

ALPA WHITE PAPER

AIRLINES AND THE ENVIRONMENT



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FOREWORD FROM ALPA PRESIDENT JOE DEPETE

Our modern world is characterized by, perhaps more than almost any other attribute, a continual and aggressive pursuit to do virtually everything in life faster, better, and at a lower cost. No industry exemplifies this so well—nor has been so successful—as commercial aviation, which allows a person to travel at upwards of 600 miles per hour and with less risk than any other mode of transportation at any time in history.

During its nearly 90 years of existence, ALPA has been at the forefront of the unceasing effort to make airline travel safer and better. And it is extremely safe—there were zero fatal U.S. passenger airline accidents over the last 10 years—but it is also significantly less expensive when adjusted for inflation than when the industry began, due to airline competition plus advanced aviation technologies, training, and methods.

However, there is a growing societal movement to harm the airlines and shame their customers into using other forms of transportation in a perhaps well-intended but profoundly misguided effort to reduce the environmental impacts of air travel. Some may not realize it, but as successful as the airline industry has been in developing a safer, faster, and less expensive mode of transportation, it has also excelled in lessening its impact on the environment. Because of the industry's efforts, which includes proactive operational procedures performed by airline pilots to reduce fuel burn, airline CO₂ emissions per seat mile have dropped an astounding 80 percent since the first jet aircraft, and presently accounts for only 2 percent of human activity-caused global emissions.

Is there more work to be done to reduce aircraft emissions? Of course. And the good news is that the airline industry understands that and is working with government and other stakeholders to increase the average aircraft fuel efficiency each year by 1.5 percent, cap net aviation CO₂ emissions starting this year, and reduce net aviation emissions by 50 percent by 2050, as compared to 2005 levels.

Far from being ashamed, airline pilots are proud to be part of an industry that drives a truly global economy and enables anyone to do business in any corner of the globe, an impossibility just a few decades ago. We take great pride in safely transporting millions of travelers to their destinations and delivering high-value cargo around the world, every day, while taking aggressive, proactive measures to reduce carbon emissions and fuel consumption.

The aviation industry has a great story to tell about its environmental accomplishments and goals and ALPA is very proud to provide its perspective on that story in this white paper.

Capt. Joe DePete

A handwritten signature in black ink that reads "Joseph S. DePete". The signature is written in a cursive, flowing style.

ALPA President

EXECUTIVE SUMMARY

The Air Line Pilots Association, Int'l (ALPA) strongly supports the efforts that are being made, with the active involvement of pilots, to further reduce aviation's small overall environmental impact while concurrently enhancing its economic viability. These two goals are complementary: as fuel and operational efficiency continue to improve, so do airline economics.

This update of a 2009 ALPA paper on the same subject explains that commercial airline flying, which is the safest means of transportation, contributes only about 2 percent of the carbon emissions attributable to human activity, despite accounting for nearly 4 percent of the world's gross domestic product and indirectly enabling many other industries to thrive.

Future airframe and engine improvements promise continued fuel-efficiency gains and noise reductions. Technological improvements in navigation and surveillance have contributed tremendously to improved capacity and operational efficiency in the national airspace system (NAS) which has led to growth in operations without a corresponding increase in aviation's carbon dioxide (CO₂) "footprint." Commercial aviation deserves

great credit for taking the initiative to implement improvements that have led to substantial and growing environmental gains.

This paper provides eight reasons for passengers, businesses, environmental interests, and governments to use and promote air travel. It also identifies the role of governments in supporting airline environmental improvements, and makes recommendations to support and improve the industry's environmental stance.

INTRODUCTION

Passengers, businesses, stockholders, regulators, and the general public expect airlines to reduce fuel consumption and be environmentally responsible. An executive from a major U.S. airline went so far as to say that the pressure on the global airline industry to limit and mitigate emissions is "an existential threat to the growth of our industry."¹ For that and other reasons, ALPA has a strong stake in the ongoing environmental sustainability of the airline industry.

Airline pilots work at the intersection of new technology, operational measures, air traffic management procedures, and varying aircraft capabilities. This gives them a unique vantage point



Boeing Historical Archives

A Douglas DC-8 at the beginning of the jet age.

¹ "Delta Air Lines Takes Minority Stake in Private-Jet Operator Wheels Up." *Wall Street Journal*, December 12, 2019, Doug Cameron.

Table 1: Travel Between New York, N.Y., and Los Angeles, Calif.

Travel Mode	Safety (1 = worst, 5 = best)	Time En Route	Carbon Emissions Per Person ²	Costs	Ease of Travel (1 = worst, 5 = best)
Motorcycle	1	14-plus days	.6 tons	\$4,700-plus ³	2
Personal Automobile	3	4-plus days	.9 tons	\$1,932 ⁴ plus hotel, etc.	3
Bus	4	2.75 days	.5 tons	\$185 ⁵ plus meals, etc	3
Train	4	3.2 days	.03 tons	\$193 ⁶ plus meals, etc	5
Airline	5	6.5 hours	.3 tons	\$338 ⁷	5

Table 2: Nonstop Travel Between New York, N.Y., and London/Southampton, UK

Travel Mode	Safety (1 = worst, 5 = best)	Time En Route	Carbon Emissions Per Person	Costs	Ease of Travel (1 = worst, 5 = best)
Cruise ship	4	8 days	1.7 tons ⁸	\$1,595 ¹⁰	5
Airline	5	6.75 hours	.44 tons ⁹	\$600 ¹¹	5

to see and experience firsthand what well-intended, but unrealistic, operational procedures can do to safety margins. Fortunately, new technology is reducing the attractiveness of riskier procedures which provide very small margins of capacity. Current and future technologies are having, and will continue to have, a direct and very significant impact by increasing fuel efficiency and lessening environmental impacts. Pilots help their airlines safely burn less fuel, and thereby have less of an environmental impact, using numerous operational techniques described herein.

NOT ASHAMED TO FLY

Mark Twain once said, “Travel is fatal to prejudice, bigotry, and narrow-mindedness, and many of our people need it sorely on these accounts. Broad, wholesome, charitable views of [humanity] and things cannot be acquired by vegetating in one little corner of the earth all one’s lifetime.”

Not surprisingly and for a multitude of reasons, including Twain’s, ALPA has always been a staunch champion of air travel. The jet age of the 1950s ushered in a safer, faster form of travel that was universally celebrated. However, as airline travel

² <https://www.carbonfootprint.com/calculator1.html>

³ www.forbes.com/sites/brianroberts/2017/08/25/heres-how-much-itll-cost-you-to-take-a-motorcycle-trip-across-america/#24da6a843794

⁴ 2,832 miles x \$.58

⁵ www.greyhound.com/en/ecommerce/schedule Tickets priced at 30 days from date of travel.

⁶ <https://tickets.amtrak.com/itd/amtrak> Tickets priced at 30 days from date of travel.

⁷ www.expedia.com

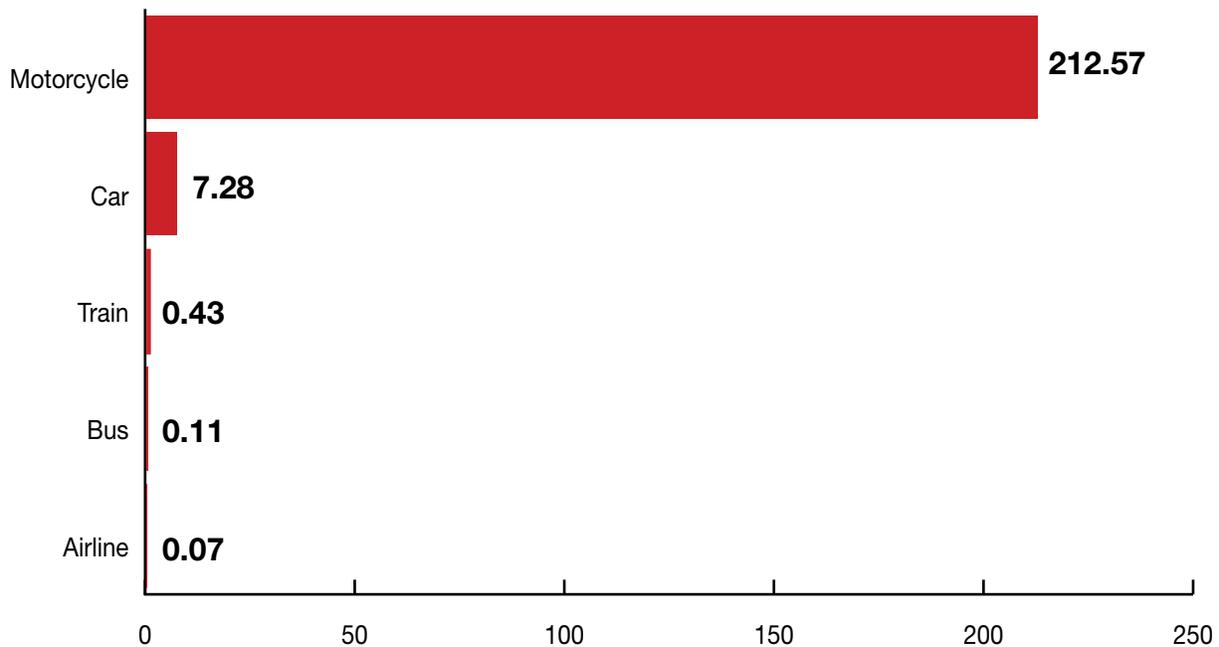
⁸ https://co2myclimate.org/en/portfolios?calculation_id=3021123

⁹ www.cunard.com/en-us/cruise-destinations/transatlantic

¹⁰ <https://www.carbonfootprint.com/calculator1.html>

¹¹ www.expedia.com Tickets priced at 30 days from date of travel.

Chart 1
 Passenger Deaths Per 1 Billion Passenger Miles
 2000 to 2009



Source: *The Washington Post* / Northwestern University

becomes increasingly commonplace, its value has been minimized by some over environmental concerns. In fact, a growing movement against air travel began in Europe and has spread elsewhere. An October 2019 article in *The Nation*, explains that, “In Sweden, *Flygskam*, or flight shame, has become a significant phenomenon. In July, it fueled a 4 percent decline in passenger numbers at Swedish airports compared to the previous year, and the trend is catching on around the world.”¹²

The financial giant Citigroup Inc. said that flight shaming is “causing consumers to explore alternate modes of transportation when possible,” and look for ways to offset carbon emissions, which could be as much as \$6.2 billion per year for combined pleasure and business travel. The firm takes the position that the airlines will bear the brunt of the offsetting costs, which could reduce profits by 17 percent.¹³ The Swiss financial firm UBS found that 21 percent of 6,000 people surveyed in the United States, Germany, France, and the United Kingdom

had reduced their air travel over environmental concerns.¹⁴

Unfortunately, flight shaming may not end with mere denunciation, but it can ultimately take the form of behaviors intended to harm the airline industry and dissuade the public from using air travel. As an example, in September 2019, London, UK, law enforcement officers made preemptive arrests of several individuals associated with a group called “Extinction Rebellion.” The activists had announced plans to disrupt airline operations by flying drones in the low airspace of flight paths around the airport.

When it comes to traveling long distances, there are still just a handful of options. Tables 1 and 2, which include data from carbon-emissions calculators, demonstrate the vast superiority of air travel over any other form of transportation.

¹² www.thenation.com/article/greta-travel-climate/

¹³ www.cnbc.com/2019/10/24/citi-flight-shaming-getting-traction-could-cost-airlines-billions.html

¹⁴ www.bbc.com/news/business-49890057

Aviation's economic and societal benefits to all people around the globe, whether directly or indirectly, are many and varied. According to the Air Transport Action Group (ATAG), the global commercial aviation industry contributes greatly to national economies, as evidenced by these accomplishments in 2018:

- Employed 65.5 million people with jobs which are 4.4 times more productive than those in other industries.
- Had a global economic impact of \$2.7 trillion, which includes direct, indirect, tourism, and others. This is equivalent to 3.6 percent of the world's gross domestic product.

EIGHT REASONS TO SUPPORT COMMERCIAL AIR TRAVEL

The following are eight major reasons for passengers, environmentalists, governments, and the general public to put their full support behind commercial air travel.

1. Airline Travel Is Safest (and Fastest!)

The most critical element when choosing a method of travel is whether it can be done safely. And for that all-important metric, airline travel is the best, as depicted in Chart 1. For the period 2000–2009, airline travel was 1.6 times safer than taking a bus, 6 times safer than riding a train, and 104 times safer than car travel.

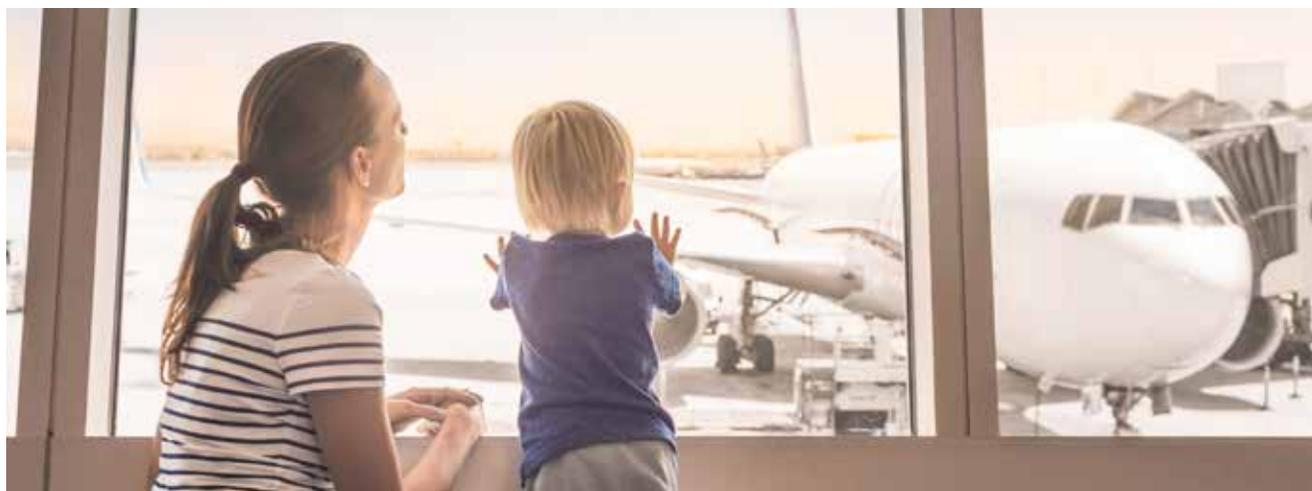
From February 2009 to the end of 2019, there was only one U.S. airline passenger fatality. By comparison, the number of fatalities in other modes of transportation for the years 2009–2018 were as follows:¹⁵

- Motorcycle: 48,469
- Motor vehicles (cars and light trucks): 223,876
- Trains: 76
- Buses: 461
- Ships: 425

One former FAA administrator called ALPA the “conscience of the airline industry.” Our active involvement with government and industry partners to continually improve safety has helped make commercial airline flight the safest mode of travel. The greatest safety feature of any aircraft is a flight crew of at least two well-trained, qualified, experienced, and rested pilots, which ALPA advocates for every day.

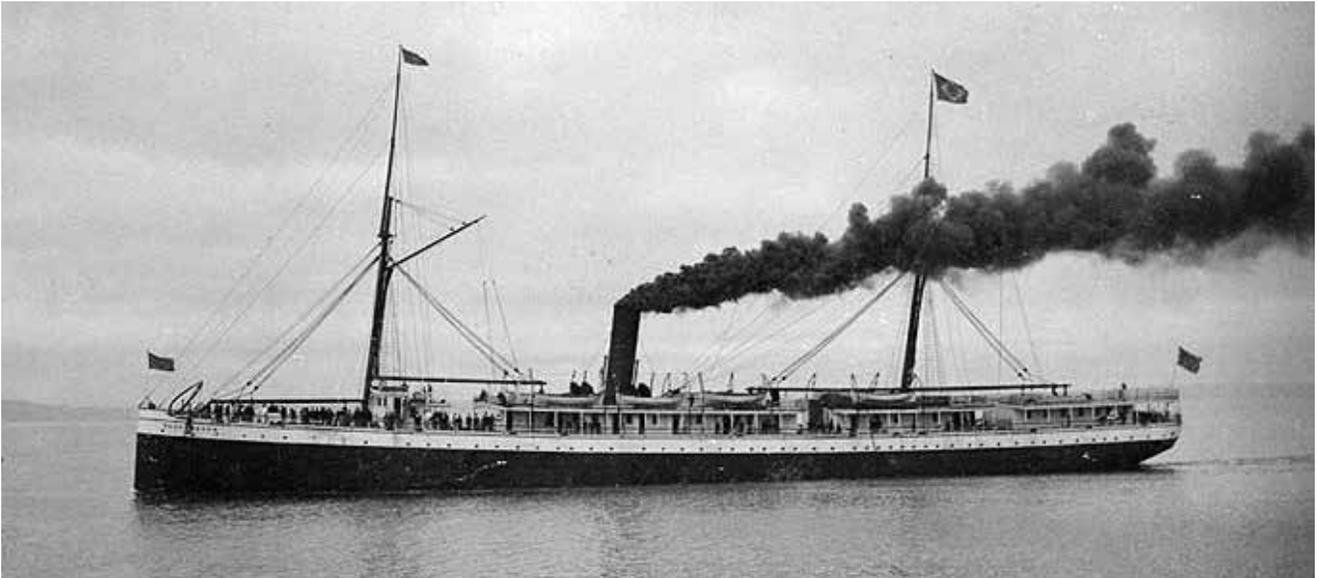
2. Airline Travel Has Positive Environmental Impacts

Some decry the internal combustion engine, and commercial aviation's use of it, because of its tailpipe emissions. They advocate for a return to simpler, less-polluting forms of mass transportation. However, it should be remembered that oceanic transportation prior to the advent of the internal combustion engine consisted of slow-moving ships powered by wind or coal, which made dangerous ocean crossings. On land,



Getty Images © kieferpix

¹⁵ www.bts.gov/content/transportation-fatalities-mode



Wikimedia Commons © Wilhelm Hester

coal-smoke-spewing trains and horse-drawn conveyances were the primary means of mass transit just a little more than 100 years ago. The world prior to the internal combustion engine and commercial aviation was actually much more dangerous for travelers and much more polluted than the one we live in today.

An online curator of the history of the United Kingdom explains the horse-powered environmental nightmare of the late 19th century, and its technological solution (i.e., the internal combustion engine), this way:

By the late 1800s, large cities all around the world were ‘drowning in horse manure.’ In order for these cities to function, they were dependent on thousands of horses for the transport of both people and goods. In 1900, there were . . . over 50,000 horses transporting people around [London] each day. On average a horse will produce between 15 and 35 pounds of manure per day, so you can imagine the sheer scale of the problem. The manure on London’s streets also attracted huge numbers of flies which then spread typhoid fever and other diseases. But this wasn’t just a British crisis: New York had a population of 100,000 horses producing around 2.5 million pounds of manure a day. The terrible situation was debated in 1898 at

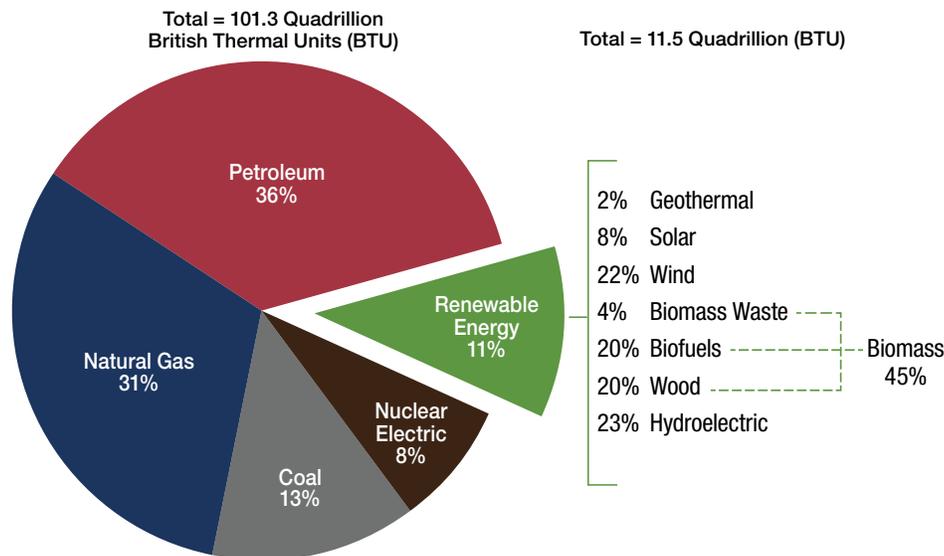
the world’s first international urban planning conference in New York, but no solution could be found. It seemed urban civilisation was doomed. However, necessity is the mother of invention, and the invention in this case was that of motor transport. Henry Ford came up with a process of building motor cars at affordable prices. Electric trams and motor buses appeared on the streets, replacing the horse-drawn buses. By 1912, this seemingly insurmountable problem had been resolved; in cities all around the globe, horses had been replaced and now motorised vehicles were the main source of transport and carriage.¹⁶

Jet aircraft represented a vast improvement in safety, speed, and comfort over their reciprocating-engined predecessors, but the earliest jet engines spewed highly noticeable carbon-based particulates in their wake and were very noisy. Today’s jet engines produce much less tail pipe emissions, burn a fraction of the fuel, and are significantly quieter. As shown in Chart 2, commercial aviation is a very small contributor to humanity-caused CO₂, and emissions are substantially reduced with each new generation of aircraft.

Electric vehicles, including small electric aircraft, are gaining popularity, and for good reason. They are very powerful, quiet, and cost much

¹⁶ www.historic-uk.com/HistoryUK/HistoryofBritain/Great-Horse-Manure-Crisis-of-1894/

Chart 2
U.S. Primary Energy Consumption by Energy Source, 2018



Note: Sum of components may not equal 100% because of independent rounding.
Source: U.S. Energy Information Administration²², *Monthly Energy Review*, Table 1.3 and 10.1, April 2019, preliminary data.

less to operate than vehicles powered by internal combustion engines, and are coming down in price as battery technology advances and manufacturer competition increases. Yet even with electric “zero emission” vehicles, it is often overlooked that the production of electric energy results from a primary energy-producing source, 85 percent of which is still derived from carbon-based fuels (e.g., petroleum, natural gas, coal, and biomass), as Chart 2 depicts.

Those opposing air travel on environmental grounds may have the best of intentions for the planet, but they are profoundly mistaken if they believe that reducing air travel will also reduce pollution. In fact, just the opposite would occur:

- According to the founder of an internationally recognized ecotourism firm, a decrease in airline flying would put heavily forested parts of the world in jeopardy. In the absence of tourism, landowners in underdeveloped countries would remove forests, which absorb CO₂, and raise cattle on the land instead. This would have the net effect of greatly increasing CO₂ emissions.¹⁷

- A reduction in air travel would result in a commensurate lessening of capital resources airlines need to purchase new, less-polluting aircraft.
- Travel by all other means is less safe and results in an emissions increase in all modes but rail.

No one knows what the future may hold for further technological breakthroughs in aircraft propulsive power. Perhaps a new type of engine will be developed which does not rely on any carbon-based fuels. Even as new and innovative concepts are developed, the airline and aerospace industries are successfully making continual and effective changes to today’s technology to decrease fuel burn, atmospheric pollution, and noise.

3. Airline Operations Are Green and Getting Greener

Air transportation provides a significant and growing portion of public transportation and shipping around the globe. According to ATAG, in 2018 approximately 4.4 billion passengers and 61.9 million tons of cargo were carried on 41.9 million

¹⁷ “What if All That Flying Is Good for the Planet?,” *New York Times*, November 19, 2019, Costas Christ.

¹⁸ www.eia.gov/energyexplained/us-energy-facts/

commercial flights operated by 1,300 airlines using 31,700 commercial aircraft.¹⁹ As impressive as these numbers are, however, the industry's continual increase in fuel efficiency and emissions reduction is even more so, as demonstrated by the following:

- Aviation accounts for only 2 percent of the global CO₂ emissions resulting from human activity.
- CO₂ emissions per seat mile have dropped 80 percent since the first jet aircraft.
- Perceived noise from aircraft has been reduced by 75 percent since the first jet aircraft.
- Fuel efficiency increased by 2.1 percent each year across the entire fleet from 2009 to 2016.
- Over 10 billion tons of emitted CO₂ have been avoided since 1990.
- Airlines have spent \$1 trillion on more than 12,200 new, highly fuel-efficient aircraft since 2009.
- Civil aerospace interests spend \$15 billion annually on efficiency-related research and development.
- Work on sustainable, lower-emitting aviation fuels could reduce CO₂ emissions as much as 80 percent compared with traditional fuel. An expected one million flights powered by an alternative fuel blend will take place by the end of 2020.
- Air traffic management modernization is greatly contributing to increased capacity, improved efficiency, and reduction of CO₂ emissions.
- The industry is working with governments to implement the world's first market-based measure to offset international aviation's CO₂, as described herein.

The airline and aerospace industries have jointly made continual improvements to airframes and engines which result in quieter, more powerful, more efficient, and less polluting air travel. For example, a Boeing 787-8 traveling from New York

to Los Angeles will consume fuel at the equivalent of 104 miles per gallon per seat²⁰ and make the trip in a little more than six hours. This level of fuel efficiency directly competes with the most fuel-efficient electric cars on the road, but does so while traveling 10 times faster, and with safety that greatly exceeds that found on the highways.

Airlines have voluntarily adopted numerous programs to reduce their environmental impacts, including tree-planting programs, new electric-powered tugs to reduce fuel consumption by aircraft and ground vehicles while taxiing, and aircraft operating procedures which reduce fuel consumption, among other such activities.

4. The Industry's Ambitious Environmental Goals

According to the International Air Transport Association, the industry has achieved a 50 percent reduction in carbon emissions per passenger since 1990 and fuel efficiency has increased 2.3 percent since 2009.²¹ However, work continues to further limit environmental impacts from aviation with three goals:

1. Increase the average aircraft fuel efficiency by 1.5 percent annually from 2009 to 2020. (The industry has thus far exceeded that goal by more than 50 percent with a 2.3 percent annual improvement.)
2. Cap net aviation CO₂ emissions starting in 2020.
3. By 2050, reduce net aviation CO₂ emissions by 50 percent, as compared to 2005 levels.

The airline industry is using four means to reach those goals:

1. New technologies, including alternative fuels.
2. Improved aircraft operational efficiency.
3. Improved infrastructure, including traffic systems.
4. Use of a single, global market-based measure for offsetting emissions as needed.

¹⁹ "Aviation Benefits Beyond Borders," Air Transport Action Group, 2018.

²⁰ <https://leehamnews.com/2014/12/08/737-max-8-could-be-enabler-for-some-lcc-long-haul/>

²¹ www.iata.org/en/policy/environment/climate-change/

5. Enhanced Operational Procedures and Air Traffic Services

According to the Eno Center for Transportation, “Aviation is part of the lifeblood of modern economies, moving people and goods around the nation and the globe. The American economy literally could not function without it and a tremendous collaborative effort of industry and government maintains the safest airspace in the world.”²² The safe and efficient control of aircraft in the navigable airspace has a great bearing on capacity, efficiency, and environmental impacts.

PILOT PROCEDURES

The following are examples of procedural improvements that pilots use to enhance operational efficiency and save fuel, when safety can be maintained:

- **Single-engine outbound taxi**—Under certain conditions, it is not necessary that all aircraft engines be operated to taxi on the ramp or taxiways. When conditions permit, only one engine on twin-engine jets or fewer than all engines on aircraft with three or more engines may be started until the latter stages
- **Engine shutdown during inbound taxi**—Under certain conditions, once the aircraft has cleared 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.
- **Use of auxiliary power units (APUs)**—The aircraft APU is an auxiliary engine that provides supplemental power to the aircraft, usually while on the ground. Procedures have been developed to minimize the use of these units, thus reducing both emissions and fuel consumption.
- **Technology-enhanced departure procedures**—New procedures are being developed with the aid of area navigation and required navigation performance technology, which permit shortening the distance and time traveled during approach and departure.



²² www.enotrans.org/issues-and-modes/aviation

- **Optimal altitude**—Each 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 an optimal altitude in order to conserve fuel, which also reduces emissions.
- **Optimal speed flight plans**—Planning and operating a flight at efficient speeds can also save fuel. Pilots can optimize fuel burn based on aircraft weight, winds, and other atmospheric conditions, given air traffic control restraints and safety considerations.
- **Continuous Descent Arrival (CDA)/ Optimized Descent Procedure (ODP)**—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 approach and landing. The CDA, or what may also be called an ODP, permits pilots to reduce power on all engines and not use significant thrust until safety concerns dictate establishing a stabilized

approach configuration prior to landing. This procedure does not always work at all airports 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**—Taking advantage of improved technology, appropriately equipped aircraft can fly at 1,000 feet of vertical separation—compared with 2,000 feet previously—at higher altitudes. This technology-enabled operational change added six additional altitudes at the higher flight levels, increasing the opportunity for pilots to fly at the optimal, most fuel-efficient altitude, and provide for greater airspace utilization/capacity.

AIR TRAFFIC MANAGEMENT SERVICES

The FAA and industry are transitioning to the Next Generation Air Transportation System (NextGen). This modernized NAS is planned to be fully implemented by 2025 and will transform the current ground-based air traffic navigation and surveillance system to a state-of-the-art satellite-based system. The FAA has already



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achieved numerous critical NextGen milestones. They have initiated and expanded satellite-based surveillance, improved airport runway access, increased safety and efficiency on the ground, and enhanced airspace safety and operations. NextGen technologies and procedures, along with airspace redesign, have enabled more direct routes and more efficient operations while using less fuel and reducing emissions.

Based on the FAA's 2016 NextGen Implementation Plan, numerous initiatives are underway that do or will reduce aircraft fuel burn and emissions. Nav Canada invested heavily in a system similar to NextGen called the Canadian Automated Air Traffic System, the most ambitious and complex modernization project in the country to date. Now fully operational, this flight-data processing system has realized key safety, efficiency, and time-saving decision-support tools that have significantly reduced the carbon footprint of airliners as they navigate throughout Canada. Appendix B provides a summary of these activities.

6. Less-Polluting, Sustainable Aviation Fuel

Electric aircraft development notwithstanding, jet fuel is now and will for the foreseeable future be the "lifeline" of aviation. For the industry to survive, jet fuel must be available in large quantities at a reasonable price. Fuel costs are traditionally the airlines' largest expense category, so the carriers have strong, competitive motivations for reducing its use to the maximum practical extent. As such, the industry is seeking to develop and deploy commercially viable, environmentally friendly, alternative and sustainable aviation fuels. Enormous amounts of capital, as well as committed research and development, are required to advance science and technology, all of which are essential to produce new sources of energy, increase fuel efficiency gains, and reduce CO₂ emissions.

In this regard, ALPA is supportive of the work of the Commercial Aviation Alternative Fuel Initiative (CAAFI),²³ which began in 2006 with the collaboration of airlines, aircraft manufacturers, and the scientific community to develop new and better sources of fuel for aviation. CAAFI's long-term goal

is to "facilitate the development and deployment of alternative jet fuels that will significantly reduce emissions associated with aviation operations in commercially meaningful quantities while improving price stability and supply security. The availability of fuels produced from renewable feedstocks and/or other waste-streams will help operators reduce aviation's net carbon footprint, even as aviation activity increases."

The organization further states that it is "confident that sustainable aviation fuel derived from several feedstocks will be commercially available in the next one to five years and is working with other stakeholders to enable various industry goals. This includes the commitment of the commercial airlines and States to achieve net carbon-neutral growth in international aviation from 2020 onward. The types and volumes of alternative fuels reaching the marketplace will depend on many factors, including the extent of governmental support [R&D and policy], new technological developments, and investor interest."

Experiments and demonstration flights are being conducted in both commercial and military aircraft using biofuels and synthetic jet fuels. Research will continue to examine the feasibility of these alternative fuel sources.

As of this writing, ALPA-supported legislation is before Congress which would provide tax relief on a per-gallon basis for sustainable aviation fuel used by commercial airlines.

7. Future Aircraft

The evolution of electric-powered vehicles is now underway and expanding into commercial aviation. In late 2019, a seaplane company in Vancouver, Canada, became the first airline operator to conduct a flight using an electric-powered aircraft: a retrofitted, six-passenger DeHavilland Beaver. The company declared that "this historic flight signifies the start of the third era in aviation—the electric age."

Buttressing that viewpoint, an Israeli firm, Eviation Aircraft, has developed a prototype electric aircraft that can carry nine passengers up to 650 miles and

²³ www.caafi.org

is expected to enter commercial service with a U.S. carrier in 2022. Because of the dramatically lower fuel and maintenance costs associated with electric aircraft as compared to those powered by carbon-based fuels, the future appears to be very bright for the development of new, small airliners designed to serve short routes.²⁴ Larger aircraft serving long routes, however, are not suited for propulsion by today's electric technology.

Because of their very low costs per mile, new electric aircraft could greatly increase the availability of air travel to small communities which are presently underserved by the airlines and/or rely on government-subsidized airfares, and do so with zero emissions from the aircraft.

8. A Global Carbon-Offsetting Mechanism for Airlines

In 2016, the International Civil Aviation Organization (ICAO) created a global market-based measures (MBM) scheme in the form of the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) which will help achieve carbon-neutral growth by 2020. ALPA supported the development of CORSIA as a means of standardizing and centralizing market-based measures in lieu of each ICAO state developing their own MBMs in a patchwork fashion

across the world. ICAO describes CORSIA in the following way:

“The CORSIA has been adopted as complementary to the broader package of measures to help ICAO achieve its aspirational goal of carbon-neutral growth from 2020 onwards. CORSIA relies on the use of emissions units from the carbon market to offset the amount of CO₂ emissions that cannot be reduced through the use of technological and operational improvements, and sustainable aviation fuels.

The approach for CORSIA is based on comparing the total CO₂ emissions for a year [from 2021 onwards] against a baseline level of CO₂ emissions, which is defined as the average of CO₂ emissions from international aviation covered by the CORSIA for the years 2019 and 2020 . . . In the following years, any international aviation CO₂ emissions covered by the CORSIA that exceed the baseline level represent the sector's offsetting requirements for that year.”²⁵

Airlines began monitoring, verifying, and reporting their emissions on all international flights on



An electric-powered Eviation Aircraft “Alice” prototype, expected to enter commercial service in 2022.

²⁴ www.bbc.com/news/business-48630656

²⁵ www.icao.int/environmental-protection/CORSIA/Documents/CORSIA_FAOs_October%202019_final.pdf

January 1, 2019. Operators will purchase “emissions units” to offset whatever CO₂ emissions growth they experience.

THE ROLE OF GOVERNMENTS

Taxes on air travel in North America and elsewhere around the world are as high as “sin taxes,” which are intended to reduce the public’s participation in a vice (e.g., high taxes on cigarettes). Despite that, some governments are proposing to further increase taxes on airline tickets and the airlines in a misguided effort to reduce passenger demand for air travel and thereby lessen the industry’s environmental impacts. Instead of burdening the industry with confiscatory levels of taxation, governments should actively support the airline and aerospace industries in their quest for highly efficient, very-low-emissions aircraft and fuels.

Governments can provide this support in specific ways:

- Substantially reduce taxes on airline tickets and the airline industry. Doing so will help consumers use the safest and fastest form of travel available, and help the airlines purchase newer and less-polluting aircraft fleets more quickly.
- Provide sufficient and timely funding for necessary improvements to the national airspace. Funding the national airspace system’s implementation of NextGen and associated procedural improvements modernization components, including aircraft equipage, could eliminate as much as 15 percent of today’s delays, increase safety and capacity, and concurrently reduce emissions.
- Fully fund important infrastructure improvements including runway and taxiway additions and improvements. Poor airport designs, including those with intersecting runways, increase taxi time and fuel use. Adding high-speed taxiway exits from runways can reduce runway occupancy time and thus increase airport capacity. Additional runways reduce overhead noise, fuel wasted

in holding patterns, and long queues of aircraft waiting for takeoff.

- Encourage and provide funding for research, engineering, and development of new, sustainable aviation fuels which are cost-competitive with traditional fuel sources and emit less life-cycle CO₂ than traditional fuels.
- Encourage and provide funding for research, engineering, and development of noise-reducing technologies and systems including engines and airframes.
- Provide tax incentives for airlines to use sustainable aviation fuels and technologies which reduce CO₂ emissions.

CONCLUSIONS

Aviation is a good-news story for the traveling public and the environment. The airlines safely move billions of passengers and millions of tons of freight around the world at great speed each year, and with no greater impact on the environment than most other modes of transportation, and much less than some.

Despite these facts, airline travel has become a target by those who condemn the industry for being a driver of climate change. The aviation industry should do much more than it is currently to inform the public of its numerous environmental achievements and goals to counter industry-threatening misinformation about airline travel, including flight shaming, which is prevalent and growing.

The industry is poised to make greater strides in reducing emissions through technology and operating procedures. The best way to achieve those results is the same way that such great advances have been made thus far, namely, through investments in increasingly advanced technology and enhanced operational procedures.

APPENDIX A

Recommendations

- The aviation industry should devote more of its marketing and public messaging to inform the traveling public of its environment-related accomplishments and its plans for even greater success in the future. The traveling public needs to get the facts from the industry to counter misinformation from those who oppose airline travel on a flawed premise.
- Governments should:
 - Substantially reduce taxes on airline tickets and the airline industry. Doing so will help consumers use the safest, fastest form of travel available, and help the airlines purchase newer and less-polluting aircraft fleets more quickly.
 - Provide sufficient and timely funding for necessary improvements to the national airspace. Funding the national airspace system's implementation of NextGen and associated procedural improvements modernization components, including aircraft equipage, could eliminate as much as 15 percent of today's delays, increase safety and capacity, and concurrently reduce emissions.
 - Fully fund important infrastructure improvements including runway and taxiway additions and improvements. Poor airport designs, including those with intersecting runways, increase taxi time and fuel use. Adding high-speed taxiway exits from runways can reduce runway occupancy time and thus increase airport capacity. Additional runways reduce overhead noise, fuel wasted in holding patterns, and long queues of aircraft waiting for takeoff.
 - Encourage and provide funding for research, engineering, and development of new, sustainable aviation fuels which are cost-competitive with traditional fuel sources and emit less life-cycle CO₂ than traditional fuels.
 - Encourage and provide funding for research, engineering, and development of noise-reducing technologies and systems including engines and airframes.
 - Provide tax incentives for airlines to use sustainable aviation fuels and technologies which reduce CO₂ emissions.

APPENDIX B

U.S. NextGen Improvements

Environment and Energy	
Integrated Environmental Modeling	Better modeling capabilities allow better assessment of noise and emissions which leads to improved airspace and operating decisions for reduced environmental impact.
NextGen Environmental Engine and Aircraft Technologies	This initiative performs engineering, research, and development on ways to improve the fuel efficiency and reduce the noise of aircraft engines and airframes.
Sustainable Alternative Jet Fuels	Research is ongoing to develop acceptable non-fossil fuel alternatives for powering jet engines such as biofuels.
Improved Surface Operations	
Revised Departure Clearance via Data Communications	By enabling reroutes to be transmitted via data communications to taxiing aircraft, time is saved by eliminating voice transmission and readback, and the need for flight crews to manually type in clearances, reducing the amount of time needed. Between June 2016 and May 2019, an estimated 7.88M kg of CO ₂ emissions were prevented by use of revised departure clearance.
Surface Traffic Management	By using departure runway scheduling, aircraft can enter a virtual departure queue while remaining at the gate with engines off. Taxi times are reduced to the minimum required to move from gate to the runway and stage for departure.
Enhanced Departure Flow Operations	By maximizing the ability to depart aircraft over departure fixes, fewer aircraft wait in departure taxi queues, and taxi out times are reduced. Smaller departure queues also lead to less noise in the surrounding community.
Improved Approaches and Low Visibility Operations	
Ground Based Augmentation, Enhanced Flight Vision, and Synthetic Flight Vision Systems	In addition to capacity gains, these NextGen capabilities improve the likelihood that an aircraft will be able to land at an airport regardless of weather conditions, which reduces diversions to alternate airports. The reduction of time spent holding and flying to alternate airports.
Performance Based Navigation	
Optimized Profiled Descents, RNAV Arrivals	These procedures allow for descents which are shorter and minimize level flight, reduce use of vectoring, and allow for lower engine-power settings.
Metroplex Design	The development of optimized aircraft flows in large, metropolitan areas enables the implementation of optimized profile descents and RNAV arrivals rather than ATC vectors.

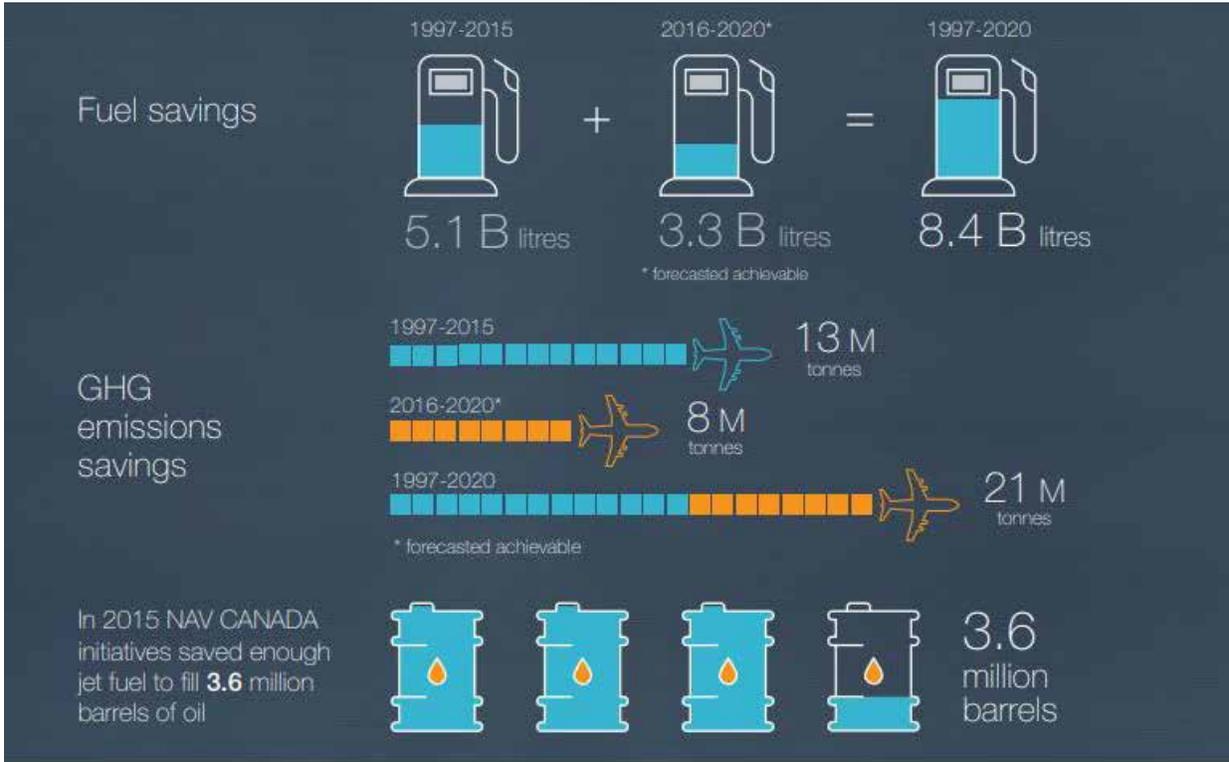
Time-Based Flow Management	
Time-Based Metering (TBM) Using RNAV/RNP Routes	The goal of managing NAS flows using time-based metering (e.g., runway scheduling) is to maximize runway capacity and minimize fuel use. By managing traffic flows over all sectors feeding an airport rather than just the closest ones, aircraft can fly efficiently with minimized vectoring and level altitudes.
TBM in Terminal, Improved Arrival/Surface/Departure Flow Operations, ADS-B Interval Management	Extending metering into the terminal and surface areas ensures the integrity of strategic flow and that those benefits are not lost in the terminal area by vectoring, long final approaches, and level-offs. ADS-B interval management helps ensure that the schedule is met at the runway threshold. Departure metering also reduces taxi-out times.
Collaborative Air Traffic Management (ATM)	
Full Collaborative Decision Making, Traffic Management Initiatives with Flight-Specific Trajectories, Initial Flight Day Evaluation, Advanced Flight Day Evaluation	The NAS operates most efficiently when there are no ceiling/visibility issues at airports and no severe weather. Since weather conditions are a daily occurrence, these NextGen capabilities help ensure that flights operate into airports with enough capacity. These capabilities help operators choose the most fuel-efficient routings around severe weather, and delay aircraft before they leave the gate.
Separation Management	
ADS-B In-Trail Procedures, Oceanic Climb/Descent Procedures, Approval of User Requests in Oceanic Airspace, Preferred Routing in Constrained Oceanic Airspace	These initiatives allow aircraft flying in oceanic airspace to cruise at their most efficient altitudes more frequently.
On-Demand NAS Info	
On-Demand NAS Information, Provide NAS Status to FOC/AOC, Improved Management of Special Activity Airspace	These capabilities give operators the most current information about potential constraints to their route of flight, thereby allowing efficient flight plans and routes to be filed.

Air Traffic Improvements in Canada

Nav Canada’s environmental corporate objective is “to introduce measurable benefits which contribute to the reduction of the environmental footprint of the aviation industry. We apply that objective by helping our customers conserve fuel and reduce greenhouse gas emissions while considering ways to reduce the impacts aircraft operations have on communities.”

ALPA is and has been engaged in the effort to make air traffic management efficiencies possible by participating on several Nav Canada committees to provide the pilot’s operational perspective on changes to procedures, separation standards and other measures that may have an adverse effect on safety. Through these efforts ALPA helped Nav Canada achieve remarkable reductions in emissions as well as improving efficiencies, as shown below.

Source: www.faa.gov/nextgen/media/NextGen_Implementation_Plan-2016.pdf



Source: Nav Canada, www.navcanada.ca/EN/about-us/Documents/CIFER_English_Final_Medium_Res.pdf



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