

Aviation and the Environment - Managing the Challenge of Growth

Meeting: NASA Fundamental Aeronautics Meeting

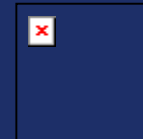
By: Carl Burleson,
Director
FAA Office of Environment & Energy

Date: October 30, 2007

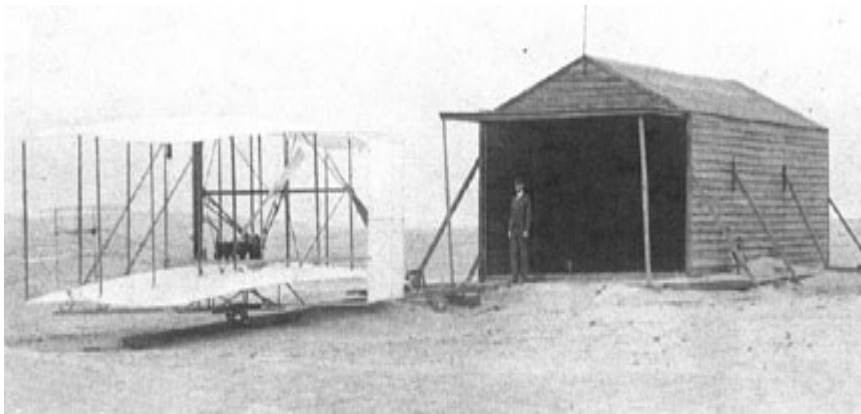


Outline

- The Historical Record
- The Evolving Challenges
- NextGen- The Way Forward
- FAA Proposals
- Can We Succeed?
- Closing Observations



Aviation and Environmental Challenges Are Not New



2003 marked the
100th Anniversary
of Flight and...

The 92nd Anniversary of the
flight editorial complaining
about aircraft noise...



Aviation and the Economy

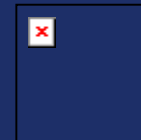
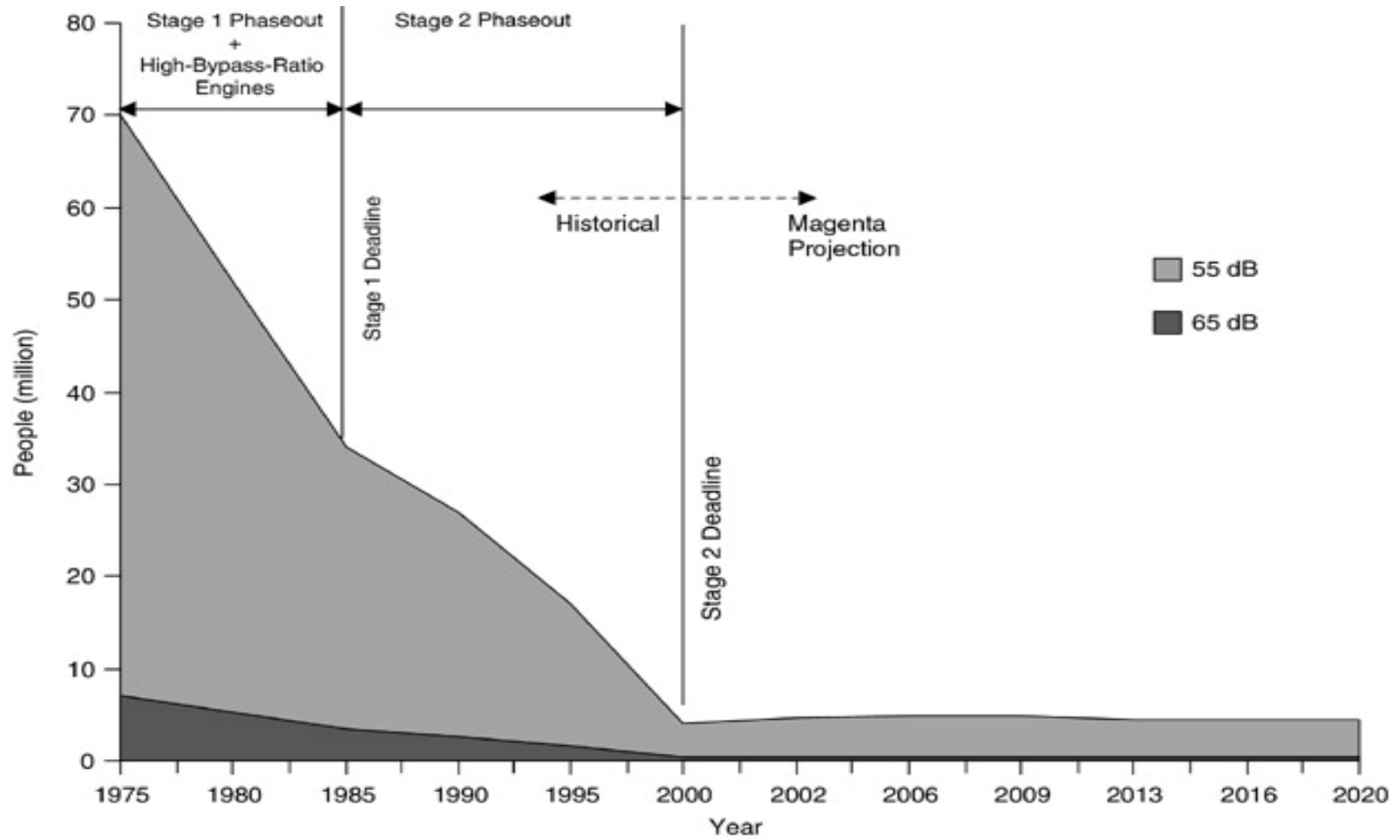


- Aviation plays a key role in the world economy
- Aviation supports 8% of global economic activity and carries 40% of the value of freight
- Aviation activity outpaces economic growth
- 2002 U.N. World Summit on Sustainable Development affirmed that economic growth is a prerequisite for improving earth's environment
- The number of air travellers is expected to double by 2025, rising to more than 9 billion a year.

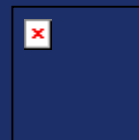
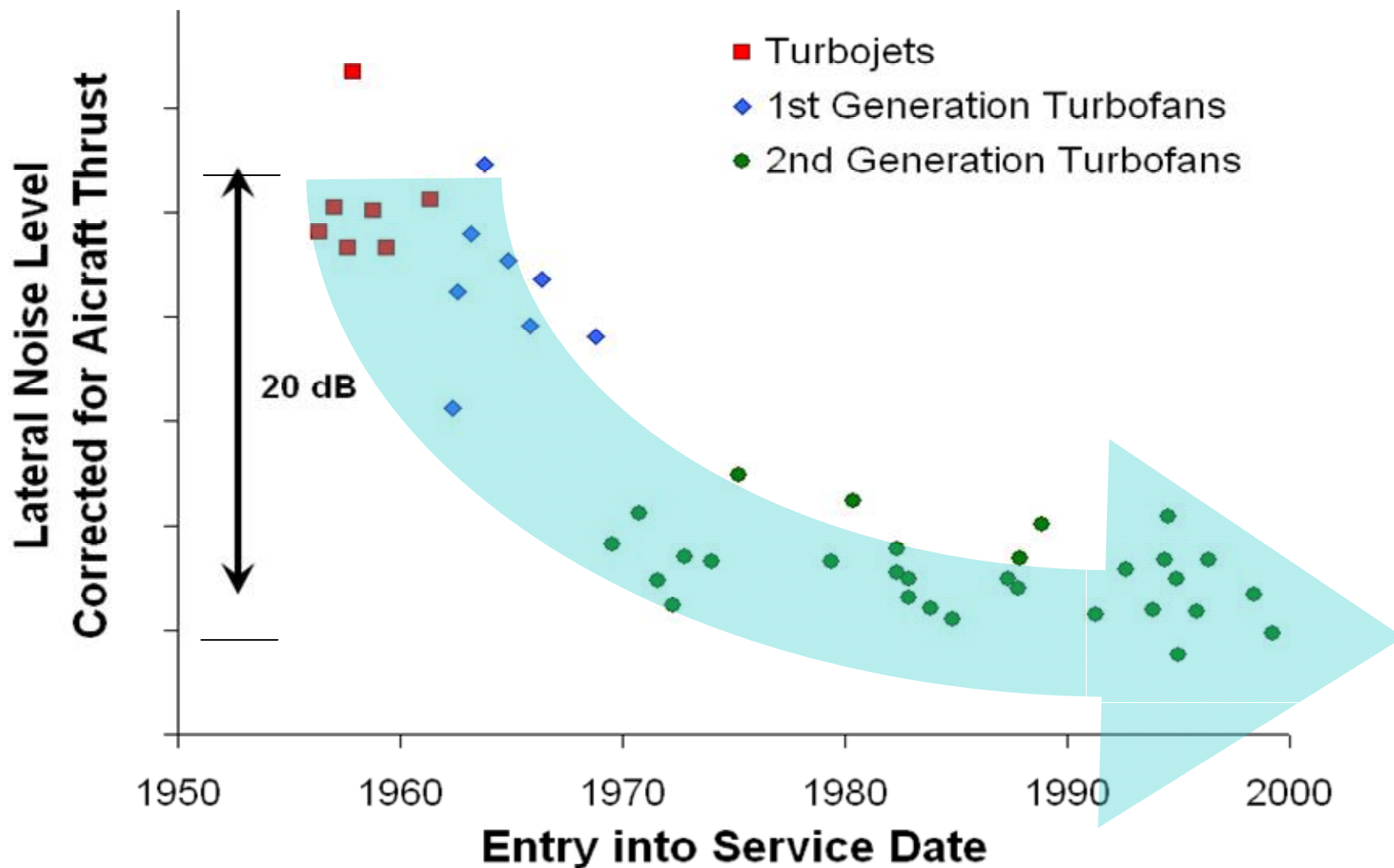
Download pdf at
<http://www.ita.doc.gov/td/aerospace/aerospacecommission/aerospacecommission.htm>



Aviation Noise: Technology & Policy Produce Gains

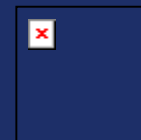
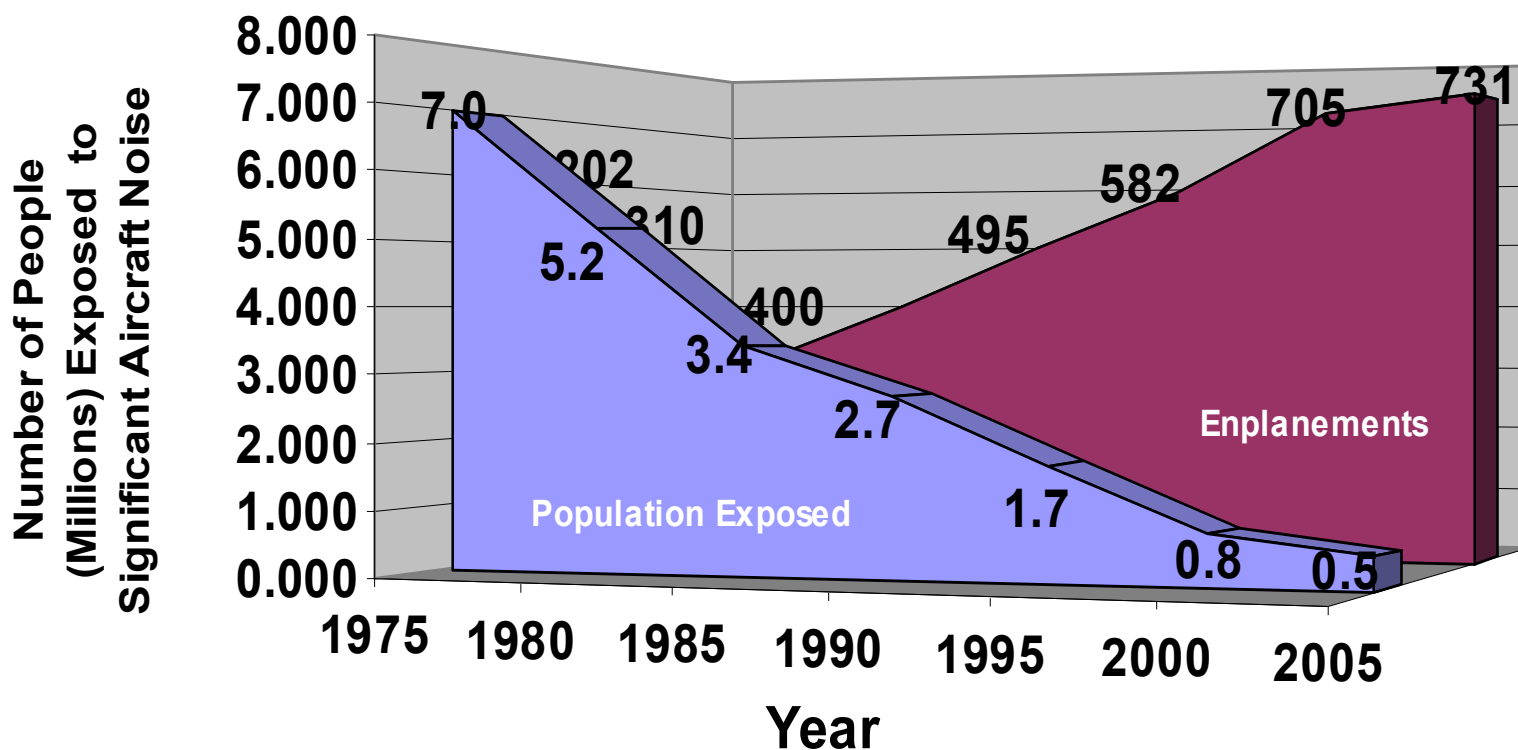


Aviation Noise: Technological Progress in Noise Reduction

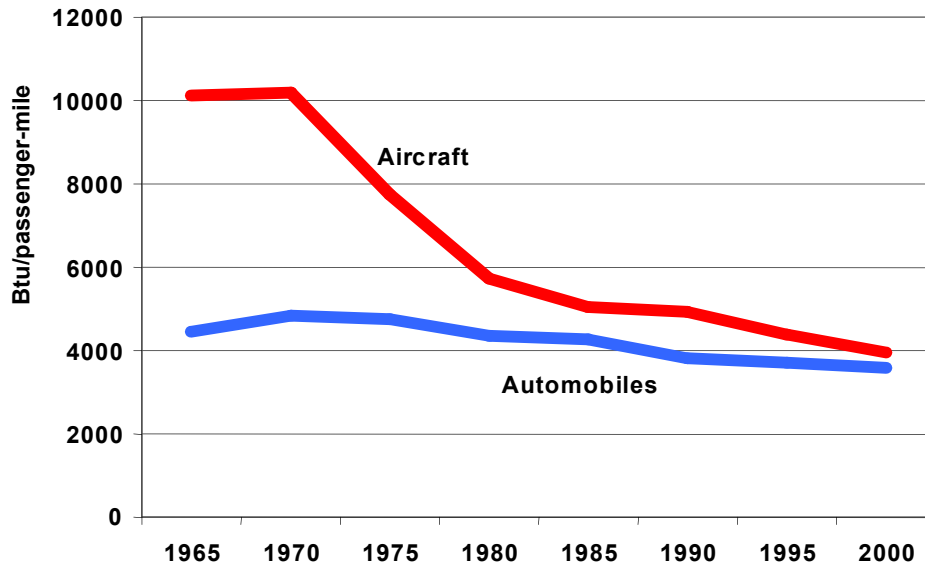


Aviation Noise: Large Gains Coupled with Growth

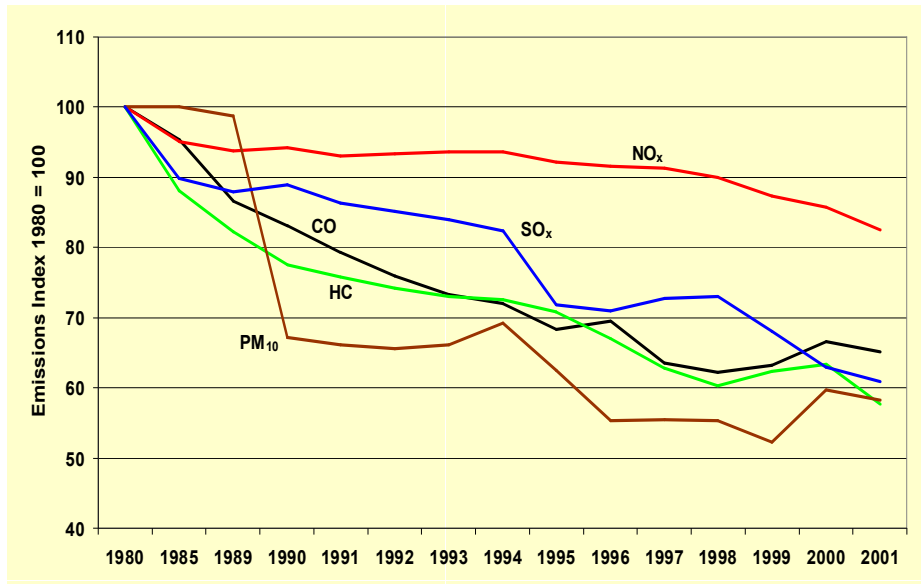
Trends in Aircraft Noise Exposure and Capacity Expansion



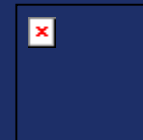
Aviation Emissions: Significant Improvements



Aircraft Energy Efficiency has improved substantially, especially when compared to the other form of US mass transit that moves passengers.

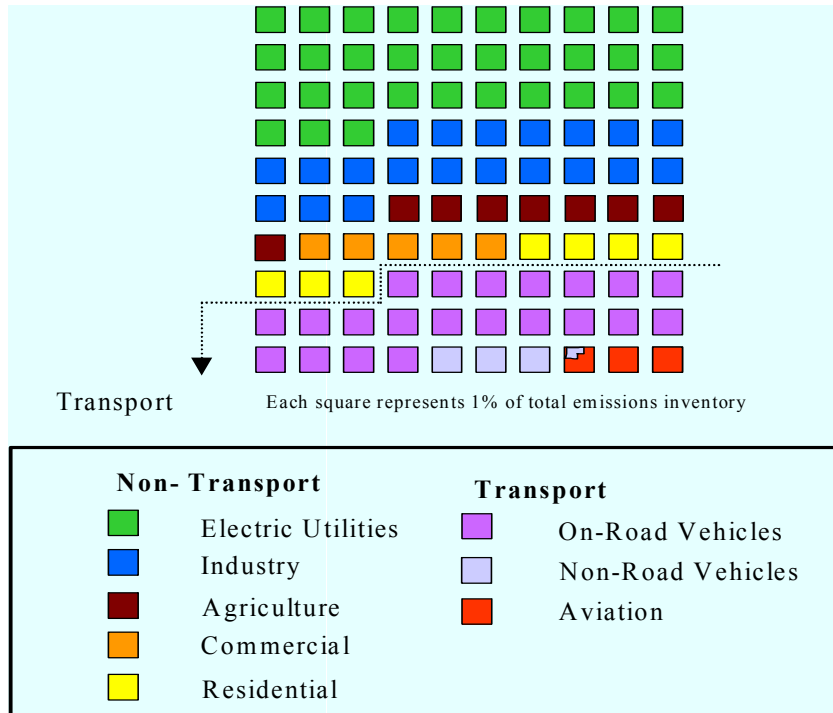


Local air quality pollutants have declined steadily over the past several years. NO_x has been the most challenging pollutant to constrain



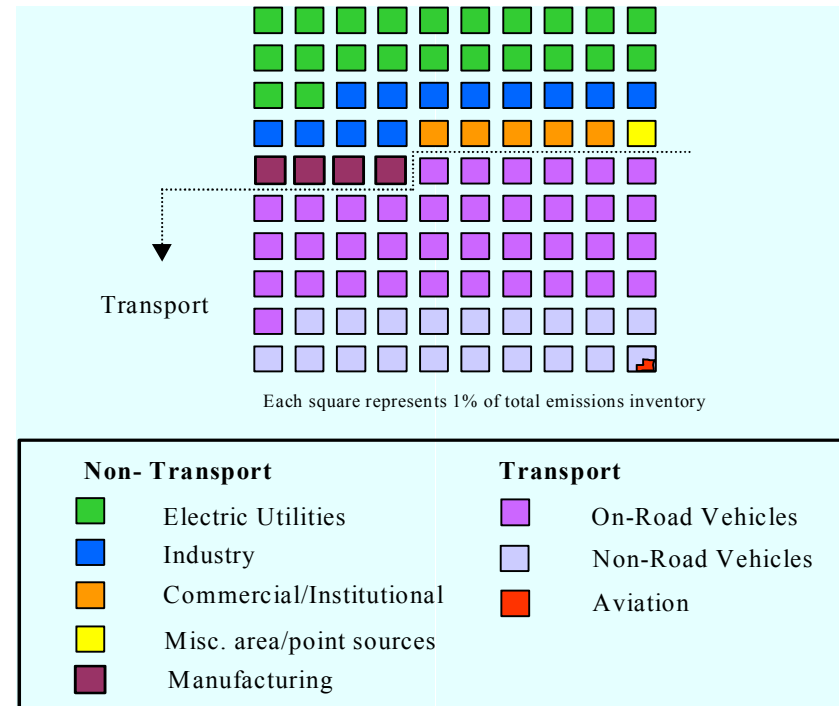
Aviation Emissions- Greenhouse and Local

Greenhouse Gas Emissions

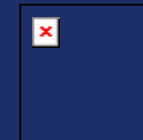


National greenhouse gas emissions in 2001

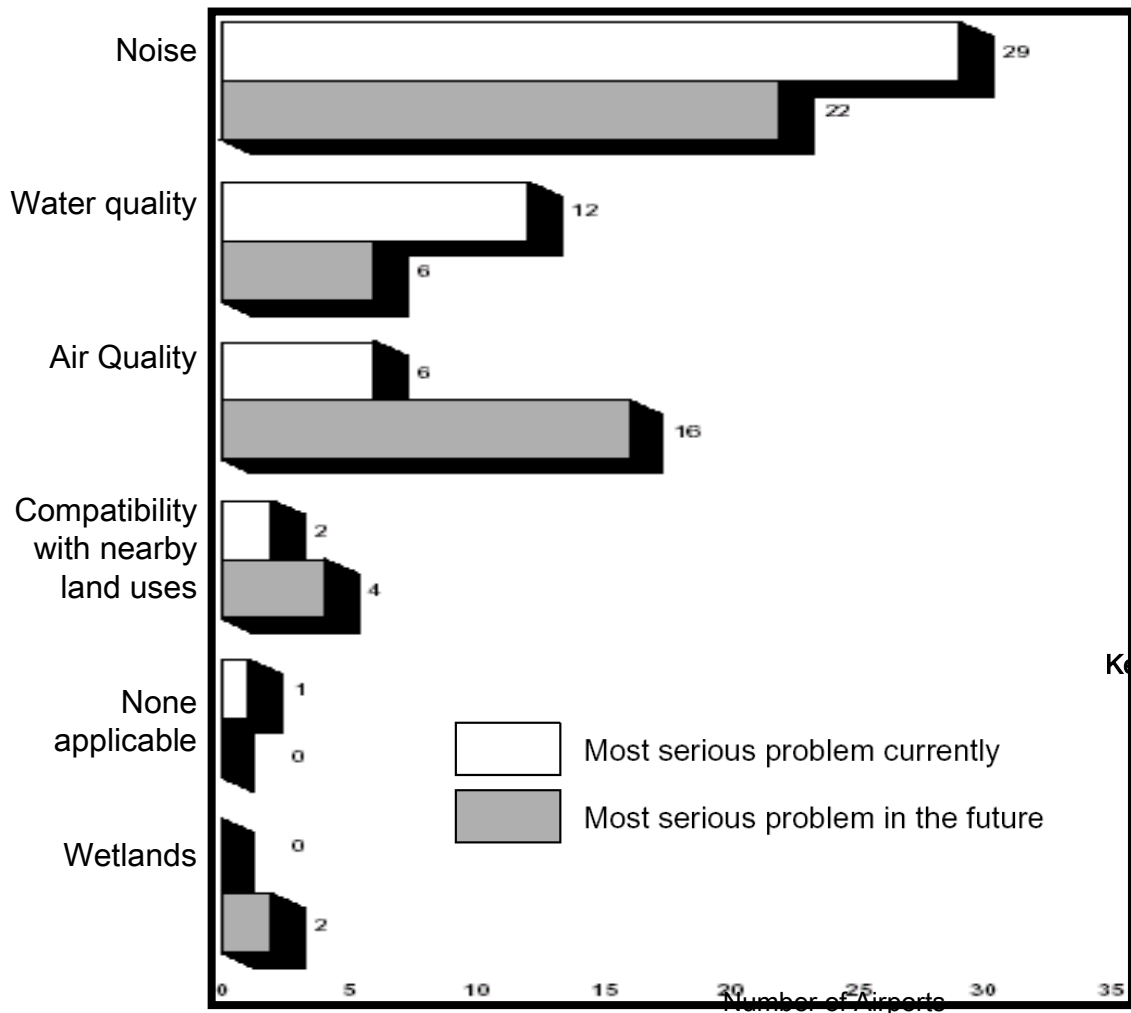
Local NOx Emissions



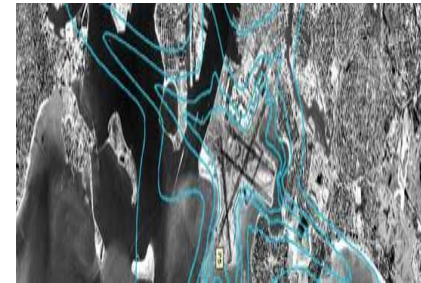
While all transportation makes up more than 55 percent of the total national NO_x inventory, aviation represents only about 0.4 percent.



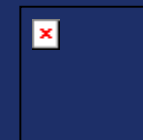
Aviation Environmental Issues- Year 2000



Source: GAO/RCED-00-153 [Aug-2000] survey of the nation's 50 busiest commercial service airports.

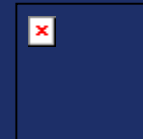


Key



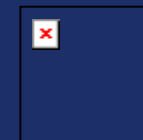
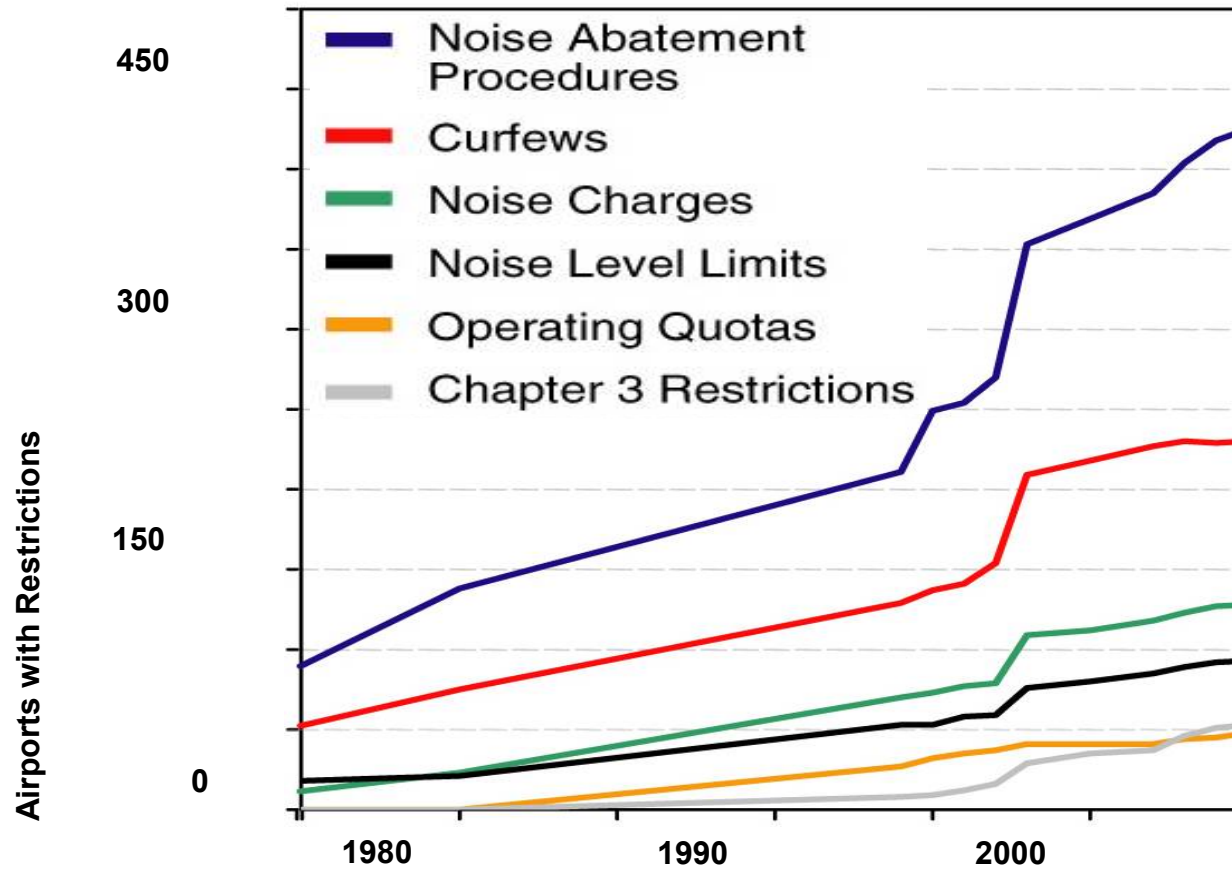
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Aviation Noise: As Predicted, Has Not Gone Away

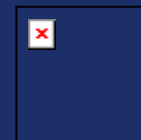
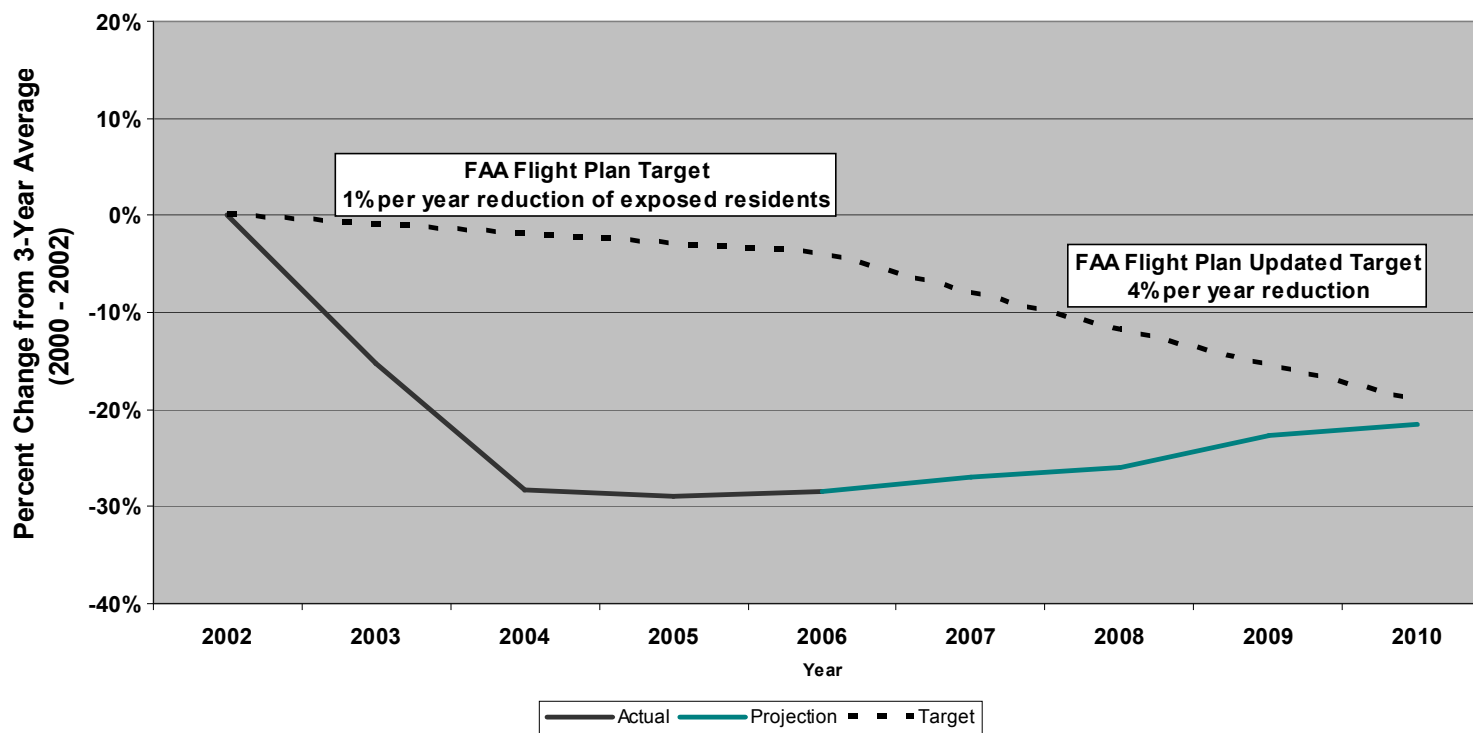
Compiled by Tam et al., 2007
from Boeing data 9/13/05



Aviation Noise: Returning As An Issue

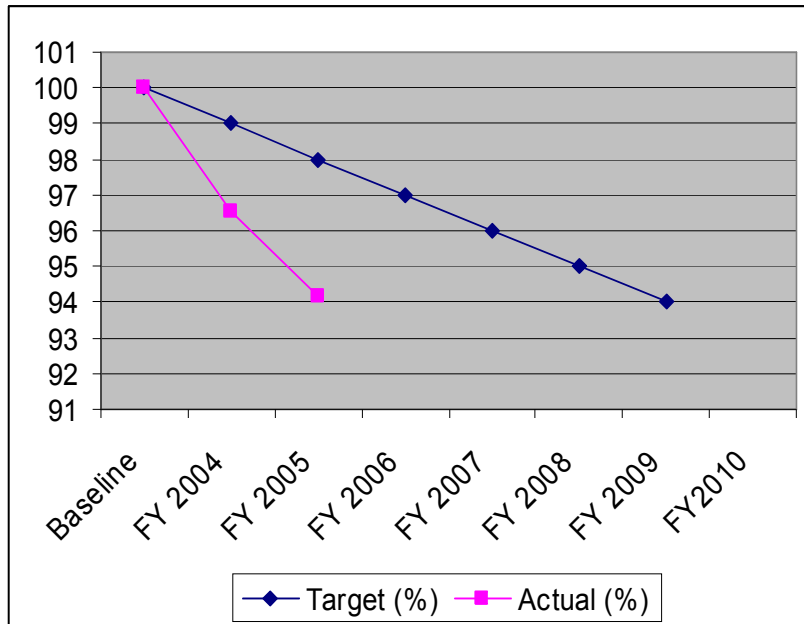
National Noise Exposure Trends vs. FAA Targets

Percent Change in Number of Residents Exposed to Aircraft Noise
(DNL 65 dB or more)



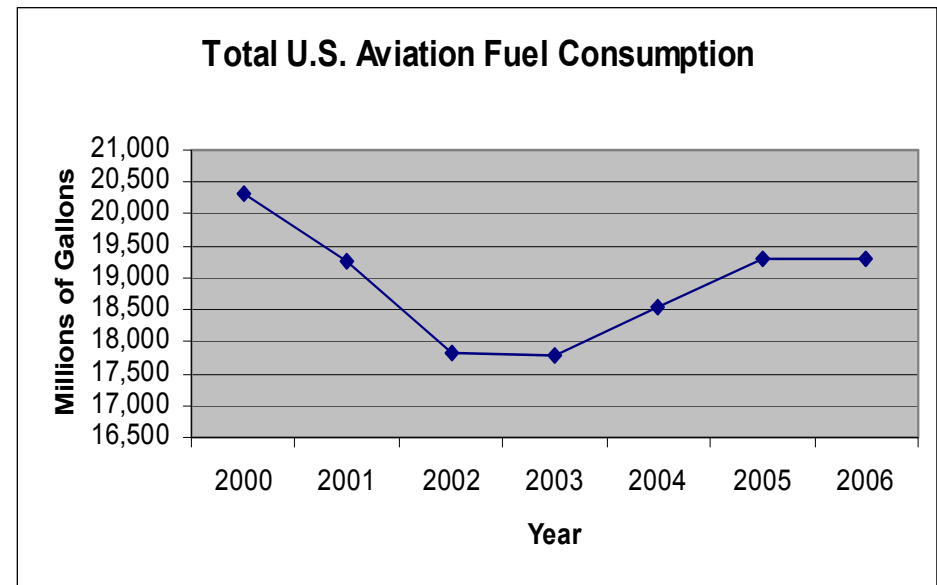
Aviation Emissions: U.S. Growth Down

FAA Fuel Efficiency Target

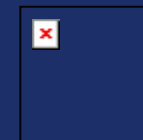


Source: FAA

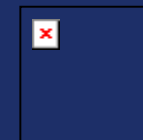
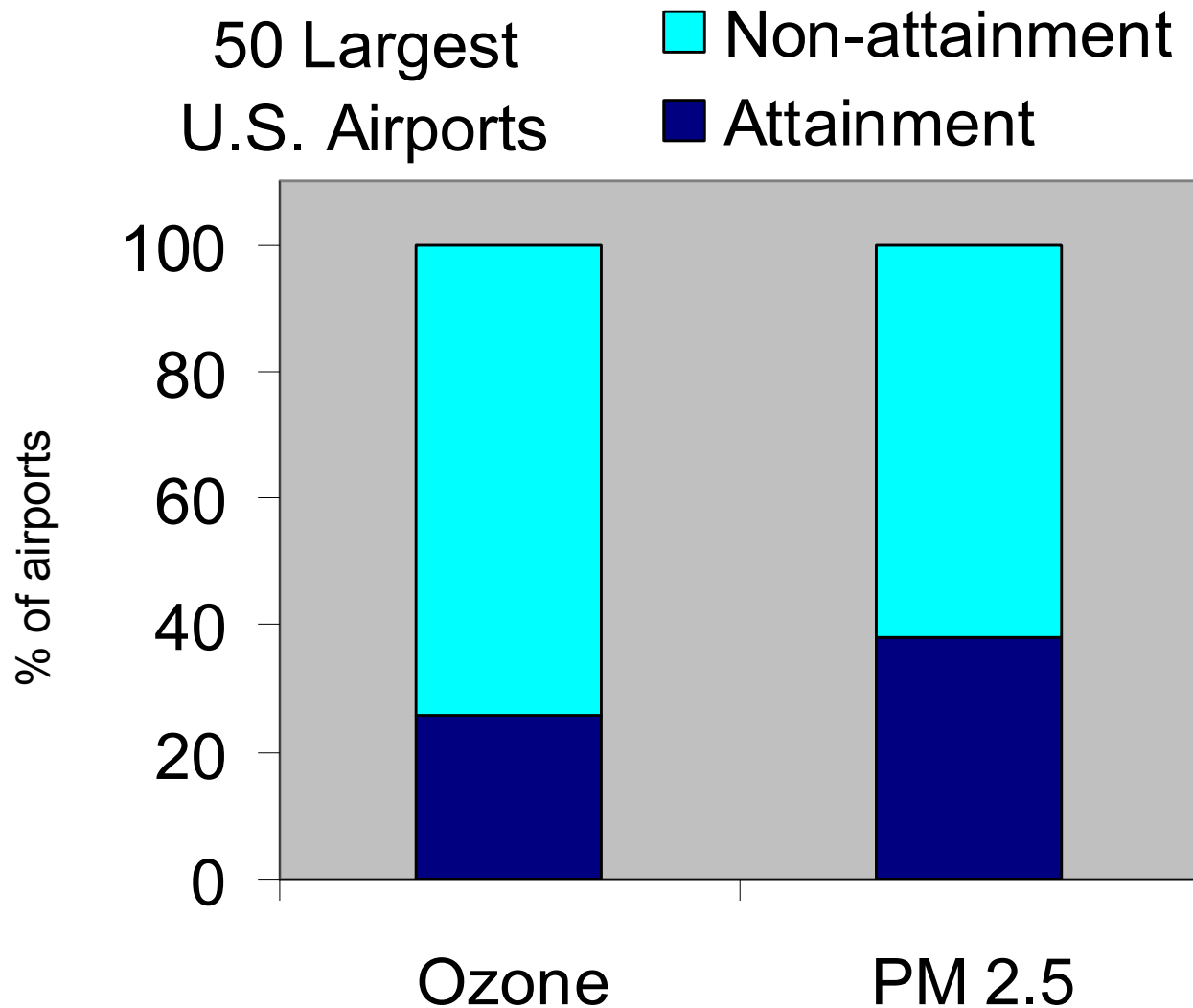
US Commercial Aviation Performance



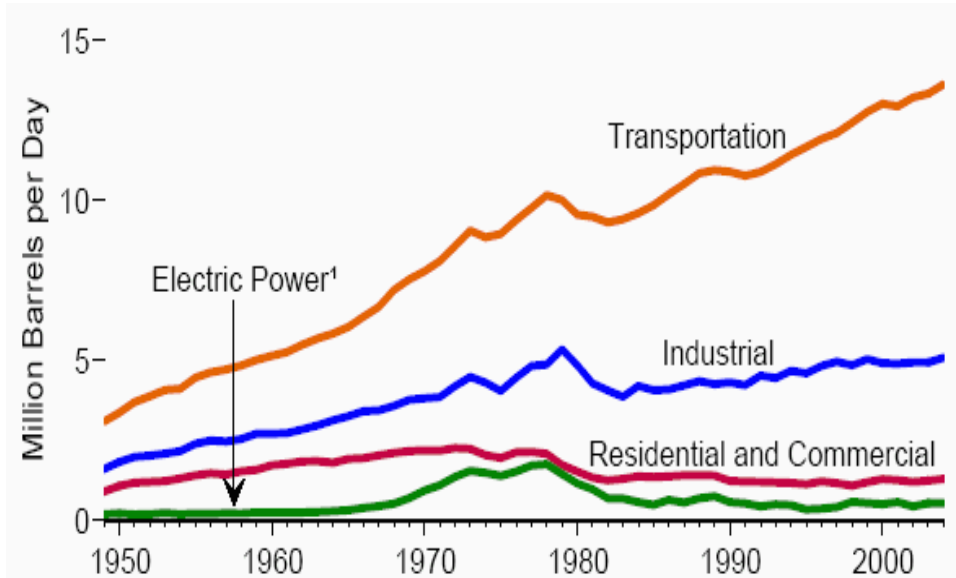
Source: FAA



As Predicted, Local Air Quality Issues Growing In Importance

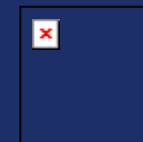
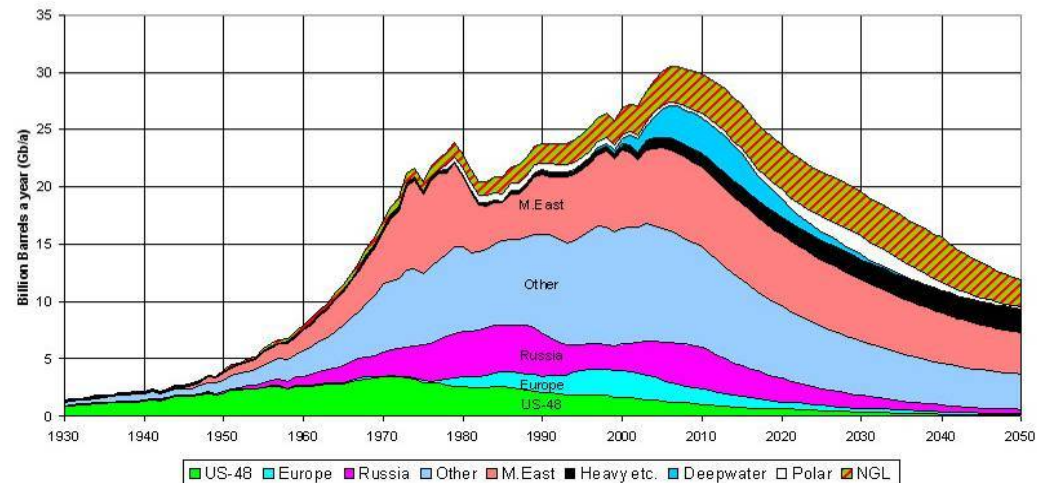


New Issue: Concern About Reliance of Transport on Oil

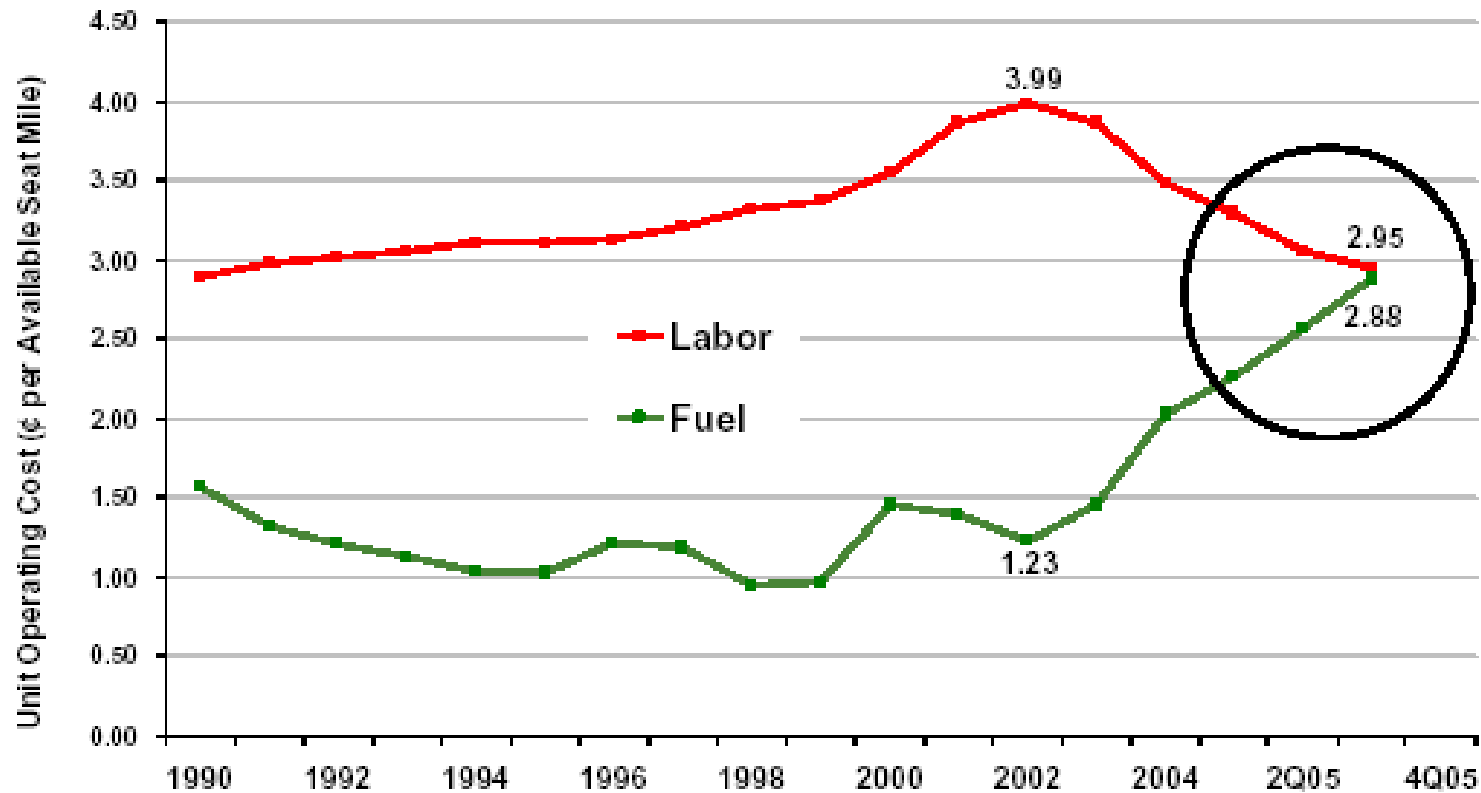


Transportation continues to have the largest reliance on oil...

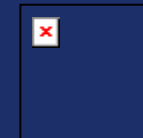
...while some are predicting that we are nearing the peak of oil supply.



New "Emphasis" Issue: Shift in Airline Cost Equation

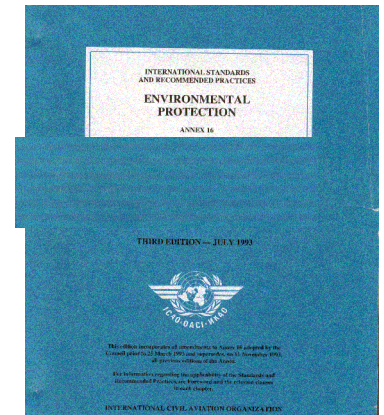


Source: Air Transport Association



New Issue: Aviation GHG Emissions Internationally

- **United Nation Framework Convention on Climate Change (UNFCCC) 1992**
 - General commitment to reduce certain greenhouse gas emissions
- **Kyoto Protocol 1997 (2005)**
 - Specific targets for reductions
 - Developing countries exempt (for now)
 - Coverage of domestic aviation up to each country
 - International aviation subject to ICAO plan (per Article 2.2)
- **ICAO Decision in 2004**
 - Limit or reduce the impact from aviation greenhouse gas emissions on climate change



New Issue: European “Mania” on Climate Change and Aviation

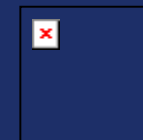
- “Flying kills. We all know it, and we all do it. And we won't stop doing it until the Government reverses its policy and starts closing the runways.”
London Guardian, February 28, 2006

- “Of all the things which an ordinary person does which damage the planet, flying is far the worst.” **Fly Now, Grieve Later, Tyndall Climate Center**

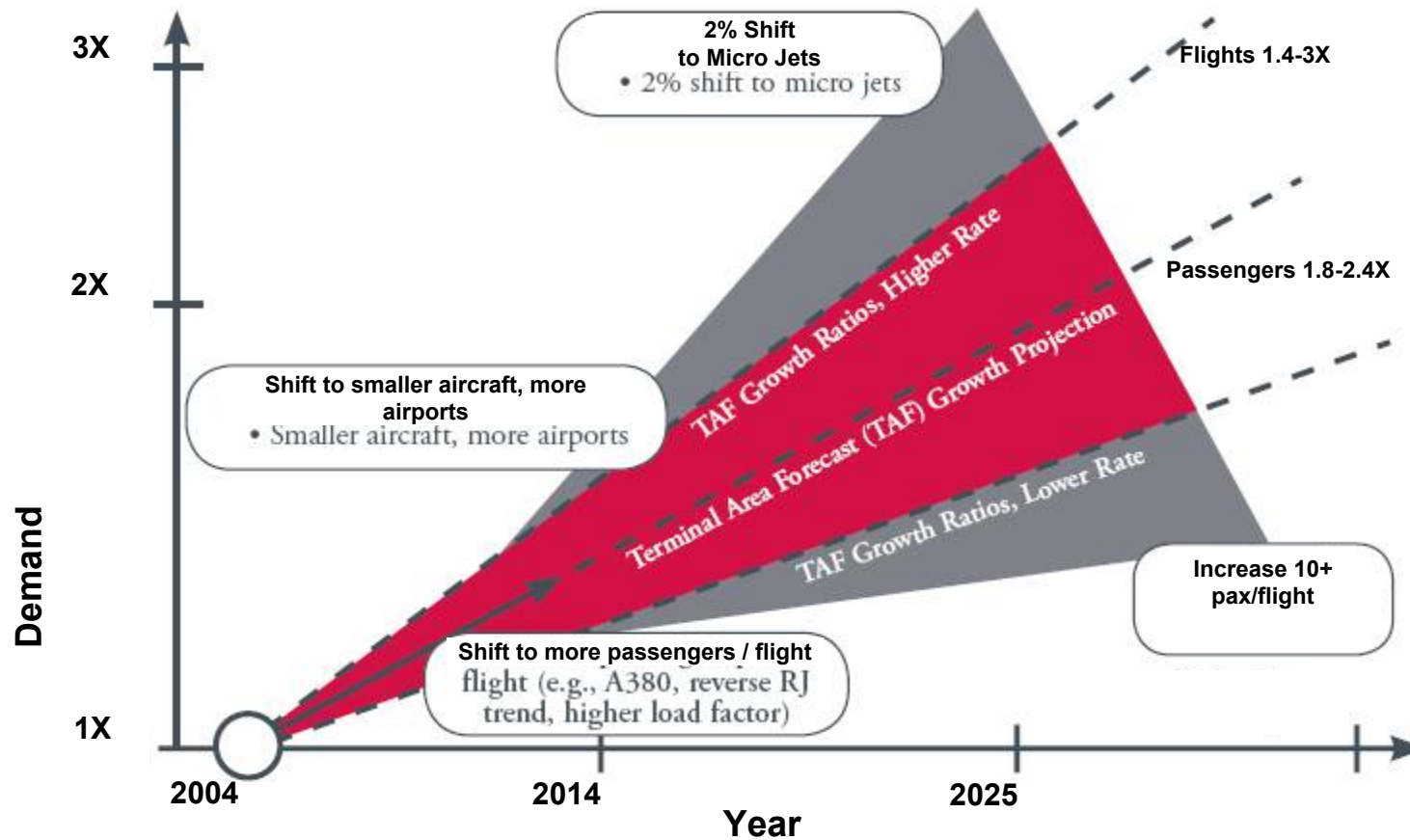
- “Aviation could be the next tobacco industry.”
CANSO Official, ATAG Conference, 2006



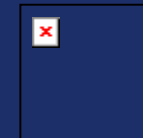
- “...we should tax aviation so heavily...that in within 10 years there should be virtually no domestic flights.” **Conservative MP Tim Yeo, January 2007**
- every time someone dies as a result of floods in Bangladesh, an airline executive should be dragged out of his office and drowned. **George Monibot, Guardian Newspaper, December 2006**



New Issue: Market Changes Increase Complexity of Challenge



Source: NextGen Integrated Plan, 2004

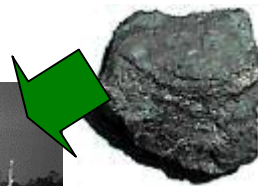


Aviation Environmental Issues – Year 2007

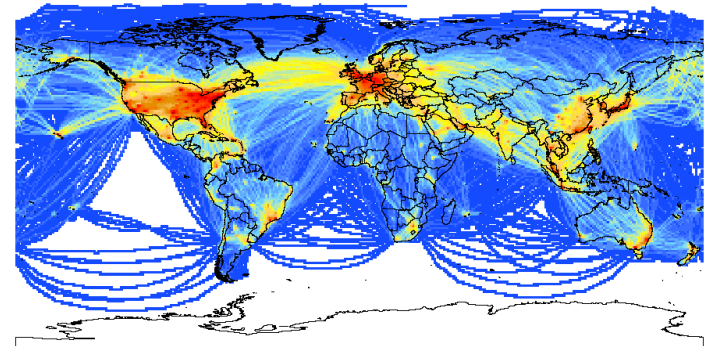
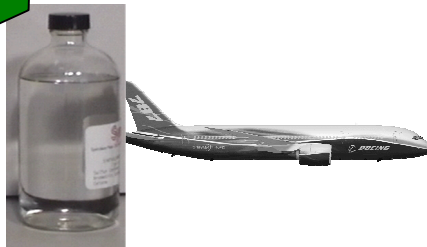
Community Noise Impacts



Air Quality

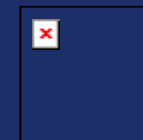


Energy



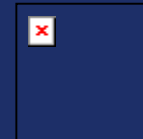
Water Quality

Global Climate



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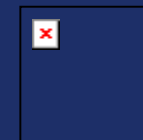
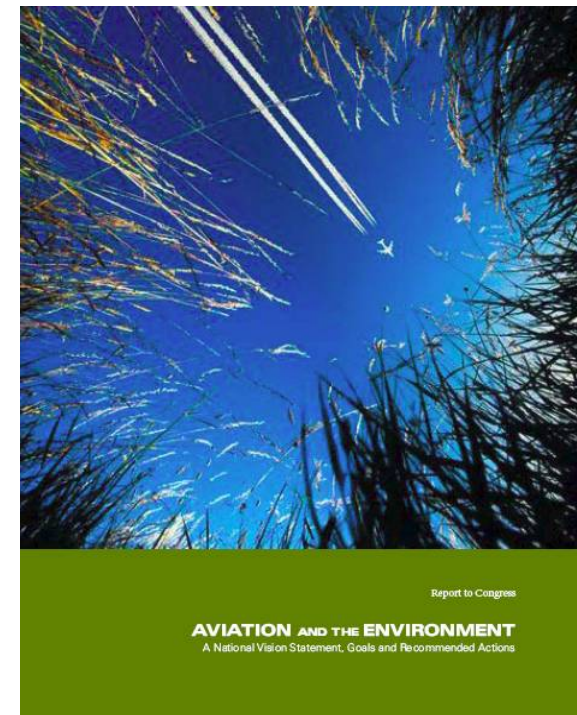
The Way Forward for the US: NextGen Plan

NextGen Vision

Provide environmental protection that allows sustained aviation growth

Factors:

- 2X increase in system by 2025
- Fundamental system changes
- Increased importance of environment
- Vision to grow aviation while reducing *significant* environmental impact
- **Technology and operational innovation essential to meet environmental vision**



NextGen Environmental Goals: Initial Quantification

Noise

- NextGen goal to reduce noise exposure (65, 55 DNL) 1%/year measured from base of 2000-2002 average (FAA goal)
- FAA goal is now 4%/year (65 DNL) through Flight Plan (2008-2012)

Local Air quality

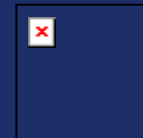
- NextGen goal analyses computed lbs emissions
- Engine emissions standards limit lbs emissions; ≠ significance
- National Ambient Air Quality Standards (NAAQS) establish significance for all sources combined
- Establishing aircraft contribution challenging

Climate

- NextGen analyses done against goal to improve aviation fuel efficiency per revenue plane-mile by 1%/year measured from base of 2000-2002 average (FAA goal)
- Historical average ~2.2%; FAA goal likely to become more stringent
- Fuel burn can be translated to lbs pollutants; ≠ significance
- Establishing metrics/aviation contribution challenging

Water

- No analyses to date



The Way Forward: Understanding the Problem

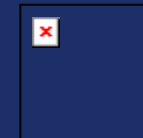
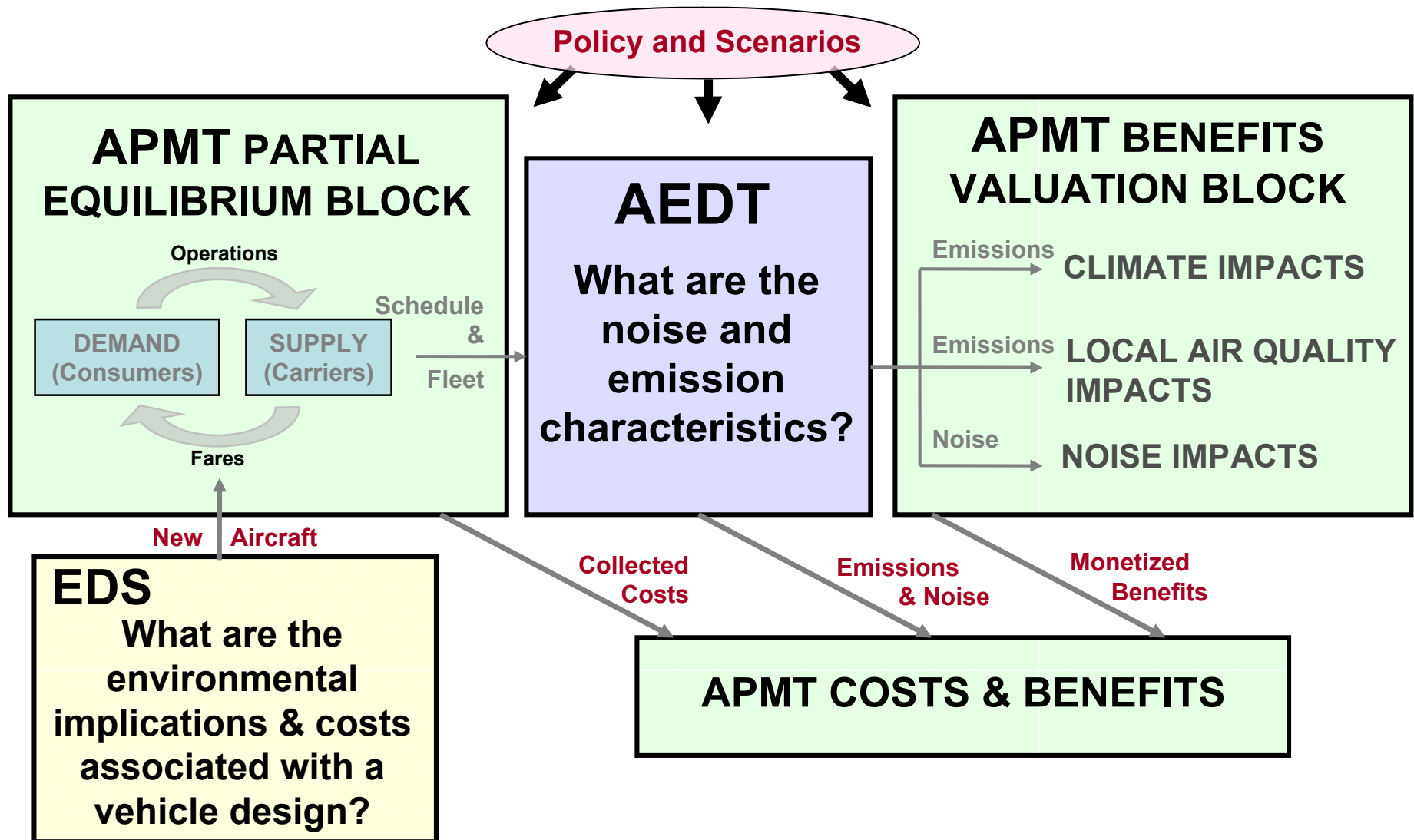


***Significant and appropriate* are policy decisions which are informed – but not established by - science**

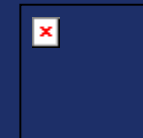
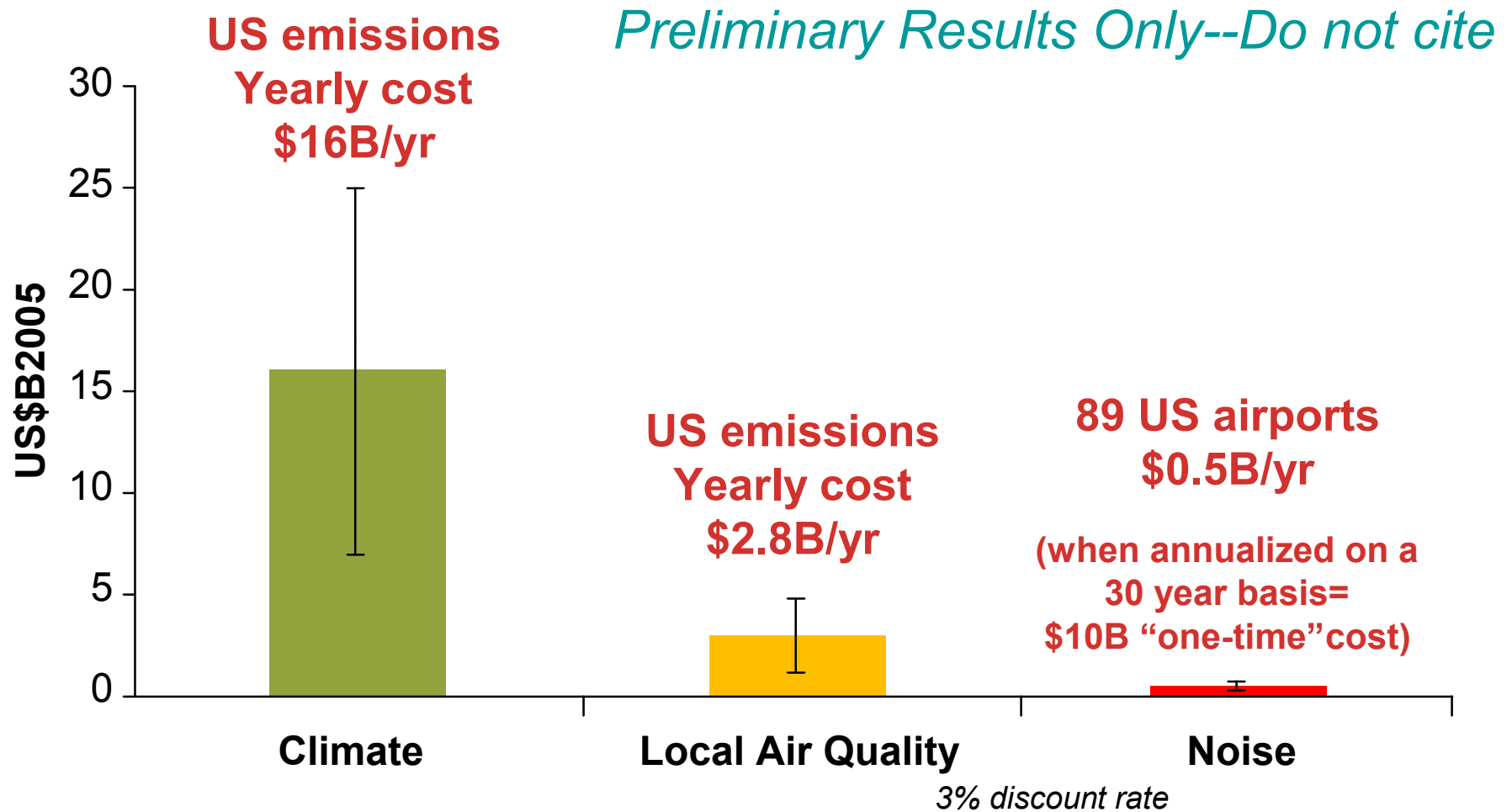
- Better science-based understanding of the impacts of aviation emissions on climate change
- Improved metrics, measurement techniques, and modeling capability to quantify and predict impacts and to understand inter-relationships of aviation environmental factors



The Way Forward: New Integrated Tools & Approach



The Way Forward: Integrated Assessment (3)



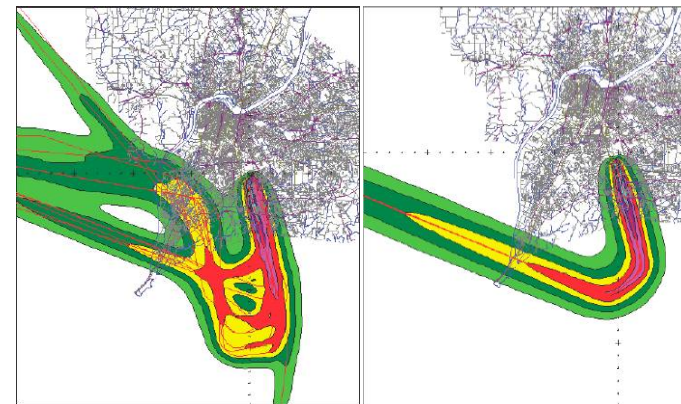
The Way Forward: Improved ATM Procedures

Opportunities

- New technologies to improve air traffic management will help reduce emissions. An example is RVSM – Reduced Vertical Separation Minimums. Full implementation of RVSM may reduce fuel use by ~500 million gallons each year.
- Other operational approaches, such as continuous descent arrivals, can reduce fuel burn as well as noise
- Reducing congestion, and optimizing airport ground and terminal air space operations offer great promise for future reductions of noise and emissions



Louisville CDA Flight Trials



The Way Forward: New Aircraft Technology

Opportunities



- Historically new technology accounts for 90% of environmental footprint reduction
- New concepts offer promise for improvement
- Collaborative demonstrations with industry can stimulate technology transition
- Need a balance in maturing technologies and enabling revolutionary concepts



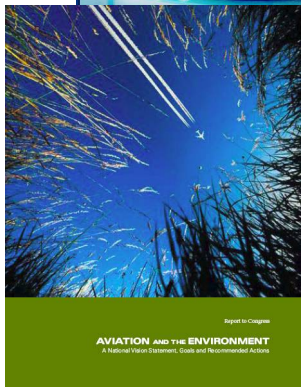
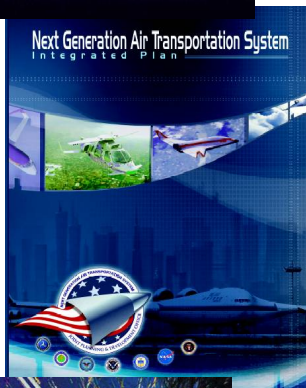
The Way Forward: Pursuit of New Fuels



Opportunities

- Synthetic Fuels may be Environmentally Friendly
- Helps Manage Interdependencies
- Commercial Aviation Alternative Fuel Initiative (CAAFI)
 - *Securing a stable fuel supply*
 - *Furthering research and analysis*
 - *Assessing environmental impacts*
 - *Improving aircraft operations*

The Way Forward: The Essential Partnership

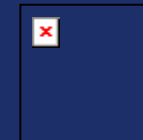
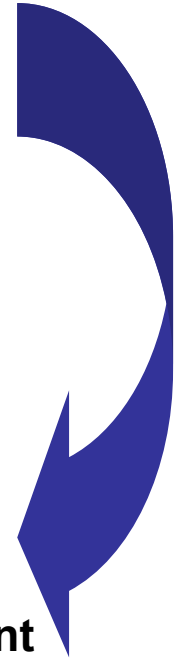


NASA

- Technology research – enable revolutionary concepts
- Alternative fuels research
- Operational procedures research
- Science to understand impacts
- First principles analytical models

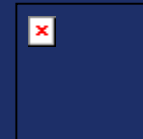
FAA

- Technology maturation
- Alternative fuels assessment/certification
- Operational procedures demonstration/advancement
- Science & metrics and measurement techniques to quantify impacts
- Analytical models



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The Way Forward: Proposals for New Programs

- **Research Consortium for Lower Energy, Emissions and Noise Technology Partnership
“CLEEN”**
- **Airport Cooperative Research Program**
- **Environmental Mitigation Demonstration Pilot Program**

http://www.faa.gov/regulations_policies/reauthorization/



Legislative Proposal: CLEEN

- **Research Consortium for Lower Energy, Emissions and Noise Technology Partnership “CLEEN”**
- **Establishes world-class consortium, via 50-50 cost share cooperative agreement, for development, & maturing of certifiable lower energy, emissions, noise engine & airframe technology over 10 years.**
- **Includes performance objectives for fuel efficiency, NOx, noise, use of alternative fuels, retrofit potential.**
- **Authorizes funding (\$22M) from NextGen.**



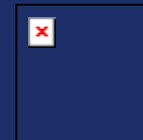
Legislative Proposal: Airport Cooperative Research Program

- **Makes ACRP permanent.**
- **Adds \$5 million a year from Airport Improvement Program (AIP) for environmental research for the airport environment, including—**
 - Reduction of community exposure to noise
 - Reduction of aviation emissions
 - Addressing water quality



Legislative Proposal: Mitigation Demo Pilot Program

- **Environmental Mitigation Demonstration Pilot Program**
- **Authorizes up to 6 projects to demonstrate at public-use airports the practical benefits of promising research to reduce impacts on noise, air or water quality in the airport environment**
- **50% share funded from AIP noise/environmental set-aside, not to exceed \$2.5 million AIP per project**
- **FAA would identify and disseminate best practice information based on project results**



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Can We Succeed- An Initial Analysis (1)

- **Calculated metrics on a national basis:**
 - Noise exposure (34 CONUS OEP airports)
 - Fuel efficiency for all operations at “top 100” airports
- **Used the Portfolio Analysis Phase 2 trajectories**
 - Number of flights determined by trimming a 3x demand (JPDO goal) to achieve reasonable delays given NextGen mid-term (2012-2018) capacity. This resulted in nominally a 2x increase in flights.
 - Enroute trajectories include NextGen operational improvements that were modeled by SMAD operational models.
 - Terminal Area trajectories for the CONUS OEP airports include RNAV-RNP & CDA routes to all runway ends.



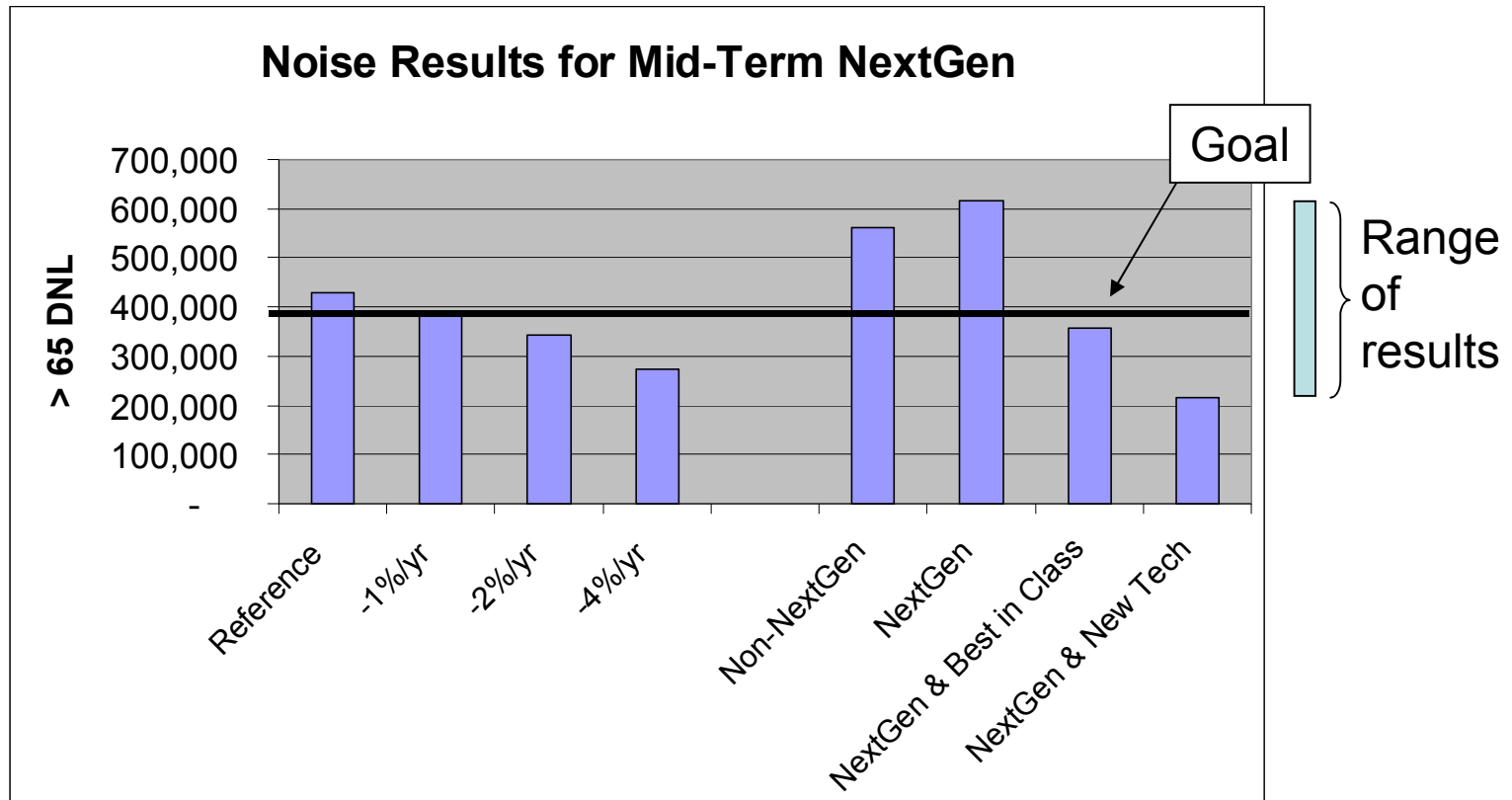
Can We Succeed- An Initial Analysis (2)

- **Several projected fleets were used**
 - MITRE projections to 2015 (“Baseline fleet”)
 - Best in class A/C in each seat class (“Best in class fleet”)
 - Best noise A/C for the noise calculations
 - Best fuel-burn A/C for the fuel burn calculations
 - Best in class fleet augmented with technology projections provided by the EWG Technology Standing Committee (“New technology fleet”)
 - New A/C were described in 3 of the 10 seat classes

The best in class and new technology fleets are not achievable in the mid-term time frame, but their use enabled “benefit pool” calculations which bracket the environmental results for the mid-term.

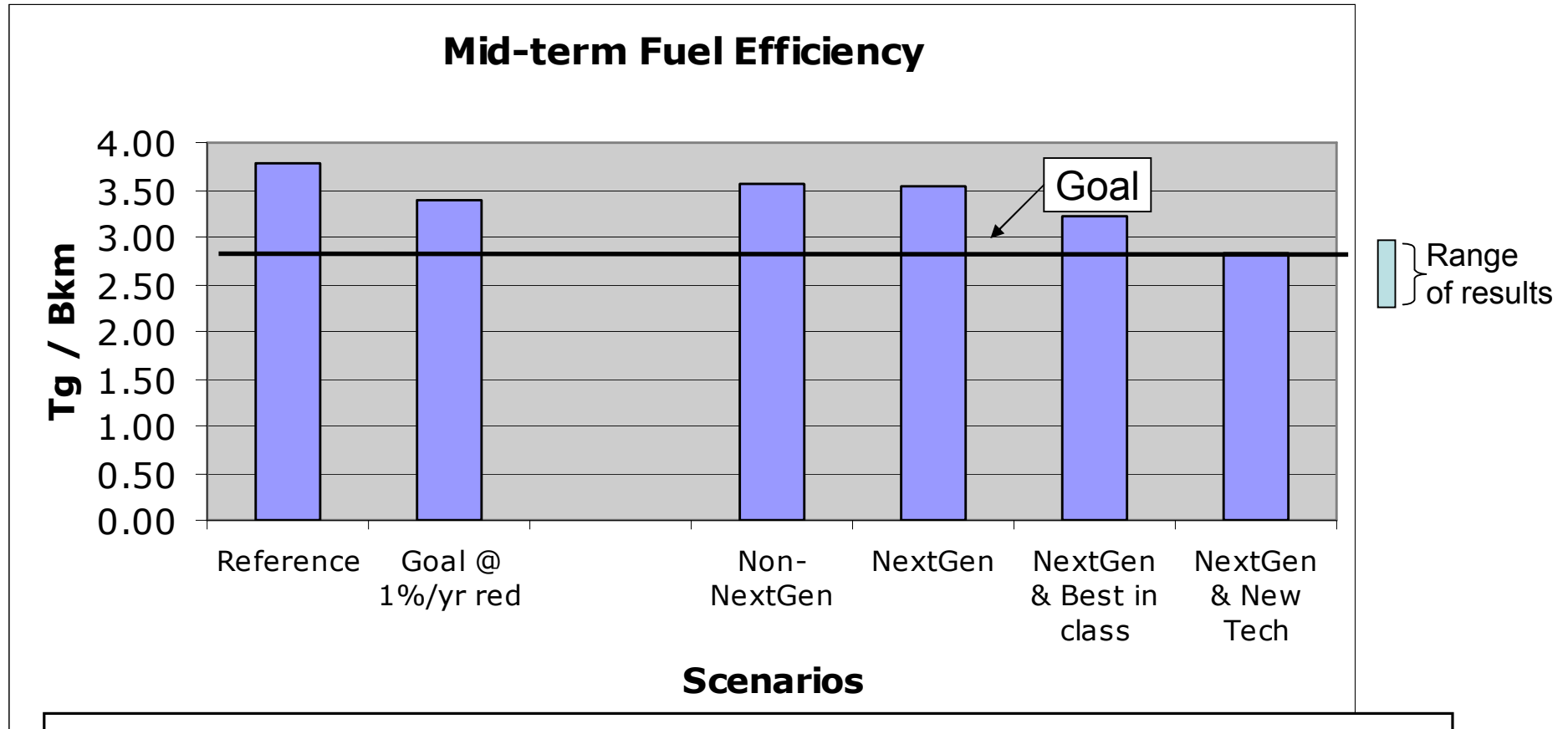


Can We Succeed- Mid-Term Noise Results



- Results for the Mid-Term NextGen w/o advanced fleets indicate that, as a result of the increased # of flights enabled by NextGen, not only will the noise goals not be met but that the number of people exposed to ≥ 65 DNL will increase.
- While neither of the “advanced” fleets is achievable in the near term, fleets with those characteristics would meet and exceed the current noise goals.

Can We Succeed- Mid-Term Emissions Results



- The Mid-term NextGen fuel efficiency performance w/o advanced “fleets” is improved relative to the baseline but does not meet the goal.
- While neither of the “advanced fleets” used is achievable in the near term they provide a method of estimating the potential “benefit pools” and bracketing the possible values of the fuel efficiency metric.
- Both the “best-in class” and “new technology” fleets exceed the fuel efficiency goal.

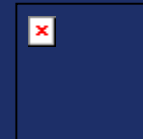
Can We Succeed- Summary Results

- **Noise and fuel metrics have been calculated for the modeled mid-term NextGen (2012-2018) using flight schedules trimmed to achieve reasonable delay.**
- **The metrics were evaluated using several projected fleets**
 - A baseline fleet based on expected A/C retirements and replacements.
 - Two “advanced” fleets. These fleets are not achievable in the mid-term time frame, but their use enabled “benefit pool” calculations which bracket the environmental results for the mid-term.
- **The desired mid-term noise and fuel efficiency goals were not met using the baseline projected fleet**
- **The benefit of incorporating aircraft with improved performance and new technologies into the fleet is indicated since both “advanced” fleets surpassed the fuel and noise goals**



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Some Closing Observations

- Despite past progress, environmental constraints to aviation growth real
- Future challenges likely to be more complex
- NextGen will not achieve environmental goals without technology and operational improvements in environmental and cost performance
- Initial assessments indicate success is possible
- Partnership between FAA and NASA efforts is essential

