Next Generation Air Transportation System
Joint Planning and Development Office

IPSA Environmental Analysis

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Metron Aviation, Inc.

Presented to Environmental Working Group
Operations Standing Committee
May 17, 2010

With Support From the IPSA Team

Outline

- **Environmental impact analysis within the IPSA portfolio process**
- **2010 Analysis plans**
- **2009 Results summary**

Next Generation Air Transportation System
Joint Planning and Development Office

Portfolio Analysis Approach

The Portfolio Analysis development process included the identification of the Initial Alternative and the assessment of its benefits, costs, and risks

1 Identify Scope

- Determine the scope for the analysis of a NextGen Alternative based on the Integrated Work Plan v1.0

"Initial Alternative"

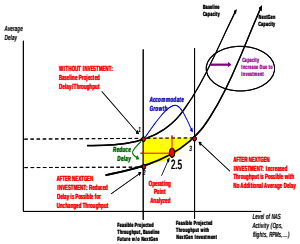
Subset of Operational Improvements (OIs) – modeled in the benefits analysis

Enablers – grouped into Cost Proxy Programs (CPPs) for costing purposes

2 Assess Benefits, Costs & Risks

A Benefits

- Run forecast simulations to estimate monetized and non-monetized benefits of NextGen*

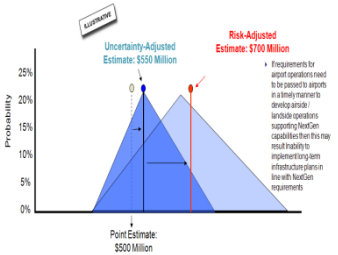


B Costs

- Coordinate with Partner Agencies to aggregate all lifecycle costs (capital and operating costs) for NextGen related programs and activities
- Apply uncertainty analysis to develop cost ranges

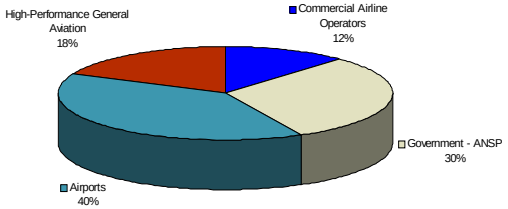
C Risks

- Identify, quantify and aggregate risks
- Assess influence of risk on cost estimates



Generate Results by Stakeholder

- Government / ANSP
- Commercial Airline Operators
- High-Performance General Aviation
- Airports
- Society / Passengers



Illustrative

3 Document & Vet Results

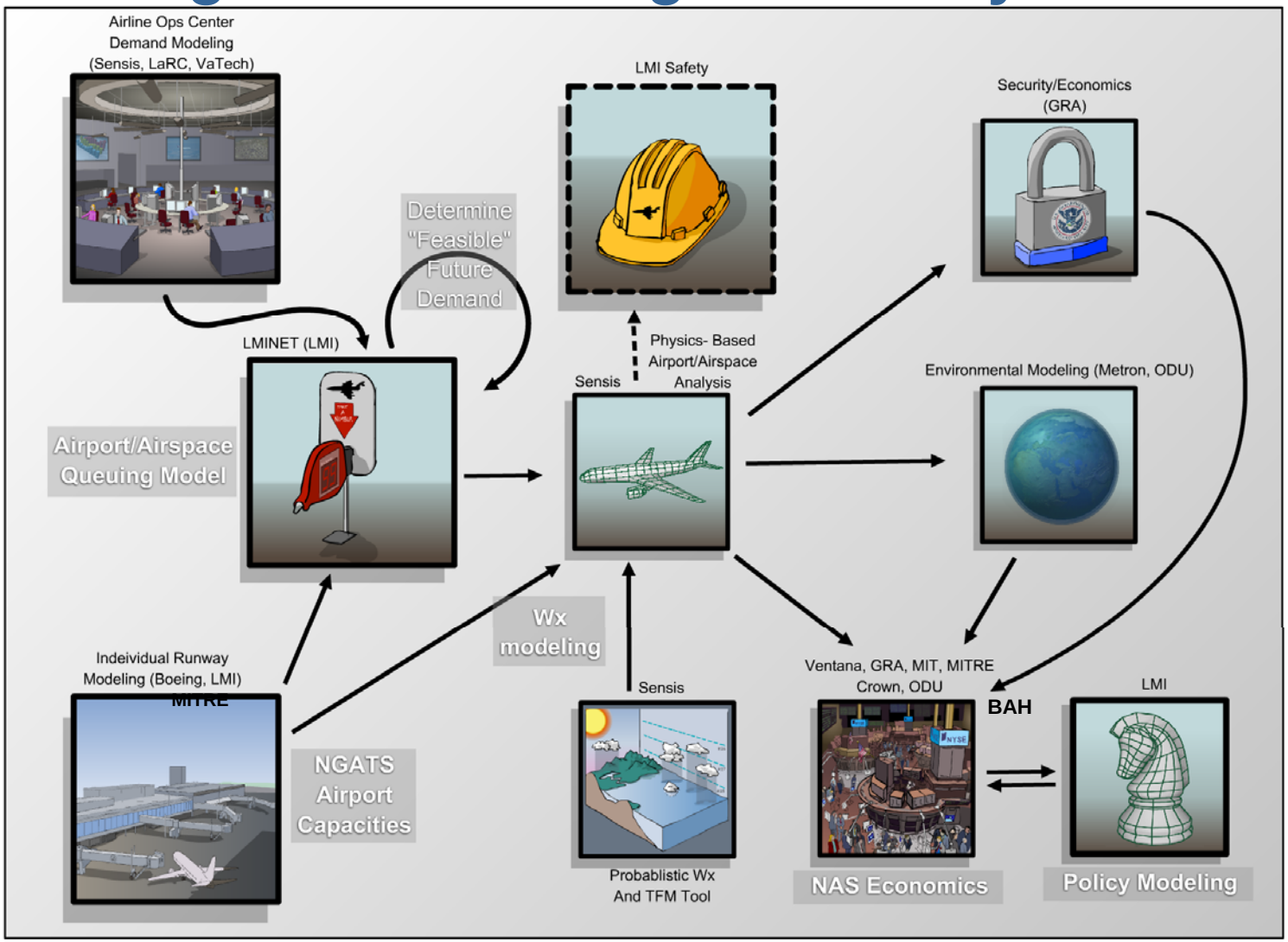
- Documentation of all analysis performed for the initial alternative
- Vet results with Partner Agencies and make refinements, as necessary

Analysis Documentation

JPDO NextGen Portfolio Analysis Package

*** Future demand taken from the FAA Terminal Area Forecast (TAF). The 2007 TAF was used for this analysis.**

IPSA Integrated Modeling And Analysis Process

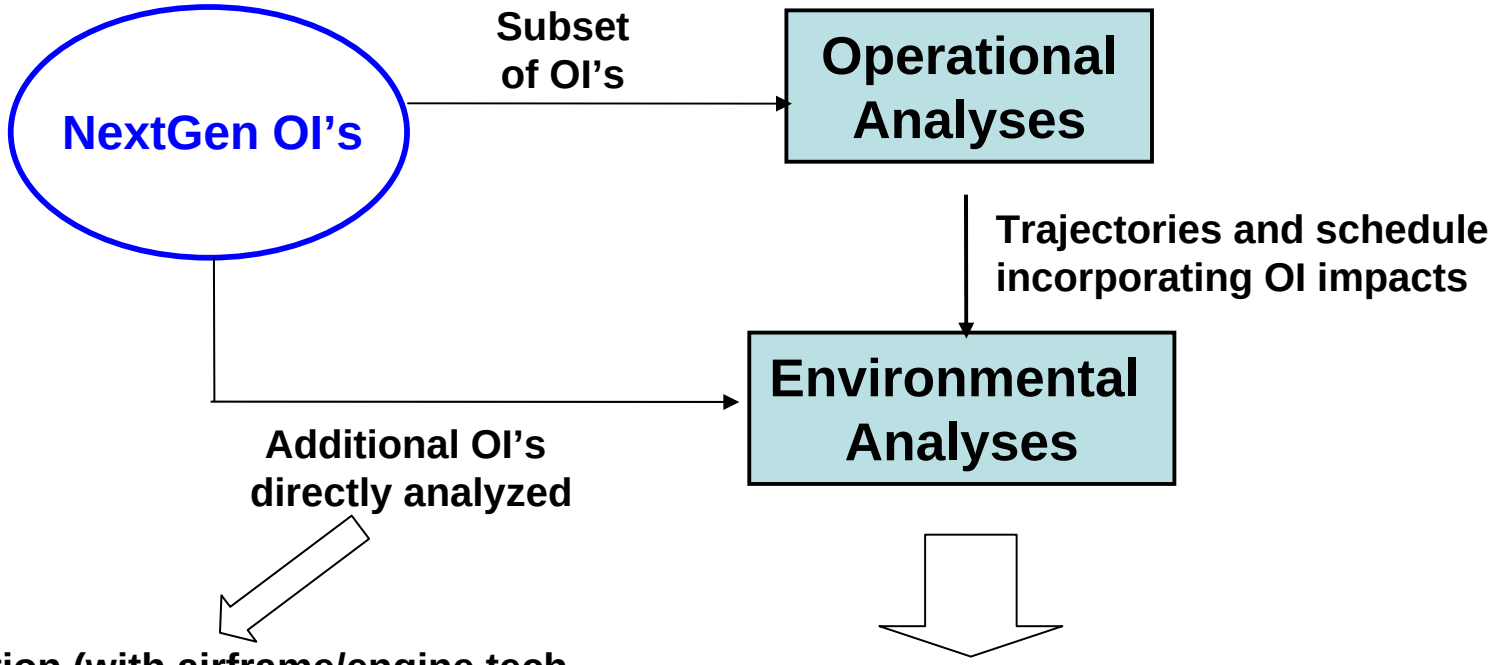


Analysis Approach for NextGen Performance Metrics

System performance metrics of interest are derived from analysis of projected NAS throughput, delays, and environmental impacts

- NextGen performance related to throughput and delay is evaluated using NAS-wide simulations.
  - Future demand for flights is based on FAA Terminal Area Forecast (TAF) and schedule generation.
  - Demand for flights is "trimmed" (reduced) to match capacity at each airport.
  - Airport capacity projections are based on NextGen capabilities and planned new runway construction.
  - Delay results are projected from queuing for departures, transiting ATC sectors, and arrivals, all within airport, terminal area, and sector capacities.
- NextGen environmental performance is evaluated based on NAS-wide analysis using a suite of environmental modeling tools.
  - Noise and fuel consumption calculations assume RNP capability and optimized profile descents (OPD) in the terminal area.
  - Advanced technology capabilities for the fleet are based on the FAA CLEEN Program, NASA Subsonic Fixed Wing and Environmental Responsible Aviation (ERA) projects
  - Aircraft retirements and insertions are derived from the FAA Aerospace Forecast.

Portfolio Modeling: Operational Improvements (OI's)



1. Fleet Evolution (with airframe/engine tech improvements)
2. Required Navigation Performance (RNP)
3. Continuous Descent Arrivals (CDA); now Optimized Profile Descents (OPDs)
4. Alternative Fuels

Environmental Metrics and Comparison to Targets

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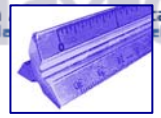
Scenario Formulation

CALIBRATION RUNS



No. 0 – Environment Baseline – Reference/Calibration Point for ENV and Capacity Benefits. Aligned to AJP-D FY10 NAS Simulations.

No. 1 – Future Baseline – Reference Point for Long Term Benefits. Aligned to ATO-P/NGIP Simulations (RTCA-5 2018 Performance)

FULL ARCHITECTURE RUNS

No. 6 – NGOps-4– Med. Level of Technology; 2025+ timeframe; Policies - Moderate

No. 7 – NGOps-5– High Level of Technology; 2025+ timeframe; Policies – R&R Challenges. Strategic Manufacturers & Airport Coordination

No. 9 – NG2025 (NGOps-5)– High Level of Technology with New Runways & Secondary Airports; 2025+ timeframe; Policies – R&R Challenges. Market Incentives on Demand/Capacity & Strategic Airport & Manufacturers Coordination

No. 10 – NG2035 (NGOps-5)– High Level of Technology with Secondary Airports; 2035+ timeframe; Policies – Moderate to Low, reduced schedule pressure, natural forward fitting. Eventual R&R Challenges

SENSITIVITY, FEASIBILITY & TRADESPACE ENVELOPE RUNS

No. 2 – Runways Only (NGOps-3)– Low Level of Technology with new Runways where Beneficial & Possible; 2025+ timeframe; Policies – Strategic Airport Coordination

No. 3 – NG Runways (NGOps-4)– Med. Level of Technology with new Runways enabled NG Techs; 2030+ timeframe; Policies – Strategic Airport & Manufacturers Coordination

No. 4 – NG 2nd Airports (NGOps-4)– Med. Level of Technology with new increased usages of 2nd Airports; 2025+ timeframe; Policies – Market Incentives on Demand/Capacity Strategic Airport & Manufacturers Coordination

No. 5 – NG Aircraft (NGOps-5)– Med. Level of Technology with aggressive new fleet & substitutions; 2025+ timeframe; Policies – Manufacturers & Strategic Airport Coordination

No. 8 – Up-Gauging(NGOps-5)– Med. Level of Technology with aggressive new fleet & substitutions; 2025+ timeframe; Policies – Manufacturers & Airline Strategies

No. 11 – NG Green (NGOps-4)– Med. Level of Technology with aggressive new Green Technologies; 2035+ timeframe; Policies – Manufacturers & Airline Strategies

No. 12 – NG Market Policy (NGOps-3)– Low Level of Technology with aggressive Market Management; 2025+ timeframe; Policies – Very aggressive. Market Incentives & Controls on Demand/Capacity

No. 13 – NG DoD– TBD

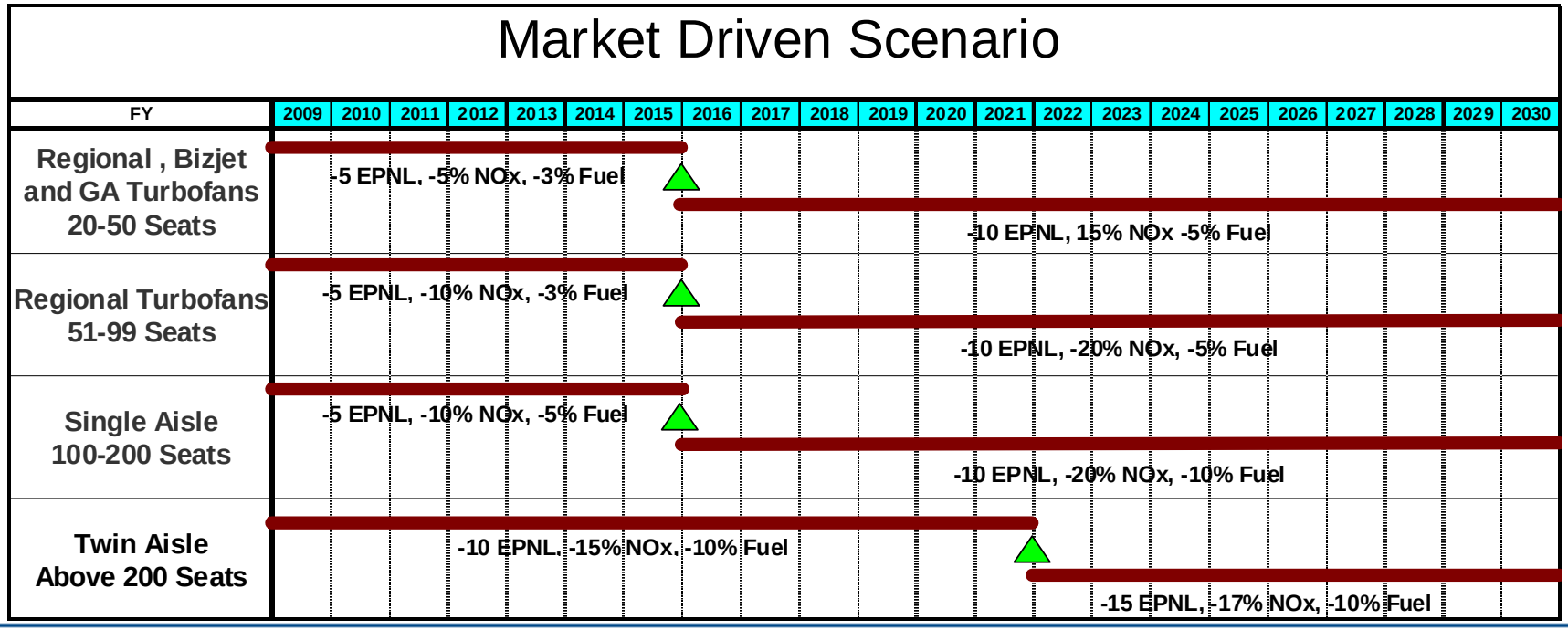
IPSA 2010: Forecasted Fleet Aircraft/Engine Technology Projections

- Rather than try to define a separate vehicle improvement level for each of the scenarios described previously, we have developed three different levels of engine and airframe performance improvement
  - "Market Driven"
  - "Government Driven"
  - "Aggressive Government Driven"

- These scenarios will be described in the following slides

Market Driven Airframe/Engine Technology Projection

- Use inputs from the Technology Standing Committee (TSC) to define the level of performance that would be expected in the absence of Government investment and/or intervention
- This becomes the new baseline, replacing the “do nothing” baseline of past years



NASA's Subsonic Transport System Level Metrics

…. technology for dramatically improving noise, emissions, & performance

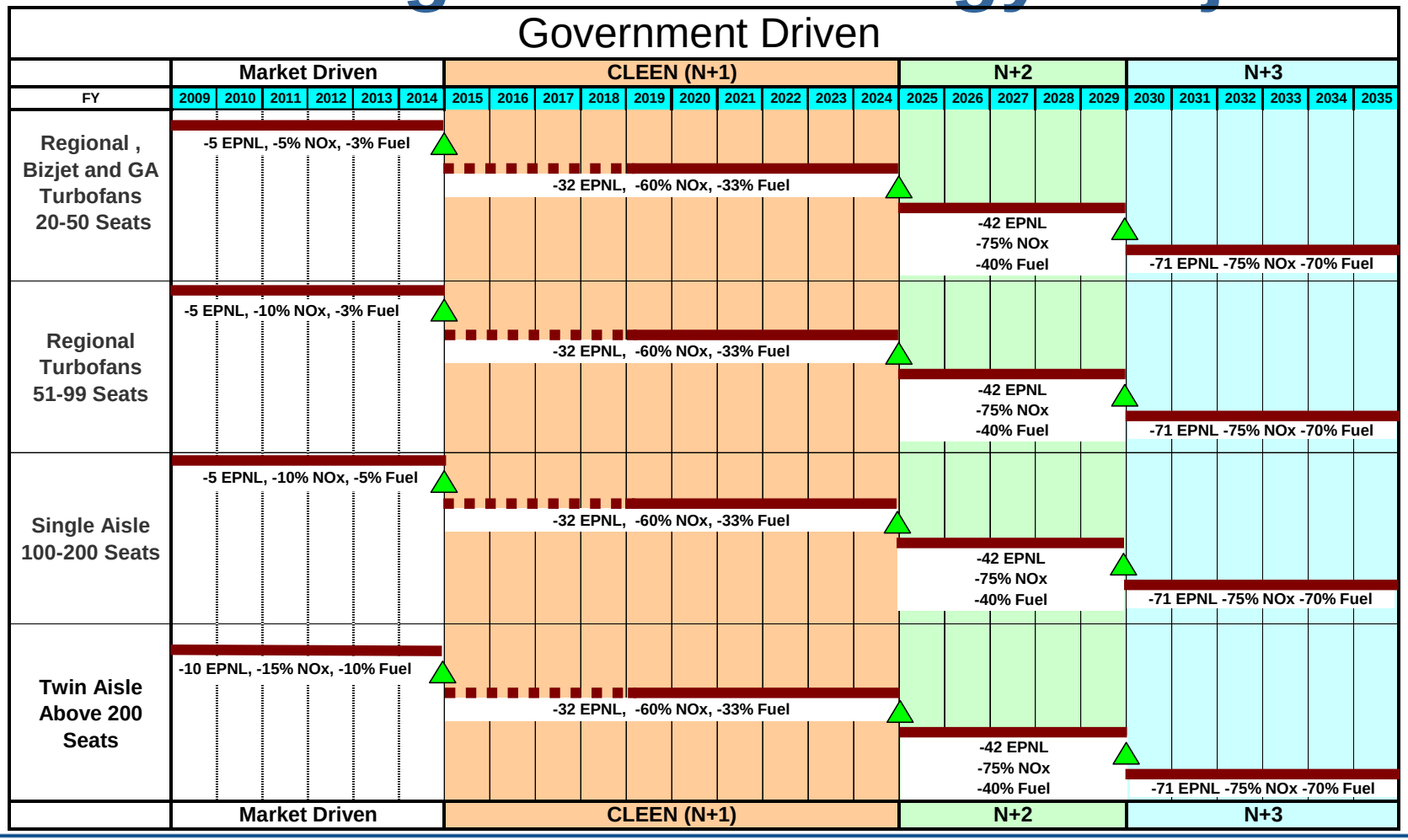
CORNERS OF THE TRADE SPACE	N+1 = 2015*** Technology Benefits Relative To a Single Aisle Reference Configuration	N+2 = 2020*** Technology Benefits Relative To a Large Twin Aisle Reference Configuration	N+3 = 2025*** Technology Benefits
Noise (cum below Stage 4)	-32 dB	-42 dB	-71 dB
LTO NO_x Emissions (below CAEP 6)	-60%	-75%	better than -75%
Performance: Aircraft Fuel Burn	-33%**	-50%**	better than -70%
Performance: Field Length	-33%	-50%	exploit metro-plex* concepts

*****Technology Readiness Level for key technologies = 4-6**
**** RECENTLY UPDATED. Additional gains may be possible through operational improvements**
*** Concepts that enable optimal use of runways at multiple airports within the metropolitan area**

ERA Approach

- Focused on N+2 Timeframe – Fuel Burn, Noise, and NO_x System-level Metrics
- Focused on Advanced Multi-Discipline Based Concepts and Technologies
- Focused on Highly Integrated Engine/Airframe Configurations for Dramatic Improvements

Government Driven Airframe/Engine Technology Projection

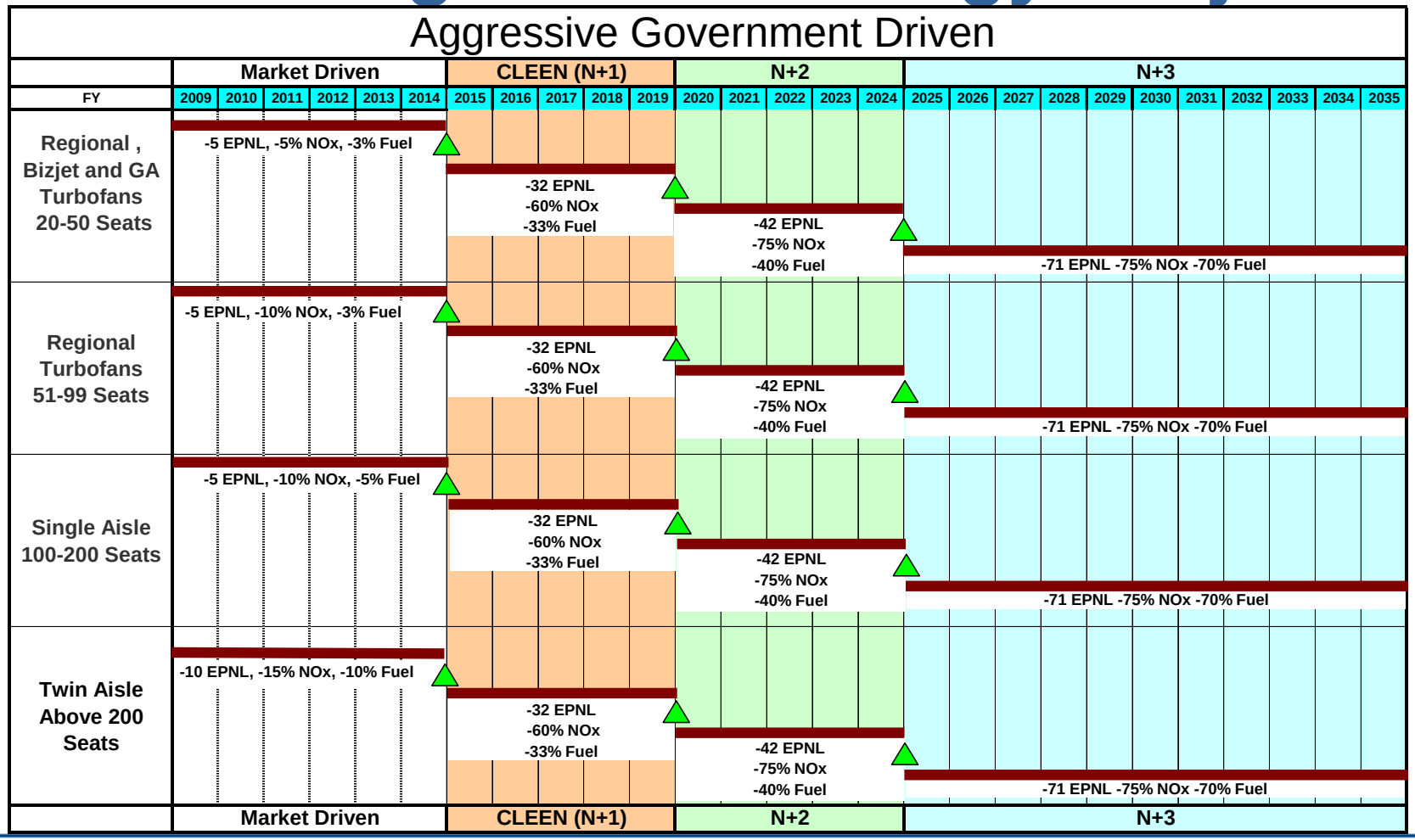


NOTE: The hashed line represents the phasing of CLEEN/N+1 improvements between 2015-2018

Aggressive Government Driven Airframe/Engine Technology Projection

- Still based on the NASA N+1,2,3 and FAA CLEEN, but assuming much larger infusion of Government resources
- Assumed 100% successful across all seat classes for noise, fuel burn, and NOx improvements
- Assume the additional investment produces a five-year improvement for initial availability of technology to enter into the fleet: N+1/CLEEN in 2015, N+2 in 2020, and N+3 in 2025

Aggressive Government Driven Airframe/Engine Technology Projection



Still based on the NASA N+1,2,3 and FAA CLEEN, but assuming much larger infusion of Government resources to achieve earlier availability.

IPSA 2010: Forecasted Fleet New Aircraft Penetration

The rate of introduction of new airframe/engine technologies into the fleet will be driven by two methods:

- Nominal – is represented and defined by the APO Aerospace Forecast which provides retirement and insertions at the aircraft level.
- Accelerated – is defined by a doubling of the APO Aerospace Forecast retirement rates while maintaining the overall number and mix of the fleet.

IPSA 2010: Alternative Fuels

- Adoption of alternative fuels may be a part of all IPSA alternatives.
- Only drop-in alternative fuel candidates, i.e., fully compatible with the existing infrastructure and equipment, will be considered.
- Their impact will be evaluated on a full life cycle basis and will be incorporated to simulation results in post-processing via multipliers that reflect the relative carbon content of alternative fuels compared to petroleum-based fuels

NOTE: Coordination with the EWG is required to review level of use for each FOC date.

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Environmental Scenarios Modeled

Scenario	Demand Level	Technolgy Improvement	Operational Improvement
2006 Baseline	N/A	N/A	N/A
2025 Baseline	2025 Most trimmed	None	None
2025 NextGen	2025 Least trimmed	None	NextGen
2025 NextGen TSC Baseline	2025 Least trimmed	TSC Baseline	NextGen
2025 NextGen TSC Level 1	2025 Least trimmed	TSC Level 1	NextGen
2025 NextGen TSC Level 2	2025 Least trimmed	TSC Leve 2	NextGen
2025 NextGen N+1	2025 Least trimmed	CLEEN/N+1	NextGen
2025 NextGen N+2	2025 Least trimmed	NASA N+2	NextGen
2050 NextGen Baseline	2050 Most trimmed	NASA N+2	None
2050 NextGen N+1	2050 Least trimmed	CLEEN/N+1	NextGen

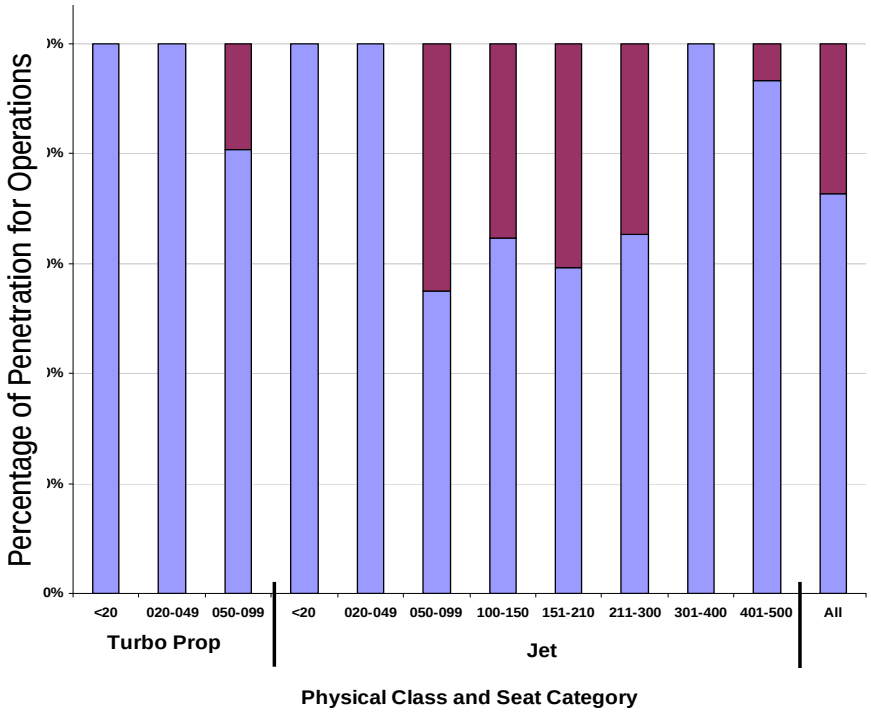
- **Here, "trimmed" describes how the schedule was trimmed to produce acceptable delay:**
  - **"most trimmed" represents TAF demand trimmed to meet Baseline capacity**
  - **"least trimmed" represents TAF demand trimmed to meet NextGen capacity**

- **Monetization of IPSA results were computed via the Aviation Environmental Portfolio Management Tool (APMT)**

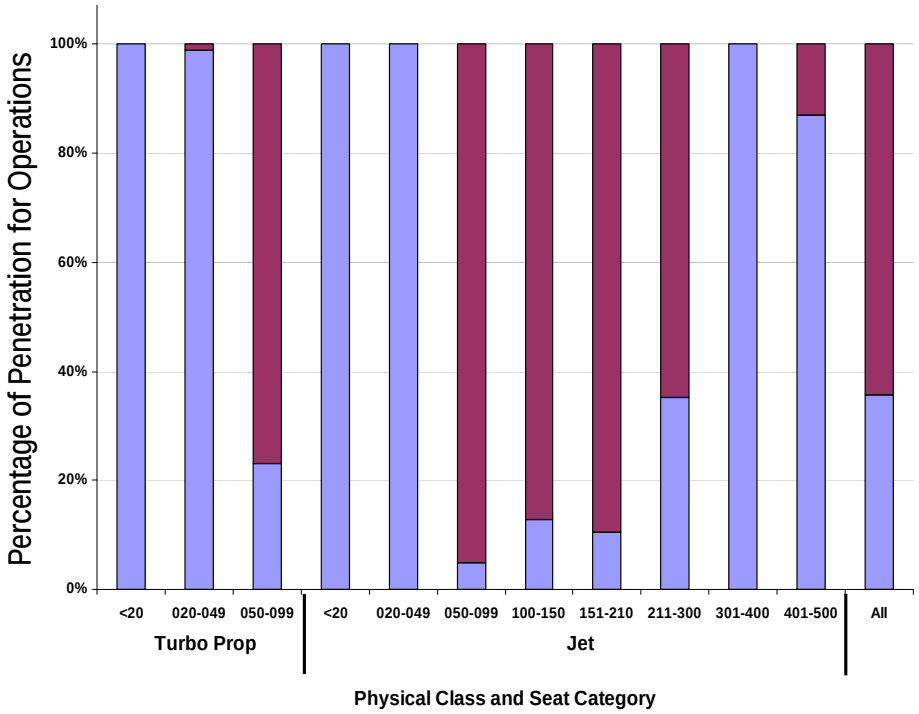
2009 Portfolio Analysis

New Technology Penetration

Through 2025



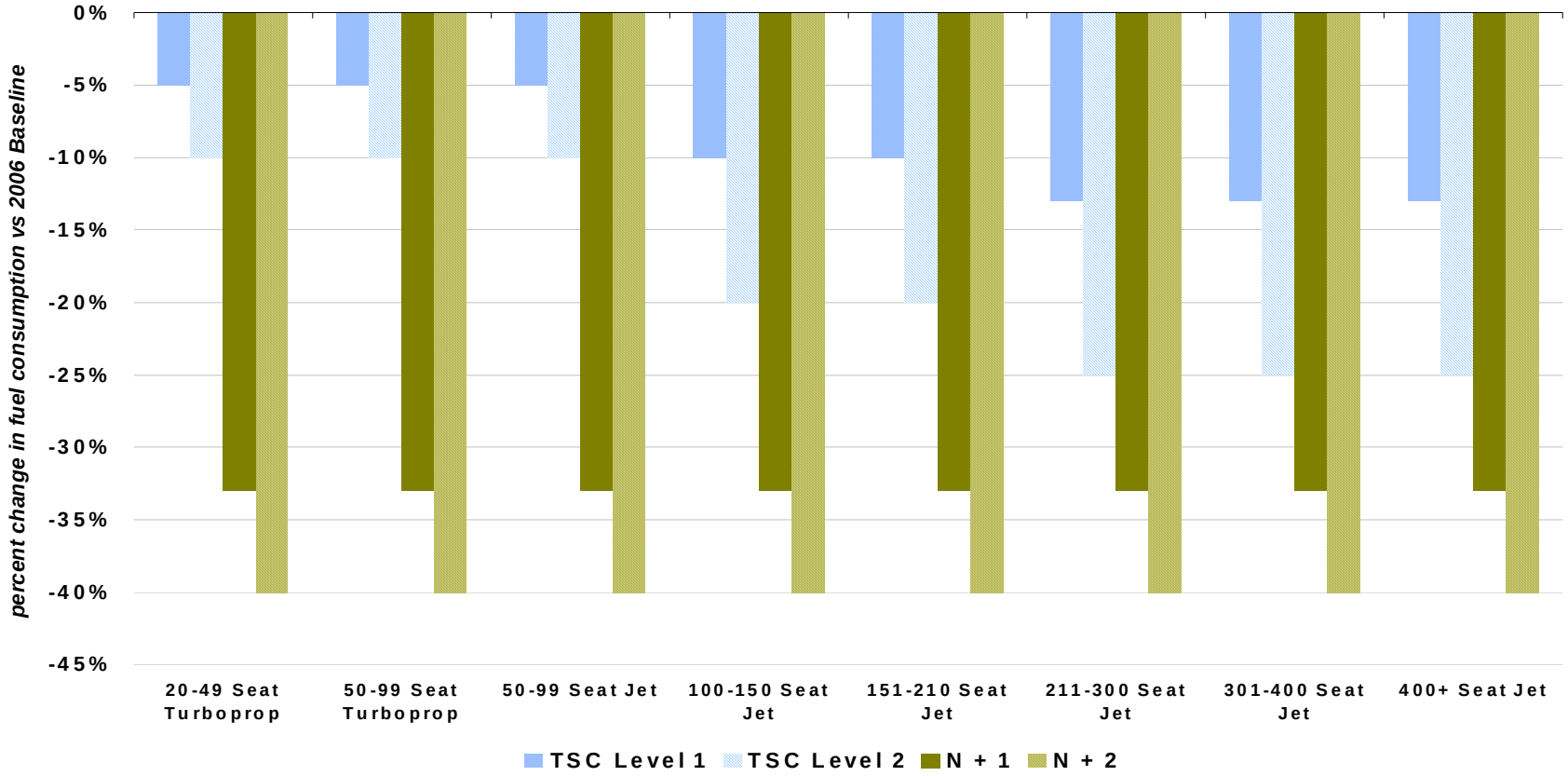
Through 2050



Current Technology **NextGen Technology**

Tech Improvements: Fuel Burn

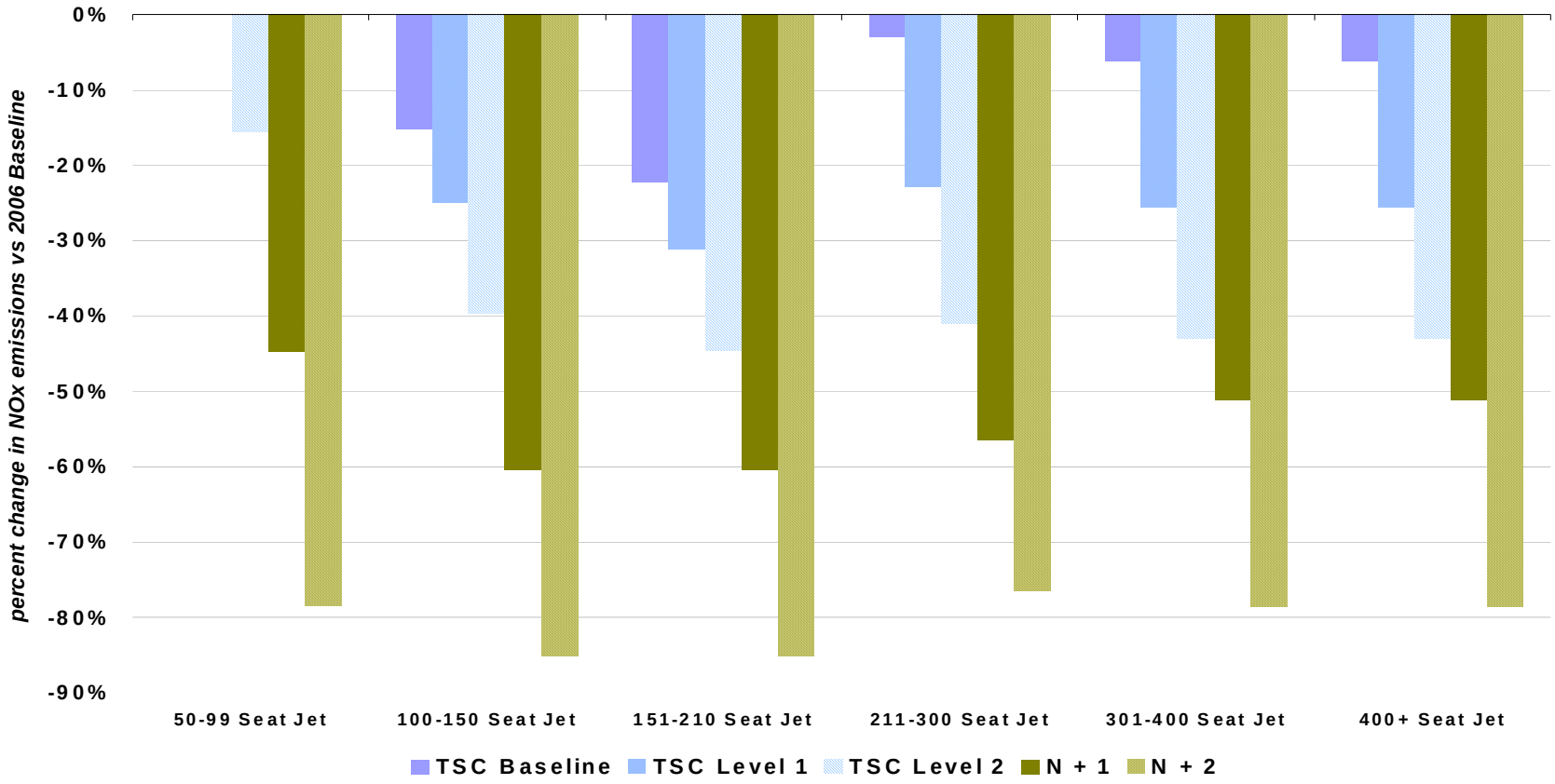
Relative to 2006



Note: TSC Baseline had no reductions in fuel consumption vs. 2006 Baseline. Turbo prop improvements were assumed to be the same as for jets in similar seat classes.

Tech Improvements: NOx Emissions

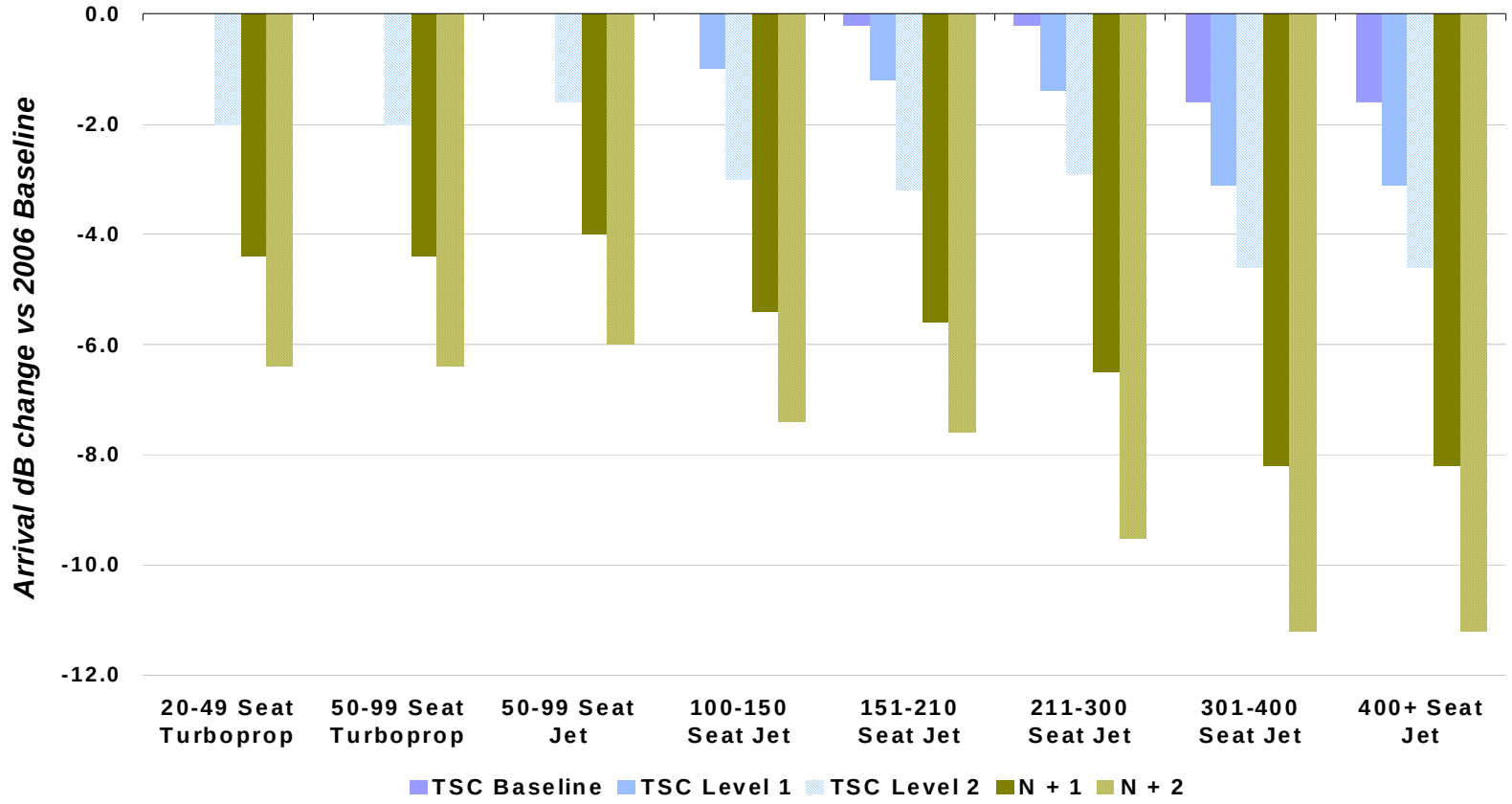
Relative to CAEP6



Note: NO_x improvements were not defined for turbo prop aircraft.

Tech Improvements: Noise

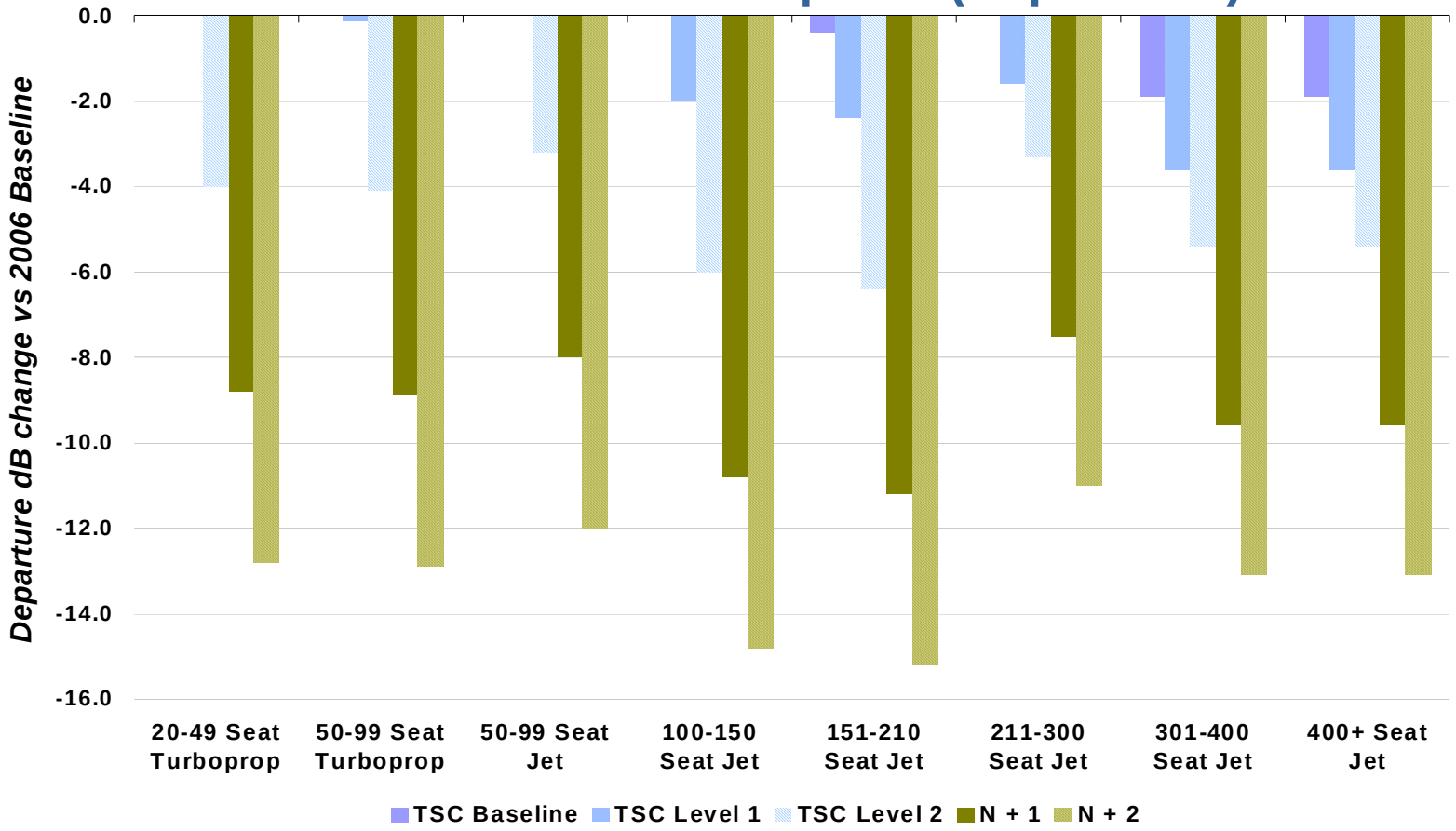
Reduction relative to Chapter 4 (Arrivals)



Note: TSC Baseline improvements for small/medium aircraft currently meet Chapter 4 limits. Turbo prop improvements were assumed to be the same as for jets in similar seat classes.

Tech Improvements: Noise

Reduction relative to Chapter 4 (Departures)

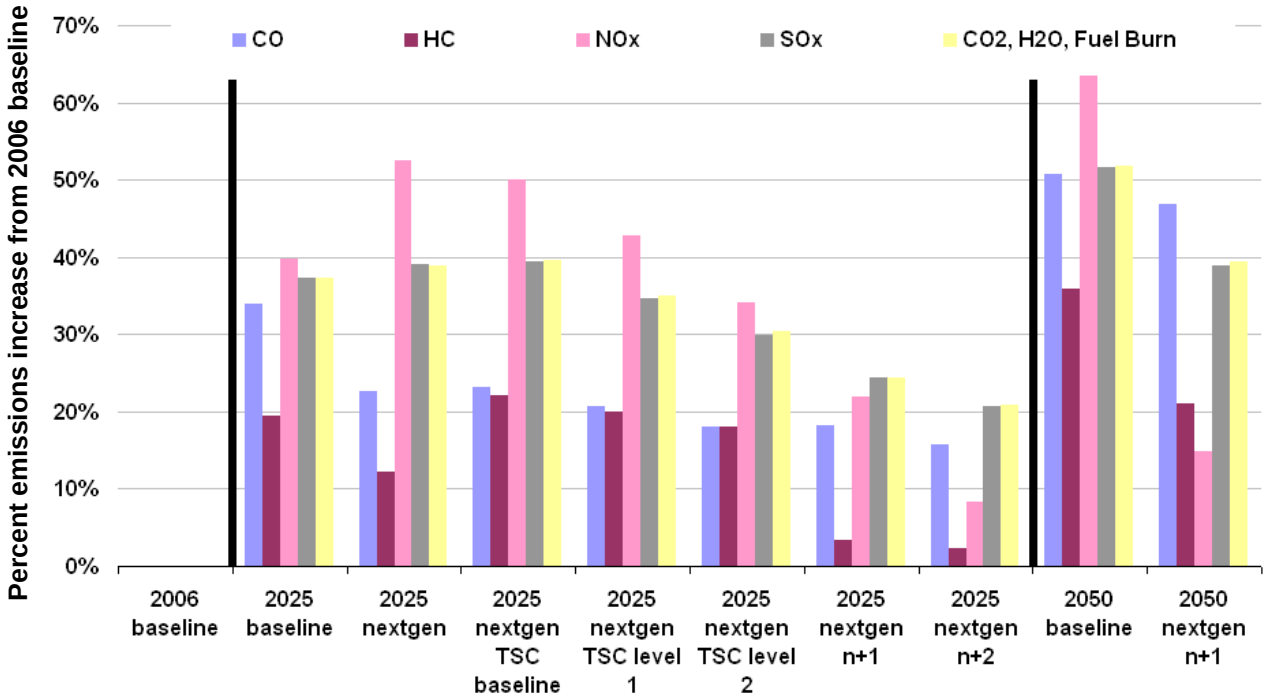


Note: TSC Baseline improvements for small/medium aircraft currently meet Chapter 4 limits. Turbo prop improvements were assumed to be the same as for jets in similar seat classes.

2009 TSC Analysis

Air Quality Emissions Inventory Changes

below 3,000 feet



- No matter what technology we used we are increasing the total amount of pollutants produced.

* 2025 baseline has ~6 thousand fewer flights serving the 294 airports than the other 2025 scenarios.

Backup Slides

IPSA 2010
Key Environmental Assumptions and Modeling Parameters

- The next few slides will present additional background in relation to key environmental assumptions and modeling parameters planned for the 2010 IPSA Portfolio Analysis
  - Full Operational Capability (FOC) and an Evaluation Period
  - Forecasted Demand
  - Forecasted Fleet
    - Aircraft/Engine Technology Projections
    - New Aircraft Penetration
  - Operational Improvement
    - Surface
    - Terminal Airspace
    - Enroute Airspace
  - Airports and Runways
  - Alternative Fuels

Government Driven Airframe/Engine Technology Projection

- Based on the NASA N+1,2,3 and FAA CLEEN
- Assumed 100% successful across all seat classes for noise, fuel burn, and NOx improvements
- In general, assume a five-year delay between the NASA estimate of Technology Readiness Levels 4-6 and initial availability of technology to enter into the fleet
  - Exception: There is a slight schedule misalignment between the most recent NASA N+1 (TRL 4-6 in 2015) and FAA CLEEN timeframes (available for EIS in 2015/2016). We have reconciled this by phasing in the N+1 improvements from 2015-2018.

IPSA 2010:
FOC and Evaluation Period

- Each alternative will have an FOC date and a set of capabilities that are expected to be available. An analysis is being performed to assign “proxy programs” to alternatives which will reflect the operational characteristics of the alternative.

- In an effort to account for return on investment (ROI) some of the alternative’s parameters require an evaluation period to provide and opportunity to account for downstream benefits. Based on the FOC date an evaluation period is defined to capture benefits through 2050.

IPSA 2010: Forecasted Demand

- For environmental modeling purposes, each year will be represented by a single day's operations. This day is selected from a sample of 8 representative days identified by FAA-ATO for future schedule generation.
- A single day representing 2005 will be selected to define a reference year for environmental performance and used to compute environmental targets for future time periods.
- A single day representing 2009 current conditions will also be selected to suggest current conditions and to seed the future forecast generation process.
- Forecasted demand is based on:
  - FAA-APO Terminal Area Forecast (TAF), ASPM Gate/Runway Times, OPSNET daily traffic counts, and cancellations
  - ATO-AIM Lab Filed Flight Plans, center crossing data, and cancellations
- Each alternative will be fed three levels of demand, low/nominal/high, in an effort to account for uncertainty in the forecast, e.g., an alternative with an FOC of 2025 will be modeled with a 2020(low), 2025(nominal) and 2030(high) demand.
- Alternatives that include the use of secondary airports or change in aircraft gauge may alter the number of operations or network distribution of future schedules. Additional analysis is being performed to identify affected airports and define rules/policy to support these alternatives.
- Future demand will be trimmed to meet operational capacity for the alternative's FOC date.

Summary of TSC Results

- Three additional runs were completed for a 2025 future state at technology improvement levels between the IPSA baseline and the CLEEN/N+1 levels
  - TSC Baseline
  - TSC Level 1
  - TSC Level 2
- Changes in baseline engine selection and fleet modeling produced small differences between the TSC baseline and the original IPSA baseline
- In general, the trends for the three additional runs are very well behaved for all analysis parameters (noise, fuel burn, and emissions), lending confidence that interpolation between varying levels of technology improvement is a reasonable assumption

IPSA 2010: Operational Improvements

- Operational Improvements affecting surface, terminal area, and enroute airspace will be defined via NextGen Operational Levels (NGOps).
- Surface and Enroute improvements will be captured and modeled in the operational models.
- Terminal Area improvements will be defined via radar derived flows for the FACT-2 56 airports.
- NGOps Levels 3, 4, 5, and 6 represent advanced levels of technology planned for both ATM infrastructure and Aircraft equipage.
- Each alternative specifies an NGOps Level which suggests RNP levels and implementation levels for other procedural improvements.

Surrogate Aircraft Changes

- Engines for fuel and emissions calculations changed for the TSC scenarios.

Seat Class & Engine	IPSA NextGen Scenarios			TSC NextGen Scenarios	
	Airframe	Engine		Airframe	Engine
020-049 Seat Turbo Prop	DHC-8-200	PT6A-45		DHC-8-200	PW123
050-099 Seat Turbo Prop	ATR72-200	PW124-B		ATR72-200	PW124-B
050-099 Seat Jet	Canadair Reg-900	CF34-8C1		Canadair Reg-900	CF34-8C5
100-150 Seat Jet	B737-700	CFM56-3C-1		B737-700	CFM56-7B22
151-210 Seat Jet	B737-800	CFM56-3C-1		B737-800	CFM56-7B26
211-300 Seat Jet	B777-200	GE90-110B1		B777-200	PW4077
401-500 Seat Jet	B747-400	CF6-80C2A5		B747-400	PW4056
500-601 Seat Jet	B747-400	CF6-80C2A5		B747-400	PW4056

FY10 Benefits Analysis Priorities

In the coming year, JPDO will be exploring other NextGen scenarios to evaluate potential alternatives

- Initial exploration of scenarios focuses on the tradeoffs between capacity and the environment through the implementation of potential policies, including –
  - **Secondary Airports:** Propose a list of airports that can be expanded, taking into consideration factors such as distance of a secondary airport from a metropolitan area
  - **Aircraft Turnover:** Research the acceleration of fleet turnover to reduce noise and emissions
  - **Aircraft Up-gauging:** Determine potential environmental impacts of changing the current fleet mix, with an emphasis on the use of larger aircraft
  - **Environmental/Throughput:** Determine breakeven point between environmental costs and accommodating throughput demand
- Future work will attempt to expand to other dimensions/attributes, such as safety, security, etc.

Summary of IPSA Analysis Approach

- Future demand scenarios are generated using FAA forecasts.
- Future baseline and NextGen airport capacities are estimated based on an airport capacity constraints analysis and performed in coordination with the FAA and Mitre for the years 2025 and 2050.
- NextGen performance related to capacity is evaluated using NAS-wide simulations.
  - Airport capacities based on the aforementioned airport constraints analysis
  - En route capacities based on prior FAA, NASA, Mitre and IPSA analyses
- NextGen performance related to environment is evaluated based on the NAS-wide analysis using a suite of environmental modeling tools
- Metrics of interest are derived from the NAS-wide analysis of throughput and delays.

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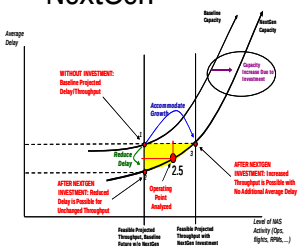

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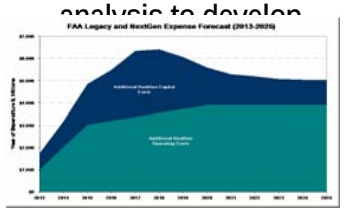

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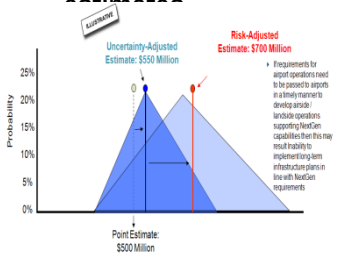
- Identify, quantify and aggregate risks
- Assess influence of risk on cost estimates



Generate Results by Stakeholder

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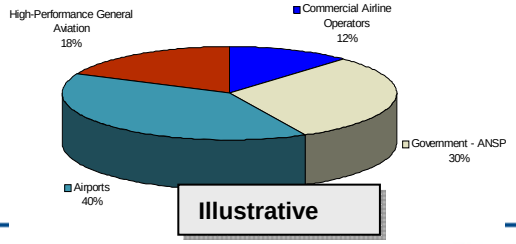
- Commercial Airline Operators
- High-Performance General Aviation
- Airports
- Society / Passengers



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Future demand taken from the FAA Terminal Area Forecast (TAF). The 2007 TAF was used for this analysis.

IPSA 2010 Alternatives (Draft)

Alternative	FOC Year	Evaluation Timeframe (yrs)	Demand Levels			Fleet		Terminal Area		Airports		Fuels Std / Alt
			Low	Nominal	High	Technology Level(s)	Penetration Level(s)	OEP 35	LMI 110	New Rwys	2nd dary	
1 **Future Baseline** Future basis for comparison of NextGen performance	2018	N/A	N/A	2018	N/A	Market, Government	Nominal	FAA NGIP / NGOps-3	FAA NGIP / NGOps-3			95% / 5%
2 **Runways Only** Add runways where possible using existing standards	2025	25	-5 yrs	2025	+5 yrs	Market, Government	Nominal	NGOps-3	NGOps-3	✓		95% / 5% 75% / 25%
3 **NextGen Runways** Use NextGen technologies and add NextGen-enabled runways with closer separations	2030	20	-5 yrs	2030	+5 yrs	Market, Government	Nominal	NGOps-4 where needed	NGOps-4 where needed	✓		95% / 5% 75% / 25% 50% / 50%
4 **NextGen Secondary Airports** Use secondary airports and NextGen technologies	2025	25	-5 yrs	2025	+5 yrs	Market, Government	Nominal	NGOps-4	NGOps-3		✓	95% / 5% 75% / 25%
5 **NextGen Aircraft** Use NextGen technologies and NextGen aircraft	2030	20	-5 yrs	2030	+5 yrs	Government Driven	Nominal, Accelerated	NGOps-5	NGOps-3			95% / 5% 75% / 25% 50% / 50%
6 **NextGen NGOps-4** * Examines fully deploying NGOps-4 technology to all LMI 110 airports with accelerated fleet	2025	25	-5 yrs	2025	+5 yrs	Government Driven	Nominal, Accelerated	NGOps-4	NGOps-4			95% / 5% 75% / 25%
7 **NextGen NGOps-5** Examines fully deploying NGOps-5 technology to all LMI 110 airports with accelerated fleet	2025	25	-5 yrs	2025	+5 yrs	Government Driven	Nominal, Accelerated	NGOps-5	NGOps-5			95% / 5% 75% / 25%

IPSA 2010 Alternatives (continued) (Draft)

Alternative	FOC Year	Evaluation Timeframe (yrs)	Demand Levels			Fleet		Terminal Area		Airports		Alternative Fuels
			Low	Nominal	High	Technology Level(s)	Penetration Level(s)	OEP 35	LMI 110	New Rwys	2nd dary	
8 **Up-Gauging** Examines impacts of "Up-Gauging" aircraft at an accelerated rate	2025	25	-5 yrs	2025	+5 yrs	Government Driven	Nominal, Accelerated	NGOps-5	NGOps-4			95% / 5% 75% / 25%
9 **NextGen 2025** Combines NextGen technologies, NextGen-enabled runways, secondary airports, and fleet improvements	2025	25	-5 yrs	2025	+5 yrs	Government Driven	Nominal, Accelerated	NGOps-5	NGOps-5	✓	✓	95% / 5% 75% / 25%
10 **NextGen 2035** Same as NextGen 2025 with a more typical fleet modernization rate	2035	15	-5 yrs	2035	+5 yrs	Government Driven	Nominal, Accelerated	NGOps-5	NGOps-5	✓		95% / 5% 75% / 25% 50% / 50%
11 **NextGen Green** Adds accelerated engine/airframe technologies to NGOps-4	2035	15	-5 yrs	2035	+5 yrs	Aggressive Government Driven	Nominal, Accelerated	NGOps-4	NGOps-4			95% / 5% 75% / 25% 50% / 50%
12 **NextGen Policy 2025** Limits demand to levels accommodated in future baseline	2025	25	-5 yrs	2025	+5 yrs	Market Driven	Nominal	FAA NGIP	FAA NGIP			95% / 5% 75% / 25%
13 **NextGen DoD** Examines the impact of NextGen on the DoD Fleet only	2025	25	-5 yrs	2025	+5 yrs	Market Driven	N/A	NGOps-4	NGOps-4			95% / 5% 75% / 25%

IPSA 2010: Operational Improvements Terminal Area

- NGOps 1 & 2 represent today's conditions
  - RNAV 2 Enroute, RNAV 1 Terminal and Approach
  - CDA/OPD used for non-conflicting traffic, not necessarily just low density, example is LAX, limited
- NGOps 3 & 4
  - RNP 2 Enroute, RNP 1 Terminal, RNP .3 Approach
  - Use Optimized Profile Descent (with high precision 4-DT) for moderate and high-density traffic
- NGOps 5 & 6
  - RNP 1 Enroute, RNP .3 Terminal, RNP .11 Approach & Departure

NOTE: Coordination with the EWG Operations Standing Committee is required to review methods, location and level of operation for each NGOps Level.

IPSA 2010:
Airports and New Runways

- Several alternatives including the future baseline include new runways.
- Within the baseline, the runways are defined from existing airport plans and FAA sources.
- The alternatives consider additional runways or the use of secondary runways in an effort to support increased demand.
- The environmental models will not specify where the new runways are physically built, but will use existing runway use and configurations as well as terminal area procedures to support the additional demand.

Next Generation Air Transportation System
Joint Planning and Development Office

Portfolio Analysis Approach

To enable detailed analysis, specific assumptions were used to define the Initial Alternative (Demand based on 2007 TAF)

Category	NextGen Portfolio Option 1	NextGen Portfolio Option 2	Selected Initial Alternative
Trajectory-Based Operations	Ground-based Separation and Trajectory Management	Flight-deck-based Separation and Trajectory Management (i.e., self separation)	Ground-based Separation and Trajectory Management
	Limited Dynamic Reconfiguration	Fully Dynamic Reconfiguration	Limited Dynamic Reconfiguration
	5-Mile Separation	3-Mile Separation	3-Mile Separation
	Variable Separation	No Variable Separation	No Variable Separation
	Conventional Surveillance Radars and Navigation Backup	E-LORAN Backup	Conventional Surveillance Radars and Navigation Backup
Weather	Full Weather Information / Integration into the Automation	Limited Weather Information / Integration	Full Weather Information / Integration into the Automation
	Additional Aircraft Sensor Integration	No Additional Aircraft Sensor Integration	No Additional Aircraft Sensor Integration
Environment	MITRE Fleet Forecast – without consideration of environmental issues	MITRE Fleet Forecast + new aircraft (three scenarios considered: no new A/C technology, Continuous Low Emissions Energy and Noise (CLEEN)/NASA- N+1) and NASA N+2)	MITRE Fleet Forecast + new aircraft (CLEEN/NASA – N+1)
	Environmental Limits Will Constrain Throughput	Not a Constraint	Not a Constraint
High Density Airports	Vertical Required Navigation Performance (RNP)/ Either Flight Management System (FMS)/ Cockpit Display of Traffic Information (CDTI) or Airborne Merging & Spacing with Automation Tools (full CDAs with no capacity impacts)	Limited CDAs	Vertical RNP/ Either FMS/CDTI or Airborne Merging & Spacing with Automation Tools (full CDAs with no capacity impacts)
	Ground Surface Traffic Systems (additional terminals/gates) – 45% Limit	Limits Demand	Ground Surface Traffic Systems (additional terminals/gates) – 45% Limit
Collaborative ATM (HD)	Traffic Management Advisory (TMA) ++, Time Based Metering	Airborne Metering	TMA ++, Time Based Metering
Equipage Profile Curve	100% by IOC Date	Less than 100%	100% by IOC Date
Rules of the Road (pay to play)	All Aircraft Equipped	Different fleets treated differently (different % of equipage)	All Aircraft Equipped

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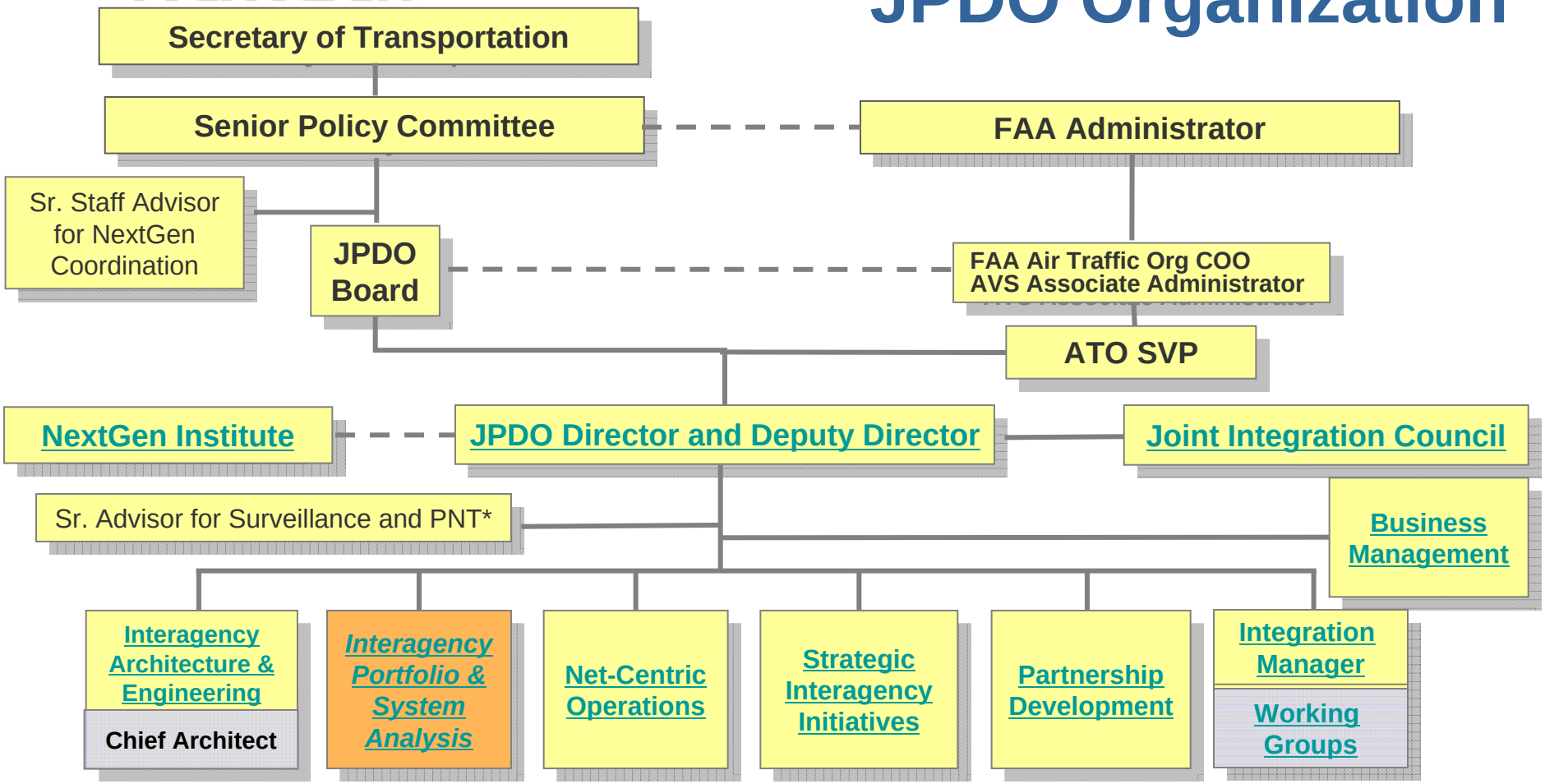
JPDO Organization



Governance

- Senior Policy Committee
- JPDO Board of Directors

Industry Leadership

- NextGen Institute Management Council (IMC)

Interagency Coordination

- CIO Board
- Joint Architecture & Engineering Board

* Position, Navigation, and Timing (PNT)

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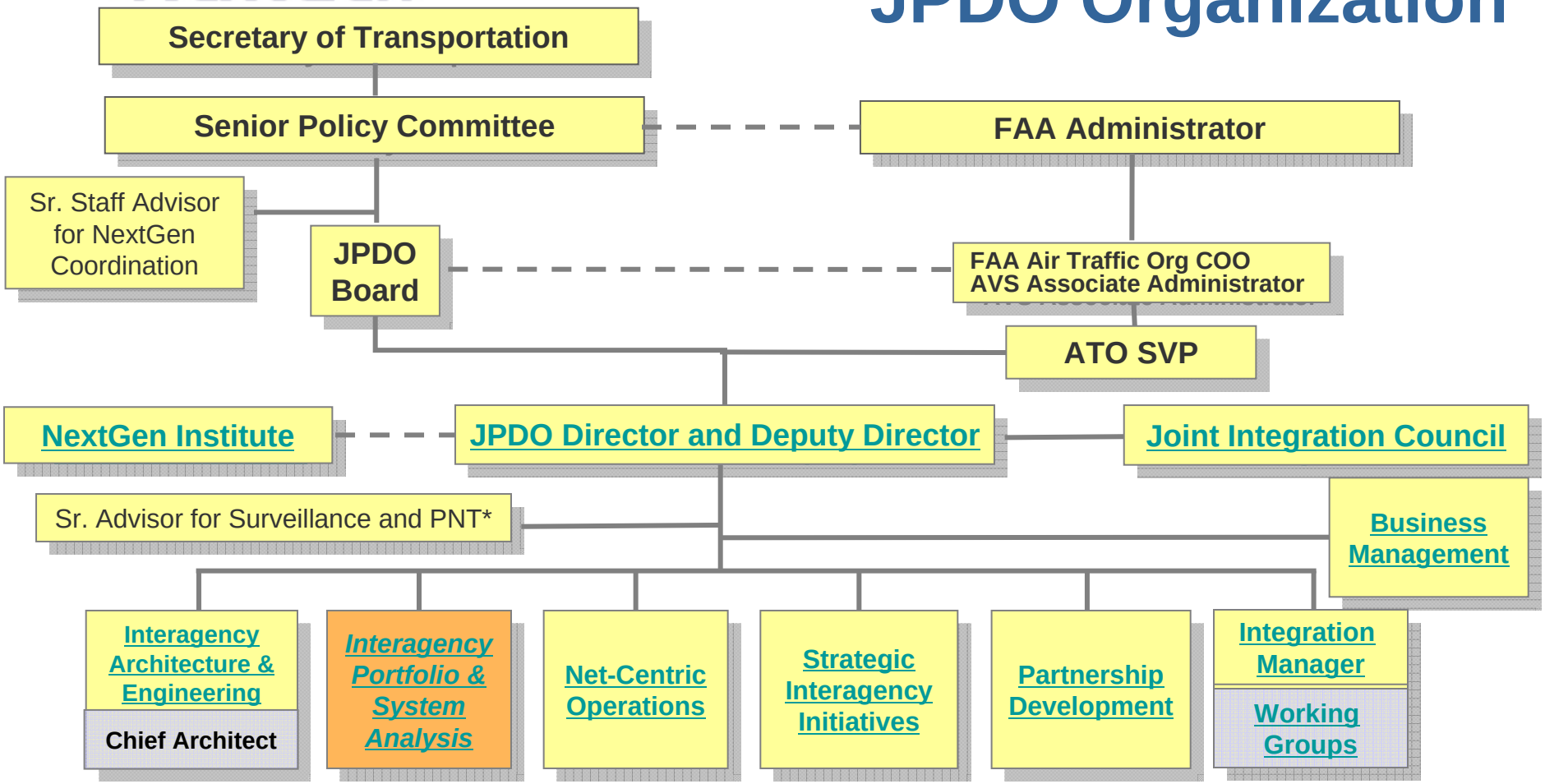
JPDO Organization



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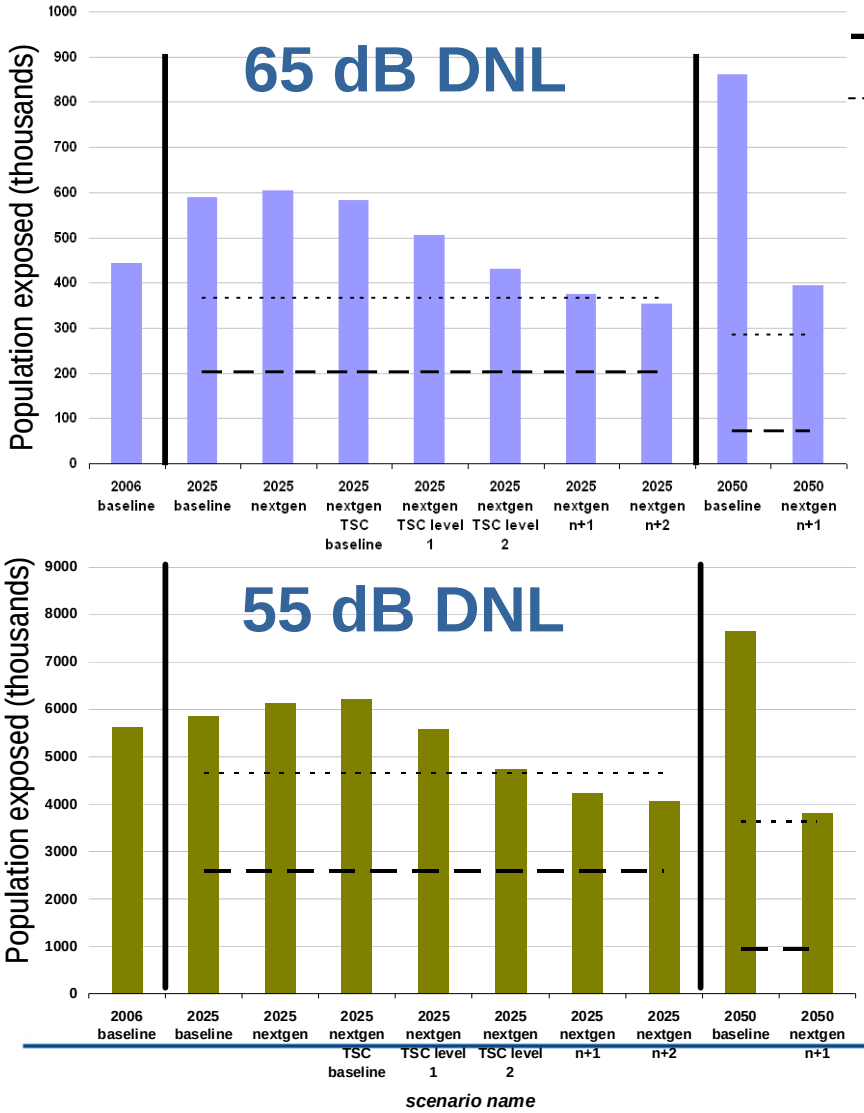
2009 TSC Analysis
Population Exposed to Noise



4% reduction per year target for both 2025 & 2050
Note that 4% is the current 65 dB target.
1% reduction per year target for 65 dB and 55 dB for both 2025 & 2050

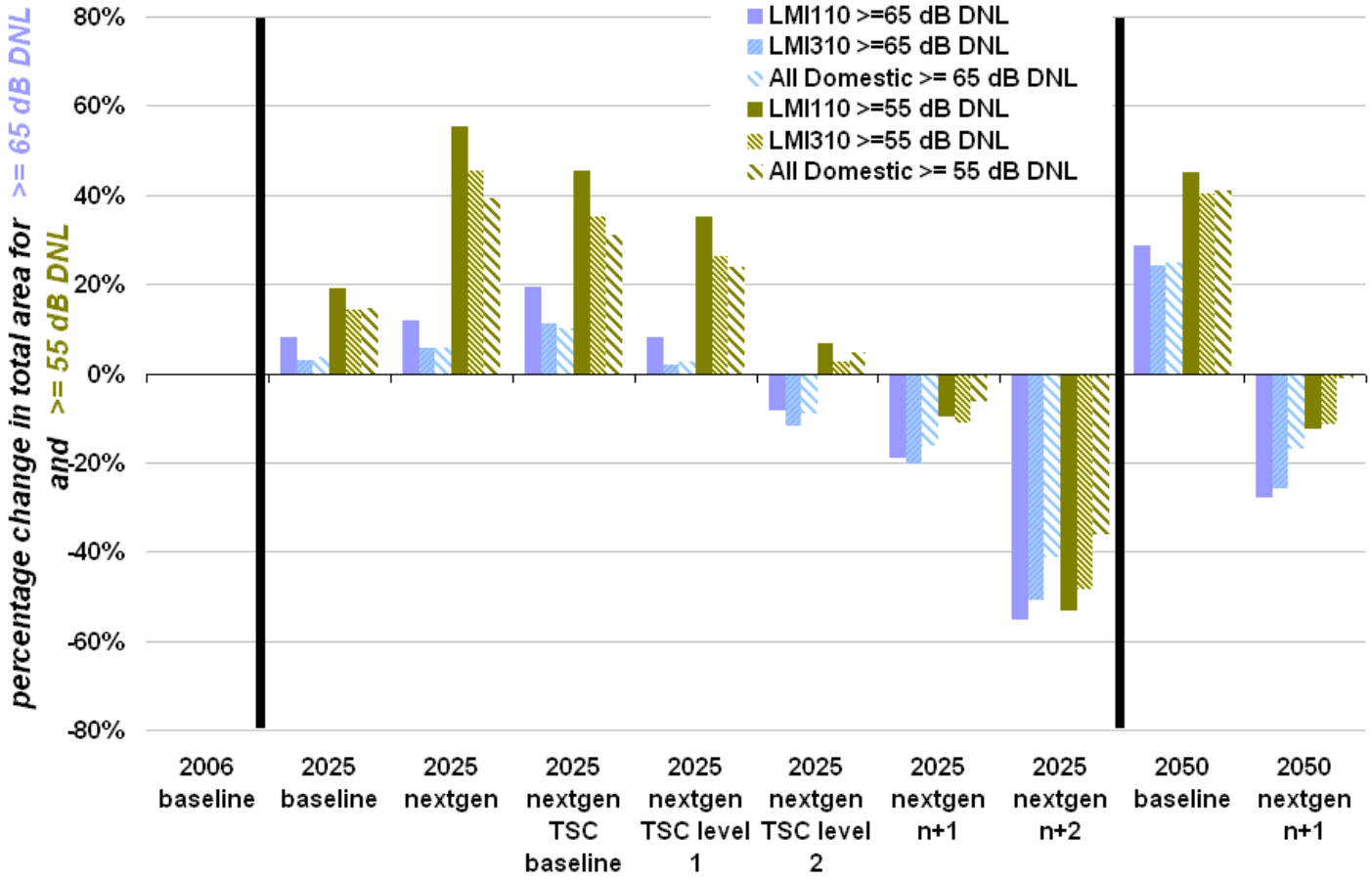
- **Population exposed to 65 dB DNL follows the same general trend that was expected.**
- **Population exposed to 55 dB DNL follows the same trend however there was a slight increase (1.5%) between the nextgen and TSC baseline.**
- **The small difference between the 2025 nextgen and TSC baseline is due in part to the TSC baseline having been treated as a "new" technology scenario where some variability in the fleet mix is lost.**

*** Population is held constant with the US 2000 Census**

Next Generation Air Transportation System
Joint Planning and Development Office

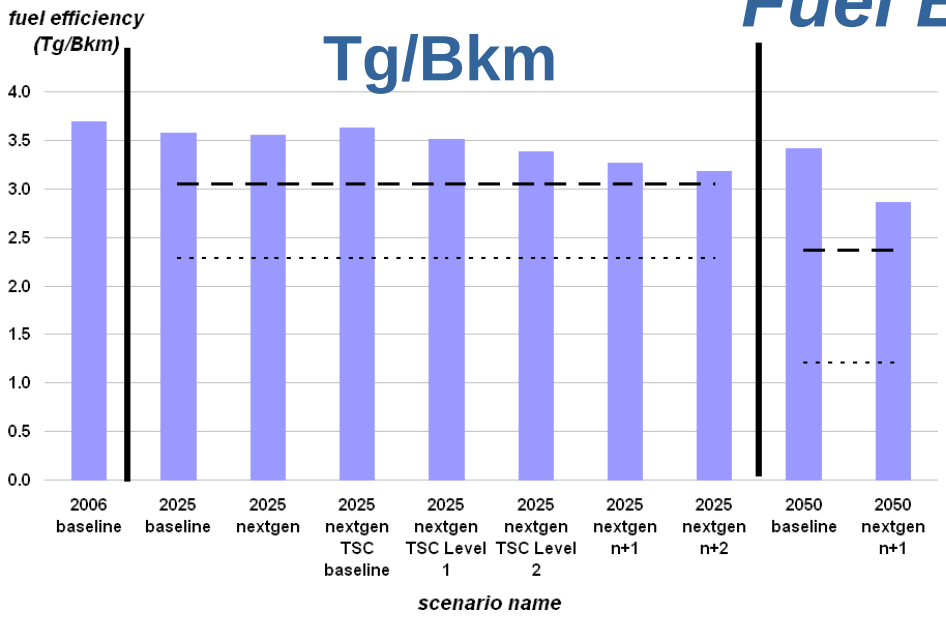
2009 TSC Analysis

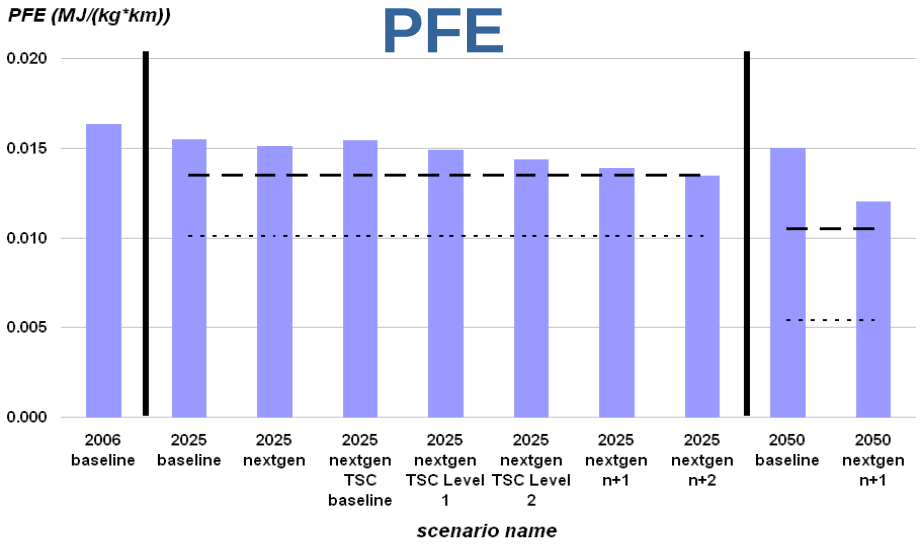
Changes in Areas of Noise Contours



- Similarities between *2025 baseline* and *2025 NextGen* are still noticeable but do not include Terminal Area improvements (RNP & CDA).
- Most of the benefits are seen at the larger airports where the majority of the operations occur.

2009 TSC Analysis
Fuel Efficiency





- – – – – 1% reduction per year by 2025 and 2050 (current target)
- - - - - - - - - 2.5% reduction per year by 2025 and 2050

- **The general trends are consistent with expectations.**
- **Engine changes specified for the surrogate aircraft produced slightly higher levels of fuel burn than the original IPSA aircraft.**
- **The engine changes account for the slight loss in fuel efficiency seen when 2025 nextgen is compared with the 2025 TSC baseline scenario.**
- **Recall also that there were no fuel improvements in the TSC baseline.**