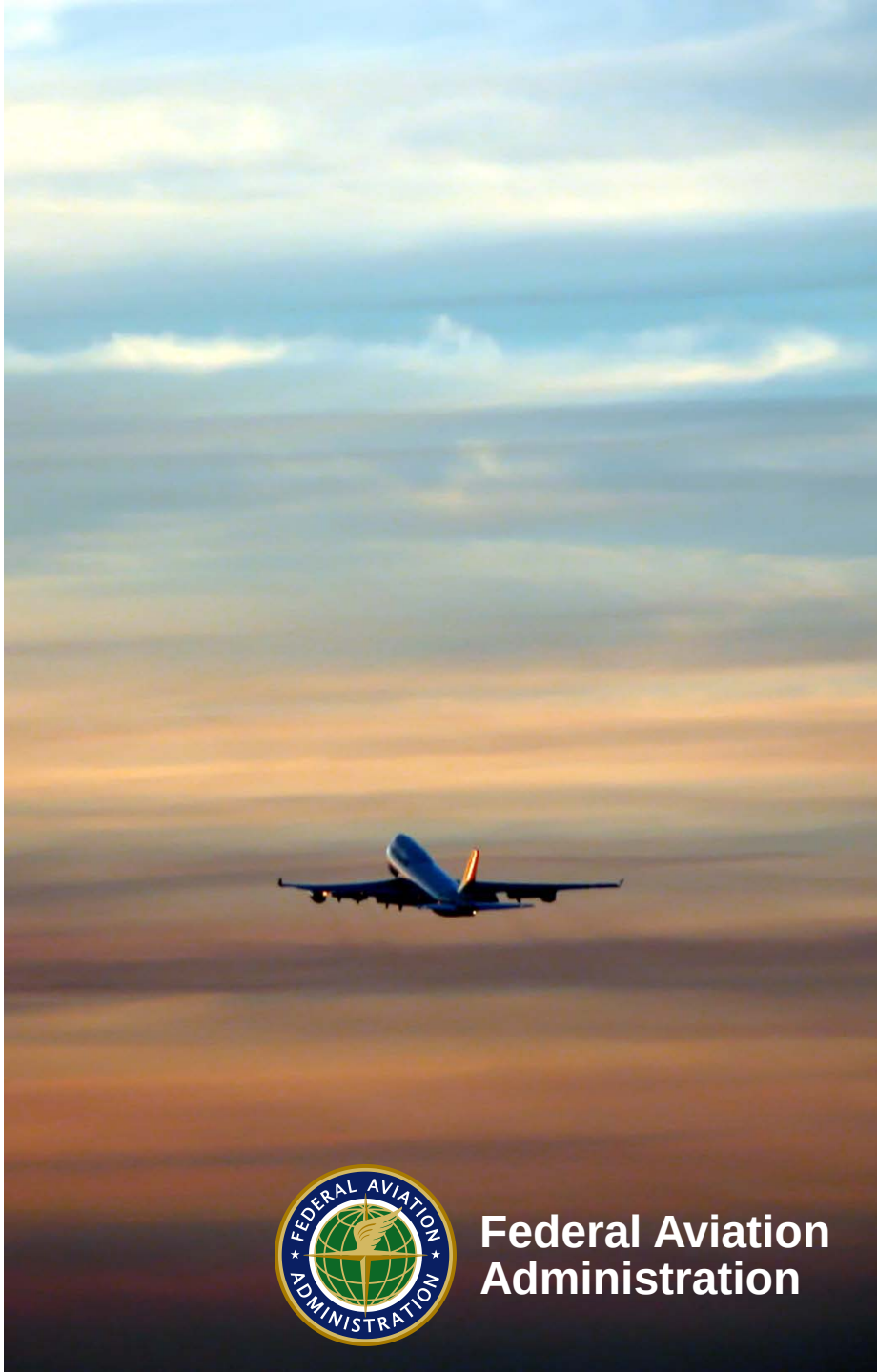
Historical Noise Exposure Trends and Goals Analysis for Noise

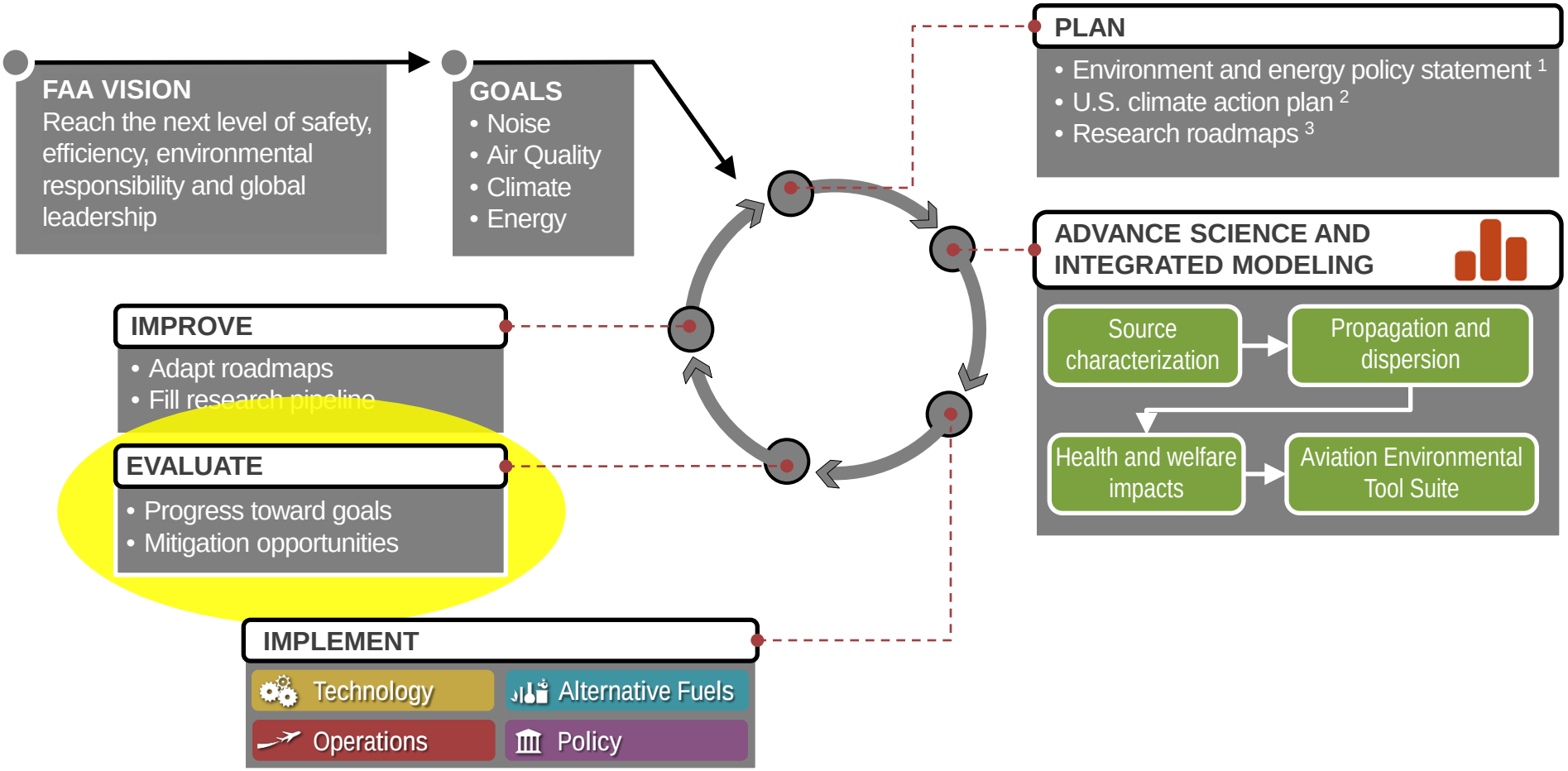
Presented by: Fabio Grandi (AEE-100)
Chris Dorbian (AEE-400)

Presented to: REDAC E&E Subcommittee

Date: August 30, 2016



Environmental & Energy Strategy



Notes:

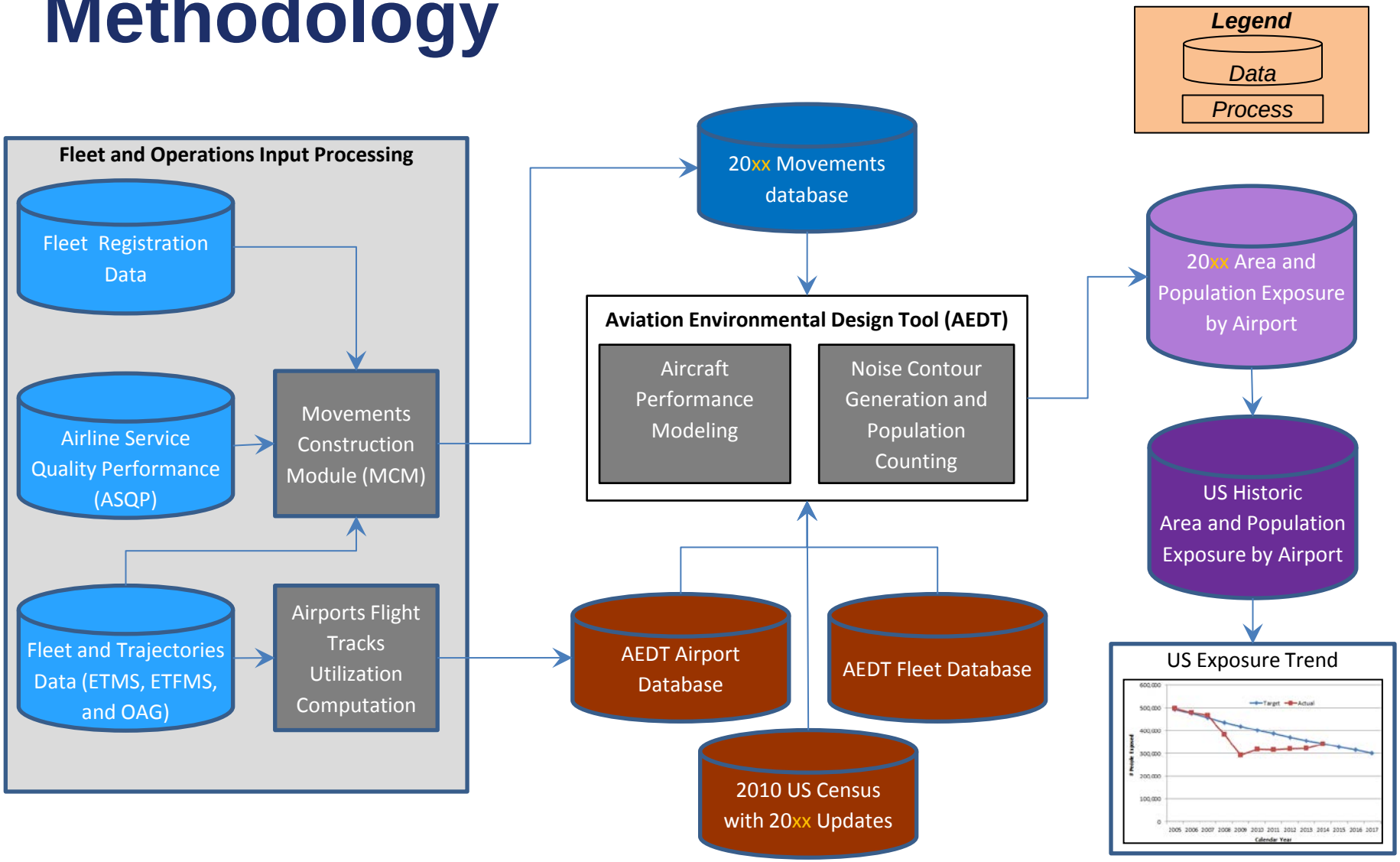
1. Aviation E&E Policy Statement (Federal Register 77-141, 2012): http://www.faa.gov/about/office_org/headquarters_offices/apl/environ_policy_guidance/policy/media/FAA_EE_Policy_Statement.pdf
2. U.S. Aviation GHG Emissions Reduction Plan: http://www.icao.int/environmental-protection/Pages/ClimateChange_ActionPlan.aspx
3. Environment and Energy Website: http://www.faa.gov/go/environment

Part I: Historical Noise Exposure

- **Overall objective**
  - Assess the aviation system progress towards the goal of reducing the U.S. population exposed to significant aircraft noise around airports to less than 300,000 persons by 2018.

- **Annual noise inventory analysis**
  - Estimate the number of people exposed to aircraft noise by collecting the best fleet and operations information available for the preceding year's for input to the Aviation Environmental Design Tool (AEDT) model
  - Use the information generated over multiple years to visualize progress towards the goal in the form of a population noise exposure trend line

Methodology

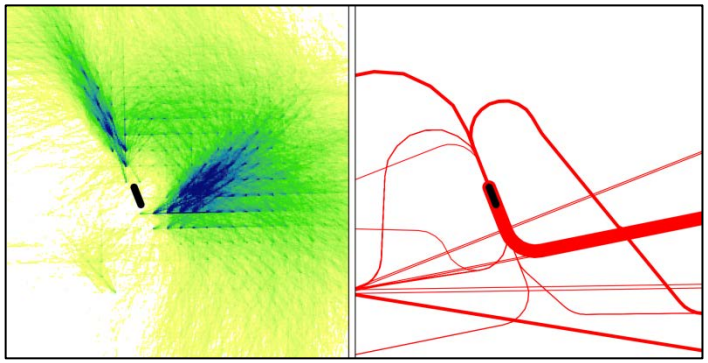


Fleet and Operations Processing

- **Fleet and operations data based on best available information**
  - Enhanced Traffic Management System (ETMS - Volpe feed)

- **Fleet assignment based on tiered best available information**
  1. Specific Airframe and engine combination based on ASQP reported tail number and Registration database
  2. Airline Specific fleet based on mix available in the Registration database
  3. Regional fleet based on Registration database

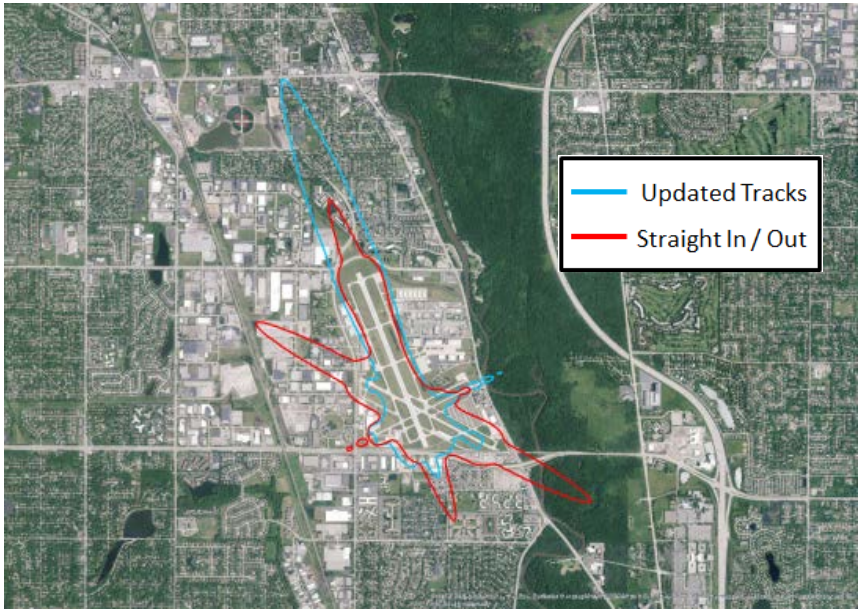
- **Airports Flight Tracks Utilization Processing**
  - Provides updated information on the utilization of ground tracks at airport where detailed airport modeling information is available

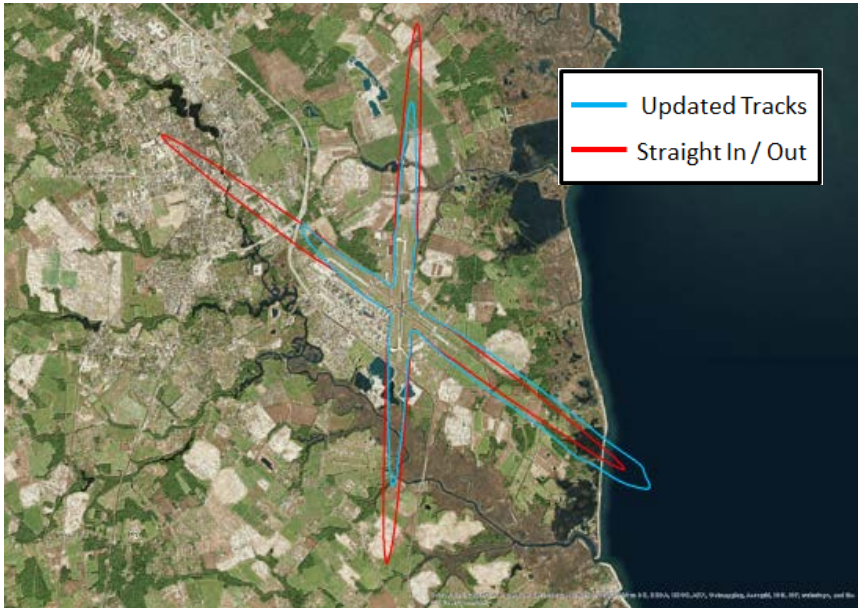


Modeling Details

Airport data

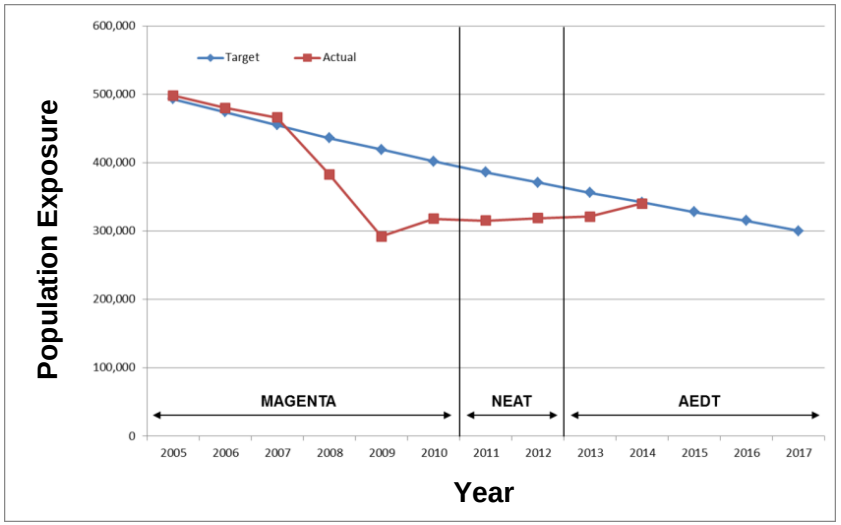
- **121 Primary airports (Tier 1)**
  - Have detailed ground tracks information and utilization information (Decks)
  - Ground tracks utilization updated using year specific radar trajectory data
- **597 Secondary airports (Tier 2)**
  - Rely on straight-in and straight-out ground tracks
  - Assume an even distribution of operations across runways
  - Only responsible for 3% of the population exposure at 65dB DNL
- **Airport data updates**
  - The ground tracks for the top 20 Tier 1 airports were updated last year
  - The top 20 Tier 2 airports where upgraded to Tier 1 level this year





Exposure Trend Line Update

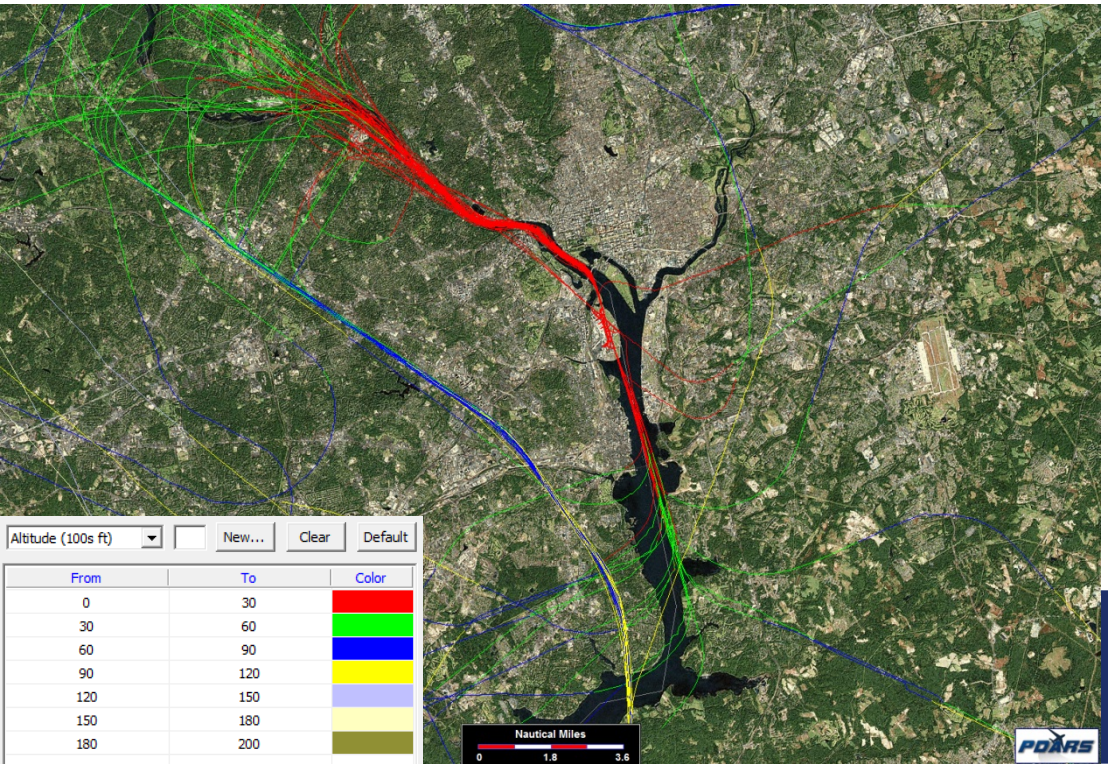
- **Current Trend line spans 10 years and 3 models**
  - US MAGENTA – Based on an INM core
  - NEAT – Based on an AEDT core
  - AEDT 2b – Final released implementation
- **Having results based on multiple models and vintages of data causes basic inconsistencies between results**
- **AEDT 2b model and data are expected to remain stable**

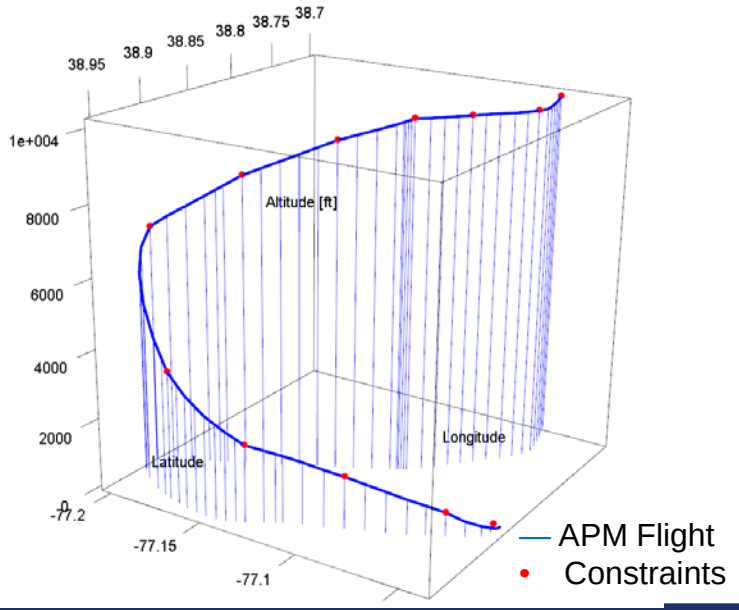


- **Already initiated a project to rerun the entire time series**
  - Priority will be give to the years: 2005, 2007, 2009, and 2012
  - The remaining years (2006, 2008, 2011, and 2013) will be rerun immediately after
  - 2014 and 2015 have already been computed using AEDT 2b

High Fidelity Flight Track Modeling

- **Developing process for Annual Inventory Generation**
- **Model each flight track as-flown in radar data (e.g., PDARS, NOP, SWIM, etc.) using AEDT's sensor path method**
  - Data reduction, smoothing, and refinement performed external to AEDT
  - APM used to model aircraft operational state along radar trajectory
  - Direct injection into AEDT (>25 million annual ops) for processing
  - Potential for modeling individual days of flight for more detailed analyses
- **Linkages with NextGen cost/benefit analysis efforts**

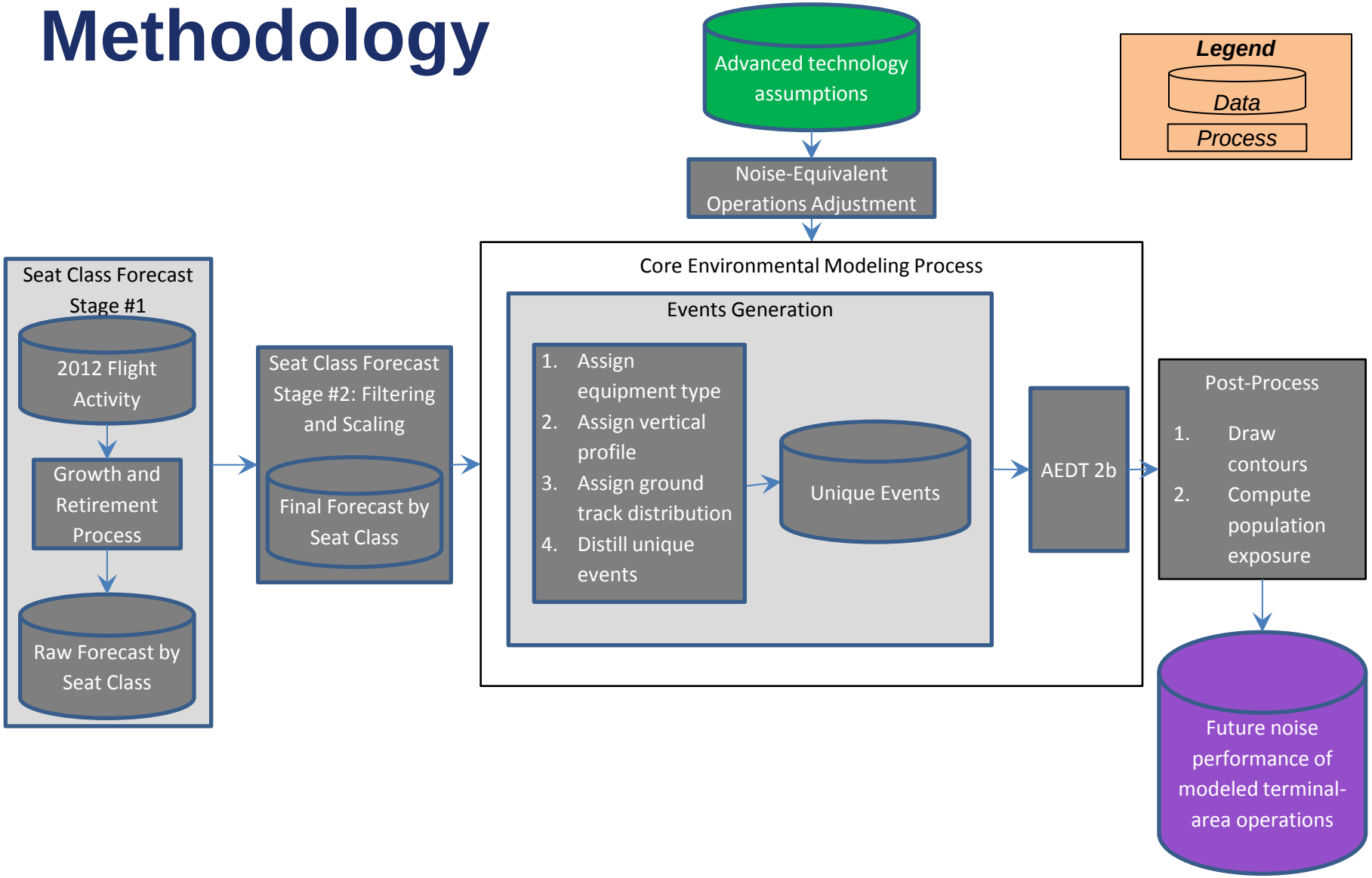




Part II: Goals Analysis

- **Overall objective**
  - Explore how expected advancements in airframe and engine technology, alternative fuels, and operational improvements will propel the U.S. aviation sector towards FAA E&E goals notwithstanding expected growth in operations
- **Noise Goal Analysis**
  - Generate noise data consistent with existing evaluations of projected aircraft operations and fuel burn levels (i.e., ‘Goals’ runs featured in 2015 US Climate Action Plan)
  - Inform future (post 2018) noise goal planning

Methodology



Experimental Setup

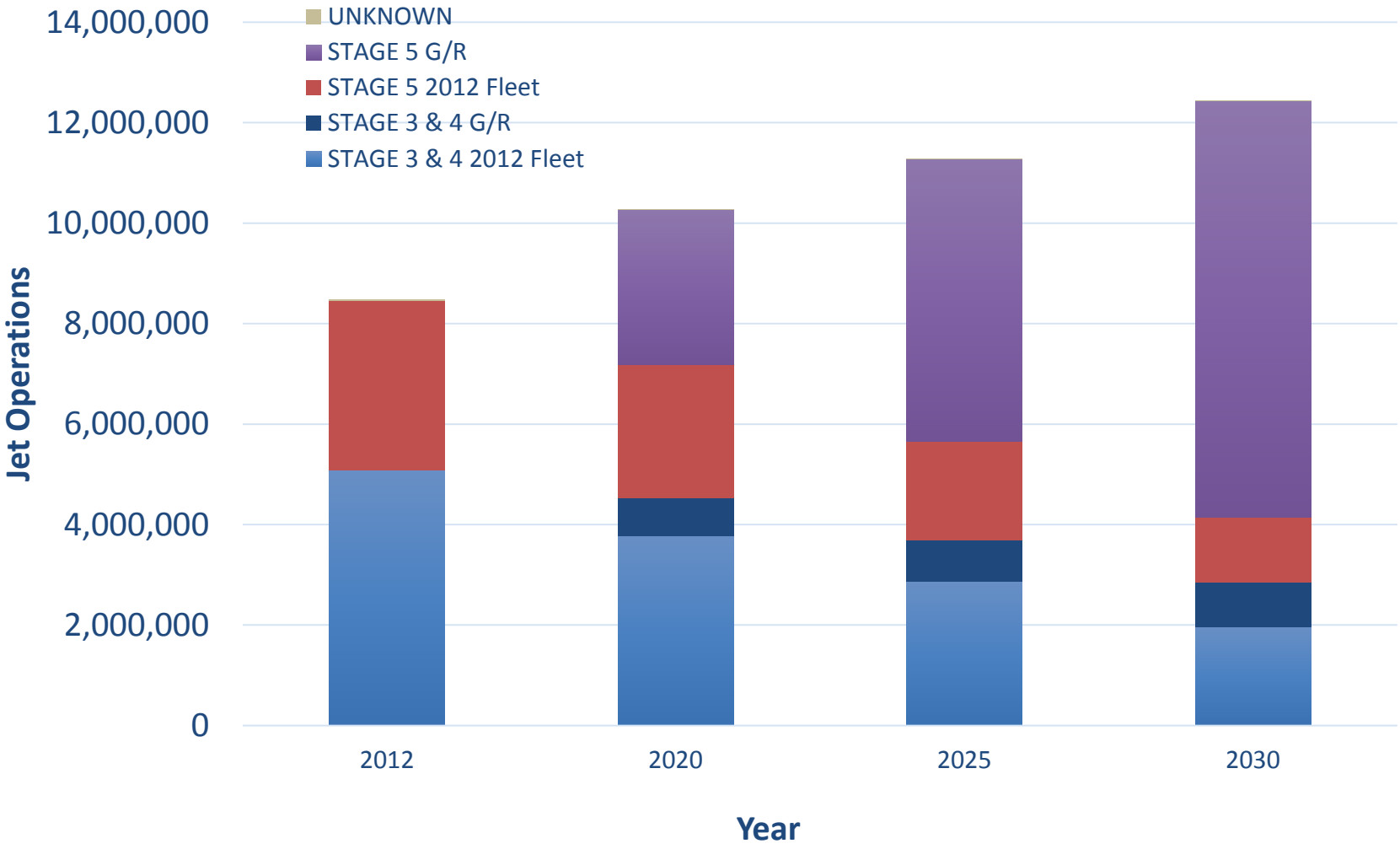
- **Year of base flight activity: 2012**
- **Forecast year, source: 2030, FAA TAF-M**
- **Population densities: 2010 Census (fixed)**
- **Decks: Consistent with CY14 Annual Inventory run**
- **Environmental engine and assumptions: AEDT 2B using traditional Annual Inventory settings**
- **Retirement and replacement**
  - **CAEP/9 retirement curves** are used throughout
  - The growth and replacement fleet comprises three categories of technology
    - Tier 1 (AEDT-native): 2012-2013 technology
    - Tier 2 (operations-adjustment-based with actual certification data): A350
    - Tier 3 (operations-adjustment-based with projected certification data)
      - **2016+ technology**
      - See slides subtitled 'Methods and data: technology assumptions'
- **48 airports – accounting for over 95% of 2012 nationwide 65 dB DNL population exposure – were chosen from the 600+ airports in the National Plan of Integrated Airport Systems (NPIAS) with at least one average daily jet departure**
- **Metrics: 55, 60, and 65 decibel (dB) day-night average sound levels**

Methods and Data: Technology Assumptions

- Adapted from PARTNER Project 36: EDS Assessment of CLEEN Technologies
- CLEEN-funded technologies as well as other public domain and proprietary industry technologies potentially available in the CLEEN timeframe, including NASA N+1 and N+2 technologies

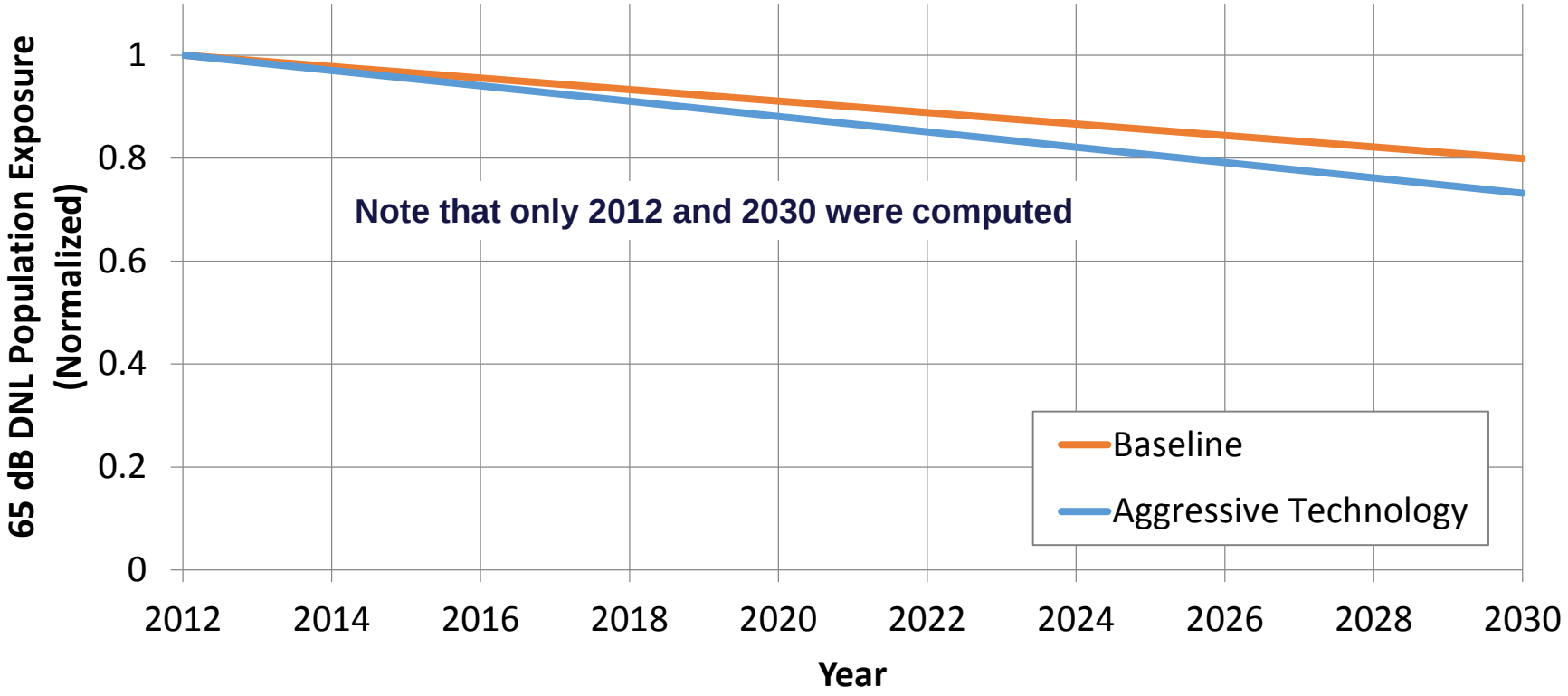
Scenario	Description
Evolutionary (Baseline)	'Normal' technology evolution. Conservative inclusion of CLEEN technologies in N+1.
Aggressive	Represents higher rate of technology development. Includes all CLEEN Techs in N+1

Fleet Evolution



Population Exposure

- 20 and 26% decrease in population exposure between 2012 and 2030 for 65 dB contour for baseline and aggressive technology scenarios, respectively.
- 8.5% difference between Baseline and Aggressive Technology in 2030.

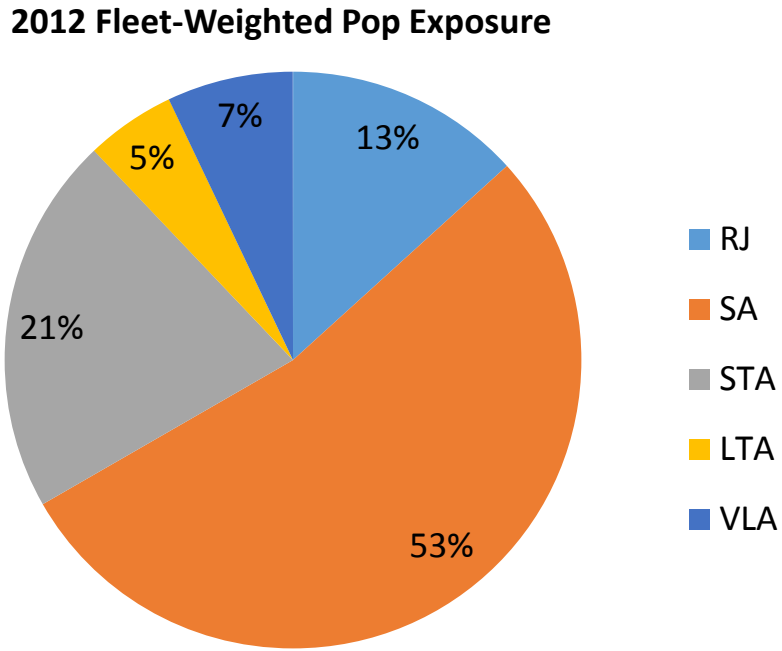


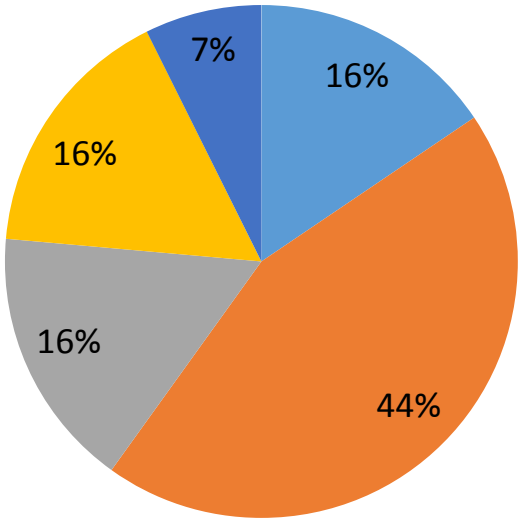
Fleet-Weighted Population Exposure

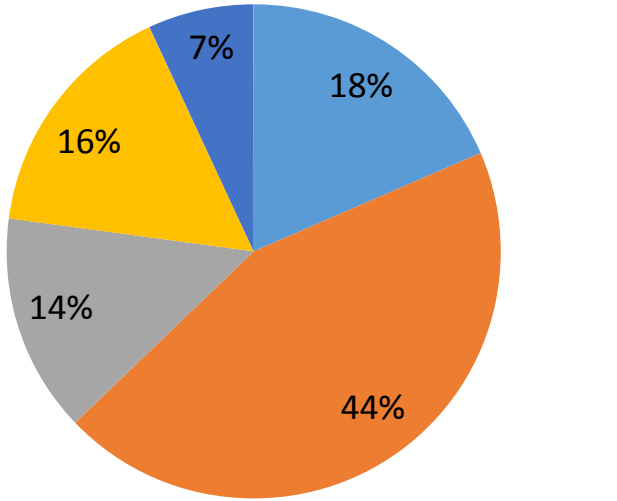
- Combines noise energy with population exposure to generate distribution of system-wide population exposure with respect to aircraft class
- Example calculation for Regional Jet (RJ):

$$FWPE_{RJ} = \sum_{i}^{airports} PopExposed_i * \frac{NoiseEnergy_{RJ,i}}{NoiseEnergy_{Tot,i}}$$

Fleet Weighted Population Exposure







Population exposure to DNL 65
Circle area is proportional to population exposure

Summary

- AEDT 2b used to generate Annual Noise Inventory as well as forward-looking Noise Goals Analysis
- Inventory provides basis for Goals Analysis
- Provide insight on system performance against current and future goals
- Tool / data improvements continually being made to enhance fidelity