFI participants have already used coal-to-liquid and gas-to-liquid fuels in jets, and most recently completed a bio-fuels flight demonstration. We are keenly aware production processes could increase the overall carbon footprint, so CAAFI is doing careful life cycle carbon emissions analyses and focusing on approaches that will lead to overall reductions.

Data indicate that low sulfur synthetic and bio-based fuels promise significant health benefits from reductions in Particulate Matter (PM) emissions. Certain fuel options also promise reduced carbon emissions. To begin to measure these, FAA sponsored a life-cycle analysis of the "well to wake" greenhouse gas emissions of multiple alternative fuels in a study due this spring that addresses the feasibility of alternative fuels for aviation.

Finally, a variety of market-based measures may offer assistance in managing aviation emissions growth. Approaches using tax incentives, emissions trading or carbon offsets may all have a role to play, though each can pose challenges in design and implementation. Consider carbon offsetting. This is a scheme which allows airline passengers to pay for carbon reductions accomplished somewhere else to compensate for the emissions generated by the aircraft flight they took. While offered by several airlines, a number of questions have arisen related to calculations of carbon emissions (calculations of the same flight can produce carbon numbers that vary by a factor of three) and how the funds collected are spent. More recently in the U.S. we are looking for market-based measures to increase utilization of congested airspace, so that we can simultaneously increase efficiency and drive down emissions per passenger.

With respect to emissions trading, the U.S. participated in the development of emissions trading guidance for aviation under the auspices of ICAO, the United Nations standard setting organization of international aviation. The U.S. and the rest of the world, except for Europe, agreed on this guidance last September for countries that decide to employ emissions trading for international aviation. The overwhelming majority of countries--developed and developing--all agreed emissions trading should only be applied to another country's airlines on the basis of agreement between States. European countries refused to join consensus, as their proposed legislation would force international airlines into their emissions trading system without the consent of governments

The U.S. has significant concerns about the European Union (EU) legislation that is currently being developed to place aviation into their emissions trading system. On top of the legal issues with respect to the Chicago Convention and our air services agreements, recent discussions with EU officials made clear that adoption of emissions trading for aviation has become an end in itself, rather than improving environmental performance. The facts that U.S. airlines pay substantially more for their fuel than their European competitors, that the U.S. has a domestic fuel tax unlike their EU competitors, and that U.S. airlines have actually reduced their emissions unlike the substantial growth from EU airlines, were dismissed.

As ICAO recognized in its work, an emissions trading system is only one approach and it remains the decision of a State whether to employ such a measure. Market based measures can reduce emissions at lower costs. However, the price of fuel already provides both airlines and manufacturers strong market incentives to reduce fuel consumption. Between 1985 and 2004, aviation outperformed every other transport mode in reducing its emission intensity (see Chart 6). Between 2000 and 2006, the price of fuel more than doubled. Consequently, U.S. commercial carriers bought 750 million fewer gallons in 2006 than they purchased in 2000 even while carrying twelve percent more passengers and 22 percent more cargo. This lends support to the 2001 finding of

ICAO's Committee on Aviation Environmental Protection (CAEP) that the price of fuel obviates the need for $CO_2$ emissions standards for aviation.

Environmental advances in the aviation sector historically have been most helped by positive economic measures that further stimulate research and innovation in the industry's fleets. As the record on aircraft noise and fuel efficiency demonstrates, implementation of new technology and operational procedures have been remarkable tools for limiting and reducing aviation environmental impacts.

As a recent Congressional Budget Office report (February 2008) highlighted, use of emissions trading as a market-measure to reduce emissions poses a number of issues. FAA remains concerned that such issues become more complex when dealing with aircraft that operate internationally. A poorly designed and implemented emissions trading system could actually hamper the ability of aviation to become cleaner and quieter.

We believe ICAO must continue to exercise global leadership to achieve aviation growth in an environmentally responsible fashion. ICAO offers the best forum to find the harmonized approaches we need for a global industry like aviation. It allows the proper balance of collaboration and State sovereignty. We are committed to supporting that effort. In February, I represented the U.S. at the first meeting of the fifteen-nation Group on International Aviation and Climate Change (GIACC). This high-level group was conceived during last year's ICAO Assembly and is developing an international plan to address international aviation greenhouse gas emissions. Our hope is to take the approach I have outlined here--a balanced approach derived from the recognition that operational and technological environmental performance improvements, coupled with market measures where necessary, can form the basis to derive data-driven, challenging, aspirational goals for the international community in reducing the growth of aviation's greenhouse gas emissions impacts. At the GIACC, we ultimately seek an effective, globally devised strategy, collaboratively entered into.

In addition to FAA's work at ICAO we are pursuing partnerships with other authorities and the international industry in a number of highly technical system areas to advance improvements in aviation's environmental performance. For example, last year the FAA and European Commission (27 countries) announced the Atlantic Interoperability Initiative to Reduce Emissions, or AIRE. The AIRE initiative is targeted to undertake demonstrations in both the U.S. and Europe to accelerate the ability of airlines and air navigation authorities to employ enhanced air traffic procedures that reduce aviation's emissions and noise footprint on either side of the Atlantic. We (the U.S., Australia and New Zealand) also just launched a similar initiative in the Pacific—ASPIRE--or the Asia and South Pacific Initiative to Reduce Emissions.

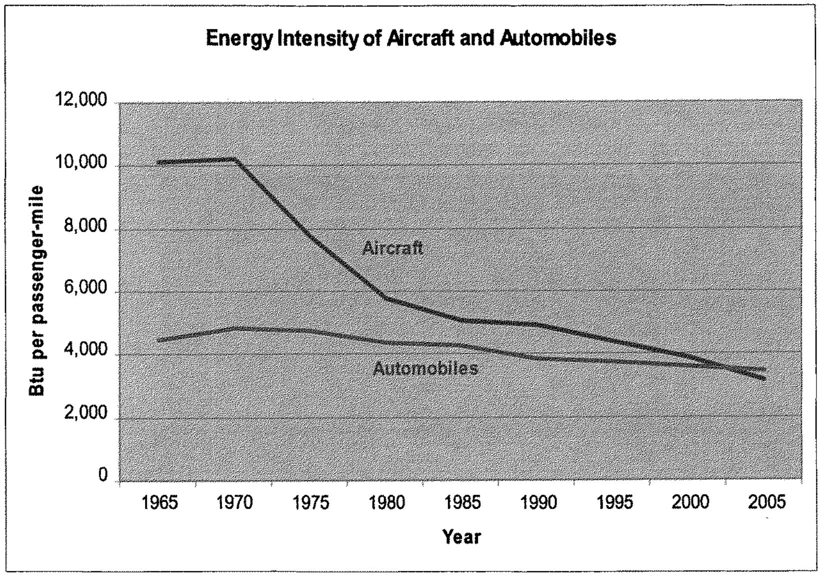
Aviation has succeeded in its first century because it has constantly met the challenge of innovation and record setting – flying faster, cleaner, quieter and safer. In doing so, aviation has transformed the world. Any fair reading of history will show that until now, aviation has done an exceptional job in improving its environmental performance. But to be blunt, the issue is not past performance, but what we are doing for the future.

In closing, it is clear today that aircraft emissions impact the climate, are an issue of both domestic and international concern and remain a potential constraint on the future growth of aviation. It is also evident we have no "silver bullets." What we do have is an approach to reduce aviation greenhouse gas emissions in a growing NextGen system. We have already initiated a number of endeavors – "silver buckshot" if you will – that will help get us there. We need the help of Congress. We have outlined a significant set of initiatives underway to address aviation emissions. We have proposals before Congress in FAA's reauthorization proposal that, if authorized and funded, would accelerate all these efforts.

Success will require partnership and shared responsibilities among many stakeholders— with air carriers operating cleaner and quieter aircraft; airframe and engine manufacturers improving efficiency of their products; air traffic management facilitating environmentally-friendly procedures consistent with safe and efficient operation; alternative fuel producers scaling up environmentally sound fuel production; airports investing in cleaner infrastructure; and federal programs and investments supporting the necessary technology and operational improvements. The FAA is committed to working with all stakeholders to find the right balance to manage capacity growth while addressing aviation emissions.

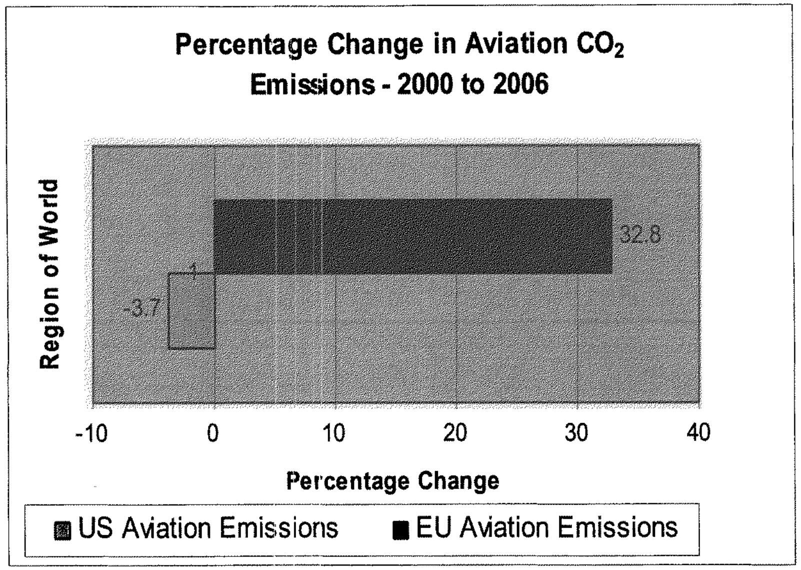
Mr. Chairman, that completes my prepared statement. I would be happy to answer any questions you or Members of the Committee may have.

# U.S. Commercial Aircraft and Automobiles



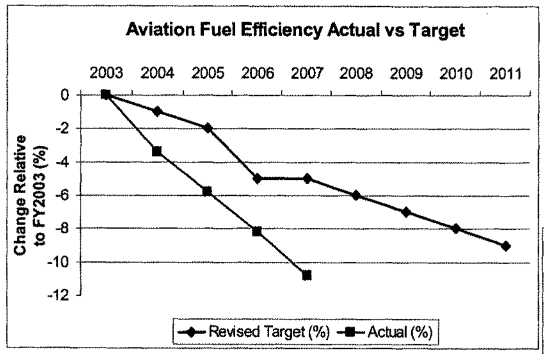

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 2007*, Table 4-20: Energy Intensity of Passenger Modes

# Differences in GHG Performance

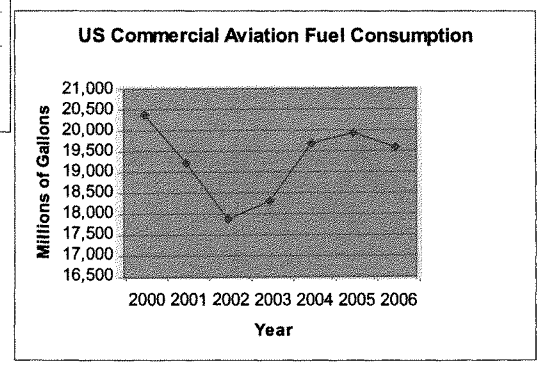



Source: Volpe. (Note: For EU-15)

# US Aviation Emissions Growth Down

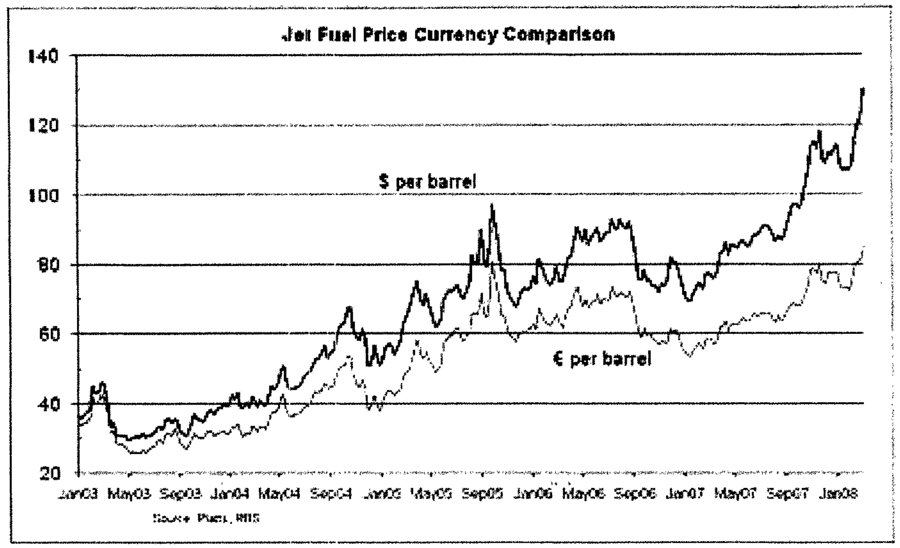



Source: FAA




Source: U.S. DOT, BTS

# Fuel Is Even More Expensive for US Airlines




Source: International Air Transport Association (IATA) and Platts

## Better Understanding of GHG Emissions

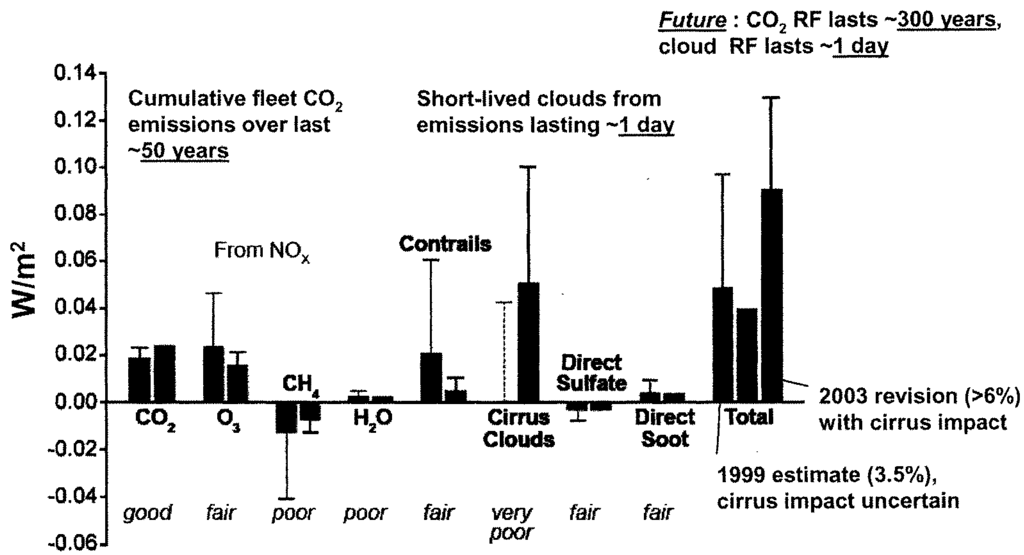
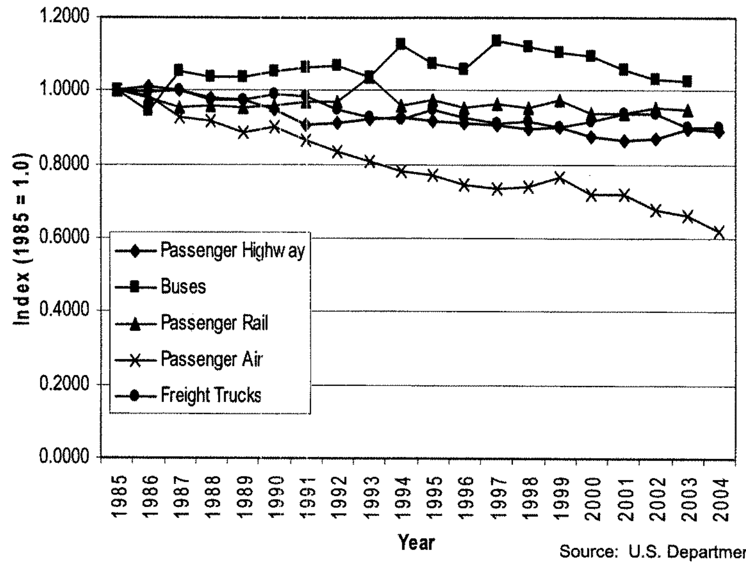



Figure adapted from IPCC (1999) with additional data from Schumann (2003)

# Energy Intensity Trends by Transportation Mode




Source: U.S. Department of Energy, U.S. Energy Intensity indicators. (intensityindicators.pnl.gov)

# U.S. House of Representatives
## Committee on Transportation and Infrastructure
Washington, DC 20515

James L. Oberstar
Chairman

David Heymsfeld, Chief of Staff
Ward W. McCarragher, Chief Counsel

John L. Mica
Ranking Republican Member

James W. Coon II, Republican Chief of Staff

May 12, 2008

Mr. Dan Elwell
Assistant Administrator
Aviation Policy, Planning, and Environment
Federal Aviation Administration
800 Independence Avenue, SW
Washington, D.C. 20591

Dear Mr. Elwell:

On May 6, 2008, the Subcommittee on Aviation held a hearing on **Aviation and the Environment: Emissions.**

Attached are questions to answer for the record submitted by Rep. Daniel Lipinski. I would appreciate receiving your written response to these questions within 14 days so that they may be made a part of the hearing record.

Sincerely,

Jerry F. Costello
Chairman
Subcommittee on Aviation

JFC:pk
Attachment

**MAY 6, 2008**
**SUBCOMMITTEE ON AVIATION**
**HEARING ON**
**"AVIATION AND THE ENVIRONMENT: EMISSIONS"**

**QUESTIONS FOR THE RECORD**
**TO:**

**MR. DANIEL K. ELWELL**
**ASSISTANT ADMINISTRATOR**
**AVIATION POLICY, PLANNING, AND ENVIRONMENT**
**FEDERAL AVIATION ADMINISTRATION**

While aviation emissions currently account for only about 3% of the world's greenhouse gasses that percentage is expected to grow rapidly in the coming years. In fact, the FAA estimates that by 2016 airlines will carry 200 million more passengers than they did in 2007. This increase in flights could have a devastating impact on our environment, adding to global climate change, decreasing air quality, and affecting the quality of life for humans and thousands of other species.

For these reasons, I was proud to work with Chairman Costello and Chairman Oberstar in authoring a provision in the FAA Reauthorization bill which would establish an FAA Center of Excellence dedicated to researching and finding solutions for the challenges posed by aviation emissions. By dedicating academic and professional resources to this important topic, I am confident that we can find long term solutions to reduce and perhaps even eliminate aviation emissions.

But in the short term, I am curious about what the industry and the federal government is doing or could be doing to reduce aviation emissions. Mr. Elwell (FAA), could you discuss some short term solutions for limiting aviation emissions?

*5/29/08*

**Response from Daniel K. Elwell, FAA Assistant Administrator, Office of Policy, Panning and Environment, to a Question for the Record from Representative Lipinski, following the May 6, 2008 Hearing, Aviation and the Environment: Emissions**

**Question:** While aviation emissions currently account for only about 3% of the world's greenhouse gases, that percentage is expected to grow rapidly in the coming years. In fact, the FAA estimates that by 2016 airlines will carry 200 million more passengers than they did in 2007. This increase in flights could have a devastating impact on our environment, adding to global climate change, decreasing air quality, and affecting the quality of life for humans and thousands of other species.

For these reasons, I was proud to work with Chairman Costello and Chairman Oberstar in authoring a provision in the FAA Reauthorization bill which would establish an FAA Center of Excellence dedicated to researching and finding solutions for the challenges posed by aviation emissions. By dedicating academic and professional resources to this important topic, I am confident that we can find long term solutions to reduce and perhaps even eliminate aviation emissions.

But in the short term, I am curious about what the industry and the federal government are doing or could be doing to reduce aviation emissions. Mr. Elwell (FAA), could you discuss some short term solutions for limiting aviation emissions?

**FAA Response:** In the short term, aviation emissions are unlikely to grow rapidly. The continued pressure of high fuel prices, operational consolidations, and air traffic improvements are likely to restrain emissions growth even as more passengers fly on U.S. airlines. Even with robust growth, aviation emissions are still expected to account for a small percentage of global greenhouse gas emissions—about 5% in 2050. Furthermore, aviation has a good record. Commercial jet aircraft fuel efficiency has improved 70% over the last 40 years and continues to get better. On a per passenger basis, the Boeing 787 will be as fuel efficient as today's subcompact hybrid car. Compared to the year 200, U.S. commercial aviation is moving 12% more passengers and 22% more freight while burning less fuel, which in turn means less emissions. So, this is an area that has been and is being managed even as aviation has grown.

There are future challenges. At the same time, aviation emissions are receiving greater amounts of attention as we develop the next generation air transportation system (NextGen). A key part of the NextGen environmental challenge is to reduce the impact of aviation greenhouse gas emissions on global climate. NextGen can help meet the challenge by improving our scientific understanding of the problem and solutions, reducing system-induced congestion and delay, accelerating air traffic management improvements and efficiencies, speeding up environmental improvements in aircraft technology, and developing alternative fuels.

On a short term basis, the fastest means of reducing aviation emissions is by reducing the amount of fuel burned. Aircraft fuel efficiency and conservation continue to be part of the solution. The airline industry is instituting measures to reduce fuel burn wherever possible, and the rising cost of fuel puts additional pressure on the industry to reduce fuel use. For example, 70% of older aircraft which are much less fuel efficient have been retired over the past six years. Airlines have reduced aircraft weight, lessened use of aircraft auxiliary power units (APUs) and shifted to ground-based electricity sources or electrified gates combined with preconditioned air, employed single-engine taxiing, and adopted a variety of other practices to reduce fuel consumption.

The FAA continues to develop and implement operational and procedural improvements to improve the safety and efficiency of the national airspace system (NAS), and to reduce fuel burn and emissions. The FAA has been working over the last few years to enhance and modernize the air traffic management (ATM) system to allow for more fuel efficient aircraft operations, including the program to reduce vertical separation minima which we estimate results in about a 2% fuel efficiency improvement. We have been conducting research and prototyping to demonstrate operational procedures such as Continuous Descent Arrivals (CDA) in the airport terminal area that enables aircraft to use lower power settings during the approach to the airport; therefore, reducing fuel burn and emissions as well as noise. CDA has been implemented in the RIIVR One (seaside) approach at Los Angeles International Airport.

Even though the FAA runs the safest and most efficient air traffic control system in the world, millions of tons of CO2 are still created every year due to ground and in-flight congestion and delays. These are a few of the near term measures focused on delay reduction:

- Airport Surface Detection, Model X (ASD-X) – Airport surface-surveillance data with better accuracy, faster update rate, and stronger reliability can improve airport safety and efficiency in all weather conditions by giving the controllers better knowledge of aircraft locations on the ground. This will allow optimization of airport ground and terminal operations (pushback, gate usage, queuing, etc.) that will result in reduced fuel burn and emissions

- Departure Flow Management (DFM) and Departure Spacing Programs (DSP) – DFM and DSP provide ATM with the capability to automate coordination of departure releases into congested airspace, with the goal of improving efficiency and reducing delays.

- RNAV/RNP Arrivals and Departures – RNAV (Area Navigation) refers to a method of navigation that enables aircraft to fly on more optimal flight paths within the coverage of reference navigation aids and/or within the limits of the capability of self-contained systems (Flight Management System [FMS]- or Global Positioning System [GPS]-based). RNP (Required Navigation Performance) refers to RNAV operations within navigation containment and monitoring, enabling the aircraft navigation system to monitor its achieved navigation performance within specified tolerances.

- AIRE and ASPIRE – Last year, FAA and the European Commission announced the Atlantic Interoperability Initiative to Reduce Emissions (AIRE). This initiative is intended to accelerate the ability of airlines and air navigation authorities to use enhanced air traffic procedures that reduce emissions on either side of the Atlantic. The U.S., Australia, New Zealand have launched a similar initiative for the Pacific—the Asia and South Pacific Initiative to Reduce Emissions (ASPIRE).

* * *

**WRITTEN TESTIMONY OF**
**DR. DAVID W. FAHEY**
**EARTH SYSTEM RESEARCH LABORATORY**
**OFFICE OF OCEANIC AND ATMOSPHERIC RESEARCH**
**NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION**
**U.S DEPARTMENT OF COMMERCE**

**HEARING ON**
**"AVIATION AND THE ENVIRONMENT: EMISSIONS"**

**BEFORE THE**
**COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE**
**SUBCOMMITTEE ON AVIATION**
**UNITED STATES HOUSE OF REPRESENTATIVES**

**May 6, 2008**

**Introduction**

Good afternoon, Mr. Chairman and members of the Committee. I am David Fahey, research physicist in the National Oceanic and Atmospheric Administration's (NOAA's) Office of Oceanic and Atmospheric Research. NOAA's mission is to understand and predict changes in the Earth's environment and conserve and manage coastal and marine resources to meet our nation's economic, social, and environmental needs. The Office of Oceanic and Atmospheric Research conducts and sponsors the scientific research, environmental studies, and technology development needed to improve NOAA's operations and applications, and broaden our understanding of the Earth's atmosphere and oceans.

I work at NOAA's Earth Systems Research Laboratory in Boulder, Colorado where I conduct research related to the chemical and particle composition of the atmosphere and work with policymakers to describe and evaluate the science of ozone depletion and climate change. As part of my research over the past 10 years, I have been investigating the role emissions from aviation operations play in climate change. I was a coordinating lead author of the chapter on aviation-produced particles and cloudiness in the Intergovernmental Panel on Climate Change's (IPCC) Special Report on *Aviation and the Global Atmosphere* published in 1999. More recently I was a lead author of a chapter of the IPCC 4$^{th}$ climate science assessment released in 2007 that included an evaluation of the influence of global aviation on climate.

Thank you for inviting me to discuss the impact of aviation emissions on climate. Today, I will provide an introduction to this hearing by presenting some aspects of our basic understanding of the role of global aviation in climate change, the key uncertainties in that understanding, and outstanding gaps in our knowledge.

Aviation is one component of human activities that contribute to climate change. Human activities contribute to climate change by altering the natural amounts of greenhouse gases, small particles, or cloudiness in Earth's atmosphere. Greenhouse gases, particles, and clouds affect climate by influencing the balance between incoming solar radiation from the sun and the outgoing infrared (thermal) radiation. This radiation balance is what controls Earth's temperatures and other climate features. When humans change the specific amounts or certain properties of greenhouse gases, particles, and clouds in the atmosphere, they change the radiative balance and create what scientists call a *radiative forcing* of the climate system. Radiative forcing, or RF as it is often designated, is the widely accepted measure of how hard the climate system is being *pushed* away from its natural state. This push is also known as climate forcing, and can be caused by natural mechanisms or through manmade pollution, such as the emissions of greenhouse gases. We know that if the climate is forced too hard, the climate state will change, altering basic climate parameters such as temperatures and precipitation. An important goal for climate scientists is to quantify climate forcing from all human activities and estimate how and when our climate system might respond to the total forcing. It is in this context that the contribution of aviation to climate change is most appropriately viewed and evaluated.

The radiative forcing contribution of aviation has been the focus of international scientific interest for some time. In 1999, the IPCC released its special report titled *Aviation and the Global Atmosphere*, which comprehensively addressed, for the first time, the processes by which aviation leads to radiative forcing. U.S. scientists, including myself, played leading roles in this effort. This report and subsequent refinements in the IPCC 4th scientific assessment of climate change released in 2007 are the preferred basis for any scientific discussion of aviation's contribution. The uncertainties and knowledge gaps identified in the 1999 report, while reduced in some respects in the intervening years, remain an important limitation in our understanding of the issue.

**What are the aspects of aviation operations that lead to climate forcing (or change)?**

There are three aspects of aviation that are of key importance in understanding and defining its role in climate change.

- *Aviation emits gases and particles into the atmosphere.* Global aviation burns fossil fuel, primarily in jet engines, to propel and operate a wide variety of aircraft. The combustion of aviation fuel (kerosene) produces a variety of gases and particles in the exhaust. Primary among them are the gases carbon dioxide ($CO_2$), nitrogen oxides ($NO_x$) and water vapor, and particles composed of soot and sulfate (*e.g.*, $H_2SO_4$). All of these components contribute to climate forcing.

- *Some gases and particles emitted by aviation at cruise altitudes have enhanced roles in climate change processes.* A large fraction of aviation fuel is burned at cruise altitudes (greater than 25,000 ft). At these altitudes, the removal of some gases and particles from the atmosphere is slower, thereby allowing these components to accumulate and stay in the atmosphere longer and have greater effect than they otherwise would if the emissions had occurred near Earth's surface.

- *Aviation operations often increase cloudiness along and near aircraft flight tracks.* Under certain atmospheric conditions, jet aircraft produce contrails (condensation trails), which are a form of cirrus cloud, in the engine exhaust plume. These contrails can sometimes persist and spread for hours to days, depending on conditions (see Figure 1). Since clouds are an important aspect of Earth's radiation balance, increasing cloudiness is a component of climate change.

The IPCC reports in 1999 and 2007 quantified many of the climate effects of aviation emissions and cloudiness. Chart 1 graphically illustrates the radiative forcing from each of the eight principal components associated with aviation as reported by IPCC. The quantitative values are radiative forcings given in units of *watts per meter squared* ($Wm^{-2}$), which is the accepted nomenclature within IPCC. *Positive* radiative forcing values shown in Chart 1 lead to a warming of Earth's climate while *negative* forcings lead to a cooling. Larger forcings are expected to cause larger climate responses. Each bar in the chart represents the *best estimate* of scientists using available data and atmospheric models. I will briefly summarize each component for the committee.

1. *Carbon dioxide ($CO_2$).* Carbon dioxide, a well-known greenhouse gas, is the largest emission (by mass) of aviation. It is a direct product of the combustion of aviation fuel, which primarily contains elemental carbon, hydrogen, and sulfur. The radiative forcing from carbon dioxide is positive (warming) and is associated with a small uncertainty. The climate role of carbon dioxide emissions from aviation is no greater or less than the same amount of surface emissions of carbon dioxide because of its long lifetime in the atmosphere.

2-3. *Nitrogen oxides ($NO_x$).* Nitrogen oxides are a byproduct of high-temperature combustion of aviation and other fuels. Most nitrogen oxides are not greenhouse gases but influence climate indirectly by causing changes in other greenhouse gases; namely ozone ($O_3$) and methane ($CH_4$). In chemical processes that occur in the sunlit atmosphere, nitrogen oxides lead to ozone formation and methane reductions. Methane is emitted in other human activities. These effects have opposite climate effects with ozone increases causing a positive forcing (warming) and methane decreases causing a negative forcing (cooling).

4. *Water vapor.* Water vapor ($H_2O$), a potent greenhouse gas, is a direct product of the combustion of aviation fuel. The highest altitude aircraft emissions occur in the lower stratosphere, where water vapor abundances are low. The accumulation of aviation water emissions in this region leads to a small positive radiative forcing (warming). The accumulation of water emitted at lower cruise altitudes (troposphere) has a negligible climate effect because the natural abundance of tropospheric water vapor is far larger.

5-6. *Sulfate and soot particles.* Sulfate and soot particles are emission products of aviation. Sulfate particles derive from the sulfur content of the fuel. Soot particles are a byproduct of incomplete combustion. The direct effects of the accumulation of these particles are opposite: sulfate particles reflect sunlight causing a small negative forcing (cooling) while soot particles absorb sunlight causing a small positive forcing (warming).

7. *Persistent contrails.* Persistent (linear) contrails form in the jet engine exhaust plume when atmospheric humidity conditions are favorable for ice cloud formation (*i.e.,* supersaturation). Contrails are ice clouds that are formed primarily from atmospheric water vapor but whose formation is triggered by emitted water vapor. Natural and contrail cirrus clouds can both cool

and warm the atmosphere depending on specific cloud properties. Contrails from the current aviation fleet are estimated to cause a net positive forcing (net warming).

8. *Induced cloudiness.* Induced cloudiness, also known as contrail cirrus, is defined as cirrus cloudiness that spreads or evolves from persistent contrails as they lose their characteristic linear shape. Induced cloudiness represents cloudiness that otherwise would not have occurred in the atmosphere. As with contrails, induced cloudiness has a net positive forcing (warming) of climate. The forcing for induced cloudiness is shown as a range in Chart 2 because no best estimate value is available.

Total aviation radiative forcing: The best estimate of the total aviation radiative forcing is positive, leading to a warming influence on climate. The total is a sum over the individual components except for induced cloudiness, which is excluded because it lacks a best estimate. Thus, the total shown is an underestimate of the actual total contribution from aviation. The contributions from carbon dioxide and ozone are the largest terms in the total. The total aviation radiative forcing in Chart 1 can be compared to the total forcing from other human activities and the natural forcing from changes in solar output as displayed in Chart 2. The comparison shows that aviation in 2005, excluding induced cloudiness, represents approximately 3 percent of that from all human activities since the start of the industrial era.

An important aspect of the contributions of aviation to climate forcing is the *lifetimes* of the individual contributions. The lifetime refers to how long a particular effect persists in the atmosphere. All of the aviation components except carbon dioxide have short lifetimes. Carbon dioxide emitted into the atmosphere has a lifetime of 100-1000 years. Thus, a large fraction of the carbon dioxide emitted into the atmosphere from aviation in the year 2000 will still be contributing to climate forcing in 2100. This is true for carbon dioxide emitted in all other human activities. In contrast, the effects of other emissions and clouds from aviation have short lifetimes (less than 1 year). Thus, the non-carbon-dioxide effects of aviation in 2000, for example, will represent a negligible contribution to climate forcing well before 2100. Another consequence is that in a future scenario in which aviation operations remain constant, the contribution of carbon dioxide forcing relative to all other aviation forcings would continually increase. The contrast in lifetimes for the different effects is an important aspect of the long-term influence of aviation on climate.

**What are the uncertainties in evaluating the impact of aviation operations on climate forcing (or change)?**

The climate effects of aviation are the result of complex interactions involving emissions and clouds in the atmosphere. As a consequence, the effects must be calculated with computer models of the global atmosphere. The processes contained in models are an attempt to represent comprehensively the chemical transformations among atmospheric trace gases, the formation and removal of particles, atmospheric air motions that transport gases and particles throughout the atmosphere, the regional and seasonal responses of the radiative forcings, and the response of the climate system to the applied forcings. The resulting model estimates are associated with varying uncertainties because our knowledge of the processes and our ability to represent them quantitatively in models is imperfect. In this presentation, I address only the uncertainties associated with the forcings.

The largest term in Chart 2, that of carbon dioxide, has one of the smallest relative uncertainties, in part, because carbon dioxide is gas with a long atmospheric lifetime and is well studied as a principal greenhouse gas associated with many non-aviation human activities.

The two radiative forcing components from nitrogen oxide emissions have large uncertainties because complex, chemical processes link nitrogen oxides to ozone and methane changes, and the natural abundances and variabilities of ozone and methane are generally larger than the calculated changes.

Contrail radiative forcing also has a large uncertainty. Contrails, despite being a visible component of climate change, are difficult to assess on the global scale required for aviation. Contrail formation on any flight is critically dependent on the atmospheric humidity conditions along the flight track. Global models have difficulty predicting atmospheric humidity along air traffic routes with the needed precision and accuracy.

The uncertainties associated with the remaining components; namely water vapor and sulfate and soot particles, are relatively small in comparison with other uncertainties. The radiative forcings associated with these components is also small relative to the carbon dioxide component.

**What are the gaps in our knowledge on climate forcing from aviation?**

Significant gaps exist in our knowledge of the effect of aviation on current and future climate. Two gaps are worth noting in this presentation:

*Estimate of induced-cirrus cloudiness.* Currently no best estimate is available for the climate forcing of induced cloudiness from aviation. Many observations have shown the existence of induced cirrus. Chart 1 shows a common example of spreading contrails forming induced cirrus. However, scientists lack the necessary observations and framework to detect and quantify induced cirrus for global aviation. Principal difficulties are distinguishing induced cirrus from background cirrus that forms in the same region and establishing the radiative forcing properties of induced cirrus. Without a best estimate for induced-cirrus, the aviation impact on climate will be incomplete and likely underestimated.

*Estimate of the role of aviation particles in background cloud formation.* Aviation particles containing sulfate, soot, and unburned hydrocarbons have the potential to alter the formation and properties of clouds in the atmosphere. Studies show that aviation likely increases the number of soot particles, for example, in the upper atmosphere, particularly near flight corridors. The presence of these particles in regions of cloud formation could potentially alter the formation rates of clouds or their radiative properties. Studies have confirmed these effects in the lower atmosphere for other sources of particles from natural and human activities, but estimates are uncertain. Studies have not been undertaken to demonstrate these effects for aviation particles.

**Summary**

Global aviation emits gases and particles into the atmosphere that affect Earth's climate. The gases include carbon dioxide, a principal greenhouse gas. The emissions occur primarily at cruise altitudes, which increases their potential to cause climate effects. In addition, aviation indirectly increases cloudiness through the formation and spreading of persistent contrails. The net result of aviation emissions and cirrus cloudiness is a positive radiative forcing which leads to a warming of climate. Global atmospheric models are required to evaluate and quantify the separate effects of aviation on climate. Model calculations for aviation are associated with notable uncertainties, particularly for contrails and the indirect effects of $NO_X$ emissions. Identifiable gaps in our understanding of aviation effects are the lack of best estimates for the forcing of induced cirrus formed by spreading contrails and for the possible effect of aviation particles on background cirrus formation and properties. The lack of a best estimate for induced cirrus leads to an underestimate of aviation climate forcing. The lifetimes of the non-carbon-dioxide effects of aviation are dramatically shorter than the effect of carbon dioxide. The contrast in lifetimes for the different effects is an important aspect of the long-term influence of aviation on climate.

**References**

IPCC, 1999: *Aviation and the Global Atmosphere: A Special Report of IPCC Working Groups I and III* [Penner, J.E., et al. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 373 pp.

IPCC, 2007: Changes in atmospheric constituents and in radiative forcing, in *Climate Change 2007: The Physical Science Basis - Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by S. Solomon et al., p. 129, Cambridge Univ. Press, New York.

**Figure 1.** Persistent contrails spreading to form induced cirrus as viewed from the ground from a location in suburban Washington, DC, USA (EPA, USA Environmental Protection Agency (EPA), Aircraft Contrails Factsheet, http://www.epa.gov/otaq/regs/nonroad/aviation/contrails.pdf).

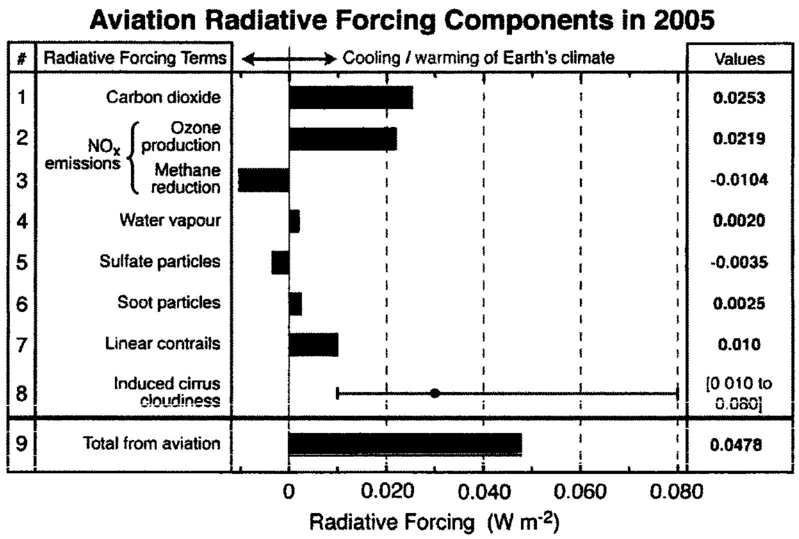



**Chart 1.** Globally averaged radiative forcing estimates for the affects of aviation on climate. The results account for all aviation operations through 2005. The black line for induced cirrus cloudiness represents a range for the best estimate. (Adapted from IPCC, 2007).

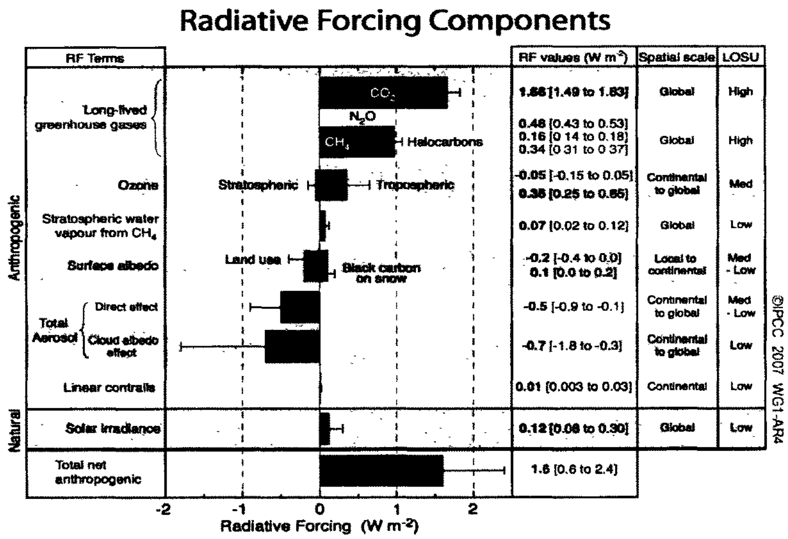



**Chart 2.** Globally averaged radiative forcing estimates and uncertainties for human-induced increases in principal greenhouse gases and for other important agents and mechanisms between pre-industrial times and the present (2005). Also shown are the typical geographical extent (spatial scale) of the forcing and the assessed level of scientific understanding (LOSU). (IPCC Summary for Policymakers, 2007; Figure SPM-2)

# BEFORE THE HOUSE OF REPRESENTATIVES

## COMMITTEE ON TRANSPORTATION & INFRASTRUCTURE

## SUBCOMMITTEE ON AVIATION

## HEARING
## "AVIATION AND THE ENVIRONMENT: EMISSIONS"

TESTIMONY OF BILL GLOVER
MANAGING DIRECTOR – ENVIRONMENTAL STRATEGY
BOEING COMMERCIAL AIRPLANES
P.O. BOX 3707 MAIL CODE 22-48
SEATTLE, WA 98124

**TESTIMONY OF BILL GLOVER**
**MANAGING DIRECTOR, ENVIRONMENTAL STRATEGY**
**BOEING COMMERCIAL AIRPLANES**

**BEFORE THE U.S. HOUSE OF REPRESENTATIVES**
**COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE**
**SUBCOMMITTEE ON AVIATION**

**MAY 6, 2008**

Mr. Chairman, Ranking Member Petri, Mr. Larson from my home state of Washington, members of the Subcommittee, thank you for the opportunity to testify.

Recently, the environment has become page-one news all over the world. At Boeing, thinking about the environment is not new. We have spent the last 50 years making the environmental performance of our commercial products a cornerstone of our business. Today the Boeing Company produces a family of 18 different aircraft --- all quieter and more fuel efficient than earlier generations of aircraft. In fact, today's jet aircraft are 70 percent more fuel efficient and therefore produce 70 percent fewer emissions than aircraft produced only 40 years ago.

Demand for these newer, more fuel efficient aircraft is tremendous. Boeing already has 57 customers for 892 new 787's which will be the most fuel-efficient in its class. Our 737 and 777 lines remain sold out for years to come and our new 16% more fuel efficient 747-8 is due to debut in 2009.

We recognize that the aviation industry, as a key element of any growing economy, must continue to make improvements in both aircraft emissions and noise. To be effective, these improvements must be made on a global basis.

Boeing has been a very active participant in the International Civil Aviation Organization (ICAO) since its inception. ICAO is the UN body that governs all aspects of international aviation. Through ICAO's Committee on Aviation Environmental Protection (CAEP) the industry has reduced the aviation noise footprint around airports and driven down aircraft-specific emissions -- CO, soot, and NOx -- on a worldwide basis.

Now ICAO is examining whether it is possible to further reduce $CO_2$ emissions. With oil at $120/barrel, the cost of fuel is likely to remain the biggest driver of fuel efficiency in an industry with limited or no profit margins. (Traditionally fuel is the airlines second largest cost behind labor. Today fuel is now the largest operating cost for many airlines.)

As aircraft are a uniquely mobile asset, designed to fly and be environmentally acceptable anywhere in the world, ICAO fills a key role in helping manufacturers and airlines develop clear *global* standards. This is critical for Boeing with customers in more than 90 countries. Currently, 80 percent of Boeing's commercial airplanes are delivered outside the United States. Boeing aircraft must be welcome in every country.

ICAO takes a comprehensive approach to all aircraft environmental challenges including aircraft noise. In some cases, improvements in noise and emissions can compete with each other, making it necessary to prioritize improvements. We cannot design aircraft to reduce $CO_2$ without considering the effects on aircraft noise. Neither our customers nor policymakers would find this acceptable.

The ICAO system for setting standards --- determining what is environmentally beneficial, technologically feasible and economically reasonable --- has been very effective. Given ICAO's global scope and its ability to address all aircraft and all locations combined with its joint approach to noise and emissions make it the best forum to address aircraft environmental parameters. We urge Congress to allow ICAO to continue its historic role of regulating aircraft emission standards.

Improving aircraft is only part of the solution. In order to reduce $CO_2$ from aviation, air traffic management (ATM), biofuels and other types of new solutions such as fuel cells are equally important.

Enhanced air traffic management can produce very immediate and significant environmental improvements. Boeing has seen this firsthand through advanced arrival trials at airports. Results of these trials have shown a savings of 400-800 pounds of fuel per flight. The International Panel on Climate Change has said that improved ATM could reduce global $CO_2$ emissions from aviation by 12 percent.

Some of our initial trials with advanced arrivals --- an intermediate step in improved air traffic management --- have shown that both noise and emissions (both NOx and $CO_2$) can be reduced with these improvements. In the U.S. we have undertaken or are working on advanced arrivals at Denver, Louisville, Miami and San Francisco. We also have a number of international operations underway involving a variety of international partners in Europe, China, and Australia.

It is imperative that governments make ATM transformation a priority. While each new generation of aircraft produces a 15 percent improvement in fuel efficiency, those significant improvements can be erased by wasted flight time over airports or en route. Imagine a ten-minute delay for a two-hour flight. In those 10 minutes, half of the improved fuel efficiency for the entire flight is lost.

We believe that transformation to NextGen is one of the most critical issues facing our industry today and a major part of the solution for reducing emissions. To that end, the President and CEO of Boeing Commercial Airplanes, Scott Carson, recently signed a Memorandum of Agreement with the President and CEO of Airbus to collaborate on air traffic management issues. Our two companies have agreed to work together to accelerate ATM transformation and ensure global interoperability.

Boeing will continue its efforts on advanced arrivals and other ATM improvements both in the U.S. and internationally. However, these benefits are very limited in comparison to the environmental opportunities that can be achieved with an updated ATM system. We ask the Congress to seriously consider the important role an improved ATM system can play in reducing both emissions and noise for future aviation. Accelerating NextGen would have a significant impact on reducing emissions in the U.S.

Mr. Chairman, we applaud the interest that you and Mr. Petri have taken in the development and future implementation of ATM. We hope that your leadership, along with that of Chairman Oberstar and Ranking Member Mica, will hasten the necessary transformation to NextGen.

We also believe that sustainable alternative fuels can help reduce the aviation environmental footprint. We are focused on second-generation biofuels that do not compete with food sources or require unacceptable quantities of land or water. Boeing will continue its research and development investments to reduce $CO_2$ emissions, and the development of alternative fuel and energy sources that will make the aviation industry less reliant on fossil fuels.

For example, we completed the first biofuel trial with Virgin Atlantic and GE earlier this year on a Boeing 747 between London and Amsterdam. We are planning an alternative fuel demonstration with Continental Airlines in early 2009. That biofuel flight will use a next generation 737 with a CFM International CFM56-7B engine. CFM engines are jointly produced by GE and Snecma.

Boeing is committed to collaborating with airlines and fuel producers to ensure the development of a commercially viable market for sustainable biofuels that represent an overall lifecycle $CO_2$ benefit to the environment.

These will also improve the environmental performance of current and future aircraft generations.

Boeing is also exploring a range of other research efforts such as fuel cells. While these efforts may not generate the same level of reductions as sustainable fuels or improved ATM each will contribute to a better environmental footprint for aviation. Boeing's fuel cell demonstrator --- being developed through the Madrid Technology Research Center --- will result in both cleaner and quieter operations in future aircraft. While the applications for larger commercial planes are still many years away, the seeds for the enabling technology are being nurtured today to further improve environmental performance going forward.

In conclusion, Boeing recognizes that it must do its part to improve the environmental footprint of aviation. Our goal is to continue to make the safest and most fuel efficient aircraft in the world. Improving the aircraft is only part of the solution.

Government must also play an important role.

- We urge the Congress to allow ICAO to fulfill its important and well-proven role of regulating aircraft noise and emissions.
- We must also engage more actively to improve air traffic management. Specifically, we urge the Congress to foster policies that will enable NextGen to become a reality. The current FAA Reauthorization bill is a good start. But there is more to do.
- We need to accelerate the authorization, funding and implementation for NextGen projects that can provide near term transitional improvements to capacity. Primary examples are use of RNP routes in high density areas, GLS, advanced arrival procedures such as Advanced Arrivals and 3D-PAM, and accelerated development and implementation of system wide information management (SWIM).
- FAA should establish, track and report metrics that will assess the true progress toward NextGen. These metrics should measure progress towards a transformational outcome, not just activity or minor steps forward.
- We need to re-energize joint international trials to ensure global interoperability and global reduction of emissions.

Mr. Chairman, thank you again for the opportunity to testify today.

**U.S. House of Representatives**
**Committee on Transportation and Infrastructure**
**Washington, DC 20515**

James L. Oberstar
Chairman

David Heymsfeld, Chief of Staff
Ward W. McCarragher, Chief Counsel

John L. Mica
Ranking Republican Member

James W. Coon II, Republican Chief of Staff

May 12, 2008

Mr. Bill Glover
Managing Director, Environmental Strategy
The Boeing Company
100 North Riverside Plaza
Chicago, Illinois 60606

Dear Mr. Glover:

On May 6, 2008, the Subcommittee on Aviation held a hearing on **Aviation and the Environment: Emissions.**

Attached are questions to answer for the record submitted by Rep. Daniel Lipinski. I would appreciate receiving your written response to these questions within 14 days so that they may be made a part of the hearing record.

Sincerely,

Jerry F. Costello
Chairman
Subcommittee on Aviation

JFC:pk
Attachment

**MAY 6, 2008**
**SUBCOMMITTEE ON AVIATION**
**HEARING ON**
**"AVIATION AND THE ENVIRONMENT: EMISSIONS"**

**QUESTIONS FOR THE RECORD**
**TO:**

**MR. BILL GLOVER**
**MANAGING DIRECTOR**
**ENVIRONMENTAL STRATEGY**
**THE BOEING COMPANY**

Living in the Chicago area, aviation is a major driver of the local economy. Midway Airport, which is in my district, employs thousands of my constituents, and local businesses benefit from the millions of passengers that pass through Chicago and its airports each year.

But at the same time, aviation noise is a huge issue for my constituents, especially those living near Midway. All day, and much of the night, my constituents are bombarded with the loud sound of flights passing overhead. In fact, the noise emissions produced by these flights has as great an impact on the quality of life of my residents as greenhouse gas emissions.

So while I understand that a certain level of aircraft sound is unavoidable, I would appreciate if you could discuss ways to minimize the sound emissions created by aviation, whether through changes in engine technology, flight practices, sound barriers, or other means.

# Before the House of Representatives
# Committee on Transportation and Infrastructure
# Subcommittee on Aviation
# May 30, 2008

**Question from Congressman Lipinski**
"So while I understand that a certain level of aircraft sound is unavoidable, I would appreciate if you could discuss ways to minimize the sound emissions created by aviation, whether through changes in engine technology, flight practices, sound barriers, or other means."

**Response from Mr. Bill Glover - The Boeing Company**
Minimizing aircraft sound emissions should really be thought of as "managing community noise impact." The balanced approach to managing community noise is through the elements of low-noise operational procedures, land-use planning, flight restrictions, and innovative new technology. Boeing plays an active role in three of the elements to minimize reliance on the fourth element, flight restrictions.

***Advanced Low-Noise and Efficient Operational Procedures:***
Operational procedures can be tailored to meet the needs of the communities and may be implemented more timely and economically compared to fleet change.

Operational procedure benefits depend on the location of the noise sensitive areas and on the system in which the aircraft operate. Operational procedure benefits can be maximized by leveraging NextGen technology like Required Navigational Precision, GPS landing systems, 3D-Path in arrival management and tailored arrivals. These technologies can provide significant noise reduction for most existing aircraft and all future fleets.

***Advanced Low-Noise and Efficient Procedure Demonstrations:***
Developing and demonstrating efficient low-noise flight procedures requires the participation of many stakeholders such as regulators, air traffic control, airlines, pilots, air traffic management, communities, etc. and with considerations for flight safety, airport and airspace capacity, noise and emissions environmental benefits and airline operational feasibility.

Following are a few examples:

- ***Louisville, KY*** - Boeing participated in the demonstration of a new arrival procedure called the Continuous Descent Arrival (CDA) which manages the thrust and the altitude of the airplanes to keep them higher for a longer period and then bringing them down in a continuous descent. The results show quite convincingly that CDAs reduces noise between three and six decibels for residents living approximately 10 to 20 miles off the end of airport runways. A special arrival procedure has been adopted for UPS nighttime operations into the Louisville airport.

- ***Amsterdam Schiphol, NL*** - Schiphol airport has a distinction of limiting capacity due to environmental concerns, in particular community noise. With this in mind, Boeing started a multiyear project to develop efficient operational procedures that allow the airport to grow while limiting or stabilizing airplane noise issues in the surrounding airport communities. The Amsterdam continuous descent arrival project demonstrated the environmental benefits of improved flight efficiency resulting in lower noise, reduced fuel use and lower emissions.

- ***San Francisco, CA*** - Boeing is conducting the trials at San Francisco International Airport under a joint program with the National Aeronautics and Space Administration's Ames Research Center at Moffet Field, Calif. to evaluate the environmental benefits of tailored arrivals. A tailored arrival combines new automation technologies on the ground and in the aircraft to effectively plan a more efficient route of the aircraft enroute to touchdown. Tailored arrivals can increase airspace capacity; maintain airline schedule integrity; reduce fuel consumption, reduce emissions and noise; and ease the workloads of controllers and pilots.

***Ground Run-up Noise Mitigation:***
Ground run-up enclosures are effective for reducing the noise in the communities surrounding the airport from aircraft engine run-ups in communities surrounding the airport. Portland International Airport has successfully implemented an enclosure allowing unrestricted daytime and nighttime engine run-ups.

***Land-use Planning and Flight Restrictions:***
Measures already adopted to manage community noise impact include phasing out noisier aircraft in favor of airplanes with quieter engine technology; enforcing nighttime curfews on some or all aircraft; insulating homes that are severely affected by aircraft noise; and enforcing effective land use planning. While these measures have reduced the impact, there is a critical need for new technology solutions.

***Engine / Airframe Technology:***
Engine noise is the primary source of community noise impact due to airplane operations. New engine designs (and those under development) are significantly quieter and have lower emissions, and improved fuel efficiency. Boeing continues to develop and implement quieter, cleaner and efficient technologies in new products and product improvements. For example, the 85 dBA noise contour for 787 is 60% smaller than the 767. Continued introduction of new environmentally progressive products will significantly help manage community noise impact. Incremental noise improvements may be achievable with the existing engines by applying improved engine nacelle acoustic treatments and chevron mixer nozzle designs.

**Testimony of Mr. Douglas E. Lavin**
**Regional Vice President (North America)**
**International Air Transport Association**

Committee on Transportation and Infrastructure
Subcommittee on Aviation
United States House of Representatives

May 6, 2008

Mr. Chairman, Distinguished Members of the Subcommittee.

My name is Douglas Lavin. I am the Regional Vice President of North America for the International Air Transport Association (IATA).

IATA represents 240 carriers engaged in scheduled international transportation of passengers, mail and cargo by air. Our members carry roughly 94% of such traffic. All of the U.S. network carriers are members of IATA. There are nearly 80 IATA members in total that fly to the US.

IATA appreciates the opportunity to brief the Subcommittee on the environmental record of the international airline industry, on our strategy and vision to reduce our future carbon emissions, as well as to offer our thoughts on what the U.S. Government should, and should not, do to support this important effort.

**The Commercial Aviation Green Record**

As this Subcommittee knows, aviation has an impressive environmental record, particularly when it comes to carbon emissions reduction. The facts speak for themselves:

- Over the last forty years, the commercial airline industry has virtually eliminated black smoke from aircraft engines and has reduced its noise levels by 75%. During the same period, it improved its fuel efficiency by 75%, leading to a similar reduction in $CO_2$. Most recently, IATA members improved their fuel efficiency by a full 20% between 1997 and 2006.

- According to the United Nations Intergovernmental Panel on Climate Change (IPCC), aviation emits two percent of global carbon dioxide (or $CO_2$) emissions. That contribution could reach 3% of global emissions under a "business as usual" scenario by 2050.

- While air travel is growing at a rate of 5% to 6% a year, our carbon footprint is growing at about half that rate.

**Our Green Targets Going Forward**

Aviation has one of, if not the best green record of any industry. However, IATA and its member airlines are not resting on the industry's accomplishments to date:

- IATA airlines have committed to improve our fuel efficiency over 2005 levels by another 25% by 2020. Members of the Air Transport Association of America have themselves committed to an even more aggressive target: 30% better efficiency by 2025.

- In the medium term, we strive to reach carbon-neutral growth, i.e. that our anticipated growth does not result in a corresponding increase in $CO_2$ emissions.

- In the longer term, IATA has committed to a vision of a zero emissions commercial aviation industry. To that end, we aim to operate a zero-emissions aircraft in the next 50 years. We recently entered into a partnership with Solar Impulse, the solar airplane that will fly around the world with no fuel and zero carbon emissions by 2011. We believe this prototype exemplifies IATA's vision of a carbon free future for commercial aviation.

These are all aggressive goals. The technology does not exist today to support a zero carbon emissions commercial air transport industry in the foreseeable future. However, IATA and its member airlines are confident that we will ultimately reach these short and long-term goals.

Our confidence stems in large part from the fact that this industry cannot afford to miss these targets. Our fuel efficiency record has been driven by our industry's focus on reducing its costs in order to enable it to continue to provide critical transportation services to the world. Over the last five years, our fuel bill has increased by 340% making it our members' number one cost item. We estimate the total fuel bill for our members to be $156 billion in 2008. No government program, regulation or tax can serve as a greater incentive to the aviation industry to reduce our $CO_2$ emissions than the cost of fuel. Quite simply, we cannot remain a viable industry without continuing to focus our attention and our resources on reducing our fuel burn and, in turn, our $CO_2$ emissions.

**IATA's Four Pillar Strategy**

IATA and its Board of Governors, made up of the Chief Executive Officers of the world's leading airlines, are committed to these targets and have implemented a four-pillar strategy to ensure our success:

1. **Technology:** We need cleaner and more efficient aircraft. Initial reductions in emissions will be achieved through new airframe and engine technologies. These advancements will come in the form of weight reduction, engine upgrades and better aerodynamics. Zero emissions can only be reached through radically different aircraft that are powered by radically different fuels. We are establishing a technology roadmap with the major airframe and engine manufacturers to bring us to carbon neutral growth and beyond. We need research into new, lighter materials and sustainable alternative fuels.

2. **Infrastructure**: We need more, better, and more efficient air traffic infrastructure across the globe. We also need air routes to be optimized and improvement in the use of airport terminals. In 2007 alone, IATA worked with governments around the world to optimize almost 400 routes and 80 airports, thereby yielding a reduction of nearly 4M tons of $CO_2$.

3. **Operations**: Airlines need to fly smarter and greener. IATA has deployed a network of "green teams" that benchmark airline operations against best practices in the industry in order to save fuel and $CO_2$. In 2007, we identified efficiency savings of 6.7M tons of $CO_2$ from operations.

4. **Economic measures**: We need positive economic measures to cover any gap between the growth in aviation and the corresponding growth in emissions that cannot be eliminated employing the first three pillars. More importantly, we need to eliminate negative economic measures that undermine our ability to support the first three pillars.

As part of this strategy, IATA's Board of Governors has committed IATA to developing standards and guidelines for an industry carbon offset program and to pilot it with at least six airlines in four different regions by the end of 2008. We believe a well structured, consistent offset program will be an effective tool in meeting our overall carbon targets.

IATA and its member airlines, along with our manufacturing partners, are committed to aggressively addressing this challenge in ways that yield results rather than sound bites. The International Civil Aviation Organization (ICAO) adopted these pillars as their own at their September 2007 Triennial Meeting. On April 22, 2008, IATA signed a Global Declaration on Aviation and Climate Change with 17 leaders across the air transport industry committing all of us to this four-pillar strategy. We are perfectly incented to reach these goals and are committing substantial resources towards that end.

**Government Help We Need**

Unfortunately, no matter how committed we are to this four-pillar strategy, IATA and its member airlines cannot achieve these critical targets alone. We must rely on the support of this Congress as well as governments around the globe if we hope to make commercial aviation even greener than it is today.

More specifically, we need the U.S. Government to play a leadership role in addressing the two major challenges facing us in our effort to reach carbon neutral growth in the medium term. First, we need to put the right economic incentives in place for the development of radically new green technologies. This must become a clear political priority. We are not asking for subsidies. We are asking the Congress to restore funding cut from NASA and FAA budgets and to provide greater support to DARPA so that potentially breakthrough research into lighter materials, radical new aerodynamics and new fuels – such as third generation, algae based fuels and hydrogen fuel cells – can go forward. The United States and its outstanding research bodies like the National Laboratories can serve to achieve real emissions reductions.

Second, in the area of infrastructure, the Congress can show leadership by providing accelerated funding for the NextGen, which offers the greatest opportunity for carbon savings in this pillar. Similarly, this Congress can demand that Europe deliver on their long promised Single Sky project, which could deliver up to 12 M tons of $CO_2$ savings annually. Government support is also needed to encourage the optimization of U.S. and global air routes. We challenge governments to set their own target of eliminating air traffic inefficiencies by 50% over the next five years, which would result in an annual reduction of 35M tons of $CO_2$.

**Government Help We Cannot Accept**

This type of positive government support will prove critical as we strive to meet our green targets. However, even more important than adopting economic incentive programs is the need for this Subcommittee and this Congress to make it clear to the world that it will avoid the temptation of implementing short sighted, counterproductive, negative economic measures in the name of the environment. Green taxes and charges do nothing to address emissions growth. Rather, these increased costs will only reduce the opportunity for airlines to increase their fuel efficiency and decrease their $CO_2$ emissions. While some may gain political points by imposing green taxes on the airline industry, we are not aware of a single example of an environmental improvement being achieved following this path.

There are a number of recent examples of these types of negative economic measures that serve to derail efforts to meet stringent environmental targets. Most recently, the UK Government announced its intention to replace the air passenger duty (APD) with a duty payable per plane, rather than a per passenger duty, with the stated intention of ensuring that aviation makes a greater contribution to covering its environmental costs. Putting aside the fact that this tax is incompatible with UK obligations under international law, it will do nothing to improve environmental performance, as monies raised will go into the government's general fund to address a £500M (approximately $1B) shortfall in this account. Green-in-name only taxes only make it more difficult for already economically challenged airlines to make the investments necessary to meet our shared targets. These taxes are simply a means to increase government coffers and curb aviation growth.

A second type of negative economic measure can be seen in the European Commission's proposed inclusion of aviation in their emissions trading scheme (ETS). Some have argued that ETS is the only means to effectively curb our emissions, short of eliminating flying. In contrast, IATA points out that fuel prices serve as a much greater incentive to curbing emissions than any emissions trading scheme. That being said, ETS could play a role in reaching carbon neutrality, which by definition makes ETS irrelevant. If, in the end, we cannot reach carbon neutrality through technology, operations and infrastructure improvement, a properly designed ETS offers an option for bridging the gap between aviation and emissions growth.

Unfortunately, the European ETS is an improperly designed scheme that will hinder airlines' ability to achieve carbon neutrality. It is a unilateral, regional measure when our highly mobile industry demands global solutions. It is extraterritorial in that it proposes to include non-EU carriers in its scheme (even for the portion of their flights over other countries and international waters), a clear violation of international law. It in effect punishes rather than rewards the aviation industry for its past and future commitment to emissions reductions. As currently designed, it would by 2020 require airlines to buy permits for ALL of their emissions, thereby serving effectively as an additional onerous tax. IATA strongly believes that any ETS must be designed and implemented by the International Civil Aviation Organization (ICAO), as designated by the Kyoto Protocol. IATA is strongly encouraging ICAO member states to take the difficult steps necessary to address this global challenge in a global manner. At the same time, it is critical to understand that an ETS without substantial improvements in the other three pillars may reduce emissions, but only by substantially curtailing the substantial role international aviation plays in the world economy.

It is important to note that the current European ETS proposal only covers $CO_2$ emissions. However, the European Commission is now considering possible measures to reduce $NO_x$ emissions from aviation. Myths to the contrary, the IPCC itself has recognized that the science on the impact of $NO_x$ on global warming is far less developed than that on $CO_2$ emissions and therefore controls at this time would be in appropriate. We are very concerned that the European

Commission will repeat the mistakes in $NO_x$ that it made in developing the unilateral, counterproductive ETS proposal.

Finally, closer to home, IATA and its member airlines are very concerned about the ETS scheme set forth by the Lieberman-Warner Climate Change Act (S. 2191). Rather than including aviation directly in an ETS, the bill proposes to cover transportation by requiring fuel producers to acquire allowances to cover the GHG content of the fuel they sell to the transportation sector. The cost of these allowances would in turn be passed on to the airlines by the producers, thereby serving as a tax on airline growth. To make matters worse, the producers would be required to cover 100% of the emissions targets with no allowances for efficiency gains already made by the airline industry (in contrast to other industries that have not already made the substantial investments we have made in these green programs). Moreover, aviation should not be held accountable for fuel inefficiencies resulting from outdated air traffic systems and inefficient routes. Finally, every dollar paid by airlines to producers for allowances is a dollar less than airlines can spend to meet our aggressive efficiency targets. We urge this Subcommittee to send a clear message to their Senate colleagues that this industry and its passengers cannot afford yet another ill conceived environmental tax.

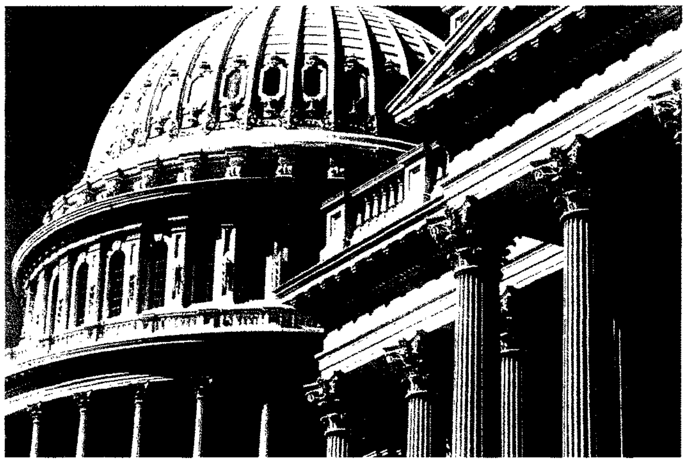
**Where We Go From Here**

In summary, the global commercial aviation industry has made tremendous strides in increasing its fuel efficiency and in reducing its carbon footprint. The ever-increasing cost of fuel serves as the perfect incentive for airlines to meet aggressive emissions targets in the short, medium and long terms.

Commercial aviation is a major driver of the U.S. economy, responsible for 8% of gross domestic output and 11.4M jobs. This productivity is threatened not only by rising oil prices but also by ill-conceived governmental efforts to control emissions by curtailing this economic engine. We accept that government plays an important role in the achievement of our targets going forward. We encourage the U.S. Congress to monitor our progress towards these important goals in the future. At the same time, we urge this Subcommittee and your Congressional colleagues to enact positive economic measures in this area and to avoid erecting barriers to our achievement of these green goals.

ATA TESTIMONY

# *Aviation and the Environment: Emissions and the Commercial Airlines' Climate Change Commitment*



Statement of James C. May
President and CEO
Air Transport Association of America, Inc.
before the
Subcommittee on Aviation of the
House Committee on Transportation and Infrastructure

May 6, 2008

AIR TRANSPORT ASSOCIATION

Thank you, Mr. Chairman. ATA airline members transport more than 90 percent of all U.S. airline passenger and cargo traffic.[1] Our airlines take their role in controlling emissions very seriously. Recently, there has been a great deal of focus in Congress on greenhouse gas (GHG) emissions in particular, and how this nation might achieve reductions in these emissions while maintaining economic stability and enhancing energy independence. Commercial aviation has a vital role to play in this regard and I appreciate the opportunity to appear before you today to discuss what we are doing to tackle this important issue.

INTRODUCTION AND OVERVIEW

For generations, flying has contributed to a better quality of life in America. Commercial aviation has been essential to the growth of our economy, yielded breakthrough technologies, brought people together and transported critical cargo – all while achieving an exceptional environmental track record. Today's airplanes are not just smarter – they are quieter, cleaner and use less fuel than ever before – but we also fly them smarter. That's why our industry represents just two percent of all GHG emissions in the United States, while driving three times more economic activity. But we are not stopping there. The initiatives that we are undertaking to further address GHG emissions are designed to responsibly and effectively limit our fuel consumption and GHG contribution while allowing commercial aviation to continue to serve as a key contributor to the U.S. economy. At the same time, while our industry represents well under one percent of the nation's oxides of nitrogen ($NO_x$) local emissions inventory, we continue to support technological and standards developments to further reduce $NO_x$ output from aircraft. I want to emphasize three points that are essential to moving our emissions-reducing efforts forward:

First, ***commercial airlines are extremely GHG efficient.*** For the past several decades, commercial airlines have dramatically improved our GHG efficiency by investing billions in fuel-saving aircraft and engines and innovative technologies like winglets and cutting-edge route optimization software. Fuel is our largest cost center, creating an economic imperative to maintain our record of continuously improving GHG efficiency. And while commercial aviation accounts for only two percent of domestic man-made GHG emissions, we shepherd this to good use, driving a far larger percentage of economic activity, not only directly, but also indirectly, as a necessary element in the airport and tourism sectors and in all business sectors that rely on the rapid delivery of goods and human resources.

Second, ***ATA airlines are proactively committed to further limiting their emissions footprint*** through a set of measures that will simultaneously address climate change, energy independence and local emissions impacts while preserving economic stability and the opportunity to grow. At the core of these measures is the ATA carriers' commitment to an additional 30 percent fuel efficiency improvement by 2025 – improvement that only comes from the airlines' investment in new aircraft, new aircraft engines, navigation aids and enhanced operational procedures. In addition, we are dedicating ourselves to developing commercially viable, environmentally friendly alternative jet fuel, which could be a game-changer in terms of aviation's output of GHGs and $NO_x$. Moreover, we are central stakeholders in partnering efforts to modernize the outdated air traffic management (ATM) system and to reinvigorate

[1] ATA airline members include ABX Air, AirTran Airways, Alaska Airlines, Aloha Airlines, American Airlines, ASTAR Air Cargo, Atlas Air, Continental Airlines, Delta Air Lines, Evergreen International Airlines, Federal Express Corporation, Hawaiian Airlines, JetBlue Airways, Midwest Airlines, Northwest Airlines, Southwest Airlines, United Airlines, UPS Airlines and US Airways. Associate members are: Air Canada, Air Jamaica Ltd. and Mexicana.

research and development in aviation environmental technology, both of which can bring extensive additional emissions reductions.

Third, ***there is a critical role for the federal government to play***, not for the industry and hopefully not against the industry, but, rather, with it. While the ATA airlines' 30 percent fuel efficiency improvement target will be met purely through the airlines' investments and operating initiatives, the other measures in the package require a significant measure of congressional support. For example, although we are working with the Federal Aviation Administration (FAA) on plans to replace the antiquated ATM system – an upgrade that promises to bring 10-15 percent emissions improvement on top of the ATA commitment – congressional approval is needed before significant progress can be made in implementing this system. Further, the commercial airlines cannot stimulate the development of environmentally friendly alternative jet fuel and aircraft environmental technology on our own. Congressional support and funding and other incentives are vital to these research-intensive initiatives.

Just as we ask Congress to continue to work with us, we also urge Congress to calibrate any climate change-related legislation so it does not work against our efforts. To have the resources to continue our fuel efficiency and other advances, we must have the capital to invest in newer aircraft and other emissions-reducing measures. Punitive economic measures that siphon funds out of our industry would severely threaten that capability, as would unilateral efforts that do not take the international nature of aviation into account. A vibrant, competitive and growing aviation sector is a key part of the solution – not an impediment to ensuring a future where a strong economy, freedom from foreign oil and cleaner air are the order of the day.

*Commercial Aviation Is Extremely GHG Efficient*

Commercial aviation in the United States has a decidedly strong track record that is often overlooked or misstated. U.S. commercial aviation contributes about two percent of domestic U.S. GHG emissions.[2] To put that into context, with passenger vehicles (cars and light duty trucks) alone accounting for over 17.5 percent,[3] as illustrated in Figure 1, road transport accounts for over a fourth of U.S. GHG emissions and power plants account for over a third.[4] The picture is similar when viewed on a global basis. Worldwide commercial aviation contributes about three percent of man-made GHGs.[5] To put this into perspective, cattle and other livestock account for approximately 18 percent.[6] Further, EPA data confirm that while the

---

[2] The United States Environmental Protection Agency's (EPA's) most recent general inventory reports commercial aviation's contribution to the total GHG emissions in 2006 was 2.04 percent. EPA, *Inventory of Greenhouse Gas Emissions and Sinks: 1990 -2006* (April 15, 2008) (hereinafter *EPA GHG Inventory 1990-2006)* at pages ES-4 and 21 ("in 2006, total U.S. greenhouse gas emissions were 7,054.2" teragrams of carbon dioxide equivalent (Tg $CO_2$ Eq)) and Table 2-15 at pp. 2-22 & 2-23 ("Commercial Aircraft – Domestic" account for 143.6 Tg. $CO_2$ Eq.).

[3] *EPA GHG Inventory 1990-2006*, Table 2-15 at pp. 2-22 & 2-23.

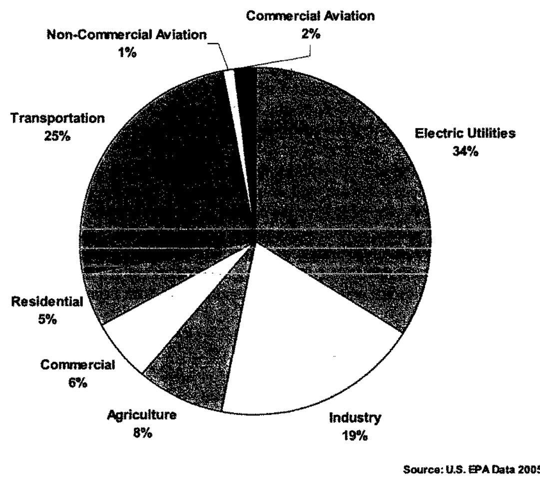
[4] *EPA GHG Inventory 1990-2006*.

[5] It is estimated that on a worldwide basis, commercial aviation accounts for approximately three percent of total GHGs, while at the same time contributing over eight percent of the world's economic activity. *See* International Air Transport Association, *Debunking Some Persistent Myths about Air Transport and the Environment.*

[6] United Nations, Livestock Environment and Development Initiative, *Livestock's Long Shadow – Environmental Issues and Options* (2006) at p. 271.

overall transportation sector accounts for more than 58 percent of the nation's $NO_x$ inventory, aviation contributes only 0.5% of that inventory.[7]

Figure 1 – U.S. Aviation Greenhouse Gas Emissions
2 Percent of the Inventory




At the same time, commercial aviation is critically important to local, national and global economies, enabling a large percentage of U.S. economic output. A March 2006 study by the Campbell-Hill Aviation Group found that "the national economy is highly dependent on commercial aviation, which is directly or indirectly responsible for 5.8 percent of gross output, 5.0 percent of personal earnings and 8.8 percent of national employment."[8] The study further noted that this translated into $380 billion in earnings, 11.4 million jobs and $1.2 trillion in U.S. output in 2004. Placing our economic output side-by-side with our GHG output, it is clear that commercial aviation is an extremely GHG-efficient economic engine, bringing good "bang" for our GHG "buck."

We have been able to deliver such strong economic output while reducing our emissions by continually improving our fuel efficiency through reinvestment in technology and more fuel-efficient operations. In fact, U.S. commercial airlines (passenger and cargo combined) improved their fuel efficiency by 110 percent between 1978 and 2007, which (given the one-to-one relationship between fuel consumption and

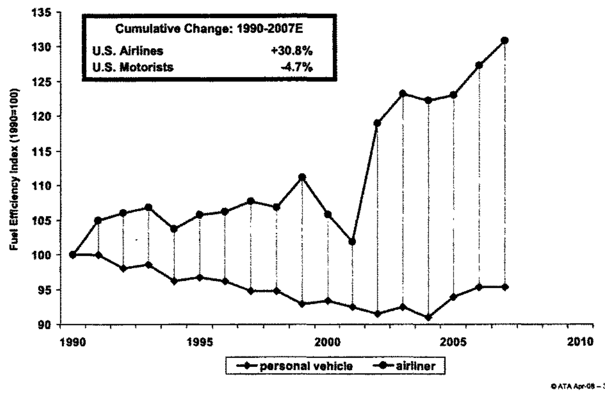
[7] EPA data cited in *Overview of Aviation & Air Quality Impacts* (presentation by Dr. Lourdes Maurice, FAA, March 19, 2008).

[8] The Campbell-Hill Aviation Group, *Commercial Aviation and the American Economy*, March 2006.

carbon dioxide ($CO_2$)) has resulted in 2.5 billion metric tons of $CO_2$ savings – roughly equivalent to taking 18.7 million cars off the road each of those years.[9] Further, Bureau of Transportation Statistics data confirm that U.S. carriers burned four percent less fuel in 2006 than they did in 2000,[10] resulting in absolute reductions in GHG emissions, even though they carried 12 percent more passengers and 22 percent more cargo.

Commercial aviation's GHG efficiency compares very favorably to other modes and other sectors. While commercial aviation improved its per-passenger fuel efficiency from 1990, freight trucks showed the reverse trend, with GHG emissions growing faster than vehicle miles traveled.[11] EPA also has confirmed that passenger vehicles have lagged far behind aircraft in fuel and GHG efficiency.[12] (*See* Figure 2). Within the aviation sector, it is important to remember that different types of commercial aircraft have vastly different impacts on the environment. Commercial jets are five to six times more fuel efficient than corporate jets. The math is simple: carrying 200 people and cargo across the country in a single plane burns a lot less fuel than 33 separate corporate jets, each flying six people.

Figure 2 – In Contrast to Personal Vehicles, Airline Fuel Efficiency Has Improved Substantially Since 1990




[9] Between 1978 and 2006, our carriers' fuel efficiency improvement was 103 percent. Our 2007 data shows a jump to 110 percent.

[10] This figure reflects reductions achieved by all international and domestic flights from U.S. carriers. The reductions in domestic flights were even more dramatic, as the U.S. carriers burned 13.4 percent less fuel on domestic flights since 2000. *EPA GHG Inventory 1990-2006*, Table A-98 at pp. A-123 & A-124.

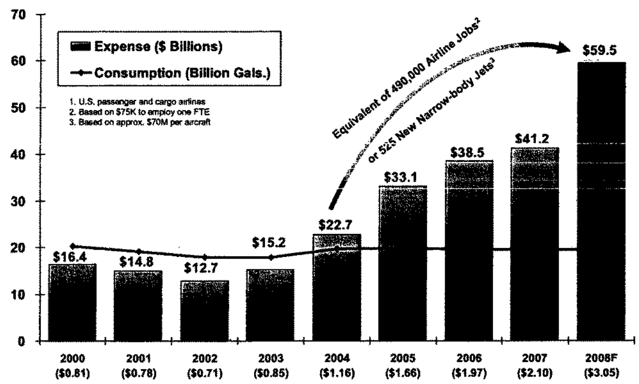
[11] *EPA GHG Inventory 1990-2006* at 3-8.

[12] *Id.*

U.S. airlines are highly motivated to continue this trend. Fuel, long one of the two highest costs for airlines, is now our largest cost center, averaging between 30 and 50 percent of total operating expenses. In fact, jet fuel costs to the U.S. airlines in 2008 are projected to be just under $60 billion, breaking the 2007 record of $41.2 billion, resulting in what some analysts are likening to the economic effects of the 9/11 terrorist attacks.[13] As shown in Figure 3, the price change alone between 2004 and year-end 2008 is the equivalent of 490,000 airline jobs or the purchase price of 525 new narrow-body jets.

**Figure 3 – 2008 Jet Fuel Expense Will Break 2007 Record**

Avg. Price Paid per Gallon (Excl. Taxes and Into-Place Fees) Likely to Exceed $3



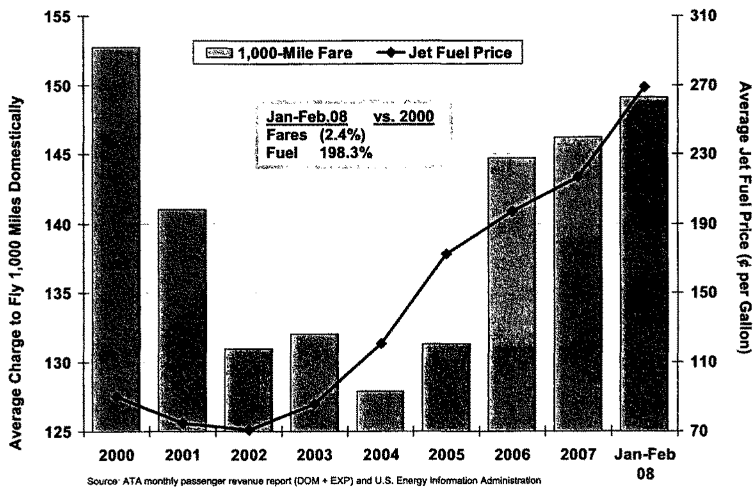

Note: Value in parentheses below year is average price paid excluding taxes, into-plane fees, pipeline tariffs and hedging costs
Sources: ATA, Energy Information Administration, Department of Transportation

© ATA Apr-08 – 16

And contrary to popular belief, the airlines cannot pass on significant portions of these costs. Indeed, as illustrated in Figure 4, today's U.S. domestic air fares remain below 2000 levels, although fuel prices have tripled. While a slightly more robust international aviation market has allowed today's systemwide fares to increase approximately three percent above 2000 levels, this hardly makes up for the three-fold increase in fuel prices over the same period. (*See* Figure 5.) Thus, the market already is sending the commercial airlines a "price signal" that some call for in legislation. We have an unrelenting economic imperative to reduce fuel consumption; therefore, an economic win is an environmental win.

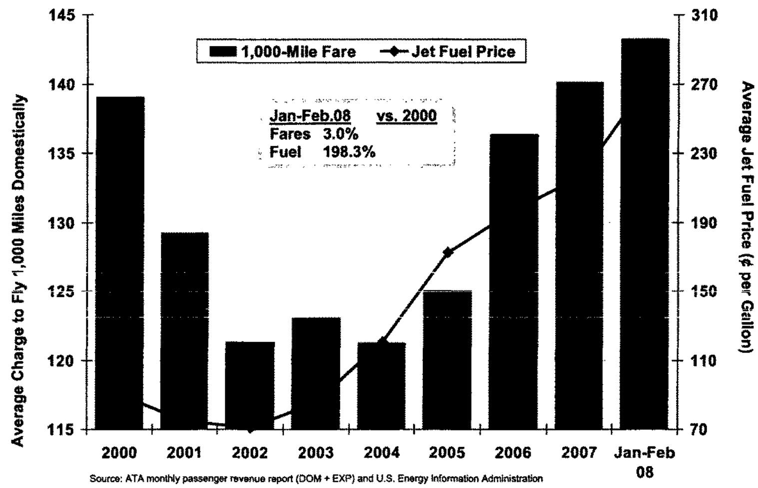
[13] *See* J.P. Morgan Securities North America Corporate Research (April 15, 2008).

Figure 4 – As of Early 2008, Domestic Airfares Remain Below 2000 Levels, While Jet Fuel Prices Have Tripled




Source: ATA monthly passenger revenue report (DOM + EXP) and U.S. Energy Information Administration

Figure 5 – As of Early 2008, Systemwide Airfares Just Above 2000 Levels, While Jet Fuel Prices Have Tripled

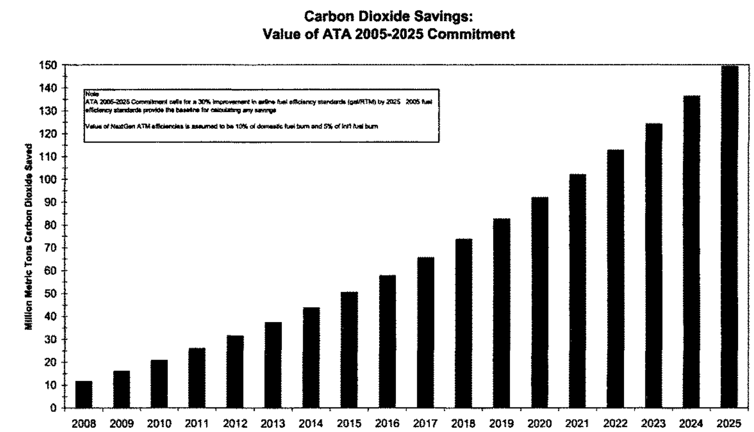



*ATA Airlines Are Proactively Committed to Further Limiting Their Emissions Footprint*

As demand for air passenger and cargo services grows, some growth in aviation emissions is predicted. However, this growth must be kept in context. The Intergovernmental Panel on Climate Change (IPCC), which is considered the authority on this issue, has determined that under the most likely scenario, $CO_2$ from global aviation in 2050 will account for only about three percent of total man-made $CO_2$ emissions and that aviation's overall GHG impact will be around five percent.[14] Yet even though those remain relatively small numbers, the ATA carriers are relentlessly pursuing measures to further limit their emissions footprint.

[14] IPCC, *Aviation and the Global Atmosphere* (1999) at 8.

Figure 6 – ATA's 30 Percent Fuel Efficiency Goal Will Translate into $CO_2$ Savings




At the core of our efforts, the ATA carriers have made a commitment to achieve an additional 30 percent systemwide fuel efficiency improvement through 2025, on top of prior improvements. That equates to an additional 1.2 billion metric tons of $CO_2$ saved – roughly equivalent to taking over 13 million cars off the road each year. (*See* Figure 6). To accomplish this, our airlines will continue and step-up the tremendous investments in new equipment and in operational innovations that have allowed us to attain such great fuel efficiency improvements in the past, achieving not only GHG emissions reductions but also reductions in local emissions such as $NO_X$. We are leaving no stone unturned. Some examples of our efforts include:

- **Upgrading Fleets**. Even in the highly constrained financial environment we now find ourselves in, the ATA airlines are expending billions to upgrade their fleets through investments in new airframes and engines, removing less fuel-efficient aircraft from their fleets, installing winglets to reduce drag, altering fan blades and other measures aimed at improved aerodynamics. As a critical element of our commitment to achieve an additional 30 percent fuel efficiency improvement by 2025, Boeing estimates that the North American carriers will spend approximately $730 billion on new aircraft through 2026.[15]

- **Introduction of Innovative, Cutting-Edge Technologies**. Our airlines also are investing millions of dollars in technologies to make existing airframes more efficient. For example, the

[15] The Boeing Company (2008).

airlines have undertaken equipage for Required Navigation Performance (RNP) approach procedures, which provide navigation capability to fly a more precise path into an airport. The ATA airlines also have developed software to analyze flight paths and weather conditions, allowing aircraft to fly more direct, efficient routes (subject to air traffic approval).

- **Improved In-Flight Operations**. The ATA airlines are doing all they can within the existing ATM system to utilize systems 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, the ATA carriers have worked with FAA to pioneer protocols for continuous descent approaches (CDAs), which reduce both emissions and noise, and we are doggedly pursuing implementation of CDAs where the existing ATM system allows.[16] Further, our carriers are implementing Automatic Dependent Surveillance Broadcast (ADS-B) satellite tracking technology, which avoids the circuitous routings that occur with today's radar-based systems. 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**. The ATA airlines also are introducing single-engine taxiing when conditions permit, redesigning hubs and schedules to alleviate congestion and converting to electric ground support equipment when feasible. Further, they are improving ground operations by plugging into electric gate power where available to avoid running auxiliary power units and using tugs to position aircraft where feasible.

- **Reducing Onboard Weight**. The ATA 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.

Second, recognizing that improving fuel efficiency with today's carbon-based fuel supply can only take us so far, ATA and its airlines are making extensive resource commitments to stimulate the development of commercially viable, environmentally friendly alternative fuels. As a framework for doing this, we are a founding and principal member of the Commercial Aviation Alternative Fuels Initiative (CAAFI), a consortium of airlines, government, manufacturers, fuel suppliers, universities, airports and other stakeholders who hold the various keys to research, development and responsible implementation of alternative jet fuels. Developing alternative jet fuels is a "higher hurdle" than developing alternative fuels for ground-based units, as jet fuel must meet rigorous FAA specifications, which include reliability and stability at altitude and in greatly varying temperature and pressure conditions to ensure safety. Thus, absent a cooperative initiative like CAAFI, fuel providers almost certainly would not undertake the investments needed to clear this higher hurdle, opting instead for the surer payoff at ground level.

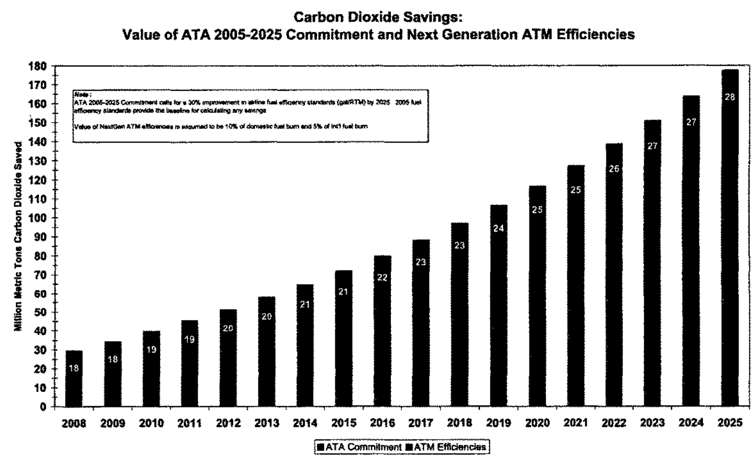
While each entity involved in CAAFI has a role to play, our airlines understand that – as end users of the ultimate product – they must not only make clear their specifications for alternative jet fuels, but also signal the market that we will financially back fuels meeting those specifications. On Earth Day this year, the ATA Board of Directors took another significant step in this regard, issuing the "ATA Alternative

[16] For example, one of our carriers is achieving an average savings of 1300 pounds of $CO_2$ savings per flight for approaches into the Atlanta airport.

Fuels Principles Document." Among other things, that document stipulates that the ATA carriers require that any future alternative jet fuel be more environmentally friendly, on a life-cycle basis, than the jet fuel available today. Through CAAFI and other partnerships, we are undertaking the work to be sure that tomorrow's alternative jet fuel meets that criterion. And accomplishing that will ensure the full decoupling of growth in aviation demand from growth in GHG emissions.

Third, while the ATA airlines are doing all that they can to promote efficiencies within the current ATM system, the limitations of that system account for 10-15 percent of unnecessary fuel burn and resulting emissions. To address this, and to achieve much-needed modernization of our outdated ATM system, ATA and its carriers are working with FAA and other agencies on a fundamental redesign of the system through the Next Generation Air Transportation System (NextGen) project and on various regional airspace design initiatives. ATA is supporting this modernization initiative through our "Smart Skies" program.[17] However, congressional approval, including fair and equitable distribution of costs among all system users, is needed before significant progress can be made in implementing this system. Congressional authorization and implementation of this initiative will bring 10-15 percent additional savings <u>on top</u> of the ATA 30 percent commitment. (*See* Figure 7).

Figure 7 – $CO_2$ Saved Under ATA and NextGen Initiatives
(As if NextGen Implemented in X Year)




¹⁷ "Smart Skies" is a national campaign led by ATA airlines, which advocates modernization of the U.S. ATM system and its funding mechanisms. For more on this initiative, see the Smart Skies Web site, at <u>http://www.smartskies.org</u>.

Fourth, at the same time ATA and its members are pushing the envelope with existing technology, we continue to contribute to work that will advance new technology. For example, ATA participates in key, joint government/stakeholder initiatives, including the Steering Committee of the Partnership for AiR Transportation Noise & Emissions Reduction (PARTNER) and the Environment and Energy Subcommittee of FAA's Research Engineering and Development Advisory Committee. While additional evolutionary environmental improvements are in the pipeline as a result of such initiatives, revolutionary environmental breakthroughs can only come about through the reinstatement of significant federal investments in basic aeronautics research and development programs at NASA and FAA. Indeed, Pratt & Whitney's new geared turbofan engine, which offers both noise and emissions benefits, as well as many features of Boeing's more environmentally efficient 787 were spawned through such programs. As we have noted in other contexts, however, congressional funding to NASA and FAA for aeronautics research and development – specifically including for environmental projects – has been cut significantly (by about 50 percent) in the past 8-10 years, compromising the public-private partnership for exploring and bringing to market products with significantly improved environmental performance.[18] Thus, we continue to urge Congress to provide this needed funding, which also is critical to preserving America's competitiveness in aeronautics.

*Congress Has a Positive, Partnering Role to Play*

We are confident that the measures ATA is undertaking and supporting will continue to limit and reduce aviation's emissions footprint, such that commercial aviation will remain a very small source of GHG and other emissions, even as air traffic grows with future improvements in the economy. However, as you, Mr. Chairman, recognized in your recent Op-Ed in *The Hill* publication, Congress has a key role to play. First, as noted, congressional approval for implementation of a modernized ATM system is critical, as is reinstatement of funding for research and development programs to foster aviation environmental technology breakthroughs. Further, while Congress generally is supporting several alternative fuel research programs, specific support and funding should be provided for the development of environmentally friendly alternative jet fuels.

Just as we ask Congress to continue to work with us, we also urge Congress to calibrate any climate change-related legislation so it does not work against our efforts. To have the resources to continue our fuel efficiency and other advances, we must have the capital to invest in newer aircraft and other emissions-reducing measures. Indeed, FAA estimates that 90 percent of the fuel efficiency and emissions improvements that the airlines have achieved has come through the airlines' own investments in technology. Punitive economic measures that siphon funds out of our industry would severely threaten our ability to continue that record.

---

[18] While later funding cuts were even more drastic, a 2002 study by the National Academy of Sciences observed:

> In constant year dollars, NASA funding for aeronautics research was cut by about one-third between 1998 and 2000, reducing the breadth of ongoing research and prompting NASA to establish research programs with reduced goals, particularly with regard to TRL (technology readiness level). This significantly reduces the likelihood that the results of NASA research will find their way into the marketplace in a timely manner, if at all. The ultimate consequence is that the federal expenditures are inconsistent with the long-term goal of support for an aviation enterprise compatible with national goals for environmental stewardship.

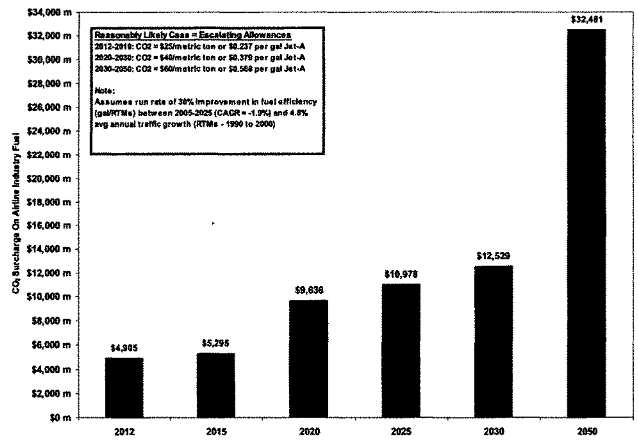
*See* National Academy of Sciences, Committee on Aeronautics Research and Technology for Environmental Compatibility, *For Greener Skies: Reducing Environmental Impacts of Aviation* at 44 (2002).

Against this backdrop, we are compelled to share our concerns about the apparent front-runner cap-and-trade legislation in the U.S. Senate, S. 2191, the "Lieberman-Warner Climate Security Act," in the hopes that the House of Representatives will craft its legislation to avoid or minimize those concerns.

First, the Lieberman-Warner bill would, in effect, impose a punitive emissions tax on aviation, which would not only harm the economy but also would be counterproductive. As drafted, the bill proposes to cover the transportation sector – including aviation – indirectly, through a cap-and-trade system "upstream," which would require fuel producers to acquire allowances sufficient to cover the GHG content of the fuel they sell to the transport sector. Fuel producers will incorporate the cost of these allowances into fuel prices, passing the costs on to fuel consumers (including airlines) – in effect, operating as a fuel tax on jet fuel and other transportation fuels. This would have significant economic repercussions on the airline industry and the economy, as every penny increase in the price of a gallon of jet fuel drives an additional $190-200 million in annual fuel costs for U.S. airlines.

It is not difficult to calculate the likely costs of application of the Lieberman-Warner bill to aviation. Unlike most sectors, commercial aviation is required to report all of its fuel consumption to the federal government, which compiles and reports this data. Based on this data, and factoring in FAA forecast information, the annual costs to the U.S. commercial airlines of the Lieberman-Warner bill in 2012 would be approximately $5 billion, assuming a $25 emissions allowance price. Using analysts' estimates that emissions allowance prices likely will be in the $40 range by 2020, the annual costs to aviation would escalate to almost $10 billion in that year, and would grow thereafter. (*See* Figure 8). These increased costs would diminish the airlines' ability to continue to realize the tremendous fuel efficiency improvements and emissions reductions we have achieved within the industry and, therefore, would be counterproductive. Indeed, it is difficult to imagine how we could handle a GHG-based surcharge on top of the exorbitant fuel prices we are experiencing.

Figure 8 – Lieberman-Warner Bill – Fuel Surcharge Costs to U.S. Commercial Airlines



Second, based on our fuel and GHG efficiency records and commitments, application of a cap-and-trade bill to commercial aviation simply is unnecessary. As noted, we already are incentivized by the market to minimize GHGs, without further market-based measures. However, if such a measure is to be applied to aviation, it should be carefully calibrated to take key considerations into account, which the Lieberman-Warner bill currently does not do.

One such mechanism would be to provide the commercial airlines with allowances up front, either directly or as a required pass-through from fuel providers, in recognition of the fuel efficiency achievements we have made to date and the importance of preserving the airlines' ability to continue to invest in new aircraft technology. As drafted, the Lieberman-Warner bill does not do this. In contrast, the bill would accord to several sectors – including to industries that do not come anywhere near commercial airlines' fuel and GHG efficiency record – a tremendous amount of free allowances, purportedly to cushion the economic blow and to allow them to invest in modernizing their equipment and facilities to reduce emissions. In effect, the bill would require the airlines to subsidize future efforts of other industries that have done comparatively little to reduce their GHG profiles. The U.S. House of Representatives can avoid the inequity and public policy flaws in this approach in crafting its own legislation.

Another key calibration mechanism would be to take some of the proceeds generated from the auctioning of allowances and reinvest those proceeds into aviation. This could allow for additional funding of programs and technologies that promise to further reduce aviation GHG emissions. With a 10-15 percent GHG savings directly on the line, equipage for NextGen is perhaps the most significant candidate in this regard, but funding for aviation alternative fuel and aircraft environmental technology breakthroughs are also well-deserving candidates. A fundamental flaw of the Lieberman-Warner bill is that while it proposes to rechannel proceeds from auctions into industries like automobile manufacturing, it does not include any provisions for reinvestment in aviation.

Further, any climate change legislation proposing to cover aviation should be crafted to take into account the international nature of aviation, not only that aviation is a global industry and that U.S. carriers must compete with the airlines of other nations on many routes, but also that the United States by treaty has agreed that the International Civil Aviation Organization (ICAO) has the authority to establish standards and policy for international flights.[19] Arguably, the United States should defer to ICAO for additional measures addressing aviation GHGs. At a minimum, however, we should ensure that any measures taken in the U.S. are compatible with our international aviation agreements.

As an additional example of the need to carefully calibrate any climate change legislation, it is important to recognize that policies that make flying more expensive can have the effect of pushing more people into their cars. This would result not only in increased GHG emissions from the less fuel-efficient ground transportation sector, but also in more GHG emissions and increased traffic deaths, as the highways are much less safe than the air. Again, the U.S. House of Representatives has the opportunity to factor such concerns into its work on this issue.

CONCLUSION

I close by asking you to note the achievements that commercial airlines have made in reducing fuel burn and GHGs, particularly when compared to other industries, and the actions that we are taking to continue our progress in this regard. While we are fully committed to working with Congress and are asking for

[19] This is pursuant to the Convention on International Civil Aviation, commonly referred to as the "Chicago Convention," to which 190 countries, including the United States, are parties.

congressional leadership and support in each of the areas I have described, we are not asking you to work for us, we're asking you to work with us in addressing this environmental and energy concern. We also are urging you to refrain from adopting policies that would work against our efforts. A vibrant, competitive and growing aviation sector is a key part of the solution, not an impediment to ensuring a future where a strong economy, freedom from foreign oil and cleaner air are the order of the day.

**U.S. House of Representatives**
**Committee on Transportation and Infrastructure**
Washington, DC 20515

James L. Oberstar, Chairman
David Heymsfeld, Chief of Staff
Ward W. McCarragher, Chief Counsel

John L. Mica, Ranking Republican Member
James W. Coon II, Republican Chief of Staff

May 12, 2008

Mr. James C. May
President and CEO
Air Transport Association
1301 Pennsylvania Avenue, NW
Suite 1100
Washington, D.C. 20004

Dear Mr. May:

On May 6, 2008, the Subcommittee on Aviation held a hearing on **Aviation and the Environment: Emissions.**

Attached are questions to answer for the record submitted by Rep. Daniel Lipinski. I would appreciate receiving your written response to these questions within 14 days so that they may be made a part of the hearing record.

Sincerely,

Jerry F. Costello
Chairman
Subcommittee on Aviation

JFC:pk
Attachment

**MAY 6, 2008**
**SUBCOMMITTEE ON AVIATION**
**HEARING ON**
**"AVIATION AND THE ENVIRONMENT: EMISSIONS"**

**QUESTIONS FOR THE RECORD**
**TO:**

**MR. JAMES C. MAY**
**PRESIDENT AND CEO**
**AIR TRANSPORT ASSOCIATION**

Living in the Chicago area, aviation is a major driver of the local economy. Midway Airport, which is in my district, employs thousands of my constituents, and local businesses benefit from the millions of passengers that pass through Chicago and its airports each year.

But at the same time, aviation noise is a huge issue for my constituents, especially those living near Midway. All day, and much of the night, my constituents are bombarded with the loud sound of flights passing overhead. In fact, the noise emissions produced by these flights has as great an impact on the quality of life of my residents as greenhouse gas emissions.

So while I understand that a certain level of aircraft sound is unavoidable, I would appreciate if you could discuss ways to minimize the sound emissions created by aviation, whether through changes in engine technology, flight practices, sound barriers, or other means.

AIR TRANSPORT ASSOCIATION

**JAMES C. MAY**
PRESIDENT AND CEO

May 23, 2008

The Honorable Jerry F. Costello
Chairman, Subcommittee on Aviation
House Committee on Transportation & Infrastructure
2251 Rayburn House Office Building
Washington, DC 20515

Re: Response to Follow-Up Question; May 6, 2008 Hearing on Aviation and the Environment: Emissions

Dear Chairman Costello:

Thank you again for the opportunity to testify before the Subcommittee on Aviation during its hearing on Aviation and the Environment. This letter responds to the follow-up question you forwarded from Congressman Lipinski. I repeat the question immediately below, followed by my answer.

> **Question:** Living in the Chicago area, aviation is a major driver of the local economy. Midway Airport, which is in my district, employs thousands of my constituents, and local businesses benefit from the millions of passengers that pass through Chicago and its airports each year.
>
> But at the same time, aviation noise is a huge issue for my constituents, especially those living near Midway. All day, and much of the night, my constituents are bombarded with the loud sound of flights passing overhead. In fact, the noise emissions produced by these flights has as great an impact on the quality of life of my residents as greenhouse gas emissions.
>
> So while I understand that a certain level of aircraft sound is unavoidable, I would appreciate if you could discuss ways to minimize the sound emissions created by aviation, whether through changes in engine technology, flight practices, sound barriers, or other means.

AIR TRANSPORT ASSOCIATION OF AMERICA, INC.
[illegible] Pennsylvania Avenue NW Suite [illegible] Washington, DC [illegible]
[illegible] Fax [illegible]

The Honorable Jerry F. Costello
May 23, 2008
Page 2

**Answer:** The commercial airlines have made tremendous progress in reducing aircraft noise over the years. In fact, statistics from the Federal Aviation Administration (FAA) confirm that we have reduced the number of people exposed to significant levels of aircraft noise by 94 percent since 1975, while tripling enplanements. But we are not resting on our laurels. Our airlines continue to play a key role in achieving further noise reductions.

As you may know, the airlines' main contribution to noise improvement, which accounts for the vast majority of noise reduction to date, comes from our continual investment in newer aircraft, which are quieter and more fuel efficient. Critical to our ability to continue this trend, however, is ensuring that funds that we would use for such investments are not siphoned off through punitive taxes and charges. Another area where our airlines have achieved great success is in pioneering and implementing operational procedures that reduce noise and emissions. By way of example, the Air Transport Association (ATA) member airlines have been instrumental in designing and implementing continuous descent approaches (CDAs), in partnership with FAA and the air traffic controllers.[1] CDAs not only reduce fuel burn and resulting emissions, but, as FAA has testified before the Subcommittee on Aviation, they also significantly reduce aircraft noise exposure. Similarly, Area Navigation/Required Navigation Performance (RNP) procedures permit aircraft to descend on more precise routes that allow them to avoid populated areas. While our airlines are implementing such procedures everywhere we can, there are limits to what can be accomplished in the nation's out-dated air traffic control system. Hence, not only will modernization of this system achieve the significant emissions improvements I noted in my testimony, it also will allow the airlines to implement more noise abatement operational procedures in more locations.

The development of aircraft and aircraft engine innovations that reduce noise plays a critical part in our ability to continue our trend of noise improvements. Toward this end, ATA participates in key, joint government/stakeholder initiatives, including the Steering Committee of the Partnership for AiR Transportation Noise & Emissions Reduction (PARTNER) and the Environment and Energy Subcommittee of FAA's Research Engineering and Development Advisory Committee, which are designed to foster aviation environmental research and development. While additional evolutionary environmental improvements are in the pipeline as a result of such initiatives, revolutionary environmental breakthroughs can only come about through the reinstatement of significant federal investments in basic aeronautics research and development programs at NASA and FAA. Indeed, Pratt & Whitney's new geared

[1] Under this approach, the pilot flies a continuous descent path to land at an airport, rather than the traditional "step downs" or intermediate flight level operations. This descent is initiated from a high altitude in a near "idle" (low power) engine condition until reaching a stabilization point prior to touchdown on the runway.

The Honorable Jerry F. Costello
May 23, 2008
Page 3

> turbofan engine, which offers both noise and emissions benefits, as well as many features of Boeing's more noise- and emissions-efficient 787 were spawned through such programs. As I noted in my testimony before the Aviation Subcommittee, however, congressional funding to NASA and FAA for aeronautics research and development – specifically including for noise and emissions reduction projects – has been cut significantly (by about 50 percent) in the past 8-10 years, compromising the public-private partnership for exploring and bringing to market products with significantly improved environmental performance.[2] Thus, we continue to urge Congress to provide this needed funding, which also is critical to preserving America's competitiveness in aeronautics.
>
> Finally, we remain concerned that the tremendous gains we have made in reducing noise at the aircraft level have been eroded by population encroachment in the vicinity of airports. As the Government Accountability Office (GAO) testified before the Aviation Subcommittee in October 2007, "there is a disconnect between federal aviation policy and local land-use decision-making," with incompatible land use in the vicinity of airports continuing to proliferate. While largely in the hands of state and local authorities, the GAO recommended that such officials be encouraged to "take action, through land-use planning and development, zoning, and housing regulation, to limit the use of land near airports to purposes compatible with airport operations." FAA has several initiatives aimed at this, and we are working to support those efforts.

I hope you find this letter responsive to the follow-up inquiry from the hearing. Please let me know if you have additional questions.

Sincerely,

---

[2] While later funding cuts were even more drastic, a 2002 study by the National Academy of Sciences observed:

> In constant year dollars, NASA funding for aeronautics research was cut by about one-third between 1998 and 2000, reducing the breadth of ongoing research and prompting NASA to establish research programs with reduced goals, particularly with regard to TRL (technology readiness level). This significantly reduces the likelihood that the results of NASA research will find their way into the marketplace in a timely manner, if at all. The ultimate consequence is that the federal expenditures are inconsistent with the long-term goal of support for an aviation enterprise compatible with national goals for environmental stewardship.

*See* National Academy of Sciences, Committee on Aeronautics Research and Technology for Environmental Compatibility, *For Greener Skies: Reducing Environmental Impacts of Aviation* at 44 (2002).

**Testimony of**
**Mark M. Reis**
**Managing Director, Seattle-Tacoma International Airport**
**Before The**
**Aviation Subcommittee**
**Transportation and Infrastructure Committee**
**US House of Representatives**

**May 6, 2008**

Seattle-Tacoma International Airport
PO Box 68727
Seattle-Tacoma International Airport
Seattle, WA 98168-0727
(206) 433-5388

Mr. Chairman, thank you for the opportunity to testify today on the very critical issue of airport efforts to reduce greenhouse gas emissions. While I am here as the Managing Director of the Seattle-Tacoma International Airport and will focus my testimony on the progress we are making at our airport, I am also a member of the Board of Directors of Airports Council International-North America and will represent the interests of the broader airport industry.

Before I begin though, I want to express my sincere appreciation for the Subcommittee's leadership on H.R. 2881, the FAA Reauthorization Act. H.R. 2881 contains numerous environmental provisions that will help airports address environmental concerns. In particular, the pilot program to demonstrate measurable reductions or mitigation of aviation's impact on noise, air quality or water quality in the airport environment will allow promising environmental practices to be tested in an operational setting. Additionally, the Aircraft Departure Queue Management Pilot Program will help reduce aircraft idling time while in departure queues, reducing aircraft ground emissions and improving air quality. Additionally, I commend your efforts to extend authorization for the Airport Cooperative Research Program (ACRP) and increase funding to $15 million in FY 2009 through FY2011. ACRP has provided an invaluable resource for airports in helping to better understand and address many of the environmental issues facing the aviation industry, including a recently-initiated project to develop a guidebook for airports to use in inventorying their greenhouse gas emissions.

Environmental protection has for decades been an integral part of airports' responsibilities. As the "public face" of the aviation industry in our communities, airports must continue to play a leadership role in demonstrating environmental stewardship to the local and global communities we serve. Airports have and continue to implement proactive measures to reduce their environmental impacts, addressing such areas as noise, local air quality, water quality, wildlife management, waste minimization, and greenhouse gas emissions.

Greenhouse gas emission reduction strategies employed by airports have included: investing in and promoting the use of alternative fuel and low emission vehicles and energy saving equipment; recycling building and construction materials, waste and water; improving the operational efficiency of the airfield and landside system; acquiring green power; and providing emission-reducing services for aircraft at the gate.

ACI-NA recently conducted a survey of its member airports to benchmark initiatives to reduce greenhouse gas emissions. Based on responses from 73 airports representing almost 60 percent of traffic in both the United States and Canada, the survey found:

- 24 airports have an Environmental Management System.
- 9 airports are generating renewable energy.
- 19 airports purchase renewable energy.
- 48 airports have installed or upgraded improved HVAC systems.
- 59 airports are utilizing more efficient lighting.

- 32 airports have conducted an air emissions inventory.
- 15 airports have conducted a greenhouse gas emissions inventory.
- 17 airports have established GHG/climate goals.
- 34 airports have infrastructure to support clean vehicles.
- 48 airports have at least one loading bridge with 400 HZ power.
  - 2,187 out of 2,653 loading bridges at responding airports
- 38 airports have at least one loading bridge with pre-conditioned air.
  - 1,639 out of 2,653 loading bridges at responding airports
- 21 airports have employee trip reduction programs.
- 52 airports have public transit access.
- 26 airports have consolidated rental car facilities.
- 53 airports have a waste management program (recycling/reuse/composting).
- 33 airports have green purchasing programs.
- 5 airports have a LEED-certified building.
- 8 airports have a building for which they are seeking LEED certification.

Airports' contribution to aviation's global greenhouse gas emissions is small, and airports have little or no control over some of the larger contributors such as aircraft and off-airport vehicles. In spite of our small role, however, we recognize that every industry and every institution has a responsibility to reduce its contributions to climate change and that airports must plan how to modify the nation's airport infrastructure to withstand the climatic changes that will occur. Airports also play a critical role in facilitating greenhouse gas emission reductions across the entire aviation industry. By working with our airline partners, tenants, FAA, ground service providers and local communities, airports can help effectuate further reductions in those areas not directly within our control.

At Sea-Tac, we take our responsibility seriously and have implemented extensive programs, placing us among the airports at the leading edge of our industry. However, it should be emphasized that the entire industry recognizes the importance of focusing on climate change. While I will be discussing the myriad initiatives we have undertaken at Sea-Tac to reduce those impacts, you can find many of these same initiatives in place at airports across the country.

**GREENHOUSE GAS INVENTORY**

Last year Sea-Tac Airport prepared a greenhouse gas emissions inventory for the year 2006. Because there was not an industry-accepted methodology to prepare such an inventory, we had to identify the appropriate boundaries for quantifying airport emissions. The protocol used in this analysis, while not complete, represents a substantial improvement in the data examined for Sea-Tac to date and is intended to guide emission reduction plans and future inventories. It relies on methods published by the Intergovernmental Panel on Climate Change (IPCC), the US Environmental Protection Agency, the World Resource Institute (WRI) and the Local Governments for Sustainability (ICLEI).

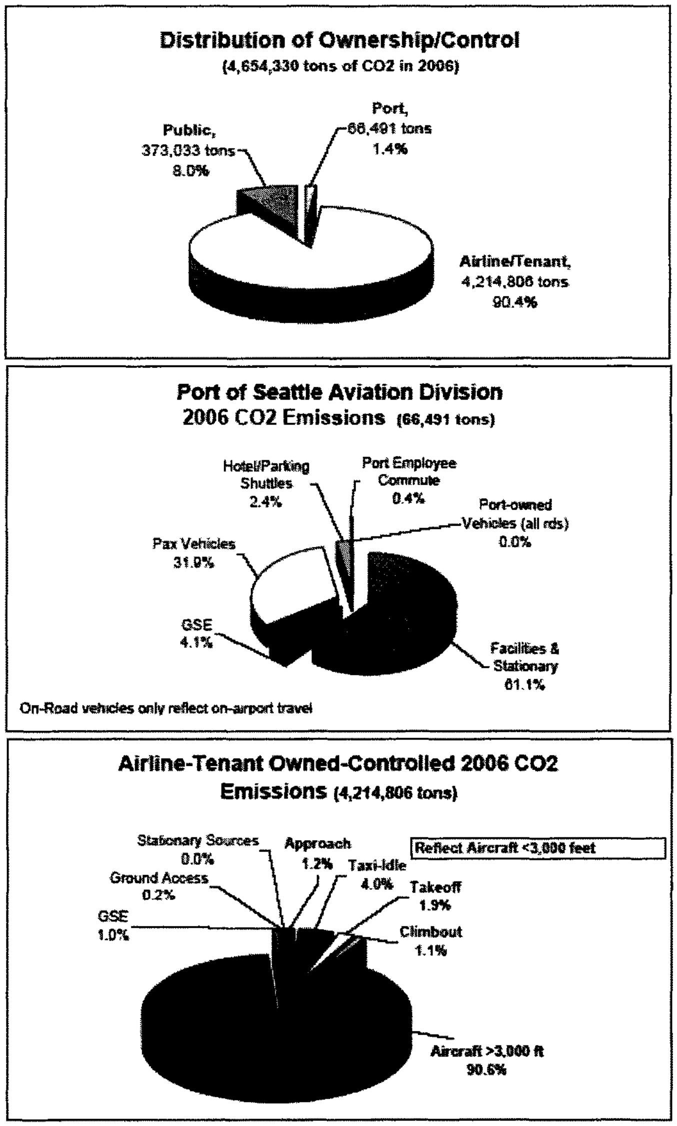
Our inventory accounts for emissions from aircraft operations, separated into two categories: (1) local emissions -- those taking place on the ground and up to 3,000 feet and (2) global, "en-route" emissions. This latter category was based on the emissions associated with the aviation fuel dispensed at Sea-Tac, no matter the location of the combustion and emissions. Because of the global nature of greenhouse gases, and the need to utilize a methodology that will neither undercount nor double count fuel burn emissions, we believe a "fuel dispensed" methodology is a sound one. It should be noted that the Airport Cooperative Research Program (ACRP) has underway an effort to develop a standard methodology. Should it differ materially from our methodology, we will utilize it in our next inventory.

This inventory also defines the local emissions that result (1) directly from Sea-Tac Airport operations (terminal buildings, mobile sources, and the power required to operate these resources) and (2) the indirect emissions that are a consequence of the airport's activities, but occur at sources owned and controlled by other parties. These indirect emissions are associated with the airlines, tenants, and general public that use the airport. Based on these boundaries, in 2006 nearly 4.7 million metric tons of $CO_2$ were generated as a result of direct and indirect airport activities.

At Sea-Tac, airport-owned/controlled emissions represent about 66,491 metric tons of $CO_2$. The largest portion of the "airport's" greenhouse gas emissions were those associated with lighting and heating airport facilities, followed by passenger vehicles on airport roads, Port ground vehicles, and hotel and parking lot shuttles traveling on-airport roads.

Sea-Tac's airline/tenant-owned and -controlled emissions represent 4.2 million metric tons of $CO_2$. As would be expected, aircraft represent the single largest source of these emissions. Over 90% of the airline emissions were from aircraft operating above 3,000 feet. All of the publicly-owned and -controlled emissions (373,033 metric tons of $CO_2$ or 8% of the total) reflect on-road travel associated with airport activity: either through vehicular access by passengers, hotel/parking lot shuttles off-airport, and airport employee work commute.

**FIGURE ES-1**
**SOURCES OF EMISSIONS**




The strategic value of this inventory, of course, is that it provides Sea-Tac with the information needed to identify opportunities to reduce greenhouse gas emissions and measure our progress.

## GREENHOUSE GAS EMISSION REDUCTION EFFORTS

Sea-Tac has taken a multi-faceted approach to greenhouse gas emissions. We started these efforts some years ago and continually search for new opportunities. Below is a summary of many of these initiatives. Some are relatively traditional energy conservation-oriented investments. Others have very substantial additional benefits – improved customer service, cost savings, safety improvements, and operational efficiencies. And, on some, we are working collaboratively with our airline partners to reduce aircraft emissions. Not all of these may be relevant to every airport or every community but they are indicative of the type of steps airports can consider as we determine how best to be part of the solution to climate change.

### Early Initiatives to Reduce Greenhouse Gas Emissions

Sea-Tac Airport initiated its focus on greenhouse gas emission reductions long before we conducted the emissions inventory. In addition to the greenhouse gas emission reductions, we sought to improve (local) air quality, conserve energy use and reduce costs. These early actions reduced the emission of approximately 60,000 tons of $CO_2$.

Green Energy Power Purchases: Airports are large consumers of power. Sea-Tac, for example, will consume approximately 148,000 megawatt hours of electricity in 2008, the equivalent of 19,000 homes. For the past several years we have purchased "green" (primarily wind) power from the Bonneville Power Administration to serve 25% of our electrical load.

Energy Conservation Investments: In addition, we have reduced our electrical energy consumption by 25% over the past 12 years, saving more than 10,000 tons of $CO_2$ and $1.67 million annually. These savings were accomplished by:

- Completing a six phase program, providing twice as much light with 20% less energy and improved lighting controls for approximately 3,000,000 square feet of space in public and non-public areas of the airport terminal.
- Adjusting Sea-Tac's heating (natural gas operated) and cooling (electrically powered) systems which are responsible for approximately 40% of the Airport's current electrical consumption. The current, more efficient HVAC system creates a more consistently comfortable environment for our passengers.
- Adjusting (slowly) building thermostats to a wider range – closer to the range of temperatures one might find in other buildings – and anticipate savings of 3,000,000 kWhs and $108,000 per year
- Retrofitting our escalators with "ecostart" energy efficiency kits that slow down escalators during periods of slow demand. The kits save 1,560,000 kWhs annually.

Compressed Natural Gas Distribution Station and Usage Requirements: In 2002, the airport commissioned the first publicly available compressed natural gas (CNG) fuel facility in the state of Washington and began a program of transitioning the airport fleet -- and using our business and regulatory authorities to facilitate the transition of the fleets of our business partners -- to CNG usage. $CO_2$ emissions from CNG vehicles are 20-25% less than their traditionally-fueled counterparts. The Port now has a fleet of 74 natural gas (light and heavy duty) vehicles, including all of our employee buses. In addition, all of the taxi cabs authorized to pick-up passengers at Sea-Tac are either CNG-fueled or hybrid vehicles. The airport CNG fueling station dispenses more than 1.25 million gasoline gallon equivalents and generates almost $100,000 in royalties that help the Port offset the costs to our airline customers.

**Price Signals Work: Putting Economics to Work**

Fundamental to the business and operations at any airport are (1) the lease / operating agreement that defines the relationship between the airport and its airline tenants and (2) the lease arrangement between the airport and the concessionaires – specifically, in this case, the food and beverage concessionaires. While there are a plethora of issues involved, key here is the question of price signals. It goes without saying that businesses will pay attention to what they pay for. However, the traditional, "residual" airport/airline agreement is characterized by combining every cost (including debt service on all facilities) of operating an airport in one bucket for the purposes of developing airline rates and charges. Subtracted from this collection of costs are most to all of the other revenues (parking, concessions, terminal rents, etc.) the airport receives. The airlines are then obligated to cover the remaining ("residual") amount.

In this scheme, the airlines pay in their landing fees, for example, the natural gas costs of the concessionaires. The heating costs for the hangar on the airfield (owned and operated by individual airline) are divided up among all the airlines. Sea-Tac long had such a system and, as a result, we were unable to signal the real costs of certain functions to the entity that used that function.

As a result, in 2001, we established several airport utilities – electrical, gas, water, sewer and even a waste grease utility. Wherever it made economic sense we metered the use of each commodity and took the costs out of the airline rate base. We established the utility rates with exactly the methodology used by regulated utilities so that we recovered not only the cost of the commodity (e.g., water, power, natural gas) but the capital and operating costs of our distributing those commodities to the actual users. With this system in place, we could evaluate on behalf of the utility consumers the cost-effectiveness of conservation measures and fairly straightforwardly convince them of the wisdom of conservation investments.

Similarly, we have taken over waste hauling throughout the terminal, replacing the many separate contracts airlines and concessionaires had with a variety of waste companies with a single comprehensive system. We put in place pairs of electronically-controlled compactors – one for garbage and one for recyclables. Our tenants pay a dump fee every time they open (with individualized codes) the garbage compactor but pay nothing for recycling. When the compactors are near capacity, a signal is automatically sent to the hauling company which brings in a replacement compactor on a "just in time" basis. The tenants are sharing significant financial savings, the airport is achieving a dramatic decrease in waste and we have reduced traffic on the airfield which improves ramp safety.

**Operational and Customer Service Programs Bring Emission Reductions**

Happily, we have found that, when we reduce greenhouse gas emissions through improved operational efficiency, we can also improve customer service and help our customers save money and time. The following three projects are examples.

Pay on Foot (POF) / Parking Floor Count: A decade ago, Sea-Tac was one of the first airports to inaugurate a "pay on foot" system which has subsequently become more common at airports and major parking facilities. Our focus was threefold: reduce the queues at our parking garage toll plaza; decrease operating costs; and improve the air quality in the garage by avoiding so many idling cars waiting to exit.

We have just put into operation a "space count" system that informs our arriving garage patrons in what sections of which floor they will have the easiest time finding a parking space. Again, customer service and efficient use of our 13,000 stall garage were the primary motives. The estimated $CO_2$ emission savings leverage by the POF system is 60 tons per year. We anticipate the garage space count system could help save up to 25 tons of $CO_2$ per year.

Fuel Hydrant System: In 2004, we completed an underground fuel hydrant system, bringing fuel to ramp hydrants at each gate and allowing us to remove 20 fuel trucks from the airfield. Ramp safety, reducing the risk of fuel spills and operational efficiency were all key reasons to undertake this significant investment, but a very valuable by-product is the 1,000 tons of $CO_2$ that will be saved every year.

Hotel Van Consolidation: Sea-Tac passengers are served by shuttles from 61 hotels, generating nearly 500,000 trips to the airport. As the airport has grown, we are beset with congestion on the roadways and drives at the airport. As a result, we have just initiated a collaborative effort with the hotels (with none of which do we have a business relationship) to consolidate their shuttle operations. In doing so, we expect to reduce traffic on our drives, costs to the hotels, and air pollution. We estimate that the initial phase of a consolidated van operation could lead to the reduction of 160,000 trips from the system. The trip reductions and use of low carbon fueled shuttles resulting from such a program could reduce $CO_2$ emissions by 1,000 tons per year.

**Airport / Airline Collaboration on Aircraft Emission Reduction**

We are working closely with our airline partners to identify opportunities to reduce fuel burn and, thus, emissions from aircraft operating on the ground at Sea-Tac. For every minute a narrow body aircraft taxis at an airport, more than 3.5 gallons of fuel is consumed and 110 pounds of $CO_2$ is emitted. These values can more than triple for a wide body aircraft.

Ramp Control Tower: In collaboration with our airline customers, Sea-Tac opened a ramp tower in 2006 and added a "taxi lane" under the control of the tower that has significantly improved the efficiency of ramp operations. These efficiencies are a product of decongesting aircraft arrivals and departures, monitoring ground service equipment (GSE) and generally improving aircraft traffic flow. We estimate that aircraft ramp movements are five percent more efficient and that this efficiency has potentially saved the airlines 800,000 gallons of fuel per year and reduced GHG emissions by 8,500 tons per year.

Gate Ground Power (400Hz): By providing airlines the option to power aircraft electrical needs (lighting, instruments, etc) with gate-side electricity, the need for operation of the aircraft's auxiliary power unit (APU) can be reduced. We have added this capability to all by five gates at Sea-Tac. For every half hour that ground power is used in place of an aircraft APU, on average, 13 gallons of fuel is saved and 280 pounds of $CO_2$ is not emitted. Because over 80 percent of the electrical power consumed at the airport comes from low carbon sources such as hydroelectric and wind sources, a reasonable expectation is that use of ground power could reduce $CO_2$ emissions by 18,000 tons per year.

Pre-Conditioned Air Conditioning (PC Air): Our airline customers are in the final stages of providing approval for Sea-Tac's investment in a centralized PC Air system that will provide temperature-controlled fresh air to aircraft at gates from a central refrigeration plant. The arrangement is suitable for Sea-Tac because of a high cooling load needed by the number of aircraft we service and because our terminal and gate layout is conducive to a centralized system. We expect to use a system that can take advantage of lower-cost off-peak electricity by creating ice that can be used for cooling during peak electrical demand periods. Based on current operations, we anticipate a fuel savings of at least 5 million gallons of aircraft fuel per year. This is a great example of a project with both substantial economic and environmental payoffs: The $31 million project has a payback period of only 2.6 years and saves 40,000 tons of $CO_2$ per year.

(When 400 Hz Ground Power is utilized in conjunction with PC Air infrastructure, an aircraft's auxiliary power unit can be completely shut down.)

Ground Support Equipment (GSE) Electrification: Airline ground support equipment (baggage cart tugs, etc.) are commonly fueled by gasoline or diesel. However, fully electric GSE is now a viable technology and the potential environmental benefits are substantial. The airport is working with its airlines and Fixed Base Operators to provide the infrastructure necessary to support a larger electric GSE fleet. Because much of the airport's electricity comes from hydroelectric and other renewable energy sources, the potential emission savings and positive climate impacts are significant. Full conversion to electric GSE could reduce emissions at Sea-Tac by 20,000 tons per year.

Required Navigation Procedure (RNP) Approaches: Sea-Tac is working closely with Alaska Airlines and the Pacific Northwest Mountain Region of the FAA to explore accelerated implementation of offset RNP procedures that could reduce fuel burn and GHG emissions. Preliminary estimates are that each such approach at Sea-Tac could cut emissions by approximately 300 pounds of $CO_2$ per landing.

**Opportunities to Support Expansion of Airport Emission Reduction Efforts**

Mr. Chairman, we believe there are several opportunities for the Congress to facilitate an expansion of the current airport efforts to reduce greenhouse gas emissions. We respectfully offer our thoughts below.

Pilot Program on Best Environmental Practices: In order to enhance the environment by encouraging the proactive adoption of best environmental practices, ACI-NA would propose the establishment of a pilot program within the Airport Improvement Program (AIP). Such a program could allow not more than ten public-use airports to use AIP funds to plan, design and construct new terminal facilities or retrofit existing terminal facilities with equipment, systems or other means of reducing adverse environmental impacts. In selecting applicants for the pilot, the Secretary might give priority to those airports that will achieve the greatest air quality or other environmental benefits. The pilot program would provide an opportunity to develop and employ innovative green systems and for DOT to assess the benefits of such projects.

Environmental Management Systems: The Committee should also consider expanding AIP eligibility to cover both the development of Environmental Management Systems (EMS) and the implementation of measured identified in such EMSs. Development of an EMS is a necessary first step, but the real environmental benefits will be achieved by implementation of measured identified in the EMS. We encourage the Committee to amend the definitions of both airport planning (for creation of EMSs) and airport development (for implementation of measures identified in such systems).

Low-Emission Vehicles: Additionally, airports encourage the Committee to remove the requirement in the current AIP program that only allows airports in non-attainment or maintenance areas to acquire low emission vehicles or convert existing vehicles to low emission vehicles. By doing so, the federal government will encourage airports to proactively convert their fleets regardless of location.

Alternative Fuel Facilities: Finally, AIP eligibility should be expanded to include compressed natural gas (CNG) and electric recharging facilities that can service low emission technology vehicles operating at airports. If construction of these facilities can be promoted through AIP eligibility, it will not only facilitate conversion of more airport vehicles but also make it easier for third parties (e.g., rental car companies, parking lots operators) to convert their fleets that are so integrally connected with airport operations.

**Conclusion**

In closing, let me reiterate that greenhouse gas emissions are just one of many environmental challenges airports and aviation face every day. We must carefully balance the need to reduce greenhouse gas emissions with the need to reduce impacts from noise and local air quality. In the end, it is important for airports to play the role of overall environmental steward within our communities to continue to meet the growing demand for air travel.

As you can see, there are a significant number of programs and initiatives that can be put in place at airports to reduce the overall greenhouse gas emissions associated with airport operations, including those emissions outside the airport's direct control. As an industry, we are continuing to share best practices in order to implement measures such as these at airports across the country and identify new and innovative steps to achieve even further emission reductions.

STATEMENT OF

CAPTAIN MARY ANN SCHAFFER, CHAIRPERSON

AVIATION SUSTAINABILITY AND ENVIRONMENT TASK FORCE

AIR LINE PILOTS ASSOCIATION, INTERNATIONAL

BEFORE

AVIATION SUBCOMMITTEE

OF

TRANSPORTATION AND INFRASTRUCTURE COMMITTEE

US HOUSE OF REPRESENTATIVES

WASHINGTON, DC

May 6, 2008

# Aviation and the Environment

Air Line Pilots Association, International
1625 Massachusetts Avenue, NW
Washington, DC 20036
(202) 797-4033

**Testimony of the Air Line Pilots Association, International**
**Before the Aviation Subcommittee**
Transportation and Infrastructure Committee
U.S. House of Representatives

Aviation and the Environment

May 6, 2008
Washington, DC

Mr. Chairman, Ranking Member and members of the Committee, I am Captain Mary Ann Schaffer, chairperson of the Air Lines Pilots Association's Aviation Sustainability and Environment Task Force. It is a pleasure and an honor for me to be here today at this hearing to represent ALPA's President, Captain John Prater, and our 56,000 pilot members who fly for 43 airlines in the U.S. and Canada. We appreciate the Committee's interest in this subject and the opportunity to present out views on it today.

It may not be apparent why ALPA would have an interest in this subject, so I will explain. ALPA's motto, since its beginning almost 77 years ago, has been "Schedule with Safety." A former FAA Administrator and others have dubbed ALPA the "conscience of the airline industry" and in that role, we take very seriously the need to ensure that any new operational measures are fully understood and thoroughly considered before implementation. Pilots literally sit at the intersection of new technology, operational measures, air traffic control procedures, and varying aircraft capabilities. This gives us a unique vantage point to see and experience first hand what well-intended, but unrealistic operational procedures can do to safety margins.

Another principal reason for our interest in this subject is the need to ensure the ongoing viability, what we call the sustainability, of our airline industry. We recognize all too well that our employers are under tremendous financial stress due to the record high cost of fuel and pressures from environmental concerns to reduce fuel consumption and corresponding emissions. Pilots have a genuine ability to help their airlines burn less fuel, and thereby put less noise and tailpipe emissions into the environment. Pilots look for opportunities to reduce fuel burn and do so every day.

Pilots and the airline industry as a whole have already made great strides toward reducing total fuel burn, noise, and tailpipe emissions. We believe Congress should take this into account when it considers any legislation regarding greenhouse gas (GHG) emissions. I will discuss later the extraordinary investments that our employers have made to reduce consumption and pollution.

With oil selling at $118 per barrel, airlines are parking airplanes because they can no longer afford to fly them, name-brand legacy carriers are looking for mergers in order to survive, airlines are spending about 40% of their revenues on fuel, and airline pilots are facing an uncertain future in an industry unstable because of this energy crisis.[1] Airlines and aviation face unique challenges. First are the long and expensive lead times for the research, development, design, and certification implementation for new technologies. Second is the lack of any economically viable alternative to fossil-based fuel. Compounding these issues is the lack of a comprehensive national energy policy that addresses the short and long term needs of our transportation systems.

ALPA's Work to Improve the Environment

As evidenced by the creation of our President's Task Force on Aviation Sustainability and Environment, ALPA takes environmental concerns very seriously. We are, and will continue to be, part of the solution as evidenced by the following activities:

- ALPA is participating in the work of Commercial Aviation Alternative Fuel Initiative (CAAFI), which involves the airlines, aircraft manufacturers, and the scientific community collaborating to find new and better sources of fuel for aviation.
- We are also a member of the Advisory Board for the Partnership for Air Transportation Noise and Emissions Reduction (PARTNER) effort and the FAA's Joint Planning and Development Office (JPDO) Environmental Working Group.
- Our most recent success story: ALPA was a principal co-sponsor of a two-day conference for more than 200 government and industry participants in March, called *Aviation and the Environment: A Primer for North American Stakeholders*. The purpose of the forum was threefold:

    1. Put the environment debate into context and educate the members of the co-hosting associations on the basic facts.
    2. Examine some of the policy options, measures and decisions proposed to curtail and reduce overall noise and emissions.
    3. Provide a platform to communicate aviation's already impressive gains in the reduction of noise and emissions and highlight ongoing industry environmental initiatives.

Safety and Operations

Airline pilots can, and do, save fuel and emissions through operating techniques. Safety is our utmost concern, of course, but where safety is not impacted, airline pilots will reduce fuel usage through such measures as:

[1] "Aviation and the Environment: A National Vision Statement, Framework for Goals and Recommended Actions," Report to the United States Congress, December 2004. Recommendation 2: Tools and Metrics states the tools should "account for airline economics and affordability in evaluating regulatory and research opportunities."

- Single-engine outbound taxi –Under certain conditions, it is not necessary that all aircraft engines be operated to taxi on the ramp or on taxiways. When conditions permit, only one engine may be started out of two or more available engines until reaching the end of the runway for takeoff.
- Engine shut-down during inbound taxi – Once the aircraft has departed the landing runway and is headed to the gate or parking stand, one or more operating engines may be shut down either in the taxiway environment or on the ramp.
- Technology enhanced departure procedures – New procedures are being developed with the aid of Area Navigation (RNAV) and Required Navigation Performance (RNP) technology which permit shortening the distance and time traveled during approach and departure.
- Optimal altitude – Each jet aircraft, based on weight and ambient conditions, has an optimum altitude where fuel burn is minimized. To the extent that conditions and circumstances permit, pilots may request that optimal altitude in order to conserve fuel, which reduces emissions.
- Optimal speed flight plans – Planning and operating a flight at an efficient speed can save fuel. Pilots can optimize fuel burn based on aircraft weight, winds, and atmospheric conditions.
- Continuous Descent Arrival (CDA)/Optimized Descent Procedure (OPD) – Normal approach and landing procedures require an aircraft to reduce power, descend to a new altitude, and then add considerable power to level off and fly straight and level – that process may be repeated several times during and approach and landing. A new approach procedure, the CDA, or what we refer to as an OPD, is being developed that permits pilots to reduce power on all engines and not use significant thrust until safety concerns dictate establishing a stabilized approach configuration just before landing. This procedure cannot work at all airports at all times due to operational constraints, but at those locations where it can be used, it can save substantial fuel on a single approach.
- Reduced Vertical Separation Minimum (RVSM) – Taking advantage of improved technology, appropriately equipped aircraft can now fly at 1,000 feet – compared with 2,000 feet previously – vertical separation at higher altitudes. This operational change added six additional useable altitudes increasing the opportunity for pilots to fly their aircraft at the optimal, most fuel efficient altitude, in addition to permitting much greater airspace utilization.

Aviation's Enviable Environmental Record

Aviation arguably has the most successful record of limiting its impact on the environment while increasing its productivity of any industrial sector. Airlines have greatly reduced carbon-based emissions through engine technology which reduces fuel burn and emission of undesirable gases and particulates. Compared to aircraft in use in 1972, the U.S. airline industry now carries six (6) times more payload using 60% less fuel and has reduced by 95% the number of people significantly impacted by aircraft noise.[2] This outstanding record of environmental achievement has resulted almost entirely from the airlines continually demanding new aircraft from the manufacturers that burn less fuel, carry greater payloads, and create less noise. Boeing is preparing for the first flight of the B-787; due to its cutting edge technology, that aircraft is designed to use 20% less fuel – thereby create 20% less GHG emissions – than current aircraft of the same size. This aircraft is just one example of the kinds of investments that the airlines make in a very heavily capitalized industry; those investments should be taken into account by any legislation that deals with fuel conservation and GHG emissions.

Recommendations

As described, the airline industry has already made great progress toward reducing GHG emissions without the creation of a new commodity market that would funnel its assets to other industries and entities. That said, the industry does need your help to boost our great progress:

- Provide sufficient and timely funding to the FAA for necessary improvements in the U.S. National Aviation System (NAS). Funding the national airspace system modernization components needed to enhance aircraft efficiency, safety, and capacity will help in reducing delays, fuel consumption, and emissions. Implementation of the Next Generation Air Transportation System (NEXTGEN) could eliminate as much as 15% of today's delays, increase safety and capacity, and concurrently reduce emissions. Funding important studies like wake vortex investigations will also help. More information and understanding of wake vortex patterns around runways will allow spacing of traffic on the runway based on real hazards – a more accurate standard than mileage separation.
- Continue funding for important infrastructure improvements including runway and taxiway additions and improvements. Poor airport design, including those with intersecting runways, increases taxi time and increases fuel use. Adding high-speed taxi way exits from runways can reduce runway occupancy time thus increasing airport capacity. Additional runways, like those in progress at Seattle-Tacoma and Washington Dulles, reduce fuel wasted in holding patterns and long lines of aircraft waiting for take-off.
- Give greater support to research for alternative fuels which are renewable, pollute less or not at all, and are less expensive than today's fuels. Because of aircraft engine design and extreme atmospheric conditions at altitude, the airline industry relies entirely on petroleum-based fuels; it cannot currently substitute ethanol or other fuels as some industries are able to do.
- Avoid adding economic burdens, in the form of market-based measures, to an already crippled industry. Such measures as are currently imposed in Europe and proposed in the Lieberman-Warner bill are biased against the airline industry and

[2] "Aviation and the Environment: A National Vision Statement, Framework for Goals and Recommended Actions," Report to the United States Congress, December 2004; *see also*, "Aviation and the Environment: A Pilots' Perspective," British Air Line Pilots Association, March 2007.

do not provide sufficient re-investment of revenue for new aviation technologies and fuel.

- Work with ICAO to establish emissions standards and operating measures for uniform application across this global industry.

Conclusion

Aviation is a good news story; we safely move hundreds of millions of passengers around the world in comfort, at great speed, and with less impact on the environment than any other mode of transportation in history. However, aviation is a visible target and has drawn the attention of many groups around the world who condemn the industry for being a driver of projected climate change.

As pilots, we deal with facts, and the facts clearly show that while aviation is a contributor of greenhouse gas and other emissions, it plays only a small role in the overall issue. Indeed, we could ground the entire world's fleet, and not have a significant effect on the climate change issue. The industry is poised to make great strides in reducing emissions through technology and operating procedures. We believe that the best way to achieve those results is the same way that we have made such great advances thus far, namely, through industry's investments in increasingly higher technology.

Thank you again for the opportunity to testify today. We urge Congress' support of our ongoing and future efforts to reduce aviation's environmental impacts.