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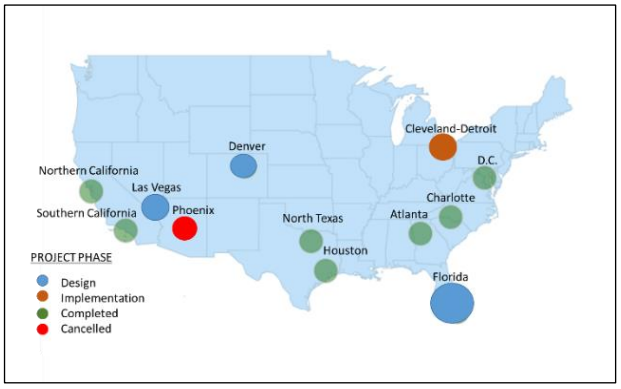
Aircraft Noise and Air Traffic Control Modernization

The Federal Aviation Administration (FAA) is replacing its radar-based air traffic control system with a satellite-based navigation and tracking system called NextGen. The stated purpose of NextGen is to increase airspace utilization and improve air traffic flows, allowing airliners to fly more efficiently, thereby cutting fuel consumption and reducing emissions. In order to achieve these objectives, FAA is reconfiguring airspace by modifying flight routes, and by creating new approach and departure procedures at airports. Planning and implementing these changes has met with backlash from some communities where overflights have become more frequent, prompting legislative action regarding FAA's approaches to measuring aircraft noise, assessing impacts, and conducting community outreach.

NextGen Changes

As part of the NextGen effort, FAA is establishing new approach and departure patterns at airports to implement precision navigation capabilities. FAA refers to these procedures as Performance Based Navigation (PBN). To implement PBN in complex airspace around major metropolitan areas, FAA is conducting a number of projects under its "metroplex" program. In planning each metroplex airspace reconfiguration, FAA prepares an environmental assessment allowing for input from communities that may be affected by proposed changes to flight patterns. Currently there are 11 metroplex projects in various stages of study and implementation (see **Figure 1**).

Figure 1. FAA Metroplex Projects



Source: CRS analysis of FAA data.

FAA reversed an earlier airspace restructuring it had implemented in Phoenix, AZ, following numerous noise complaints, criticism regarding limited community involvement in the process, and legal action challenging implementation of the flight path changes. FAA previously implemented a major airspace redesign separate from its metroplex program in the New York-New Jersey-Philadelphia region, which has also faced considerable community criticism.

Measuring Aircraft Noise

Put simply, noise is unwanted sound. Sound intensity is measured in terms of pressure exerted on the ear using a logarithmic decibel (dB) scale. For roughly every 10 dB increase, humans perceive a sound to double in loudness, so 70 dB would sound roughly twice as loud as 60 dB. A noise registering 80 dB would sound roughly twice as loud as 70 dB, and four times as loud as 60 dB.

FAA regulations require aircraft noise measurements as part of the certification process for new aircraft designs. Sound levels are measured under three conditions: (1) during full-power takeoff measured from a position offset 450 meters (m) laterally from the runway centerline and abeam the point of peak noise; (2) flyover, measured from directly beneath the flightpath at a position 6,500m from the start of the takeoff roll and past the point of initial power reduction after takeoff; and (3) approach, measured from directly beneath the flightpath at a point 2,000m from the runway threshold. A normalization procedure, called the Effective Perceived Noise Level (EPNL), is used to account for tones and sound duration. The sum of these three measurements must be below the noise certification standard for that particular aircraft, which depends on its maximum takeoff weight and the number of engines.

Noise certification standards, referred to as "stages," have become more stringent over the years as engine and airframe noise reduction technology has improved. Aircraft produced in the late 1960s through 1975 had to meet "Stage 2" noise standards. In the mid-1970s, FAA set more stringent "Stage 3" criteria for new aircraft and aircraft engines, which became mandatory for all new jet airplanes by the late 1980s. Noisier "Stage 2" airplanes were gradually phased out and were completely banned from routine operation in U.S. airspace by 2016. In 2005, FAA promulgated "Stage 4" standards, which mandated a cumulative reduction of 10 EPNLdB across the three measurement conditions compared to "Stage 3," and in 2017, FAA adopted "Stage 5" standards requiring a further cumulative reduction of 7 EPNLdB below "Stage 4" standards. Since these standards apply only to new aircraft designs, it usually takes several years for operational noise levels to noticeably decrease as airline fleets are slowly replaced.

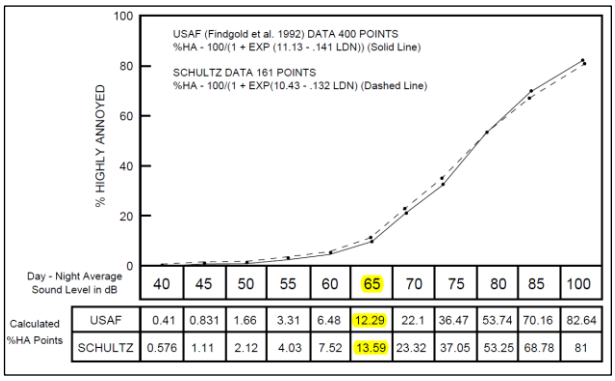
Assessing Community Response

To describe noise levels in communities, aircraft noise is modeled based on flight operations across an average busy

day for an airport or flight route. Noise events are aggregated over the 24-hour period, and penalties of 10 dB are added to nighttime flights between 10 p.m. and 7 a.m. The resulting single descriptor of the noise environment is known as the day-night average sound level (DNL).

Since the 1970s community reaction to aircraft noise levels has been described in terms of annoyance response measured through community surveys. Based on analyses of annoyance response as a function of DNL, FAA has developed recommendations regarding acceptable land uses. In a synthesis of social surveys examining community response to aircraft noise, commonly referred to as the "Shultz curve" (see **Figure 2**), 65 DNL corresponded to roughly one out of every eight individuals expressing high levels of annoyance. FAA concluded that strong community reaction to aircraft noise levels is likely above this level. For this reason, FAA advises that residential land use is generally not suitable for locations above 65 DNL.

Figure 2. The Shultz Curve



Day - Night Average Sound Level in dB	40	45	50	55	60	65	70	75	80	85	100
Calculated %HA Points USAF	0.41	0.831	1.66	3.31	6.48	12.29	22.1	36.47	53.74	70.16	82.64
Calculated %HA Points SCHULTZ	0.576	1.11	2.12	4.03	7.52	13.59	23.32	37.05	53.25	68.78	81

Source: Federal Interagency Committee on Noise, *Federal Agency Review of Selected Airport Noise Analysis Issues,* August 1992.

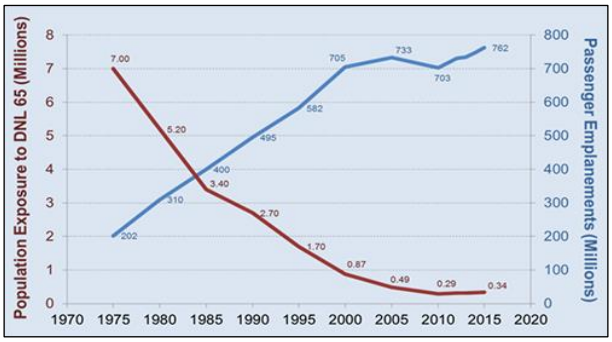
Noise Reduction Measures

Efforts to reduce aircraft noise impacts focus on three key strategies: (1) quieting noise sources such as aircraft engines and airframes, (2) increasing the distance between aircraft and communities through land use planning and noise abatement procedures, and (3) attenuating sound along the transmission path through means such as "soundproofing" homes by installing heavier insulation and thicker, double-paned windows. The combination of these approaches has led to a significant reduction in the residential population exposed to aircraft noise levels above 65 DNL over the past four decades, despite considerable growth in air traffic (see **Figure 3**).

Noise Concerns

As FAA has implemented NextGen, noise complaints regarding new flight patterns often have come from neighborhoods where cumulative aircraft noise levels are well below 65 DNL. Two key factors appear to be at play. First, the flight patterns are new, so aircraft noise is affecting communities that rarely experienced overflights in the past. Second, in some, but not all, of these communities the background or ambient noise levels are lower than in other neighborhoods impacted by aircraft noise. In locations where ambient noise is lower, aircraft overflights might be more noticeable even if the aggregate noise level is comparably lower.

Figure 3. Reduction in U.S. Population Exposed to Significant Aircraft Noise and Growth in Air Traffic



Source: U.S. Department of Transportation, Volpe Center, *Reducing Aviation Noise, Advancing the Aviation Enterprise.*

While aircraft are considerably quieter than decades ago, airlines now typically operate more frequent flights with smaller aircraft that carrier fewer passengers. Strong community reaction may be, in part, a reaction to the number of audible overflights rather than the average noise described by the DNL metric. An ongoing question is whether these negative reactions will endure. This may depend to some extent on community characteristics (such as population demographics and ambient noise levels), as well as FAA's efforts to engage in meaningful community outreach and willingness to explore viable options to address community concerns.

Legislative Response

Initially, Congress urged FAA to quickly implement NextGen changes and Performance Based Navigation procedures. The FAA Modernization and Reform Act of 2012 (P.L. 112-95) included language allowing FAA to proceed with the lowest level of environmental review, known as a categorical exclusion. Following backlash from this approach, particularly in Phoenix, Congress reexamined how FAA was conducting its noise analyses and engaging with communities regarding its metroplex projects. The FAA Reauthorization Act of 2018 (P.L. 115-254) mandated that FAA complete its review of alternatives to DNL and 65 DNL guidelines. The legislation directed FAA to study the potential health and economic impacts of aircraft noise on communities and to assess whether aircraft approach and takeoff speed restrictions could reduce noise impacts without affecting flight safety. It also required FAA to allow airports to request dispersed or fanned departure headings and flight track variations to reduce the concentration of flight paths over certain neighborhoods due to PBN, improve its community engagement practices, and appoint regional noise ombudsmen to liaise with communities impacted by noise stemming from NextGen changes. FAA officials testified in September 2019 that the agency was working to meet these requirements.

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