Aircraft Technology and Modeling Improvements

Aircraft Noise

To: NYCAR
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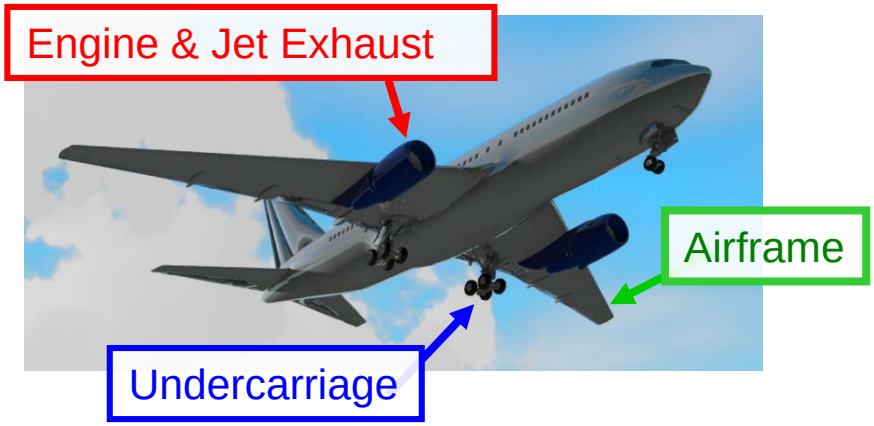
Date: September 26, 2018

Outline

- **Background**
- **Continuous Lower Energy, Emissions & Noise (CLEEN)**
- **Integrated Noise Model (INM) and Aviation Environmental Design Tool (AEDT)**
- **Closing Remarks**

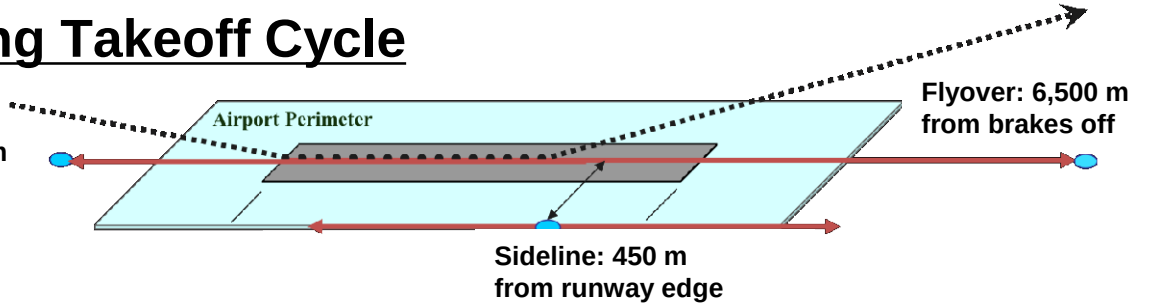
Community Noise from Aircraft

Aircraft Noise

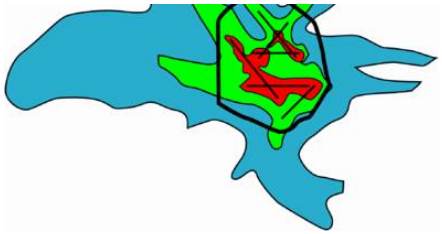


All noise sources contribute to acoustic signature – both at takeoff and during landing

Landing Takeoff Cycle

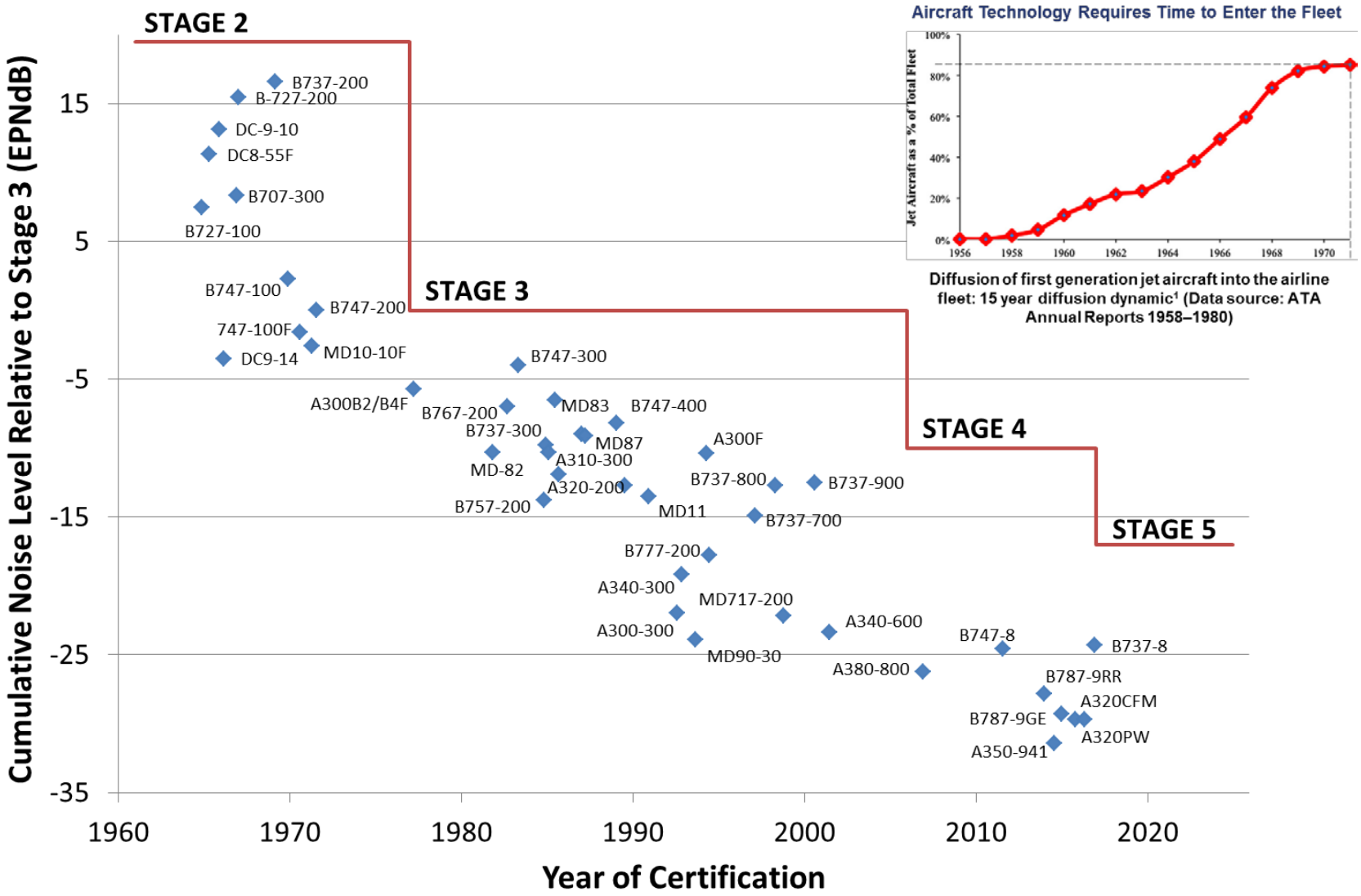


Community Exposure



Community exposure set by aircraft types and operational tempo over day and night

Commercial Aircraft Noise Evolution

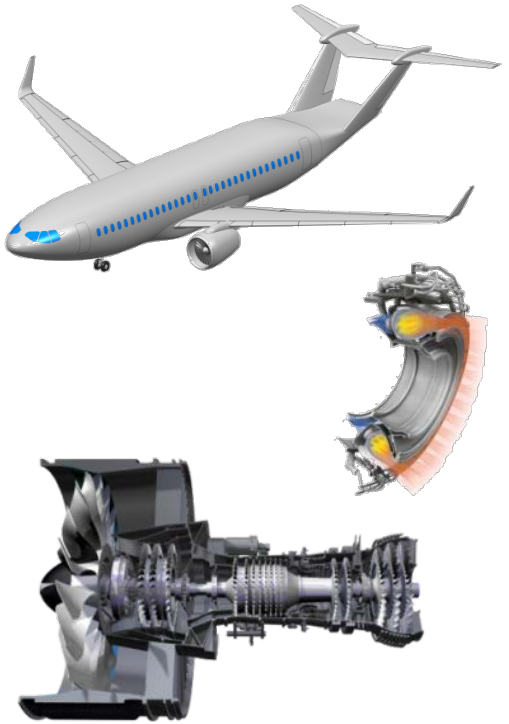


Diffusion of first generation jet aircraft into the airline fleet: 15 year diffusion dynamic[1] (Data source: ATA Annual Reports 1958–1980)

Continuous Lower Energy, Emissions & Noise (CLEEN)

- FAA led public-private partnership with 50-50 cost share from industry
- Reducing fuel burn, emissions and noise via aircraft and engine technologies and alternative jet fuels
- Conducting ground and/or flight test demonstrations to accelerate maturation of certifiable aircraft and engine technologies

	Phase I	Phase II
Time Frame	2010-2015	2016-2020
FAA Budget	~$125M	~$100M
Noise Reduction Goal	25 dB cumulative noise reduction cumulative to Stage 5	
NO_X Emissions Reduction Goal	60% landing/take-off NO_X emissions	75% landing/take-off NO_X emissions
Fuel Burn Goal	33% reduction	40% reduction
Entry into Service	2018	2026



CLEEN Details

Awardees:

- **Aurora Flight Sciences (Phase II only)**
- **Boeing**
- **Delta Tech Ops, America's Phenix, MDS Coating Technologies (Phase II only)**
- **General Electric (GE) Aviation**
- **Honeywell Aerospace**
- **Pratt & Whitney**
- **Rohr, Inc. / UTC Aerospace Systems (Phase II only)**
- **Rolls-Royce**

Phase I Technologies:

- **9 Technologies focused on**
  - Revolutionary Engine Design
  - Engine redesign
  - Wing technologies
  - Flight Management System Improvements
  - Improved Combustors

Phase II Technologies:

- **14 Technologies focused on**
  - Fuselage redesign
  - Engine redesign
  - Wing technology
  - Flight Management System improvements
  - Improved combustion

CLEEN Technology and Benefits:

Demonstrated technologies that reduce noise, emissions and fuel burn

Adaptive Trailing Edge

Boeing

Adaptive Trailing Edge
~ 2% fuel burn reduction
~ 1.7 EPNdB cum reduction in some single and twin aisles

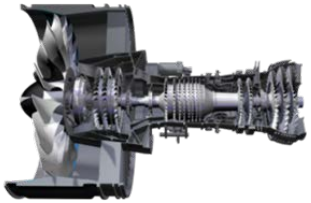
Ceramic Matrix Composite (CMC) Acoustic Nozzle
~ 1% fuel burn reduction
~ 2.3 EPNdB cumulative noise reduction

Ceramic Matrix Composite Nozzle

Pratt & Whitney

Geared Turbofan Technologies
CLEEN techs expand design space for engine with ~ 20% fuel burn reduction,
> 20 EPNdB cumulative noise margin to Stage 4

Ultra-high Bypass Ratio Geared Turbofan



CLEEN Technology and Benefits:

Demonstrated technologies that reduce noise, emissions and fuel burn

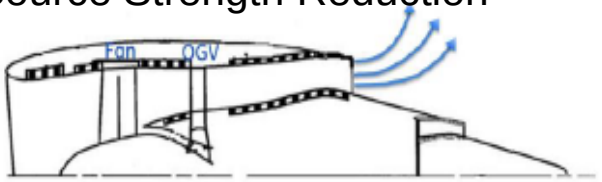
General Electric

Open Rotor
~26% reduction in fuel burn (re: 737-800)
~15-17EPNdB cumulative noise margin to Stage 4

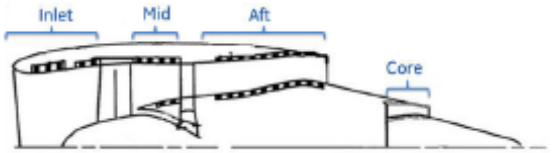
Novel Acoustic Liner Technology
~ 2 EPNdB cumulative noise reduction

Fan Noise Source Strength Reduction
~1 ENLdB cumulative noise reduction

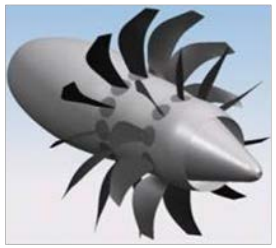
Fan Source Strength Reduction



Novel Acoustic Liners



Open Rotor Engine



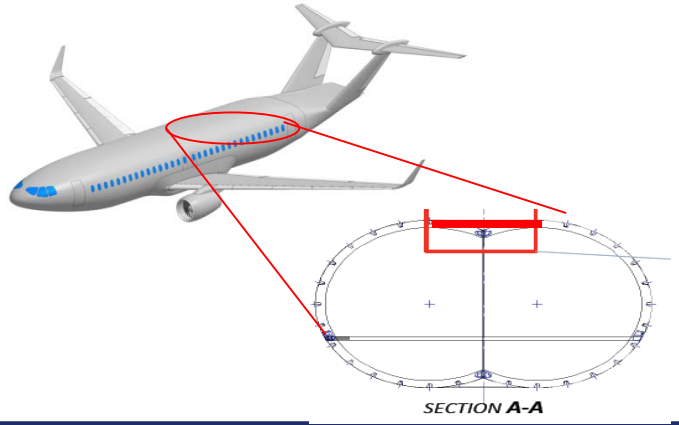
Aurora

D8 aircraft fuselage

~29% fuel burn reduction

~16 EPNdB cum noise margin to Stage 4

D8 Aircraft Fuselage



Assessment of CLEEN Technologies

Analytical Evaluation:

- Conducted by Georgia Tech
- Evaluating impact on fuel burn and noise out to 2050
- Modeled most, but not all, Phase I and II CLEEN Technologies
- Evaluation of Phase I captured in two technical reports

Key Results:

- 22 billion gallons of cumulative jet fuel saved
  - Equivalent to 1.7 million cars off road between 2025 and 2050
- Contribute to a 14% <u>decrease</u> in the land area exposed to DNL 65 dB and greater

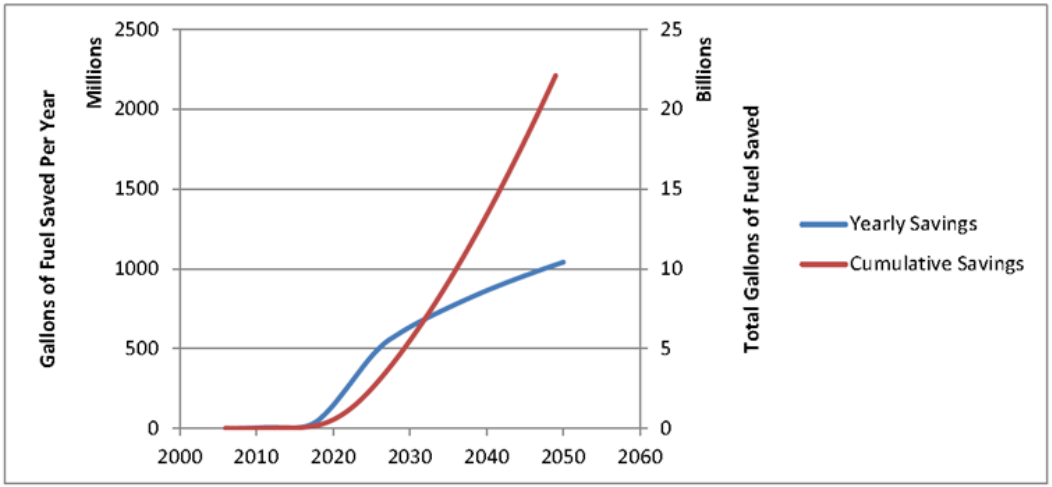


FIGURE 40: POTENTIAL FUEL BURN SAVINGS PROVIDED BY CLEEN TECHNOLOGIES MODELED IN THIS STUDY

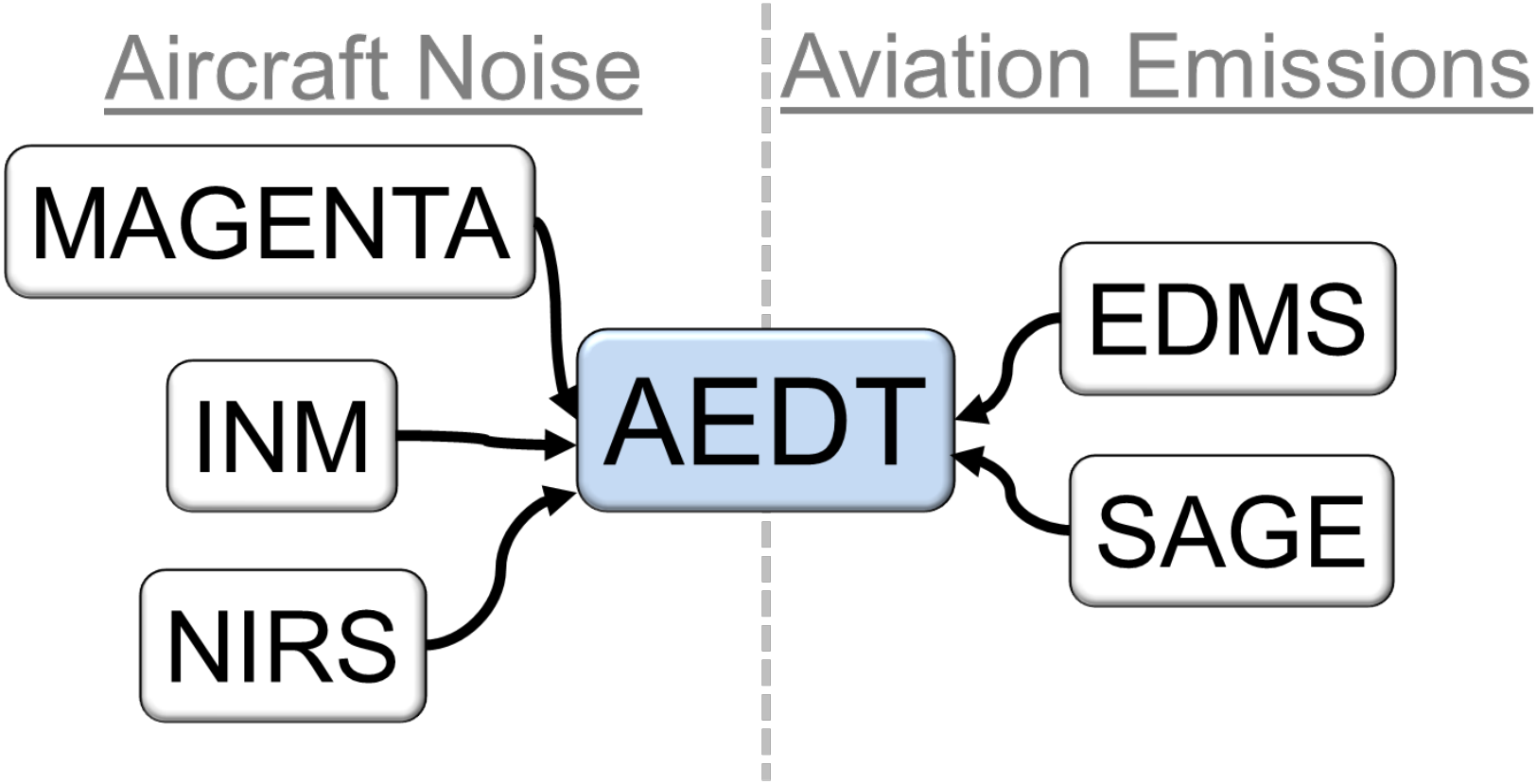
https://ascent.aero/documents/2018/07/ascent-010-2015-annual-report.pdf/

http://partner.mit.edu/sites/partner.mit.edu/files/PARTNER-Project-36-final-report.pdf

Integrated Noise Model (INM)

- **FAA's legacy tool to model aircraft noise in the vicinity of an airport**
  - Between 1978 and 2015, it was the regulatory model for the FAA
  - Also used by hundreds of international users
- **Methodology based on internationally agreed upon standards**
- **Basis for AEDT noise and performance calculations**
- **Desire for an integrated capability of computing/ identifying interrelationships between noise and emissions and amongst emissions drove AEE to replace INM**

AEDT Replaces Legacy Tools



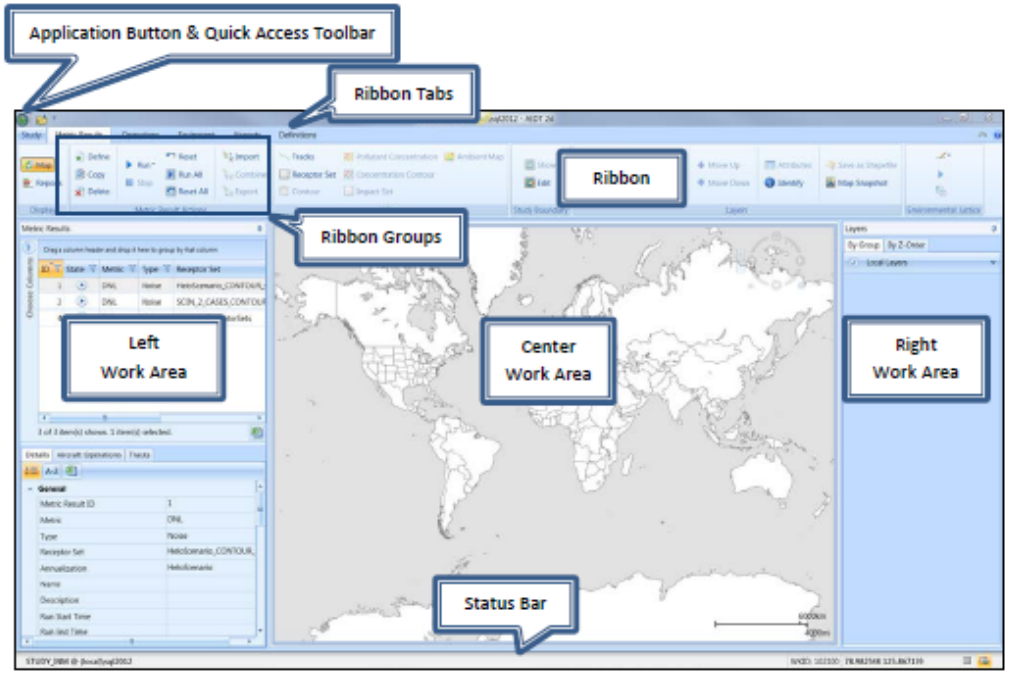
AEDT replaces legacy tools for environmental compliance, research, and policy analysis.

AEDT builds upon the methodologies in the legacy tools

Aviation Environmental Design Tool (AEDT)

Features

- Computes noise, fuel burn, emissions, and air quality
- Able to conduct analyses at airport, regional, national, and global scales



Applications

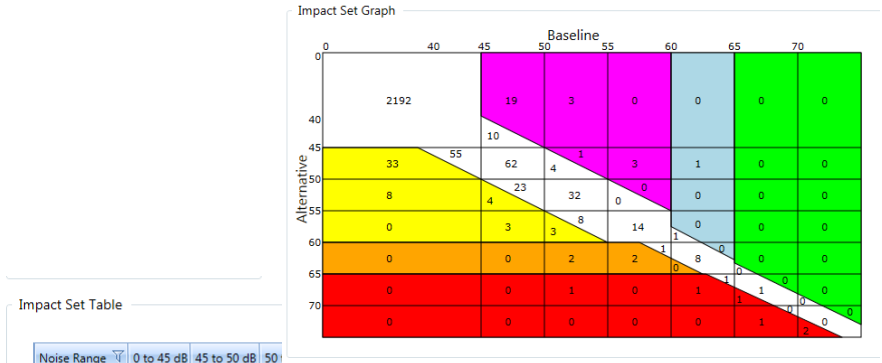
- Air space and airport design and planning (e.g., National Environmental Policy Act reviews)
- International Civil Aviation Organization (ICAO) Committee on Aviation Environmental Protection (CAEP) analyses
- Assessing benefits from introducing NextGen and new aircraft and engine technologies (e.g., from FAA CLEEN and NASA Programs)

AEDT Development Plan - Noise

- Current version of tool, AEDT2d, was designed to model DNL 65
  - Seeking to improve ability to model noise at lower DNL
- Adding noise and performance information for additional aircraft types
- Improving takeoff weight and thrust modeling
- Improving aircraft performance module
- Laying ground work to incorporate airframe noise more explicitly

Methodology Updates since INM

- NIRS legacy capabilities
  - Flexibility for larger study areas
  - Impact Report and table
  - Noise ranking and flight track reassignment for change analysis



Impact Set Table

Alternative \ Noise Range	0 to 45 dB	45 to 50 dB	50					
0 to 45 dB	2192	29	3	0	0	0	0	2224
45 to 50 dB	88	62	5	3	1	0	0	159
50 to 55 dB	8	27	32	0	0	0	0	67
55 to 60 dB	0	3	11	14	1	0	0	29
60 to 65 dB	0	0	2	3	8	0	0	13
65 to 70 dB	0	0	1	0	2	2	0	5
>= 70 dB	0	0	0	0	0	1	2	3
Total	2288	121	54	20	12	3	2	2500

8 of 8 item(s) shown. 0 item(s) selected.

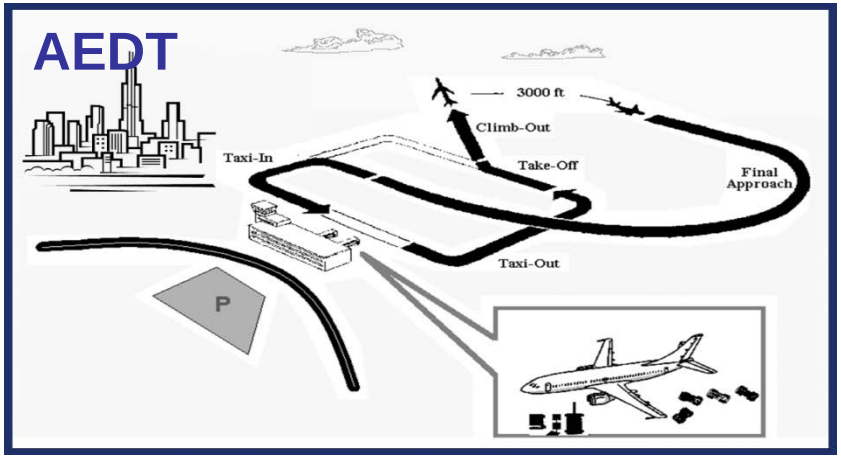
- Addition of Number of Above calculation for some metrics (e.g., LAMax, LCMax, SEL)
- Addition of Environmental Justice Population Identification feature
- Updated algorithm regarding how sound dissipates between the aircraft and what is experienced on the ground

AEDT3a Functionality: Noise

- **Aircraft performance modeling update**
  - More accurate and unified modeling of aircraft performance for both terminal area and cruise operations
  - Improved aircraft takeoff weight and takeoff thrust modeling to better represent flight operations
  - Added speed control capability to procedure modeling
- **Fleet database updates**
  - 737-800 Arrival Profiles, G650, Boeing 737-8Max

Closing Observations

- Despite considerable reductions, noise remains a challenge
- Utilizing a comprehensive approach to address this challenge
- Technology advancements are needed to achieve additional aircraft noise reductions
- Modeling tools continue to advance as new methodologies and algorithms mature

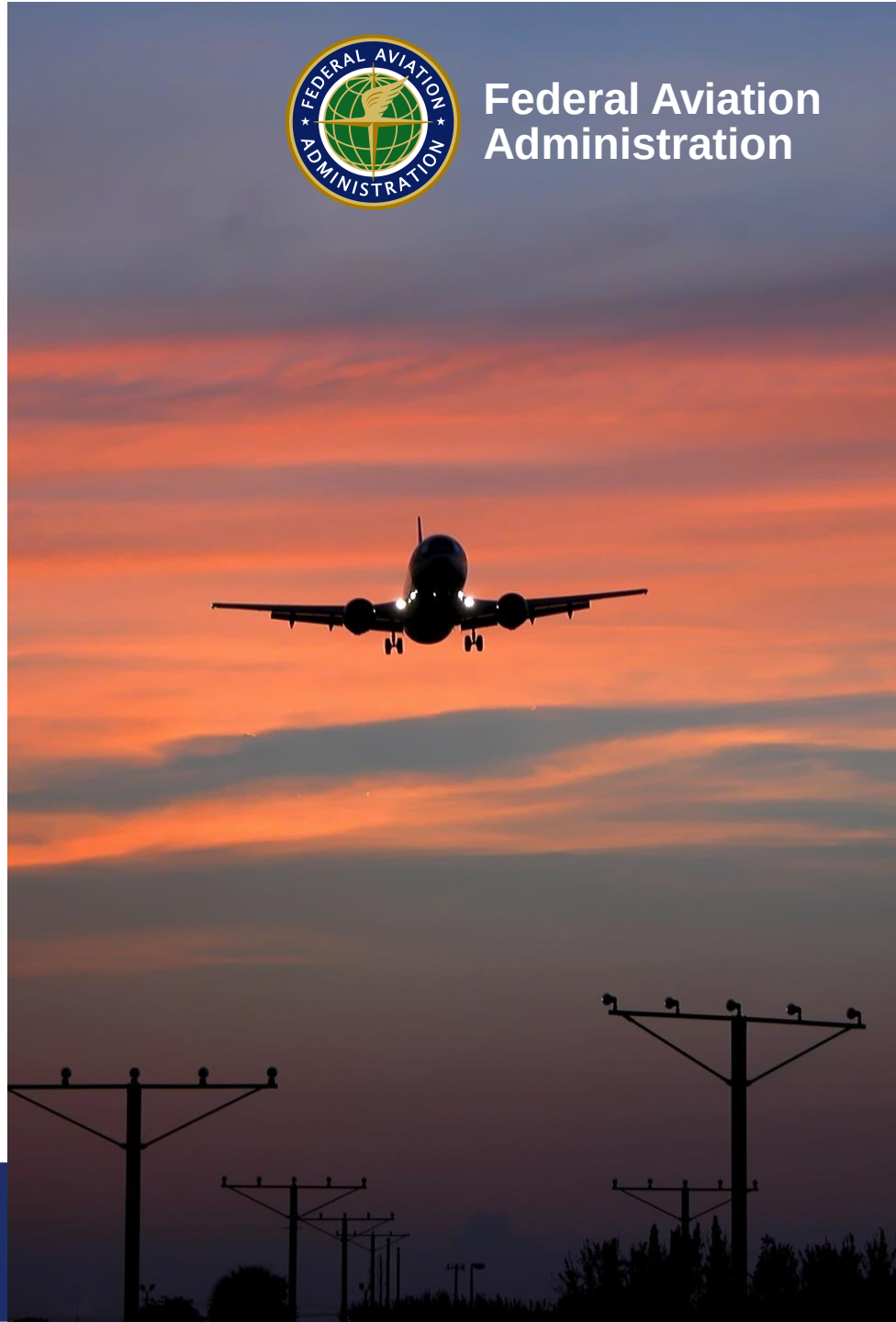


Northeast Corridor Initiative

(NEC)

Presented to: NY Community Aviation Roundtable

Date: September 26, 2018



NextGen Advisory Committee (NAC) Recommended Goals for Northeast Corridor (NEC)

Near-term goals:

- Improve execution of today's operation
  - Complete all scheduled Operations
  - Operate on time
  - Operate with predictability
- Critical to improve operations during adverse weather

Timeframe: October 2017 – December 2021

Northeast Corridor Update

Oct 2017: Interim phase 2 report approved by NAC

- Includes milestones and commitments thru March 2019.

June 2018: Final phase 2 report received by NAC

- Includes milestones and commitments thru Dec 2021

NEC Scope – What is included?

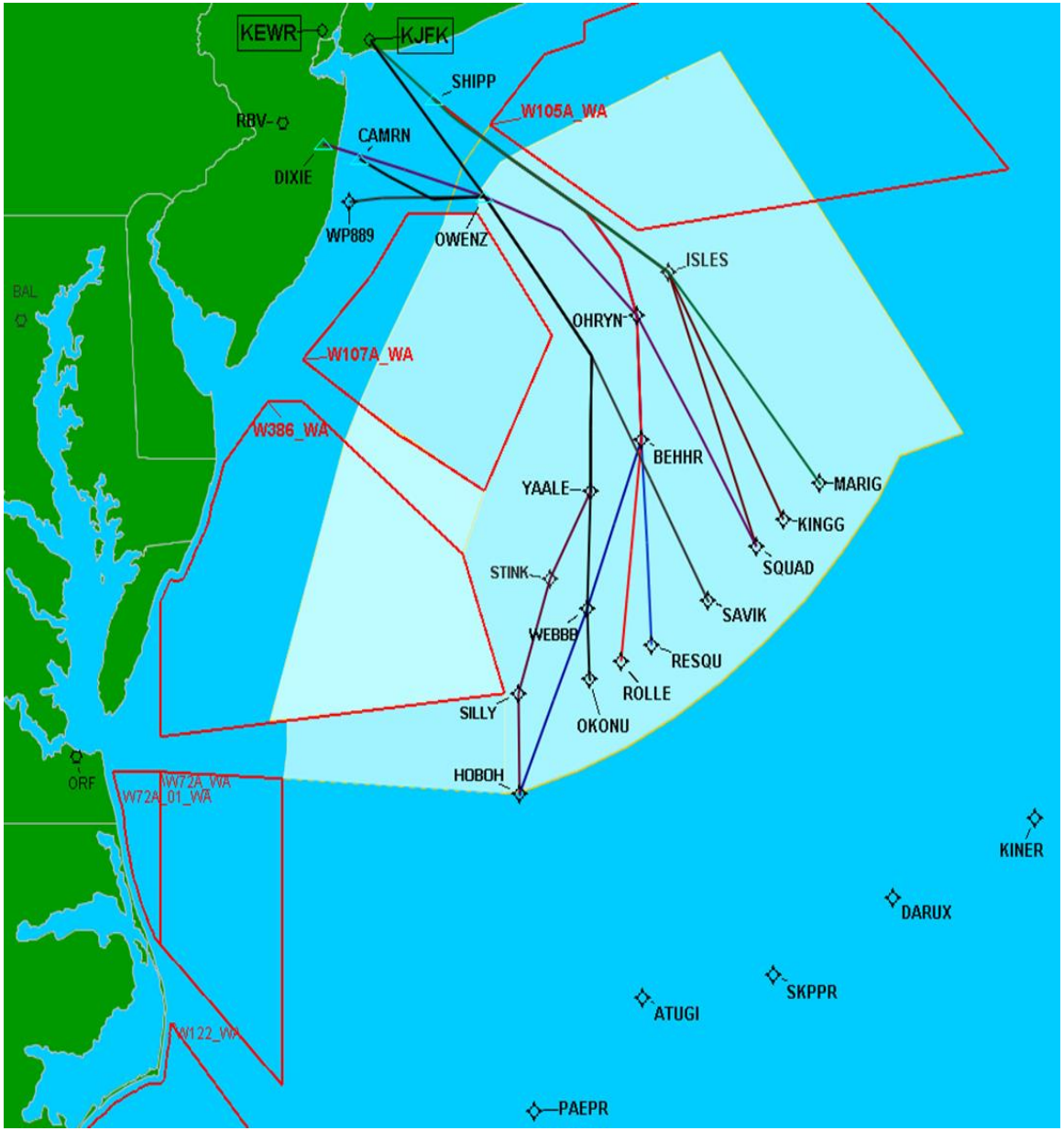
- **Airports**: build airport infrastructure on the airport surface, airport terminal buildings and air traffic towers that enable improved surface operations and airport throughput

- **Airspace and Procedures**: design and evaluate operational procedures that improve efficiency of today's airspace/airport operation; and explore opportunities to deconflict traffic between close-in airports

- **Tactical Initiatives**: maximize and evolve the utilization of already deployed tools, routes and processes to improve movement of air traffic into, out of and within the NEC during periods of exceptionally high demand and severe weather

- **Tools / Technology**: deploy new automation capabilities, decision support tools, and processes that enhance controller information and decision making such that operational performance is improved in all operating conditions

Update on key procedure items in NY Metro area



NEC Initiative: ZNY Offshore Airspace Redesign

Benefit Considerations

Improve airspace efficiency in constrained offshore airspace

Status:

Design completed Mar 2018

Implementation NLT Dec 2019

NEC Initiative: East Coast High Altitude Routes

Initiative Objective

Design high altitude (Above 18000 ft) PBN Route structure to segregate flows and better manage traffic to/from major airports on east coast

Northeast Corridor

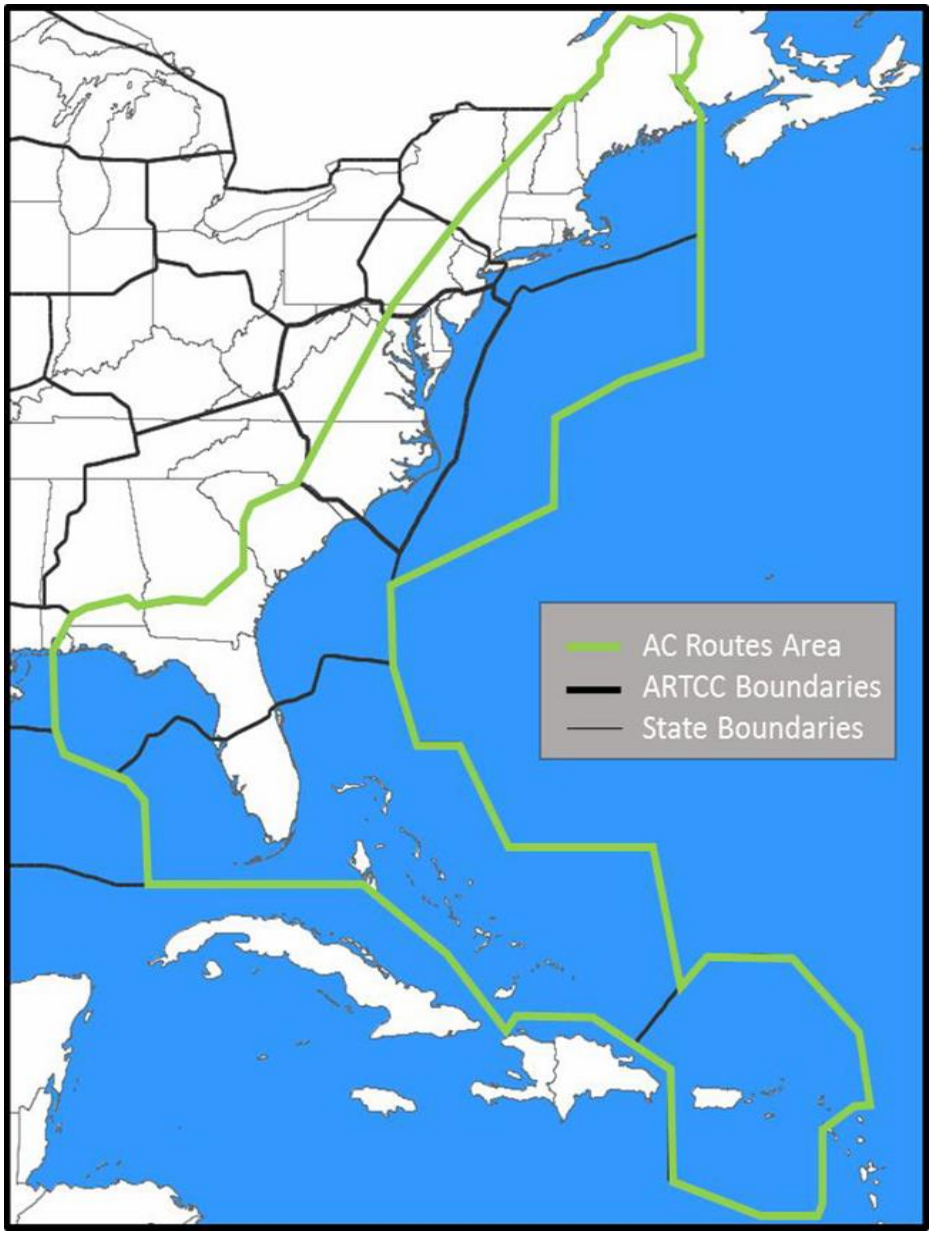
Mid Atlantic States to New England

- **Design Completed June 2018**
- **Implementation September 2020**

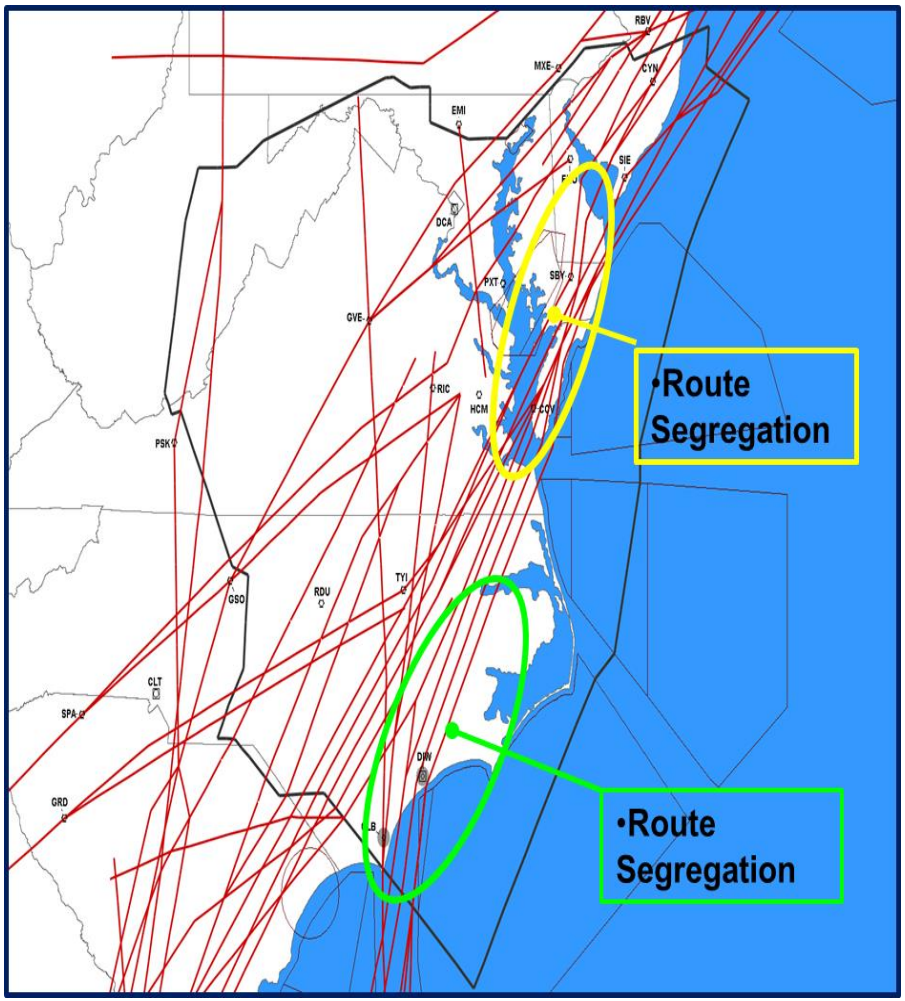
Florida Metroplex

Southern States to Puerto Rico

- **Implementation November 2018**



NEC Initiative: East Coast High Altitude Routes



•Operational Objectives:

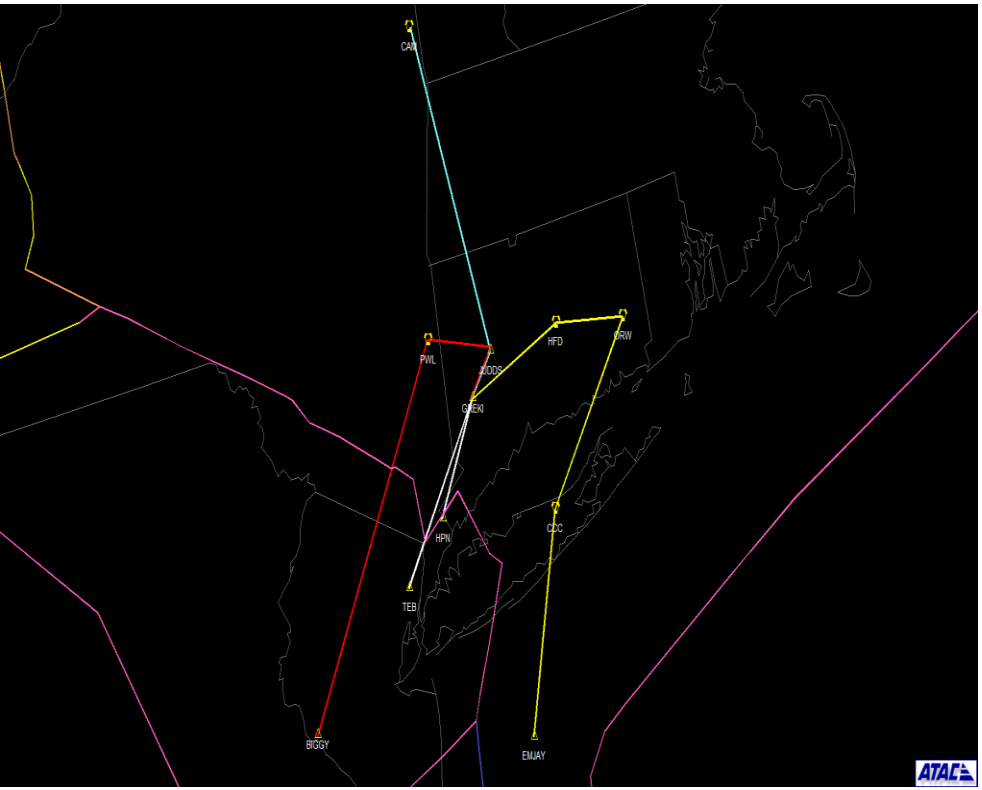
- Establish segregated routes in constricted east coast airspace to achieve higher throughput, optimal altitudes and increased routing options.
- Alleviate east coast airspace constraints

•Expected Outcomes:

- Improve airspace throughput for high altitude traffic to/from NEC airports
- Reduce traffic management restrictions due to east coast airspace constraints for NEC airports
- Reduce airspace complexity
- Reduce radar vectors and reroutes
- Improved accommodation of requested altitudes

NEC Initiative: Vertical Climb Escape Route

High performance escape route during SWAP/other constraints for TEB/HPN departures that can perform climb



- **Objective:** When severe weather or other system constraints exist, leverage high performance business jet capabilities and release to climb above constrained airspace on predefined escape route

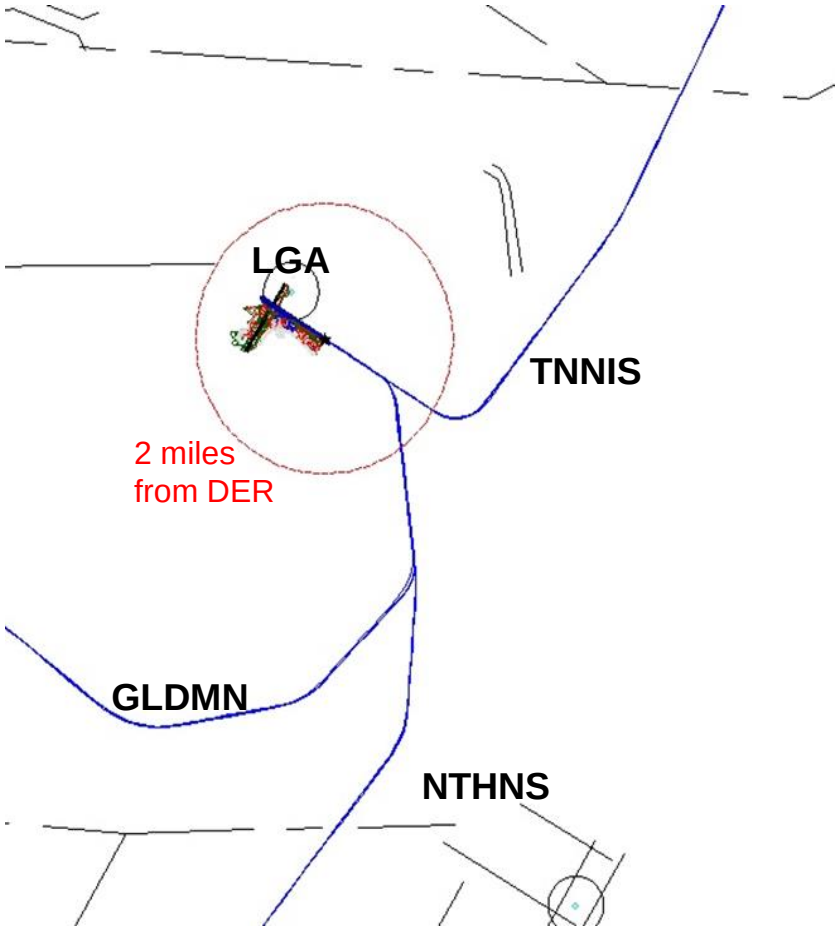
- **Status:** One flight test conducted. Additional study of routing and flight testing required.

NEC Initiative: Use of dispersal headings for LGA13 departures using TNNIS, GLDMN, & NTHNS (Q2-4 CY18) "Complete"

Use of this initiative is limited to certain operational configurations

Benefits considerations

- **Supports dispersion of Runway 13 departures**
- **Uses already published procedures**
- **Reduces average departure delay, reducing emissions and providing benefit to the traveling public**



NEC Initiative: Modify LGA22 Missed Approach to Deconflict with EWR29 RNAV GPS Approach

Milestone: Complete feasibility study for the modified missed approach for LGA22. Due Q4 2018

Benefit: Developing an alternate missed approach for LGA RY 22 that deconflicts with EWR RNAV GPS X RY29 approach would enable EWR to land two runways

Status: Design options operationally not viable

Thank you!

We will continue to keep you and your communities updated

Please click the link below to view the latest Phase 2 Addendum to Priorities for Improving Operational Performance in the Northeast Corridor (NEC) through CY2021

Approved by the

NextGen Advisory Committee June 2018

AJV-12\NEC Phase II Addendum Report June 2018 (Through CY2021).pdf