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Addressing airport community noise impacts: FAA's current efforts and future plans

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ABSTRACT

The Federal Aviation Administration (FAA) is working to meet the continued growth in air transportation demand with the Next Generation Air Transportation System, or NextGen for short. One factor that could constrain our ability to increase the capacity of our National Airspace System in order to meet demand is aviation's environmental impact on airport communities. FAA's work to mitigate the environmental impacts of aviation includes research to advance the state of knowledge on aviation noise, emissions, and alternative fuels, as well as efforts to quantify the tradeoffs between reducing aviation noise and exhaust emissions, and compute the relative costs and benefits among alternative environmental solutions. This paper focuses on FAA's current efforts and future plans to achieve the goal of reducing significant impacts due to aircraft noise in absolute terms while enabling air traffic growth.

1. INTRODUCTION

The Federal Aviation Administration (FAA) is working to meet the multiple challenges of significantly improving "safety, security, capacity, efficiency, environmental compatibility of air transportation operations" with the Next Generation Air Transportation System, or NextGen for short. NextGen's success rides in part on successfully sustaining aviation's continued indispensable role in the nation's economy while protecting the environment.

The aviation industry contributes about $640 billion annually to the US economy, generating about 9 million US jobs that earn $314 billion in wages.[1] US air carriers transport high-value goods with an average value per ton of $75,000, about 100 times the average value of goods transported solely by trucks.[2] FAA forecasts that the US industry will be enplaning 1.3 billion passengers and transporting 96.5 billion revenue-ton-miles of cargo by 2025, almost doubling the passengers enplaned and more than tripling the revenue-ton-miles of cargo transported in 2000.[3] Commuter and air taxi operations as well as general aviation operations are also forecast to rise at an annual average rate of 2.7 percent and 2.1 percent, respectively.[3]

However, accommodating such growth in aviation activity will require additional capacity beyond already planned improvements, such as new runways and as many as four new major commercial service airports according to the FAA's Future Airport Capacity Task 2 Report.[4] With aviation congestion delays estimated to cost stakeholders about $5 billion annually in recent years, the business case for increasing airport capacity is strong.[1] But building capacity will be hampered without an aggressive program to address the environmental consequences of aviation growth. National aeronautics research priorities thus include environmental research goals and objectives outlined in the National Plan for Aeronautics

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Research and Development and Related Infrastructure.[5] In support of FAA efforts towards meeting these national goals, the President's Budget request for fiscal year 2009 more than doubled the environmental research and development budget for FAA's Office of Environment and Energy.

In the last ten years, FAA's work to mitigate the environmental impacts of aviation includes research to advance the state of knowledge on aviation noise, emissions, and alternative fuels, as well as efforts to quantify the tradeoffs between reducing aviation noise and exhaust emissions, and compute the relative costs and benefits among alternative environmental solutions. This paper focuses on FAA's current efforts and future plans to achieve the goal of reducing significant impacts due to aircraft noise in absolute terms while enabling air traffic growth.

2. FAA STRATEGIC FRAMEWORK TO ADDRESS NOISE IMPACTS

A framework which illustrates the diverse but inter-related elements of the FAA's strategic efforts to accomplish the noise goal is shown in Figure 1. How to reduce the impacts of aviation noise efficiently and effectively without curtailing growth requires two major concurrent efforts: one in which we seek to continuously improve our understanding of the noise problem, and another in which we continue to develop and implement a variety of solutions or approaches to mitigate the problem.

Executing the FAA noise strategy outlined in Figure 1 involves interaction, in multiple domestic and international venues, with aviation's stakeholders: airport community groups, airframe and engine manufacturers, air carriers, airports, pilots, the flying public, aviation and environmental consultants, researchers, other governmental agencies (local, regional, state, federal), and other nations' aviation authorities. Representatives of these stakeholders have opportunities to collaborate on environmental research topics through advisory boards such as the FAA Research and Development Advisory Committee (REDAC), policy planning offices such as the National Science and Technology Council (NSTC) and the Joint Planning and Development Office (JPDO), inter-agency groups such as the Federal Interagency Committee on Aviation Noise (FICAN), research forums such as the National Academy of Sciences' Transportation Research Board (TRB), and international organizations such as the United Nations International Civil Aviation Organization (ICAO).

The FAA funds the Department of Transportation's Volpe National Transportation Systems Center, universities, and industry to conduct research, data acquisition, and environmental tool development. Among the universities funded by the FAA are those participants in the Partnership for AiR Transportation Noise and Emission Reduction (PARTNER) Center of Excellence co-sponsored by Transport Canada and NASA. The TRB's Airport Cooperative Research Program (ACRP) serves as another vehicle for the FAA to fund studies that will help us understand as well as devise solutions to the aviation noise problem. The ACRP started in October 2005 and several of the almost 100 authorized studies to date are pertinent to aviation noise.

Details of each element in Figure 1 of the FAA's strategy to address the noise problem follow, starting with the "solution" or mitigation half of the elements, which comprise: guidance, policy, and regulations; noise mitigation strategies; and effective community outreach.

A. Solutions

1. Guidance, Policy, and Regulations

The FAA participates in domestic and international efforts to develop guidance, policy, and regulations associated with aviation noise. The global nature of the industry requires that the

FAA play an active role in the environmental activities of the ICAO Committee on Aviation Environmental Protection (CAEP). It is through ICAO that new international standards for aircraft noise and engine exhaust emissions are set, such as the stricter Chapter 4 noise limits for applications for certification of new types of aircraft as of January 2006. The FAA has adopted the Chapter 4 standard as Stage 4 in Part 36 of Title 14 of the Code of Federal Regulations.

ICAO has established three environmental goals:

"to limit or reduce the number of people affected by significant aircraft noise;
to limit or reduce the adverse impact of aviation emissions on local air quality; and
to limit or reduce the impact of aviation greenhouse gas emissions on the global climate."[6] To achieve these goals, FAA is currently working with fellow CAEP members to develop technology and operational goals for reducing aircraft noise, emissions, and fuel burn, based on the international community's research and development efforts. Such activities inform CAEP's assessment of the adequacy of international limits for aviation noise and exhaust emissions, taking into account technical feasibility, environmental benefit, economic reasonableness, and the interrelationships that arise from adopting a new standard.

In the US, the FAA has implemented long-established environmental guidance, policies, and regulations such as the 1976 Aviation Noise Abatement Policy, the Title 14 Part 150 regulation on Airport Noise and Compatibility Planning, and the Title 14 Part 161 regulation on Notice and Approval of Airport Noise and Access Restrictions. The FAA recognizes that environmental policies may require updating to better reflect changes in the nature of the aviation industry, interdependencies amongst environmental impacts, the current state of knowledge, as well as to better serve the anticipated needs of NextGen. To this end, FAA will be developing NextGen environmental policy in the Joint Planning and Development Office's Environmental Working Group (JPDO-EWG), which the FAA co-leads with industry. EWG Standing Committees for Science and Metrics, Technology, Operations, and Analytical Tools are supporting the Policy Standing Committee's environmental policy efforts with respect to noise by proposing noise exposure and response metrics, technology assumptions for system-wide estimates of noise exposure, and new environmentally-beneficial operational procedures, as well as coordinating diverse tool-development efforts.

Policy updates being considered also include land-use compatibility. A currently-funded ACRP synthesis project is expected to contribute to the land-use policy debate with documentation of the state of the practice of noise compatibility programs for airport communities outside the DNL 65 noise exposure contours.[7]

2. Noise Mitigation

The FAA continues to uphold a balanced approach towards community noise mitigation, comprising the following:

- Noise reduction at the source (i.e., the aircraft)
- Land use compatibility planning and management
- Noise abatement operational procedures
- Aircraft operational restrictions

Noise reduction at the source

Aircraft noise reduction technology and its adoption by air carriers in response to national and international environmental pressure have contributed to ninety percent of airport community noise exposure reduction over the last 30 years, made possible by a combination of research and development efforts by the government and the manufacturing industry. Figure 2 illustrates the historical achievement of aircraft noise reduction technologies. New aircraft continue to get

quieter: the recently certified Airbus A380 has a 26 dB cumulative margin relative to Stage 4 limits[8], and Boeing suggests that its new 787 aircraft will have a significant cumulative noise margin below Stage 4[9].

Figure 3 illustrates the community noise impact reductions that have been achieved to date despite air traffic growth, thanks to increasingly quieter aircraft fleets. The US Airport Noise and Capacity Act of 1990 (ANCA) forced airlines to adopt quieter aircraft technologies sooner with the accelerated phaseout of Stage 2 and noisier aircraft weighing over 75,000 pounds. Today, many aircraft in the US fleet already meet Stage 4 noise limits, as ever-rising fuel prices have led airlines to retire older, less fuel-efficient and less environmentally-friendly aircraft from their fleets.

The FAA has established a near-term target to reduce the number of people exposed to significant noise by four percent per year through FY 2012 as measured by a three-year moving average, from the three-year average for calendar year 2000 – 2002.[10] While the fleet replacement trend has made the noise exposure target achievable, projected air traffic increases will likely obviate this fleet's ability to achieve absolute noise exposure reductions as shown in Figure 4. Fortunately, the research community is actively pursuing technologies intended to increase efficiency and reduce noise simultaneously.[11,12] It is however necessary to recognize that competing requirements for greater fuel efficiency and lower exhaust emissions may conflict with the potential to achieve noise reduction at the source.

To help achieve NextGen goals by ensuring that a pipeline of environmentally-friendly technologies continues to be developed and matured for adoption, the 2009 President's Budget for the FAA includes a request to fund a new initiative designed to accelerate the maturation and certification of civil subsonic aircraft technologies that reduce noise, emissions, and energy consumption.[13] The FAA's Continuous Lower Energy, Emissions, and Noise (CLEEN) Technologies initiative, closely aligned with NASA's Fundamental Aeronautics Program's Subsonic Fixed Wing Project, is planned as a multi-year, multi-million dollar cost-shared program with industry. The objectives of CLEEN are consistent with the near-term energy and environment research and development objectives of the National Plan.

Land use compatibility planning and management

Since 1982, Airport Improvement Program (AIP) and Passenger Facility Charge (PFC) funds collected from commercial air carriers have contributed towards over $7 billion on airports' voluntary noise compatibility projects, granted on a case-by-case basis, under the FAA's Part 150 Noise Compatibility Program. Funded projects include soundproofing homes and schools, buying noise-sensitive properties and relocating their uses, and encouraging compatible zoning. In the last five years, AIP funding for such projects has averaged on the order of $300 million per year. FAA continues to support airports' efforts to mitigate the impacts of noise in their communities with AIP and PFC funding.

To encourage broader participation in airport land use compatibility planning, a variation on the Part 150 program was established by the Vision 100-Century of Aviation Reauthorization Act. For fiscal years between 2004 and 2007, Section 160 of the act authorized the use of AIP funds for states and local government units, rather than airports, to establish compatible land use planning and projects around large and medium hub airports that had never participated in Part 150 program, or that had not updated its program in ten years.

Knowledge gained from recent and ongoing studies on land use will guide implementation of the balanced approach's land use component. Such studies include the ACRP project developing guidance to local land use-planners, local, state, and federal agencies, on how to protect airports from incompatible land uses that impair current and future airport and aircraft

operations and safety, and that may constrain airport development.[14] Also, a recently completed PARTNER study on land-use management and airport controls, which concludes that earlier land-use policies may have led to some of today's conflicts, offers lessons for managing land use at new or future reliever airports that do not start out with a community noise problem.[15] For such airports, actively stemming population aggregation and discouraging nearby housing construction is critical in minimizing future community noise exposure.

Noise Abatement Operational Procedures

The FAA approves airport preferential runways intended to concentrate flights over the least noise-sensitive areas near an airport, as well as in-flight noise abatement procedures, on a case-by-case basis. Except for those mandatory operational procedures and restrictions that were grandfathered by ANCA, airports encourage airlines to voluntarily use these methods to reduce community noise impact. Airlines recognize the value of reducing their community noise footprint and therefore do tend to cooperate with airport-recommended procedures. However, the voluntary aspect of this measure also offers aircraft operators the flexibility, in difficult economic times, to fly the most fuel-efficient procedures in lieu of noise abatement procedures.

Fortunately, some operational procedures such as continuous descent arrivals (CDA) have demonstrated the potential to reduce noise together with fuel burn and emissions at Louisville, Atlanta, Los Angeles International, and Miami airports. The Louisville CDA demonstration showed about 30 to 40 percent average emissions reductions as well as significant reductions in the aircraft single-event 60 dBA contours (between about 15 and 30 percent).[16] Because of CDA's environmental potential, the FAA is spearheading numerous initiatives for near-term adoption of CDA in as many US airports as possible, in collaboration with the research community, airports, and air carriers.

Aircraft Operational Restrictions

One of the goals of ANCA was to minimize the proliferation of airport-specific operational restrictions such as curfews or aircraft bans to reduce noise. Therefore, whereas airports are not prohibited from restricting aircraft operations for noise mitigation purposes, they must now seek FAA approval to impose restrictions in accordance with Part 161 rules. Of twenty airports that have applied for Part 161 approval, Naples Municipal Airport's application to ban operations of Stage 2 aircraft weighing less than 75,000 pounds is the only one that has been implemented.

FAA's view on operational restrictions is aligned with ICAO's, which discourages airports from restricting operations before considering the other elements of the balanced approach.[6] Curfews are less desirable remedies to community noise problems because of their potential to reduce airport capacity which, as discussed in the Introduction, may be needed to meet future demand.

3. Effective Community Outreach

Community support is critical to the success of airport and/or airspace projects. The PARTNER study that investigated land use trends and factors that fuel near-airport development also found that lack of communication among stakeholders was at the root of almost every airport community issue.[15] Effective outreach and communication tools and methods are thus needed so that aviation stakeholders can communicate their perspectives and foster constructive interaction in addressing likely conflicting interests.

Given the complexity of the subject of noise, the FAA is currently funding two projects related to community outreach. One is a PARTNER project to develop a website that will provide airport communities an independent source of educational information on aviation noise.

The other project, funded under ACRP, is the development of a guidebook that teaches the public about aviation noise and suggestions for improvements beyond current community outreach practice, as well as an investigation of alternative metrics to communicate noise issues.[17]

B. Understanding the Problem

The other half of the FAA strategy focuses on research and development to improve our understanding of the airport community noise problem – following the path of the noise from its point of emission through its propagation and transmission to the community, and ending with the community's response to the noise. Because our air transportation network traverses urban, suburban, rural, and wilderness communities, the noise research must extend to diverse ambient settings and study noise impacts not just on humans, but also on wildlife and structures.

FAA's Integrated Noise Model (INM) for airport community noise analysis has evolved over three decades of development and enhancement. INM methodology is core to the new integrated model (Aviation Environmental Design Tool, or AEDT) that the FAA is developing to predict the interrelated environmental effects on communities of aircraft noise and engine exhaust emissions throughout a wide range of geographic scales, from a single airport all the way to a global scale.[18] This effort requires the ability to more accurately predict community exposure to noise from the range of current and future aircraft types (including very light jets and low-boom supersonic aircraft) envisioned for a variety of future aviation scenarios. Research to achieve better noise emission characterization across a broad frequency spectrum and noise propagation modeling will feed the tool development efforts. Ongoing PARTNER projects include modeling low frequency noise from thrust reverser deployment and physics-based noise propagation modeling to account for the effects of meteorology and terrain. In addition, an ACRP "Quick Response" project is scoping the task of developing taxiway noise modeling capability, as ground operations of aircraft and the associated near-ground noise propagation increasingly become community concerns,[19] and another ACRP project is working on a plan to develop a multi-modal noise and emissions model.[20]

Another research element in the FAA strategic framework is modeling how structures, via transmission and attenuation, affect indoor perception of aviation noise. This research serves to improve our understanding of people's response to noise exposure as well as improve guidance for structural noise insulation.

The final element of FAA's research strategy seeks to improve our understanding of how, and what measure and level of aircraft noise exposure, as well as which specific characteristics of aircraft noise: contribute to annoyance and sleep disturbance, cause long-term effects on health and cognitive performance, or cause damage to structures and animals. Current research by PARTNER includes investigating: other sound attributes besides level, such as tonality and roughness that influence annoyance; more sophisticated sleep disturbance models; community reactions to different transportation noise sources as well as to low-boom supersonic aircraft; non-auditory health effects of aircraft noise.

In addition to AEDT, the FAA is developing a complement of environmental assessment tools to help inform the process of deciding how best to address aviation's interdependent environmental impacts. Environmental Design Space (EDS) is a tool to model the environmental implications and costs associated with specific aircraft designs, and the Aviation Environmental Portfolio Management Tool (APMT) is a tool to model the relative costs and benefits among different environmental strategies. The scientific understanding gained from the research described above provides key elements to the development of these environmental assessment tools.

The ACRP synthesis project on effects of aircraft noise is expected to identify issues that remain unresolved.[21] The FAA also continues to identify knowledge gaps in our understanding of noise impacts and intends to address these issues by sponsoring studies, whether through the PARTNER Center of Excellence, ACRP, or other funding mechanisms. Broad consultation with stakeholders and peer review of sponsored research will remain key to execution of the overall FAA strategy. In addition, the FAA is monitoring, will take into account lessons learned from, and will seek opportunities to collaborate on, the large body of research on aviation noise issues that the international scientific community has been actively researching.

3. CONCLUDING REMARKS

The FAA recognizes that environmental impacts have the potential to deteriorate as flight operations increase to meet growing demand for air transportation. FAA's work to mitigate the environmental impacts of aviation includes research to advance the state of knowledge on aviation noise, emissions, and alternative fuels, as well as efforts to quantify the tradeoffs between reducing aviation noise and exhaust emissions, and compute the relative costs and benefits among alternative environmental solutions. This paper has focused on FAA's current efforts and future plans to achieve the goal of reducing significant impacts due to aircraft noise in absolute terms while enabling air traffic growth. As new research reaches a level of maturity and peer acceptance, the FAA will use the research to guide development and changes of environmental guidance, policy, and regulations as needed for NextGen. The FAA will also adopt research findings that serve as "best practices and procedures" to advance future environmental analyses and reduce impacts.

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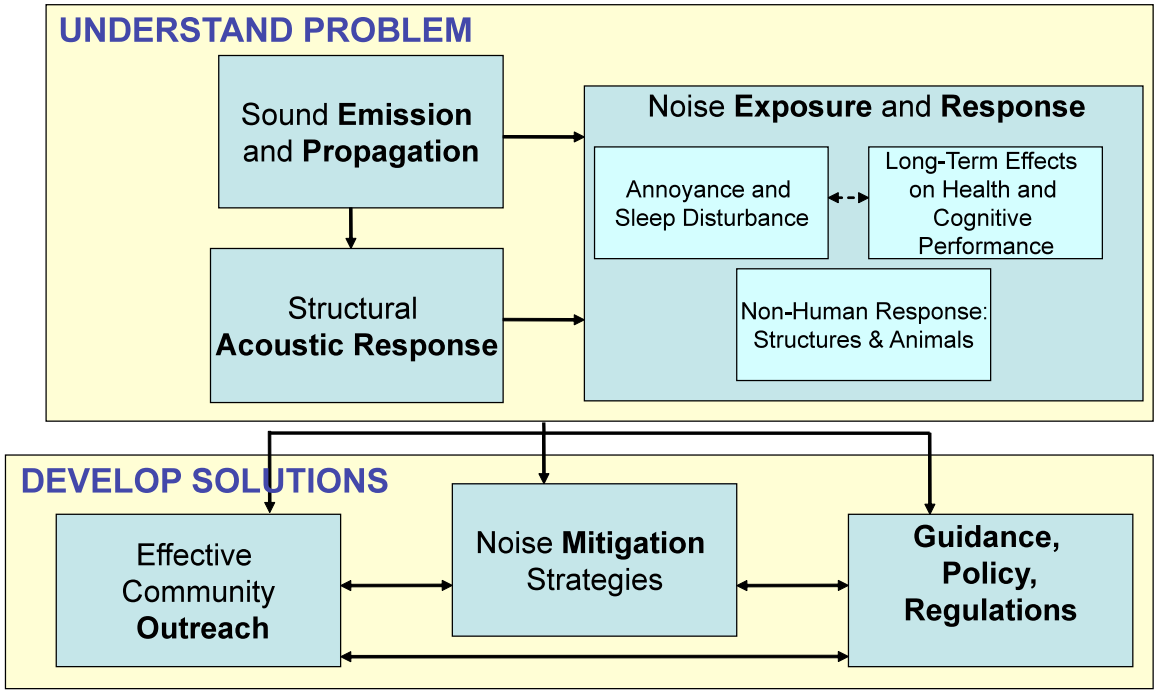

Figure 1: FAA strategic framework to improve mitigation of aviation noise impacts.

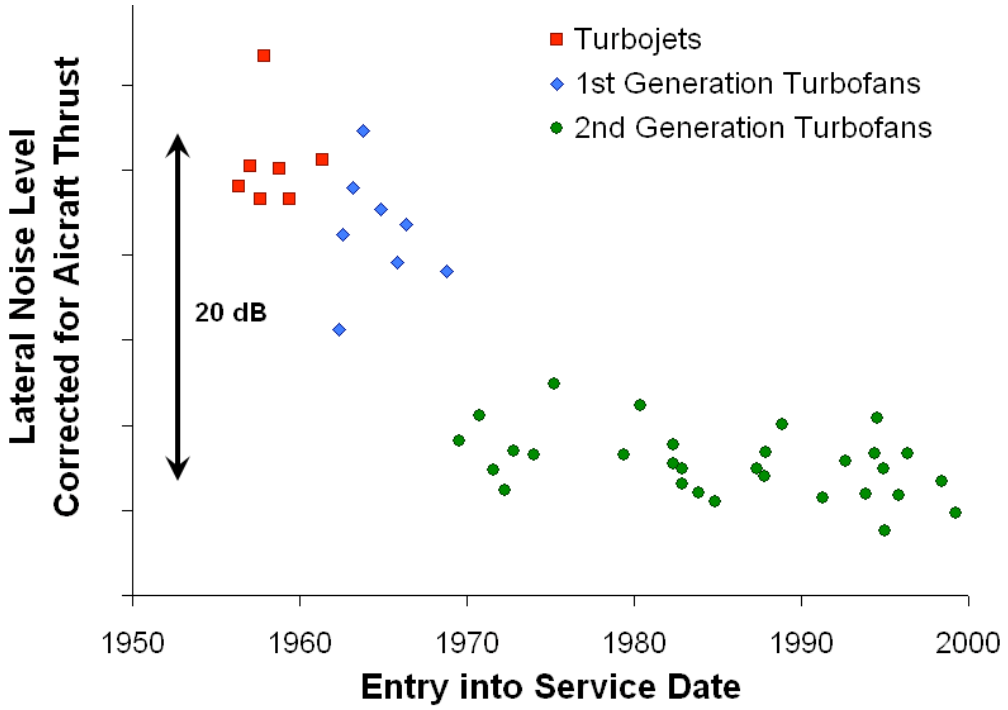

Figure 2: Historical achievement of noise reduction technologies.

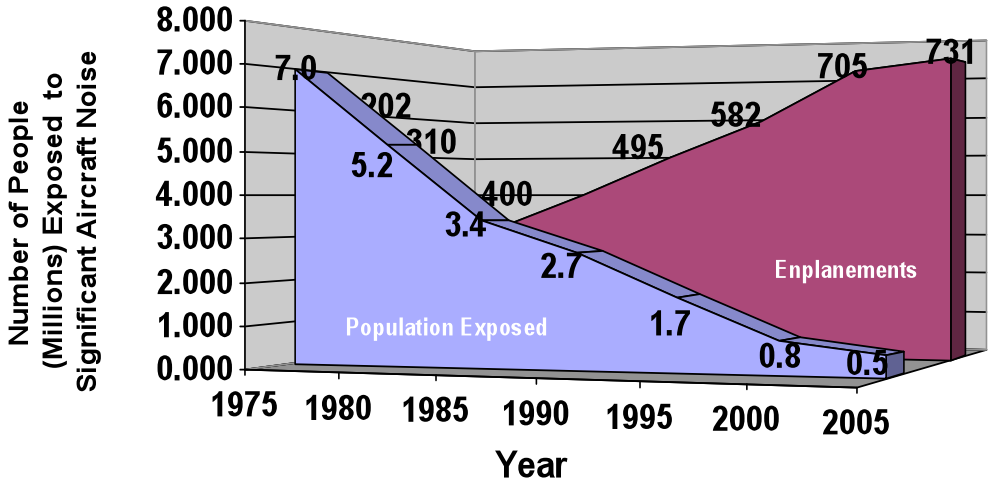

Figure 3: Declining trend of number of people exposed to significant aircraft noise despite air traffic growth.

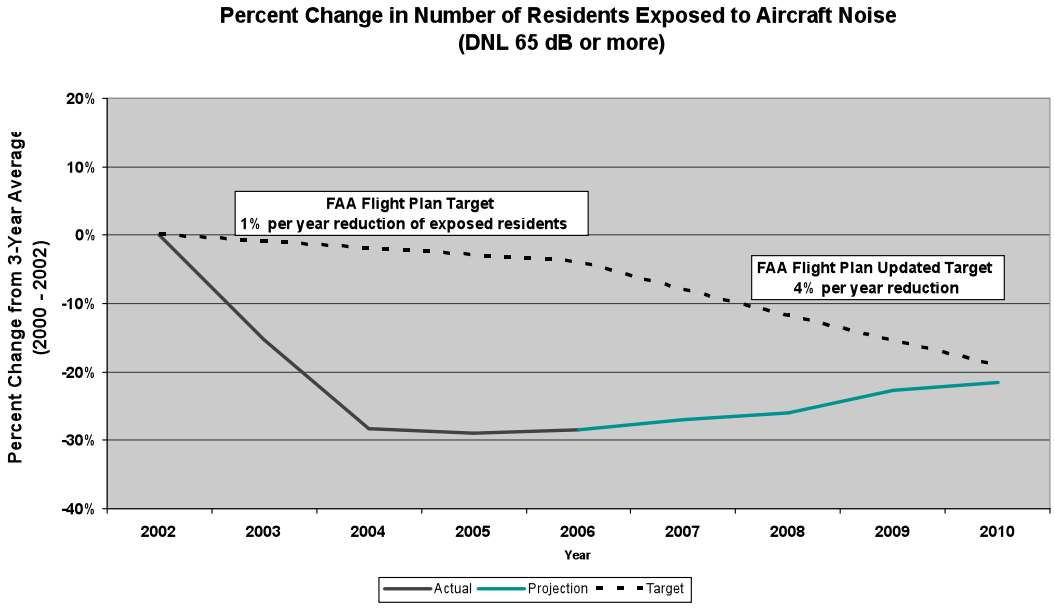

Figure 4: Comparison of FAA's noise exposure reduction targets to actual and projected noise exposure trends.