Phase-III Results

Environmental Modeling and Analysis for the Portfolio Analysis Division

01/24/2007
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Today's Presentation

- **Main Points Identified**
- Goals of the Environmental Analysis
- Overview of the Approach
- Results of this Analysis

Main Points Identified

Based on the Operational Improvements modeled and the level of fidelity performed for this analysis:

- For the scenarios analyzed the JPDO environmental goals are not achieved
  - Number of people exposed to >65 DNL increases instead of decreasing as required by the goal
  - While real decreases in fuel consumption were seen, the fuel efficiency goal is not met
  - There are no specific emission goals:
    - The Fleet evolution produced a reduction in the emissions generated per flight
    - The number of flights grew much more rapidly than the reductions per flight so that the absolute amount of emissions increased

- Refinements to the assumptions and analyses used will reduce uncertainty in the estimates and on balance would likely improve performance against goals

Today's Presentation

- Main Points Identified
- **Goals of the Environmental Analysis**
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Goals of the Environmental Analyses

- Incorporate some improvements in the analysis
- For each of three scenarios:
  - Baseline (2004)
  - Non-NGATS (2015)
  - NGATS Segment 3 (2015)
- Calculate on a National Basis:
  - Noise exposure (CONUS OEP airports)
  - Annual emissions generated by aircraft operations for the top 100 airports
  - Fuel efficiency for all operations that use the top 100 airports.
- Compare and contrast the results

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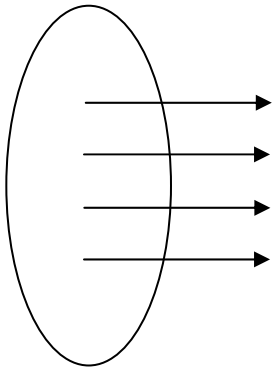
Improvements Incorporated

- In addition to the **OIs modeled in the operational models that provide the trajectories and timing of operations**, we have added:
- An initial approach to **Fleet Evolution**
- **RNP (Required Navigation Performance)** routes to all runways at CONUS OEP Airports
- An initial approach to adding environmentally enhanced arrivals in the form of **CDA (Continuous Descent Approach)**
- **National noise** analysis using CONUS OEP Airports
- **National emissions** analysis using the Top 100 Airports

In general the PMD & EIPT concurred with the methods used

OI's Modeled Directly and Indirectly

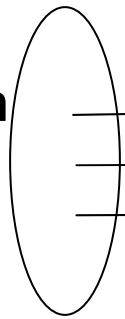


Sub-set of OI's
See Input from Dan Goldner

Operational Analyses

Trajectories and Schedule Incorporating Impacts of OI's

Fleet Evolution
RNP
CDA



OIs directly analyzed

Environmental Analyses

Environmental Results

Overview of Scenarios

	Scenario 1 Baseline 2004	Scenario 2 Non NGATS 2015*	Scenario 3 NGATS 2015*
Number of flights included in the environmental analysis	41399	77422	84595
30 day sample of radar data used to define terminal area trajectories for the OEP CONUS Airports (34 airports)	Yes	Yes	Yes**
Remaining airports (100-34) terminal area trajectories were defined algorithmically to use a primary runway	Yes	Yes	Yes
U.S. Carrier fleet evolved	Baseline Fleet	Yes	Yes
CDA - For the CONUS OEP Airports	No	No	Yes
RNP - For the CONUS OEP Airports	No	No	Yes

* Traffic was projected for the new OEP runways; however, in many cases procedures have not been defined, therefore existing runways and procedures were used.

** Backbones generated from the radar data were modified to account for CDA and RNP procedures.

Flight Count Summary

	2004 Baseline		Non-NGATS		Segment 3 NGATS	
Operational Modeling (ACES flights completed)	41500		81664		88675	
Flights Removed due to >3hr Delay	101	0%	4242	5%	4080	5%
Environmental Modeling (flights entered)	41399	100%	77422	95%	84595	95%
OEP(CONUS) - Noise	29300	71%	48197	62%	55240	65%
TOP 100(LMI 102) - Emissions & Fuel	35206	85%	63649	82%	70500	83%
Flights Rejected	0		29		33	

- **In an effort to remove excessive number of flights that shifted from "day" to "night", flights with greater than 3 hours of delay were removed based on the assumption that they would have been cancelled.**
- **Very few flights were rejected during environmental modeling due to anomalous trajectories.**

Fleet Evolution

- MITRE's US Air Transport Fleet Forecast 2005 – 2030 Forecast was used to evolve the US carrier fleet.
- Flights by international carriers and GA operations were not evolved.
- Cargo and passenger flights were not separated.
- Day and night operations were evolved separately so that both would reflect a broad mixture of the predicted future fleet.
- Evolution was performed by seat category.
- Percentages of MITRE's Forecast by seat category were applied to evolve the fleet.

Scope of Noise Analysis

- Noise Analysis
  - Included the CONUS OEP Airports (34 airports excluding HNL)
  - 20 nmi ring around each airport to capture all of the >55 DNL changes.
  - 30 days of radar data was used to capture baseline characteristics. Custom profiles were developed which included various air traffic procedures such as tunneling and arrival step downs.
  - Noise was computed for just over 1 million noise locations accounting for ~88.3 million people (based on 2000 US Census)
  - Population exposed to noise was summarized by
    - Greater than 55 DNL and less than 60 DNL
    - Greater than 60 DNL and less than 65 DNL
    - Greater than 65 DNL
    - Results for lesser amounts of exposure were generated but are limited to those locations within 20nmi of the airport
  - Aggregate results for metropolitan areas where multiple airports share population (i.e. their 20nmi-radius rings overlap) are reported. In these areas each airport contributes to the cumulative noise exposure. There were 4 such areas identified: New York Area (EWR/JFK/LGA), DC Area (IAD/DCA/BWI), Chicago Area (ORD/MDW) and Southeast Florida Area (FLL/MIA).
  - Effect of the FAA's annual investments in noise treatment using the Airport Improvement Fund are not modeled here.

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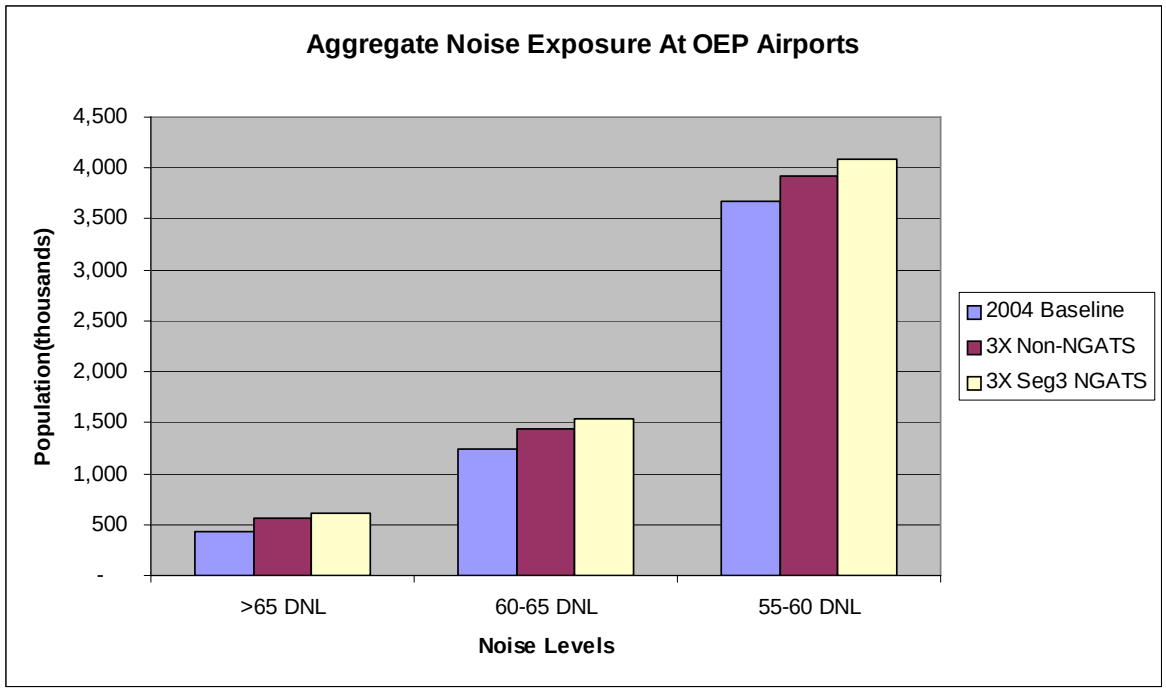
Noise Results Validation: Total Population Above 65 dB DNL

- In the baseline year there were 427,924 people exposed to noise levels at or above 65 DNL at the CONUS OEP airports. Note that these results are consistent with FAA's estimate of roughly half a million people impacted by 65 DNL in the 2000-2004 timeframe.

Noise Results: Total Population Above 65 dB DNL

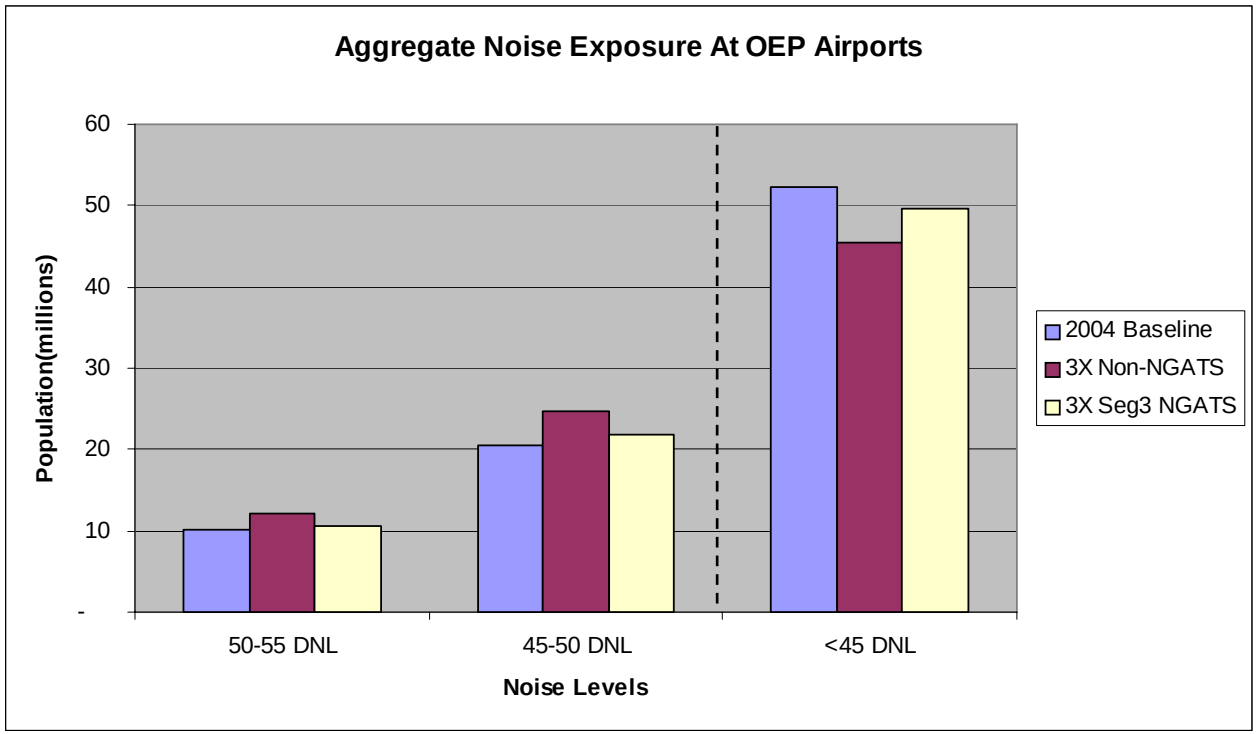
- Baseline: 427,924 people at or above 65 DNL
  - Goal: 1% reduction per year
  - Desired total by 2015: 383,137 people within 65 DNL
- Non-NGATS scenario: 64% increase in flights analyzed -- 560,611 people at or above 65 DNL
  - 31% increase over baseline results
  - 46% above the desired goal
- Segment 3 NGATS: 89% increase in flights analyzed -- 615,409 people at or above 65 DNL
  - 44% increase over baseline results
  - 61% above the desired goal.
  - Note that for this scenario there were 7043 additional flights to OEP airports above the Non-NGATS scenario. This increase in operations is derived from NGATS improvements.
- Due to fleet evolution, population impacted by 65 DNL or greater grew more slowly than would have otherwise occurred.

Noise Results: Total Population Above 55 dB DNL



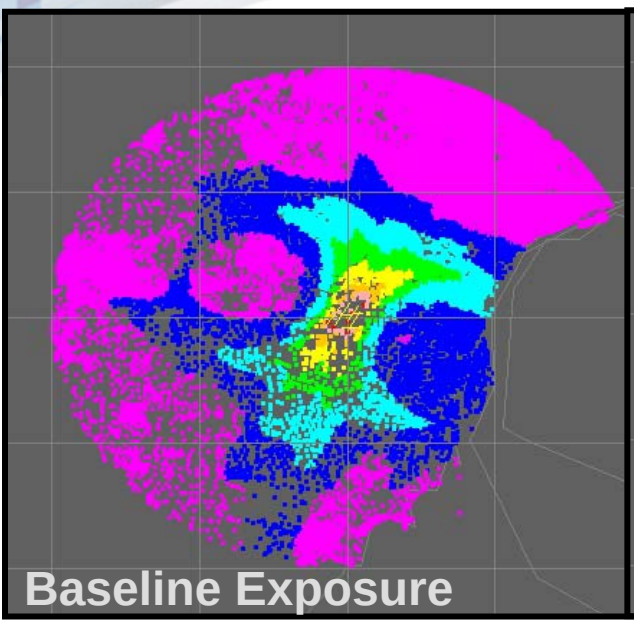
- Although operations were roughly doubled between the baseline and future scenarios (64% increase in Non-NGATS and 89% in Segment 3 NGATS), it is assumed that the improved fleet helped to reduce the overall impact.
- Changes in noise exposure between the Non-NGATS and Segment 3 scenarios are apparently due to two factors:
  - In Segment 3 NGATS, OEP airports had 7043 (~15%) more operations than in the Non-NGATS scenario
  - Terminal operations were much more concentrated due to the RNP procedures

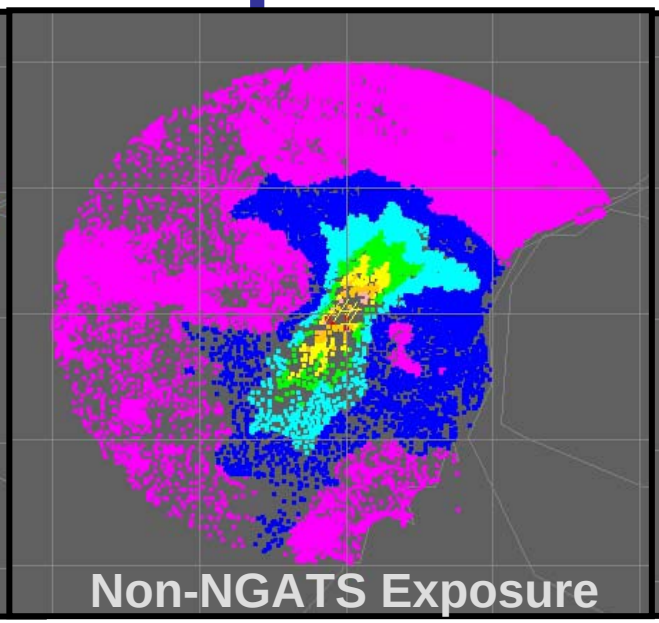
Noise Results: Total Population Below 55 dB DNL

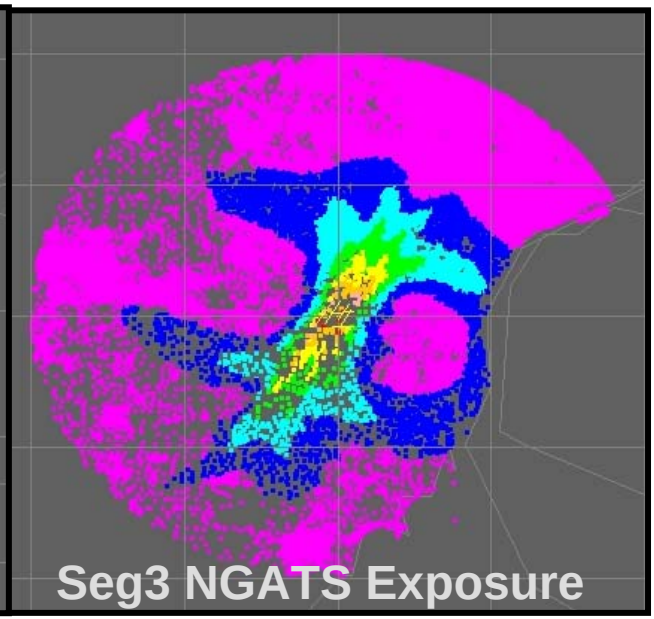


- For exposures between 45 and 55 dB, population totals decreased from the Non-NGATS to Segment 3 NGATS scenarios primarily due to implementation of the CDA procedure at CONUS OEP airports.
- The trend continues below 45 dB as more people receive less noise.

Noise Exposure: DTW







Noise Exposure	
	45dB <
	45-50 dB
	50-55 dB
	55-60 dB
	60-65 dB
	65-70 dB
	70-75 dB
	75dB >

DTW	65>	60-65	55-60	50-55	45-50	<45
2004 Baseline	2742	32414	126291	305865	541702	1609397
3X Non-NGATS	969	19020	68111	222828	543312	1764171
3X Seg3 NGATS	2485	22795	85232	233497	491884	1782518

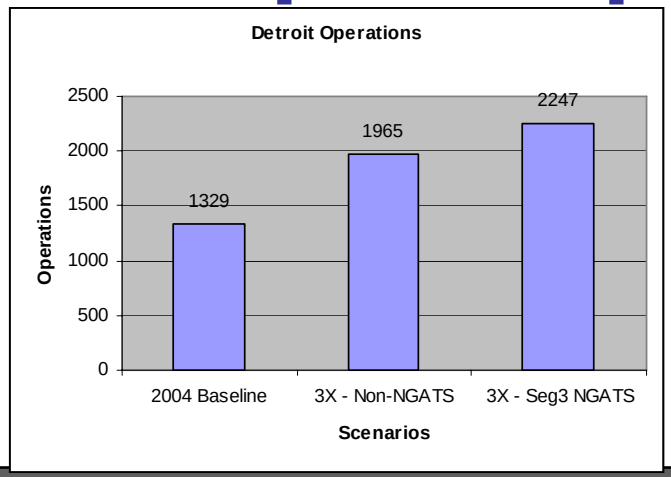
FAA Noise Impact Criteria

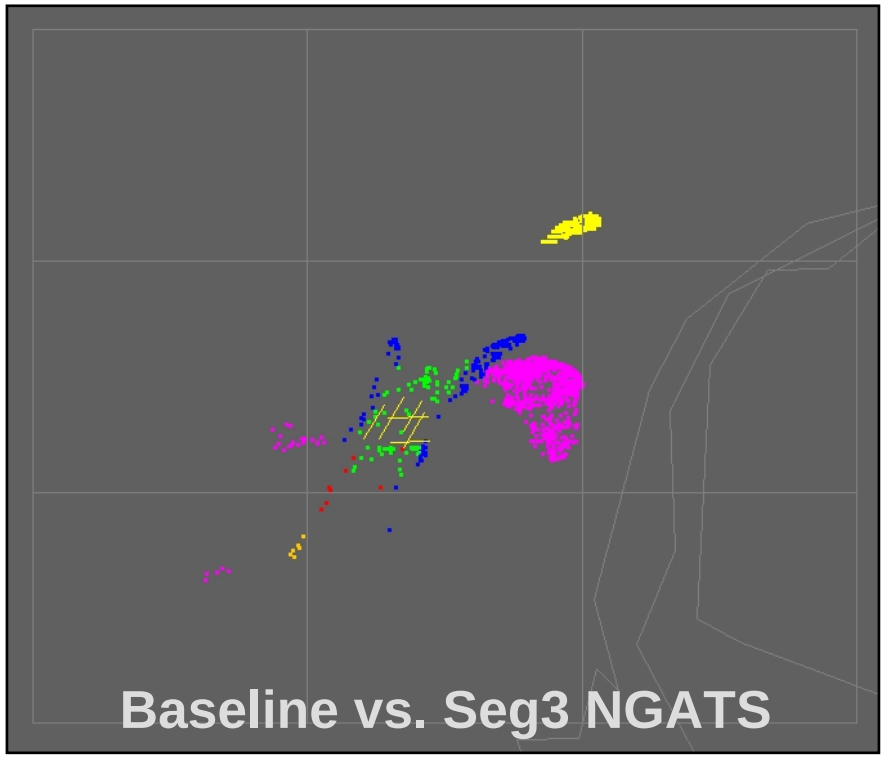
FAA Order 1050.1E

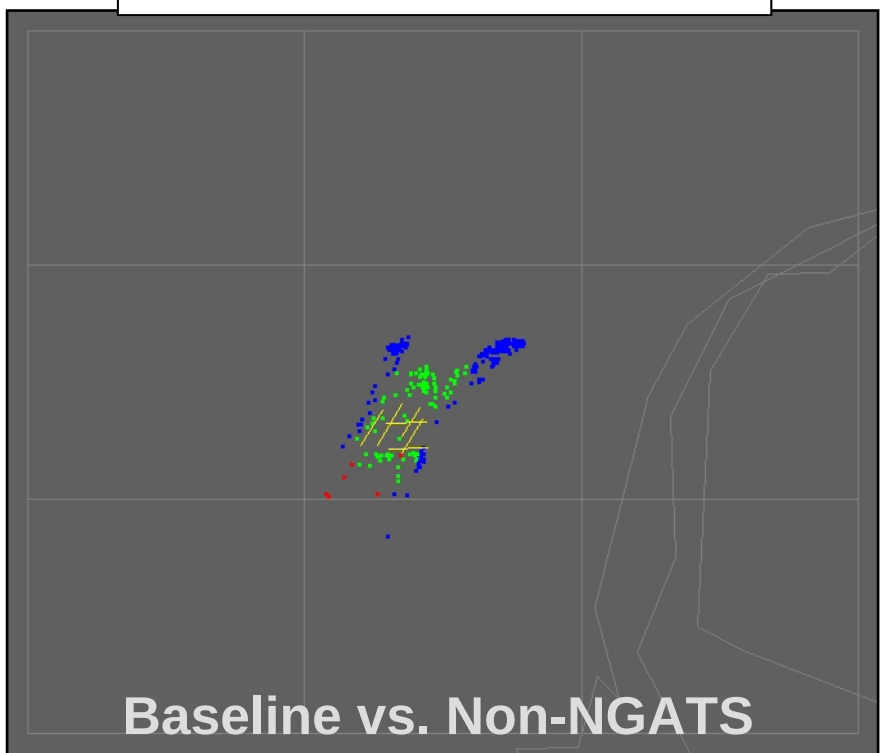
Criteria for Determining Impact of Increases in Aircraft Noise

DNL Noise Exposure With Proposed Action	Minimum Increase in DNL With Proposed Action	Level of Impact	Reference
65 dB or higher	1.5 dB	Significant	FAA Order 1050.1E, Apdx. A, 14.3 Part 150, Sec. 150.21(2)(d) FICON 1992
60 to 65 dB	3.0 dB	Slight to Moderate	FAA Order 1050.1E, Apdx A, 14.4c FICON 1992
45 to 60 dB	5.0 dB	Slight to Moderate	FAA Order 1050.1E, Apdx A, 14.5e FAA Notice 7210.360

Sample Airport Results - DTW



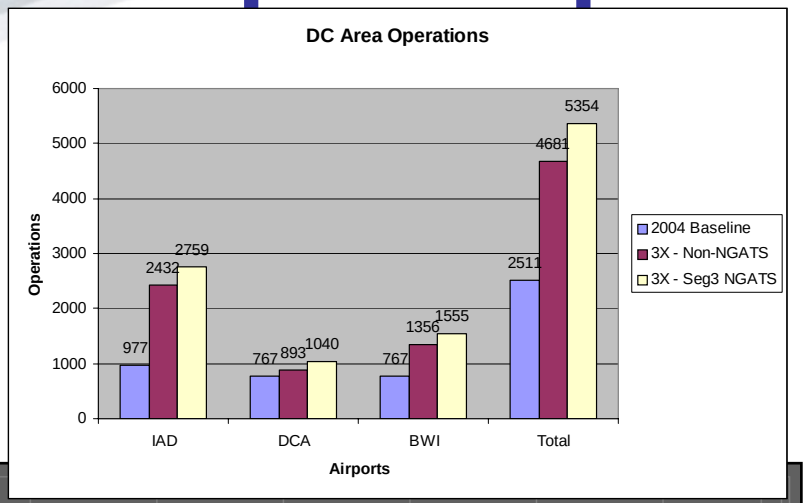


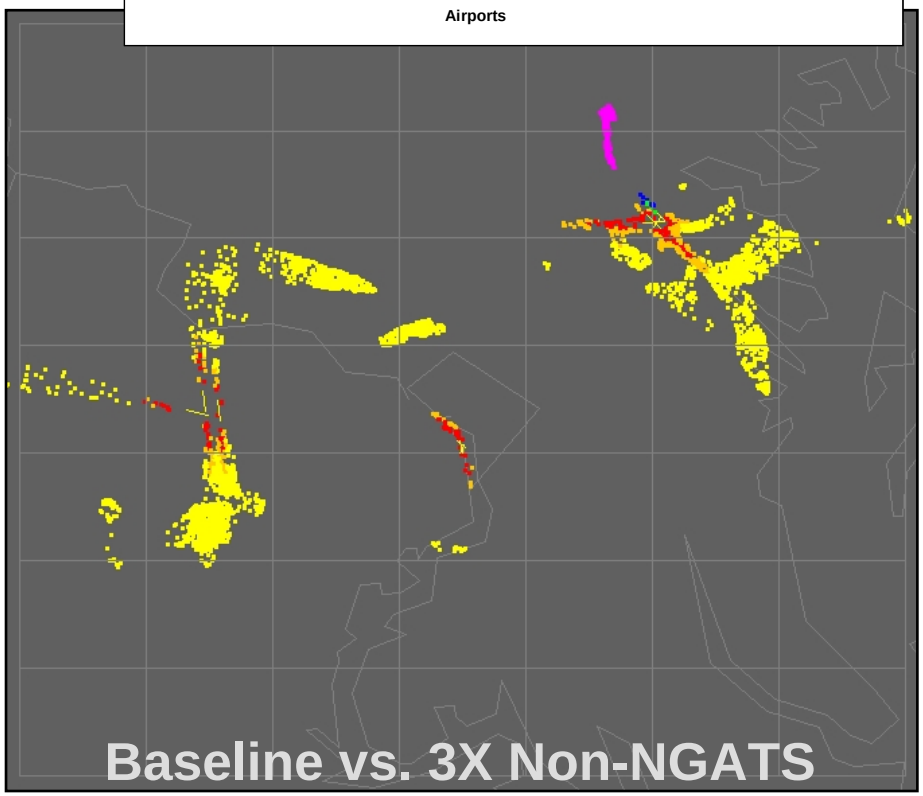


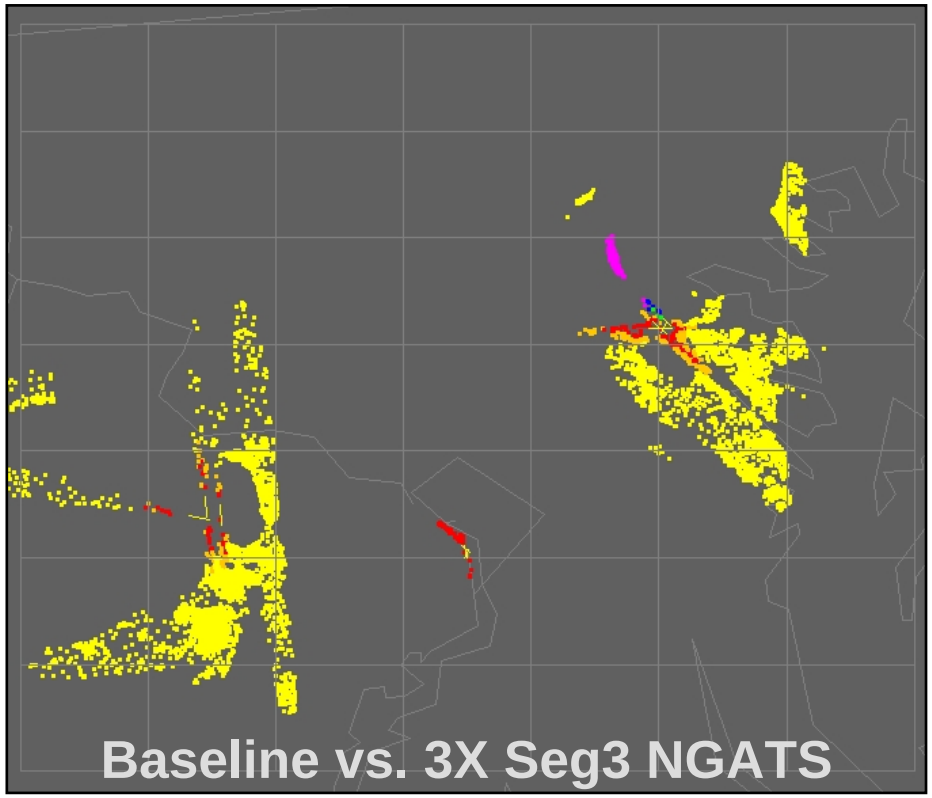
DTW	65>	60-65	55-60	50-55	45-50	<45
2004 Baseline	2742	32414	126291	305865	541702	1609397
3X Non-NGATS	969	19020	68111	222828	543312	1764171
3X Seg3 NGATS	2485	22795	85232	233497	491884	1782518

As the fleet evolved, airports that operated older aircraft in the baseline are seeing noise reductions, even with significantly increased operations.

Sample Airport Results DC Area





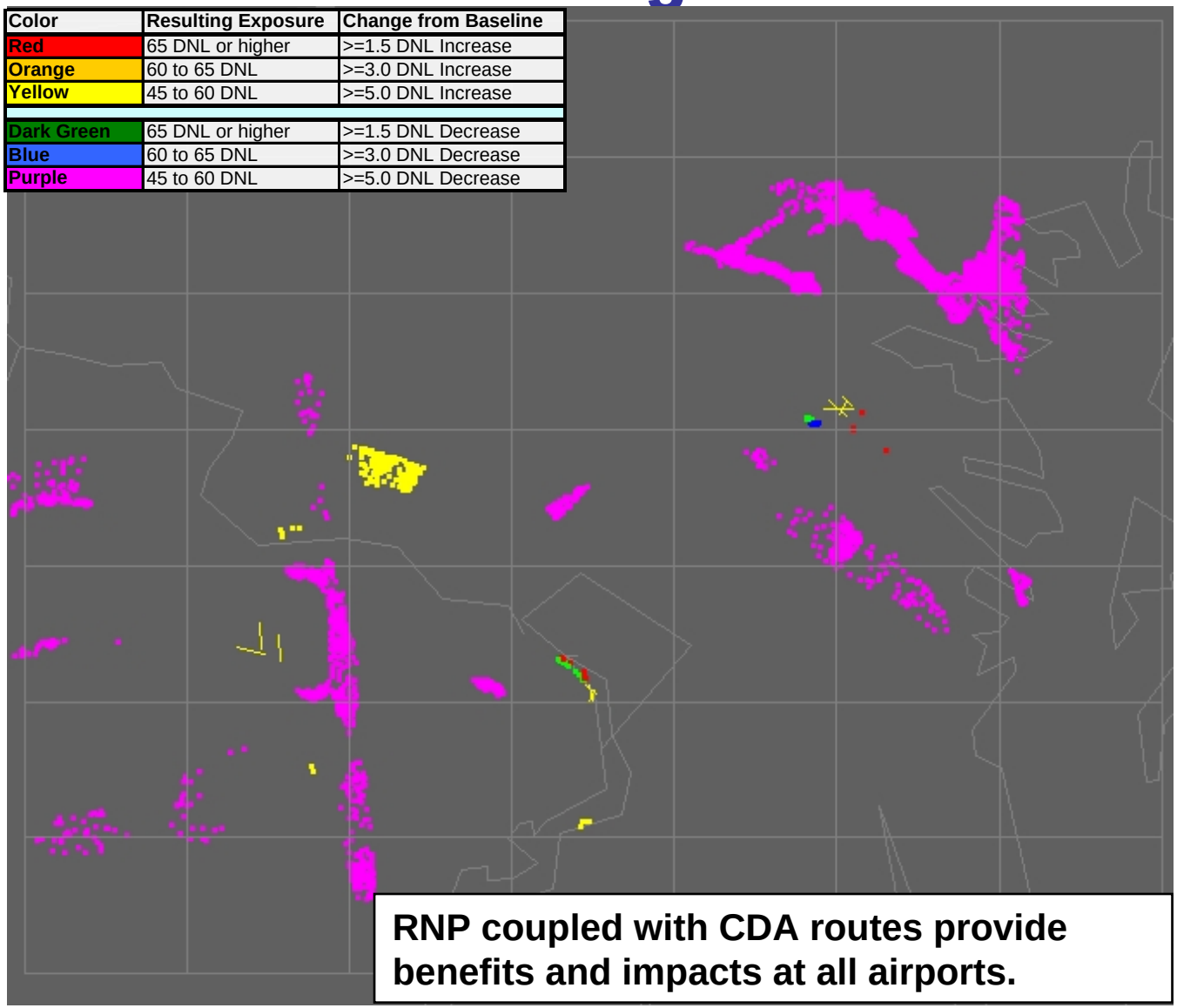


BWI-DCA-IAD	65>	60-65	55-60	50-55	45-50	<45
2004 Baseline	998	22550	73678	253251	620713	5251719
3X Non-NGATS	10980	45065	171322	444113	1254852	4296577
3X Seg3 NGATS	11782	52472	186697	350367	860561	4761030

As the fleet evolved, airports that already operated newer aircraft in the baseline are seeing noise increases.

Sample Airport Results DC Area Non-NGATS vs. Segment 3 NGATS

Color	Resulting Exposure	Change from Baseline
Red	65 DNL or higher	>=1.5 DNL Increase
Orange	60 to 65 DNL	>=3.0 DNL Increase
Yellow	45 to 60 DNL	>=5.0 DNL Increase
Dark Green	65 DNL or higher	>=1.5 DNL Decrease
Blue	60 to 65 DNL	>=3.0 DNL Decrease
Purple	45 to 60 DNL	>=5.0 DNL Decrease



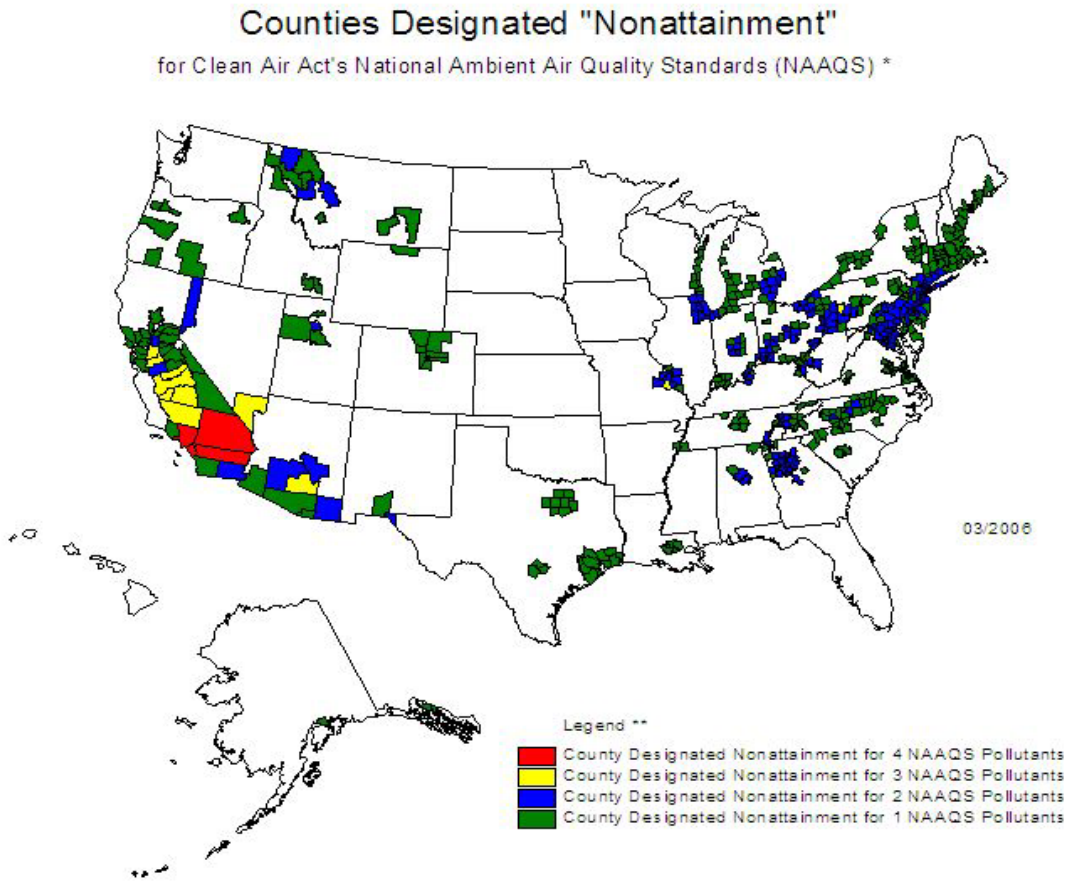
RNP coupled with CDA routes provide benefits and impacts at all airports.

Scope of Emissions and Fuel Analysis

- Top 100 airports were defined by the LMI list of 102 airports. These airports received the operational improvements assigned to the top 100 airports. The operational & environmental modeling considered 99 of the 102 airports
  - CONUS OEP Airports (HNL was excluded)
  - Remaining 67 Airports (ANC and JNU were excluded)
- Common trajectories developed from radar data were used for the OEP Airports when computing noise, fuel, and emissions.
- The remaining airports used generated terminal area extensions as described in previous analysis.
- Only contributions from aircraft are included in the emissions results.
- Emissions results were calculated for the following pollutants: CO, HC (or THC), NOx, SOx.
- Fuel burn is reported in Teragrams of fuel burned per Billions of kilometers flown (Tg/Bk)--EIPT requested we use this metric.

Counties Designated "Nonattainment"

- Nonattainment : any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant.
- Nonattainment pollutants are 8-hour ozone, particulate matter, nitrogen dioxide, carbon monoxide, sulfur dioxide, and lead.
- Nonattainment areas surround many of the major metropolitan areas around the country and therefore include many of the major airports.



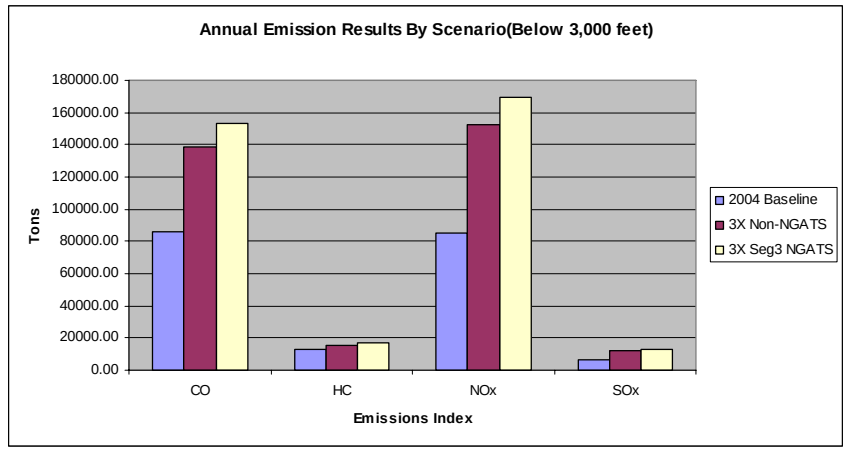
Guam - Piti and Tanguisson Counties are designated nonattainment for the SO2 NAAQS

* The National Ambient Air Quality Standards are health standards for lead, carbon monoxide, sulfur dioxide, ground level 8-hour ozone, and particulate matter (PM-10 and PM-2.5). There are no nitrogen dioxide nonattainment areas.

** Partial counties, those with part of the county designated nonattainment and part attainment, are shown as full counties on the map.

Emission Results Below 3000 ft Aggregated Across Airports

- Operations grew by 81% in the Non-NGATS scenario and 100% in the Segment 3 NGATS scenario for the 99 airports. When you consider the additional flights, the *total* pollutants grew linearly between the two future scenarios.
- Due primarily to the fleet evolution, a comparison of baseline and future scenario *per-flight* emissions does show a reduction by pollutant.
  - CO 25% reduction
  - HC 82% reduction
  - NOx 30% reduction
  - SOx 1% reduction



- Of the 99 airports included in the emissions analysis, 75 reside in non-attainment areas (for at least one pollutant) and all but one experienced an increase in at least one of the four pollutants.
- Current analysis captured enroute emissions from origin mixing height to destination mixing height. Future assessments should further separate the results to capture changes in the terminal area.
- Emission thresholds and goals have yet to be defined.

Emission Results
Enroute vs. Airports

- Enroute emissions for CO and HC account for roughly 60-70% of the total burden versus the airport's contribution.
- Enroute emissions for NOx and SOx account for roughly 80-90% of the total burden versus the airport's contributions.
- These results are consistent with FAA results describing contributions of emissions by segment of flight.
- Fleet evolution accounted for all benefits in the future scenarios.

CO (tons)						
	Baseline		Non-NGATS		Seg3 NGATS	
Airport	105610	31%	173877	29%	191596	29%
Enroute	229774	69%	417149	71%	461522	71%
Total	335383		591026		653118	

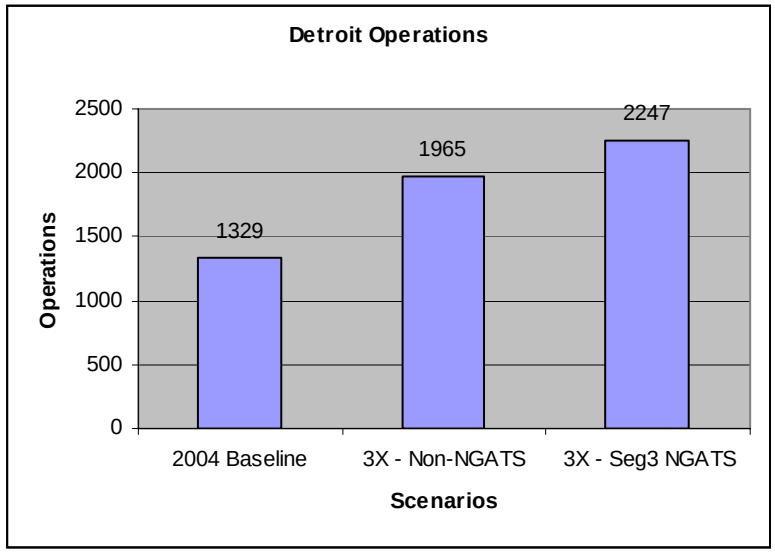
HC (tons)						
	Baseline		Non-NGATS		Seg3 NGATS	
Airport	15283	39%	19130	34%	21388	34%
Enroute	24292	61%	37400	66%	41781	66%
Total	39575		56530		63169	

NOx (tons)						
	Baseline		Non-NGATS		Seg3 NGATS	
Airport	91568	17%	169216	19%	188517	19%
Enroute	435316	83%	718086	81%	808325	81%
Total	526884		887302		996842	

SOx (tons)						
	Baseline		Non-NGATS		Seg3 NGATS	
Airport	7388	14%	13217	15%	14806	15%
Enroute	47131	86%	74859	85%	84338	85%
Total	54519		88077		99144	

Emission Results - DTW

- Operations increased by 48% in the Non-NGATS scenario and 69% in the Segment 3 NGATS scenario for DTW.
- Due to fleet evolution, airports operating older aircraft in the baseline are not seeing a linear increase in emissions, even with significantly increased operations.
- EPA Greenname or Non-attainment Area
  - Detroit-Ann Arbor, MI (Marginal)
    - Lenawee Co
    - Livingston Co
    - Macomb Co
    - Monroe Co
    - Oakland Co
    - St Clair Co
    - Washtenaw Co
    - Wayne Co



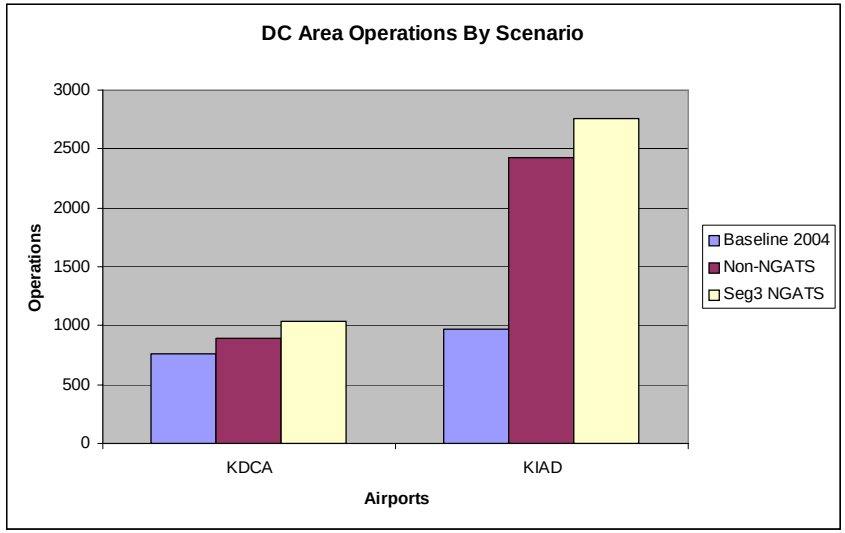
2004 Baseline				
Airport	CO (tons)	HC (tons)	NOx (tons)	SOx (tons)
DTW	1630.0	316.3	1549.7	146.2

Non-NGATS				
Airport	CO (tons)	HC (tons)	NOx (tons)	SOx (tons)
DTW	2204.9	232.8	2165.9	193.0
% Chg	35%	-26%	40%	32%

Segment 3 NGATS				
Airport	CO (tons)	HC (tons)	NOx (tons)	SOx (tons)
DTW	2437.9	249.2	2646.7	229.0
% Chg	50%	-21%	71%	57%

Emission Results Washington DC-MD-VA

- Operations increased by 91% in the Non-NGATS scenario and 118% in the Segment 3 NGATS scenario for DC Area airports.
- Airports operating newer aircraft in the baseline do not experience the moderating effects of fleet evolution.
- EPA Greenname or Non-Attainment Area
  - Washington, DC-MD-VA (Moderate)
    - DISTRICT OF COLUMBIA (Region III) Entire District
    - MARYLAND (Region III)
      - Calvert Co
      - Charles Co
      - Frederick Co
      - Montgomery Co
      - Prince George's Co
    - VIRGINIA (Region III)
      - Alexandria
      - Arlington Co
      - Fairfax
      - Fairfax Co
      - Falls Church
      - Loudoun Co
      - Manassas
      - Manassas Park
      - Prince William Co



2004 Baseline				
Airport	CO (tons)	HC (tons)	NOx (tons)	SOx (tons)
IAD	1210.3	270.6	985.3	80.9
DCA	686.6	84.0	691.4	64.1
DC Area	1897.0	354.6	1676.7	145.0

Non-NGATS				
Airport	CO (tons)	HC (tons)	NOx (tons)	SOx (tons)
IAD	2659.6	374.8	2873.1	221.2
DCA	723.5	77.7	795.8	71.7
DC Area	3383.1	452.5	3668.9	292.9
%Chg	78%	28%	119%	102%

Segment 3 NGATS				
Airport	CO (tons)	HC (tons)	NOx (tons)	SOx (tons)
IAD	3149.9	509.9	3105.2	248.8
DCA	832.5	72.2	955.1	86.2
DC Area	3982.4	582.1	4060.3	335.0
% Chg	110%	64%	142%	131%

Fuel Results

- Baseline scenario: Fuel efficiency = 3.8 Tg/Bk
  - Goal of 1% improvement per year
  - Therefore, goal would be 3.4 Tg/Bk by 2015
- Non-NGATS scenario: Fuel efficiency = 3.56 Tg/Bk
- Segment 3 NGATS scenario: Fuel efficiency = 3.54 Tg/Bk
- Improvements in the Non-NGATS, and NGATS scenarios are generated by the improved fleet.

Fuel Results – Terminal Area

- Fuel efficiency for arrival segments within the terminal area
  - Non-NGATS scenario improved 6%
  - Segment 3, NGATS scenario improved 21%
  - Non-NGATS improvements are generated by the fleet evolutions while the additional 15% improvement in Segment 3 NGATS is a result of the RNP and CDA operational improvements.
- Fuel efficiency for departure segments within the terminal area
  - Non-NGATS scenario improved by 2%
  - Segment 3 NGATS scenario improved by 2%
  - Because departures take a more direct route when exiting the terminal area, the implementation of RNP did not make as much of a difference in the Segment 3 NGATS scenario.

Summary

- The current analysis included an initial approach to fleet evolution, CDA, RNP, as well as the operational improvements captured in the trajectories.
- In general the approaches were agreed to by the PMD and the EIPT.
- Noise continues to be a critical limiting factor in meeting goals defined by EIPT.
- Although improved, fuel efficiency continues to lag behind the goal defined by the EIPT.
- While there are no goals for emissions the results show a nearly across the board increase in pollutants.
- Refinements to the assumptions and analyses used will reduce uncertainty in the estimates and on balance would likely improve performance against goals.