Environmental impact of aviation

Aviation contributes approximately 2 percent of total greenhouse gas emissions, a figure which is projected to grow through 2050. Although fuel efficiency has improved by nearly 16 percent since the 1990s, future technologies—including better flight patterns, more-efficient engines, and alternative fuels—have promise for further emissions reductions. The profitability challenges of the early twenty-first century, however, affect the industry's ability to invest in new technology.

Globally, air travel was estimated to be responsible for approximately 480 million tons (~435 million metric tons) of carbon dioxide emitted into the atmosphere in the year 2000. With the rapidly increasing onset of global warming, high carbon intensive industries (such as airlines) must find sustainable strategies to maintain growth and profitability or risk further damage to the world's environment. (Hill, 2010 17-22) Scientific analysis and debate concerning greenhouse gases and global warming have brought air quality to the forefront in the environmental community and general public concern.

The future FAA 5050 Handbook will most likely consider assessment guidelines for potential impacts resulting from emissions of air toxics from aircraft engines, ground vehicles, and other point sources at airports. Although jet engines built after 1982 emit about 85 percent less unburned hydrocarbons than jet engines built in the 1970s, and CO emissions have decreased by 70 percent, increased operations have significantly affected air quality. Air carrier airports have begun to face the task of evaluating their contributions to air quality, in accordance with the EPA General Conformity Rule within nonattainment areas.

EAs prepared in the new millennium will also focus on source emitters on the ground (idling aircraft, auxiliary power units, ground support equipment, vehicular traffic) as well as the aircraft emissions in cruise. Subsonic and supersonic aircraft emissions affect air quality in different manners, both of which have an impact on the global atmosphere. (Hill, 2010 17-22) Worldwide, passenger traffic is expected to grow 5% annually at least to 2015. Fuel use is only projected to grow 3% per year due to fuel efficiency improvements.

The earth's temperature could increase 1. 6 degrees F by 2050, and the aviation contribution to that is estimated to be 0. 09 degrees. Aircraft and engine technology improvements could increase fuel efficiency by 20% by 2015, and 40-50% by 2050. In particular there is work to reduce Nox emission by 70% during takeoffs and landings. Operational improvements may decrease fuel burned in aviation activities by 6-18%, with an additional 6-12% coming from air traffic management improvements.

Environmental Impact of Aviation Operations, 2005) The overall expected improvements in technology are not expected to completely offset the general increase in the numbers of flights and aircraft operations in the next 50 years. Fuel dumping, or jettisoning of fuel in-flight is performed in situations where the aircraft gross weights needs to be reduced in order to permit a safe landing. Many aircraft take off with gross weights above their designed landing weight. An emergency or diversion then could necessitate landing prior to their flight plan, leading to having to land over their gross weight.

Fuel is then jettisoned in flight to reduce the weight of the aircraft. Most of the fuel that is dumped turns into vapor within a few minutes. If jettisoned above 5000 feet in above freezing temperature calculations show that 98% will evaporate before reaching the ground. The fuel vapors rapidly dissipate and diffuse. This could contribute to photochemical oxidant pollution, smog. The portion that remains in droplet form could lead to condemnation of water, and possibly cause some local rain. When these droplets settle to the ground, usually they are spread over a wide area, minimizing their effect.

Environmental Impact of Aviation Operations, 2005) Noise analysis and impact criteria will certainly undergo a profound change in the next millennium. Significant improvements in technology, in conjunction with regulatory mandates, have reduced noise impacts steadily over the last 20 years. This downward trend, which is based on today's evaluation metrics, is expected to continue through 2025. However, as the volume of operations continues to increase, so too will the overall noise impact and footprint. One would expect noise standards and models to change also.

For example, in response to public sensitivity, the U. S. National Park Service has already begun review and consideration of new noise standards in wilderness areas. (Hill, 2010 17-22) A survey completed by the Government Accounting Office of the 50 busiest commercial airports, accounting for 80% of air carrier operations in 1998 revealed that noise, water, and air quality were the top three concerns. About 90% of the management of these airports thought that balancing environmental concerns with airport operations was much more or somewhat more difficult than it was in 1989.

Because 13 of these facilities were at or above capacity with another four considered to be at capacity in the following 1-2 years, the pollution concerns were only is compounded. Two thirds of these airports were planning to build new or extend existing runways in the next ten years. There was growth not only in airport operations and in air travel, but travel to and from the airport. (Environmental Impact of Aviation Operations, 2005) Noise was considered the most serious concern for the airports.

Issues with nearby land use was their third biggest concern, which is directly linked to the noise issue because of a federal mandate that noise above a certain level to be incompatible with homes and school use of the land. Considering the future, many of these managers consider air quality to be their biggest concern. The noise issue of reported greatest concern was that aircraft jet engines are still too loud, even with the national standards for quiet engines that have been implemented. This relates to the encroachment of residential areas on the airport.

Under federal land use rules, the noise limits for residential and school building from aircraft operation are 65 dB. Yet half of these busiest airports have between 1, 000 and 25, 000 people living within an area where sound levels reach 65 dB or more. Many noise complaints are still received from outside of this area. Most airports monitor noise levels daily. Noise abatement procedures are required or encouraged, such as ground run-up limitations or restrictions, preferential use of certain flight paths, and limits on uses for certain runways. Environmental Impact of Aviation Operations, 2005) There have been several ideas that have been suggested to decrease air pollution concerns from aviation activities: Increasing fuel efficiency and other aircraft engine improvements. Decreasing taxiing and, therefore ground aircraft emissions by improving the timing and therefore the efficiency of departures. Assigning aircraft to runways that minimize the time and distance on the ground. Shutting down one or more engines early. Towing airfact between taxiways and gates.

Provide electricity and preconditioned air at the gates to reduce aircraft fuel use. (Environmental Impact of Aviation Operations, 2005) Air quality and noise are likely to remain the central operational impact issues in environmental documentation into the new millennium, although the discussion of these concerns will undergo change in terms of both types of impacts considered and methods of evaluation. Similar changes are probable in the discussion of other operational impacts, including surface vehicle traffic, social and economic effects, and energy supply.

The assessment of geographical impacts will also be subject to new considerations in the future. GRAY-MULLEN 1-6) Knowing more about the environmental impacts of aviation is increasingly essential, but according to Ian Waitz, it is also an area where uncertainties abound. One thing we know for sure is that the airplanes developed today will be flying for next 30 years, as the fleet dynamics are very stable, due to the extraordinary costs and lead-time to design and build. Meanwhile, an increasingly affluent population will travel more, and more of that travel will take place on today’s airplanes.

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the extraordinary costs and lead-time to design and build. Meanwhile, an increasingly affluent population will travel more, and more of that travel will take place on today's airplanes. Waitz and his students have been developing state-of-the art modeling impacts, and advising the Federal Aviation Agency (FAA).

He characterizes the environmental impacts of aviation into three broad categories. The most omnipotent impact, noise pollution, is associated with quality-of -life issues, health, and property loss. Waitz observes that noise pollution is observed by the public, typically at levels of 55 to 70 decibels. It is estimated to cost about half a billion dollars in property losses within the United States. The aviation industry is able to mitigate some of this burden on homeowners from a dedicated tax on ticket revenue.

A second environmental impact results from gaseous pollutants that interact in the atmosphere, or more generically, " atmospheric chemistry and physics". Unfortunately, the state-of-the -art has two known limitations: first, measurements are taken in conditions under 3000 feet, which is beneath airplane cruising levels. Second, long downwind effects of the pollutants are relatively unanalyzed, for example, down-winds that travel from Europe towards the East. The third environmental impact, perhaps the best debated one, centers on global climate change.

Waitz points out that there are many counterbalancing effects; for example, ozone creation may be a warming effect in the Northern Hemisphere but methane is a cooling effect globally. Scientists know that the largest non CO2 effects are created by contrails from aircraft that recombine as cirrus clouds. Yet, these clouds might either trap heat, or reflect it. To date, government regulation of the airplane fleet has focused on reducing NOx, Even that is complicated, since more efficient fuels and engines can create more NOx.

The FAA has strict guidelines to ratchet-down, over time, NOx produced by aircraft take-offs and landings. Waitz walks through the many projections, scenarios, and Monte Carlo simulations that underlie the government policy. He notes that whether or not there is complete information, decisions continue to be made, engine and fuel standards are set, and the environmental burden of aviation will continue to increase. Knowing more about the environmental impacts of aviation is increasingly essential, but according to Ian Waitz, it is also an area where uncertainties abound.

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