FAA Office of Environment and Energy (AEE) Research Overview

Federal Aviation Administration

Presented to: E&E REDAC Subcommittee

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Outline

- **AEE Research**
  - Overview of strategy and five pillar approach
  - CLEEN Program
  - Alternative Fuels Testing
  - Operations
- **Airport Technology Research**
- **Budget summary**
- **Summary**

Aviation Environmental Challenges

- Aviation impacts community noise, air quality, water quality, energy usage, and climate change
- Environmental impacts from aviation could pose a critical constraint on capacity growth
- FAA are pursuing aircraft technology, alternative jet fuels, operations, and policy measures to address the environmental challenges facing aviation

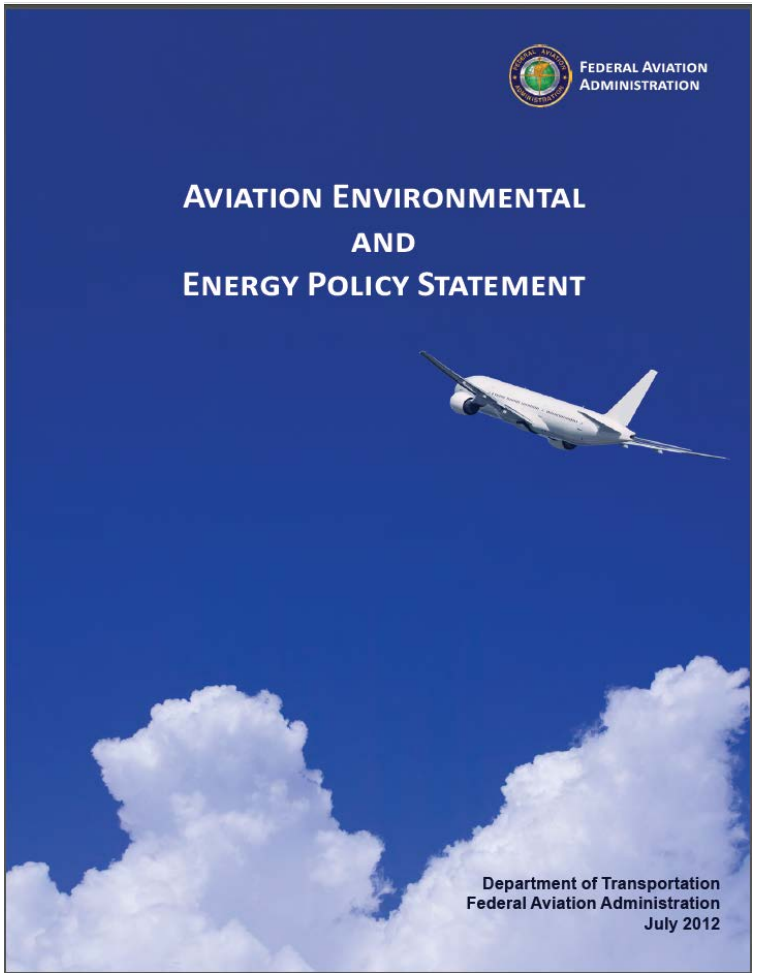
Vision and Principles

Vision:

Environmental protection that allows sustained aviation growth

Guiding Principles:

1. Limit and reduce future aviation environmental impacts to levels that protect public health and welfare.
2. Ensure energy availability and sustainability.



Want increased mobility with reduced environmental impacts and enhanced energy availability and sustainability

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

Environment & Energy Goals

Aspect	Goal
Noise	Reduce the number of people exposed to significant noise around U.S. airports in absolute terms, notwithstanding aviation growth, and provide additional measures to protect public health and welfare and our national resources (population exposed to DNL 65 in 2018 is 300,000 people).
Air Quality	Achieve an absolute reduction of significant air quality health and welfare impacts attributable to aviation, notwithstanding aviation growth.
Energy	Improve National Airspace System (NAS) energy efficiency and develop and deploy alternative jet fuels for commercial aviation.
Climate	Limit the impact of aircraft CO2 emissions on the global climate by achieving carbon neutral growth by 2020 compared to 2005 (2020 CO2 emissions equal to 2005 levels), and net reductions of the climate impact from all aviation emissions over the longer term (by 2050).

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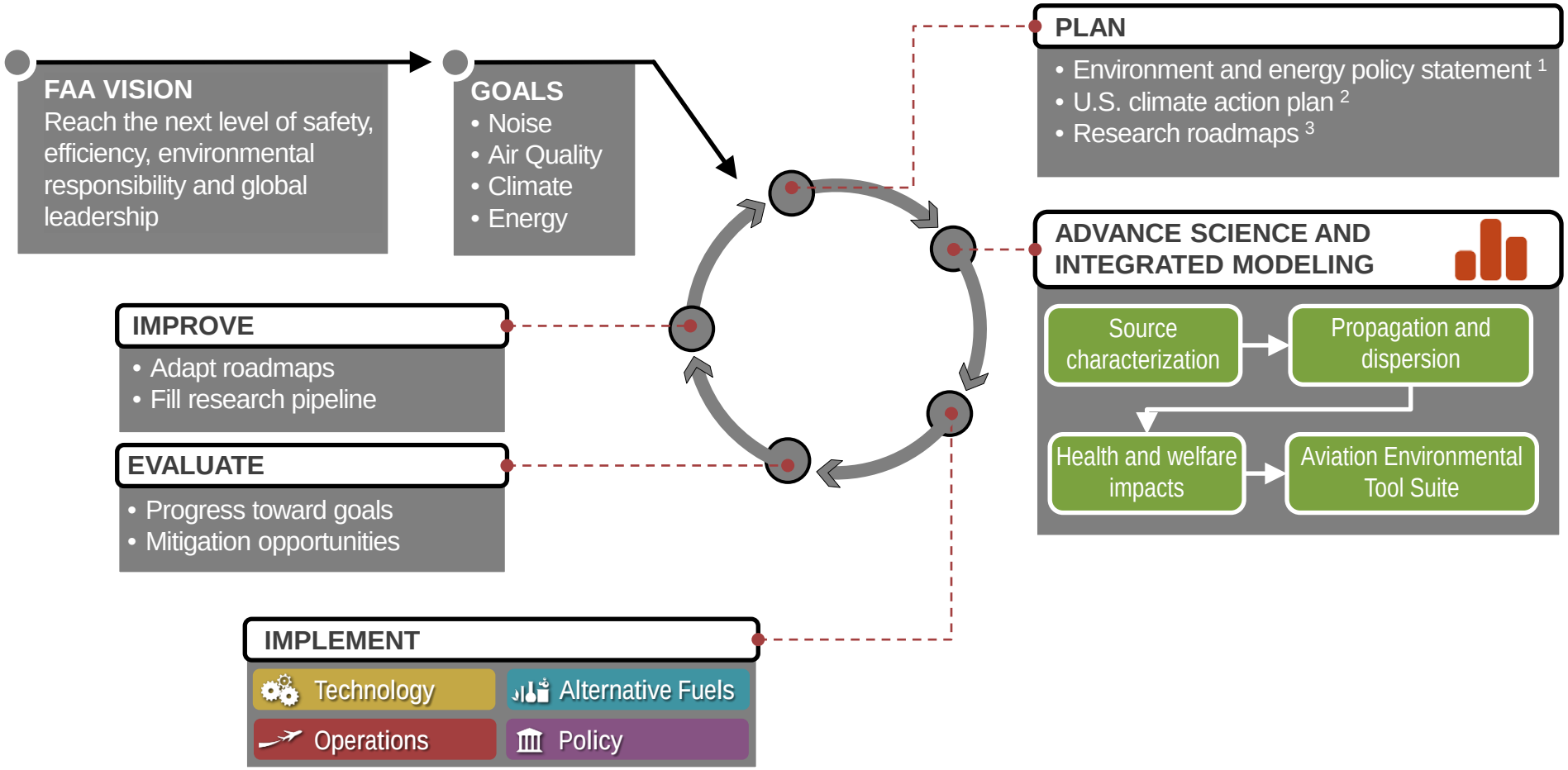
Environmental & Energy Strategy



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

The Five Pillar Approach

Science and Tools

PILLAR 1: Improved Scientific Knowledge and Integrated Modeling

- Decision-making based on solid scientific understanding
- Work with research community through the **Aviation Sustainability Center (ASCENT)**
- Understand public health and welfare impacts
- Incorporate this knowledge within the Aviation Environmental Tool Suite

Technology

PILLAR 2: New Aircraft Technologies

- Offer the greatest opportunity to reduce environmental impacts
- Partner with industry, research community, NASA, and Department of Defense
- Mature new engine and airframe technologies through the **Continuous Lower Energy, Emissions and Noise (CLEEN) Program**

Alternative Fuels

PILLAR 3: Sustainable Alternative Aviation Fuels

- Reduce environmental impacts, enhance energy security, and provide economic benefits
- Collaborate with stakeholders through the **Commercial Aviation Alternative Fuels Initiative (CAAFI)**
- Test alternative jet fuels to ensure they are safe for use through **ASCENT** and **CLEEN**
- Analyze their potential for reducing the environmental impacts of aviation

Operations

PILLAR 4: Air Traffic Management Modernization and Operational Improvements

- Increase efficiency of aircraft operations through the **Next Generation Air Transportation System (NextGen)**
- Engage with industry, research community, NASA, and Department of Defense
- Develop advanced operational procedures to optimize gate-to-gate operations
- Integrate infrastructure enhancements to the National Airspace System (NAS), improving environmental performance
- Calculate the environmental benefits of air traffic management modernization and operational improvements,

Policy

PILLAR 5: Policies, Environmental Standards, and Market Based Measures

- Implement domestic policies, programs, and mechanisms to support technology and operational innovation
- Develop and implement aircraft emissions and noise standards
- Work within the International Civil Aviation Organization (ICAO) to pursue a basket of measures to address emissions that affect climate, including a global market based measure as a gap filler
- Seek international partners to further our environmental and energy strategy

NextGEN
http://www.faa.gov/nextgen

CAAFI
http://www.caafi.org

CLEEN
NextGEN
http://www.faa.gov/go/cleen

ASCENT
http://ascent.aero

Note: Briefings provided on Noise and AQ/Climate Tools

Improved Scientific Knowledge for Solution Development

Aspect	Key Research Questions	Research Programs
Noise	How do we define significance in regards to aircraft noise? What are the public health and welfare impacts of aircraft noise?	- ASCENT COE - Tech Center - Volpe Center
Air Quality	How do we define significance in regards to aircraft emissions that degrade air quality?	- ASCENT COE - Volpe Center
Energy	How do we characterize annual variations in system-wide fuel efficiency? How do we define sustainability of alternative jet fuels?	- ASCENT COE - CAAFI - CLEEN Program - Volpe Center
Climate	What is the incremental impact of non-CO2 aircraft emissions on global and regional climate?	- ASCENT COE

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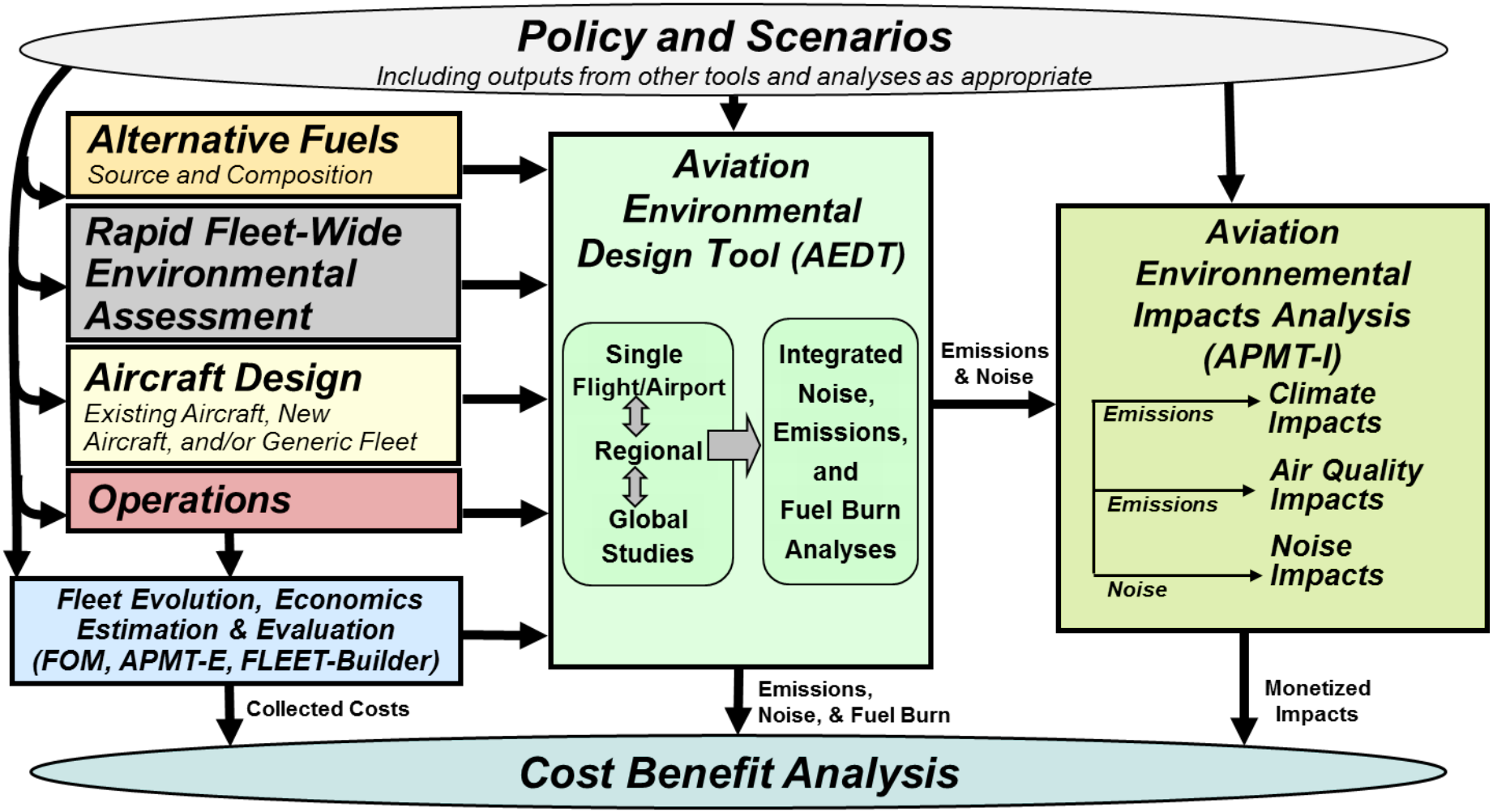
Note: Several briefings on Tools/Analysis

Aviation Environmental Tool Suite

Modeling range of solutions and their consequences on fuel use, noise and emissions (basket of measures for CO_2 and balanced approach for noise)



Note: No CLEEN Briefing this Meeting

Continuous Lower Energy, Emissions & Noise (CLEEN)

- 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
- Public-private partnership with 50-50 cost share with industry

	CLEEN I	CLEEN II
Time Frame	2010-2015	2016-2020
FAA Budget	~$125M	~$100M
Noise Reduction Goal	32 dB cumulative noise reduction	32 dB cumulative noise reduction
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

Note: Briefing on AJF Analysis Efforts

FAA Activities

- **Testing**
  - Support Certification/Qualification testing
  - Improve Certification/Qualification process
  - Emissions measurements
- **Analysis**
  - Environmental sustainability
  - Techno-economic analysis
  - Future scenarios
- **Coordination**
  - Interagency
  - Public-Private
  - State & Regional
  - International

CAAFI: http://caafi.org
CLEEN Program: http://www.faa.gov/about/office_org/headquarters_offices/apl/research/aircraft_technology/cleen/
ASCENT: http://ascent.aero PARTNER: http://partner.aero
Volpe Center: http://www.volpe.dot.gov/our-work/policy-planning-and-environment

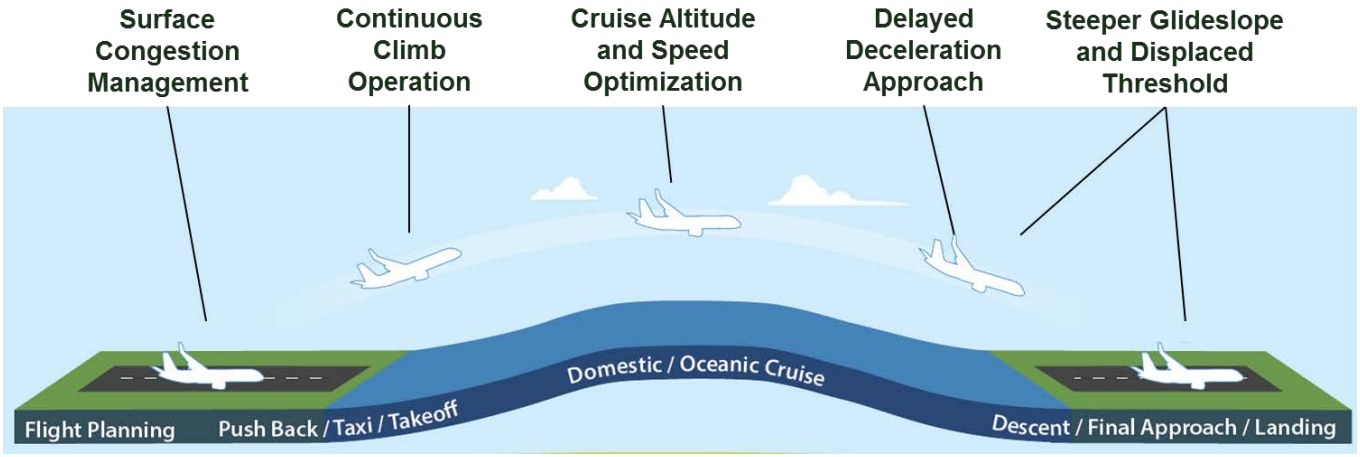
Note: Briefing on AJF Analysis Efforts

FAA Activities

- **Testing activities**
  - ASTM fuel approval testing is ongoing
  - National Jet Fuel Combustion Program continuing its efforts
  - Supporting manufacturers in their reviews of ASTM Intl alternative jet fuel research reports
- **Federal Alternative Jet Fuel Strategy**
  - Unified federal plan to advance R&D as well as science and technology solutions to support deployment of AJF
  - https://www.whitehouse.gov/sites/default/files/federal_alternative_jet_fuels_research_and_development_strategy.pdf
- **CAAFI Biennial General Meeting**
  - CAAFI celebrated its 10th anniversary this year
  - CAAFI BGM at Convention Center on October 25-27

Note: No ops briefing this meeting

Clean, Quiet and Energy Efficient Operational Procedures



Program Goals:

- Identify and accelerate implementation of air traffic management concepts that will reduce aviation environmental impacts and/or improve energy efficiency
- Investigate energy and environmental effects of operational changes
- Transition research for implementation

Key Program Elements:

- Maintain balanced research portfolio targeting all phases of flight and all environmental aspects
- Identify new opportunities to reduce community noise
- Coordinate/collaborate with ATO, ARP, ANG, NASA, etc.

Note: No ops briefing this meeting

External Technical Review – August 3, 2016

Technical review of AEE Operations Research program with 24 attendees from ACI-NA, FAA, MIT, MIT-LL and NASA

Subject	Presenter	Duration
Welcome/Introductions	FAA AEE	15 minutes
Program Overview/Review Objectives	FAA AEE	30 minutes
Assessment of Benefits & Risks Related to Steeper Glideslopes and Displaced Thresholds for Noise Abatement	BAH	60 minutes
Investigation & Support of Integration of Departure Metering Concepts into Surface Capabilities	MIT / MIT-LL	60 minutes
Cruise Altitude and Speed Optimization	MIT	60 minutes
Delayed Deceleration Approaches and Noise Modeling of Advanced Operational Procedures (ASCENT-23)	MIT-LL / MIT	60 minutes
Environmental Collaboration: Application of ELSO for Abating PBN Noise Impacts	FAA AEE / ARP	45 minutes
Recap and feedback on Technical Review process	All	30 minutes

Feedback was positive with several ideas for future direction and how to ensure results are utilized

Note: Briefing provided on Tool Use in CAEP

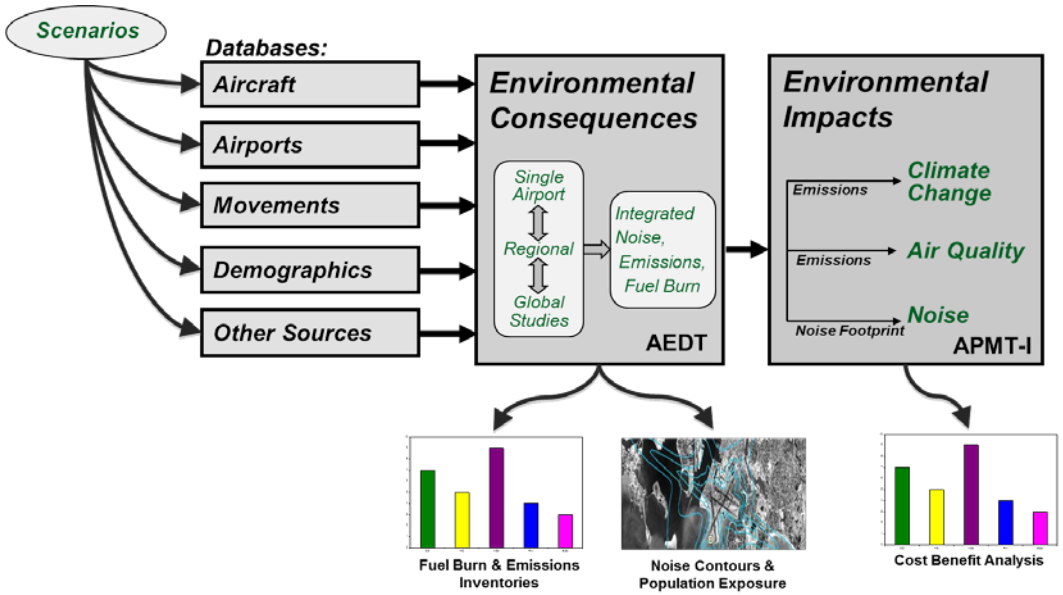
Science and Analysis to Support Decision-Making

- Aviation environmental policies impact noise, climate and air quality. Using the aviation environmental tool suite to assess the impacts of noise and emissions for policy assessment.
- Elements of tool suite inform decision making:

  CAEP/10 CO_2 Standard (2016)

  CAEP/9 Noise Standard (2013)

  CAEP/8 NOx Standard (2010)



- FAA uses cost/benefit analysis elements to supplement cost-effectiveness analysis and better inform decision-making process.
- Tool suite providing analytical support to GMBM development

Additional information on APMT-Impacts and its use is available at:
http://partner.mit.edu/projects/valuation-and-trade-offs-policy-options

Environment & Energy Research

Core RE&D (A13.a) Environment & Energy (AEE)

- Improve scientific understanding of environment & energy constraints
- Incorporate scientific knowledge into an integrated analytical tool suite
- Analyze mitigation options for reducing environmental impacts including policy measures and environmental standards

NextGen RE&D (A13.b) Environmental Research (AEE)

- Mature airframe and engine technologies
- Advance sustainable alternative jet fuels

NextGen F&E (1A08D) Environment Portfolio (AEE)

- Environmental analysis support to NextGen
- FY16 is last year for these funds – zeroed out starting in FY17

AIP Airport Technology Research (ARP – AEE – Tech Center)

- Aircraft Noise Annoyance & Sleep Research
- Airport Environmental Research

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http://www.faa.gov/about/office_org/headquarters_offices/apl/environ_policy_guidance/policy/media/FAA_EE_Policy_Statement.pdf

Airport Environmental Research Overview

- Extending model of airport technology research programs on pavement and airport safety to improve the performance of airports in reducing their environmental impacts while responding to community needs for transportation services

- Following collaborative model used for community noise survey - coordinated effort among Office of Airports, Tech Center, and Office of Environment and Energy

- Initiated with five projects using FY16 funding

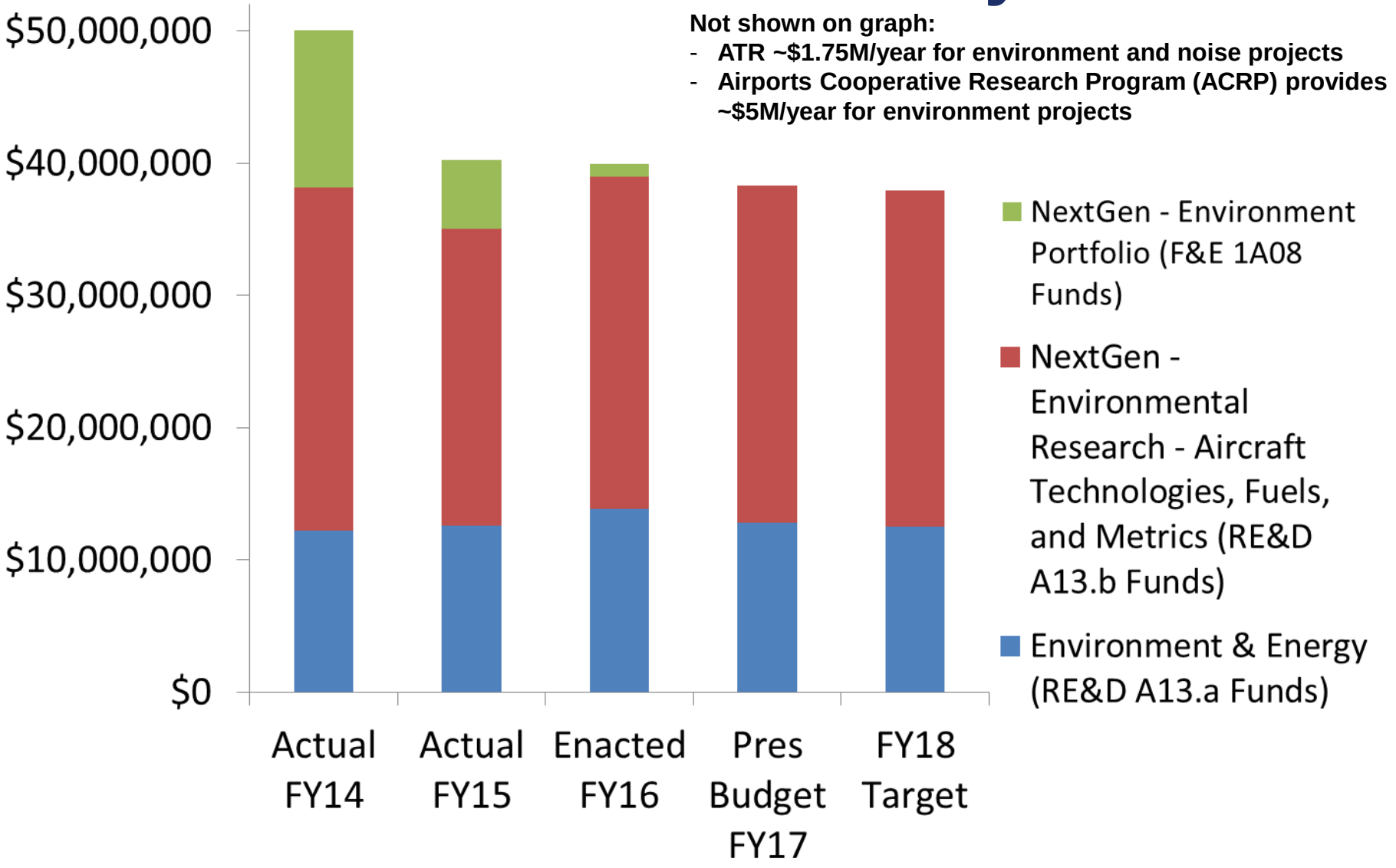
Airport Environmental Research FY16 Projects

1. **Develop air quality screening criteria for airport actions**
   - KB Environmental (via SEMRS Contract)
2. **Noise Dispersion with ELSO PBN departures**
   - MITRE
3. **Evaluating Fixed dB Values used in Determining Noise Level Reduction Requirements [with sound insulation programs] (aka Investigation of ASTM E966 Correction Factors)**
   - CSRA with subcontract to Dr. Ben Sharpe (SME)
4. **Research on Airport Environmental Concerns and Mitigation Measures (aka 10-Year Plan)**
   - BAH/Kimley Horn (via SEMRS Contract)
5. **Review of Airport Guidance for Climate Adaptation and Resiliency**
   - VHB (via SEMRS contract)

Airport Environmental Research FY17 Projects

1. **Noise Abatement Procedure Effectiveness**
   - (estimated funding level $300K)
2. **Steeper Glideslope Feasibility**
   - (estimated funding level $200K)
3. **Sound Insulation**
   - (estimated funding level $200K)
4. **Phase 2 Climate Adaptation and Resiliency**
   - (estimated funding level $300K)
5. ***GIS Applications to Enhance Environmental Resource Assessment***
   - (TBD)

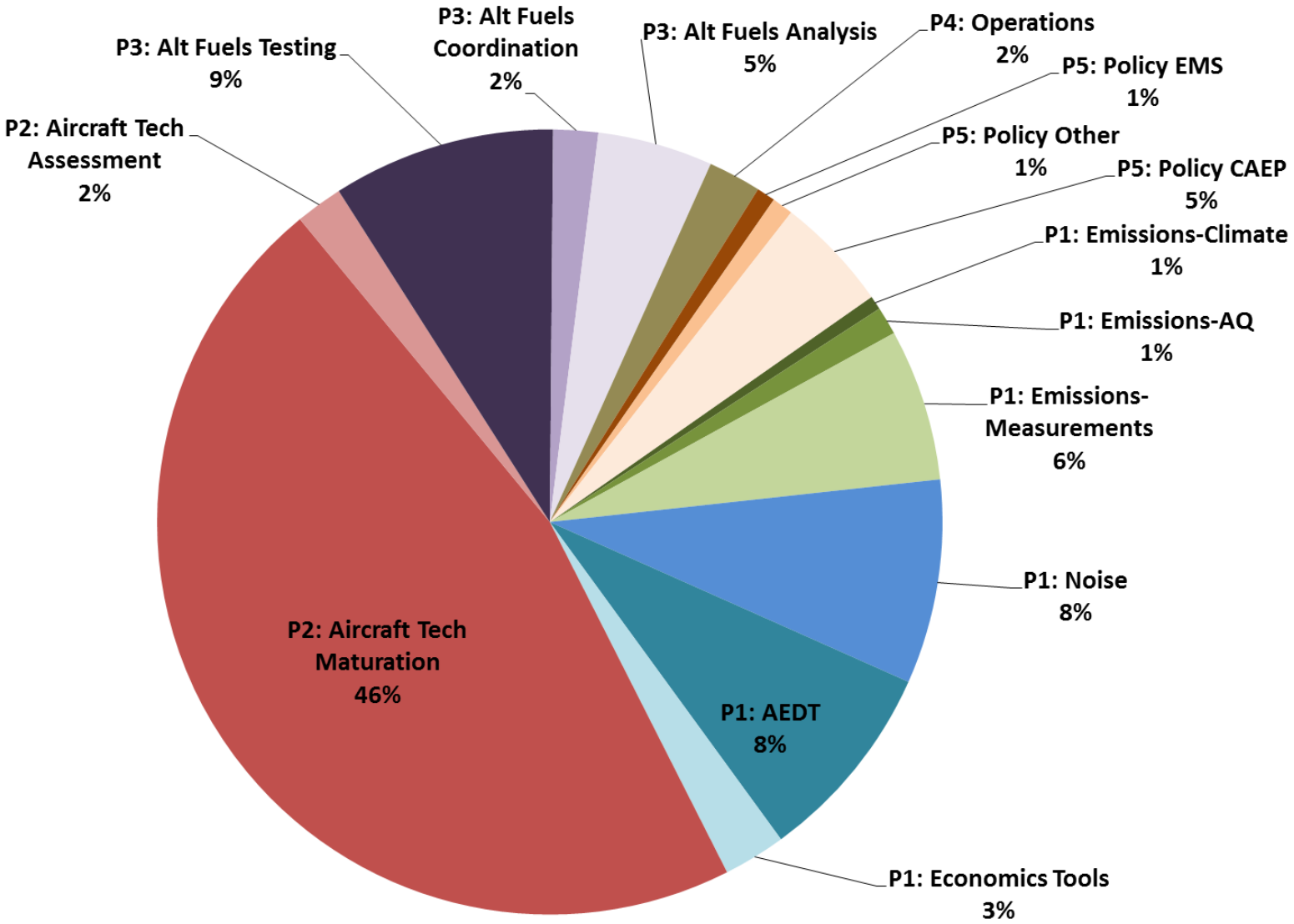
FY14-18 Financial Summary



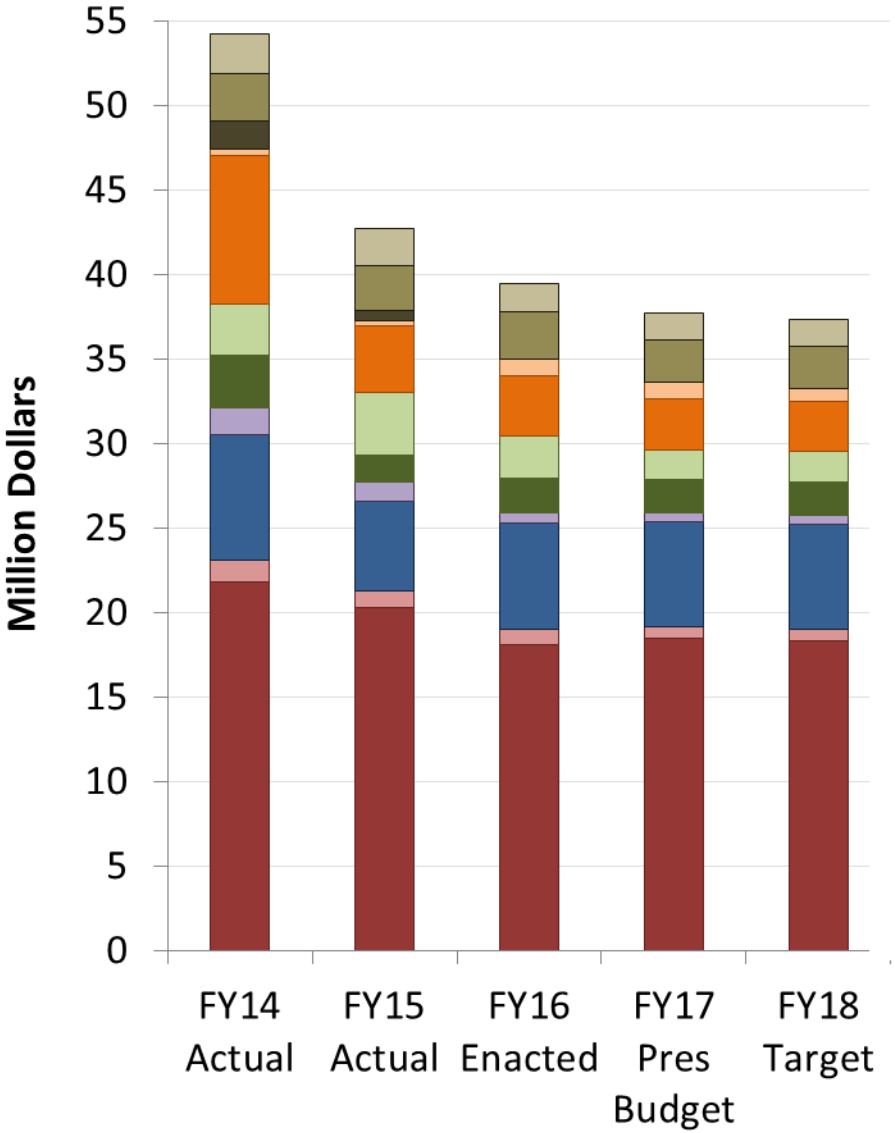
Not shown on graph:

- **ATR ~$1.75M/year for environment and noise projects**
- **Airports Cooperative Research Program (ACRP) provides ~$5M/year for environment projects**

FY16 Budget Allocation by Pillar & Topic



Environment and Energy Program Funding



Office of Airports (ARP) has been providing funding for community noise survey. Starting in FY16 they will be providing additional funds for environment projects too.

Recent Successes

capabilities and solutions that are helping today

- Integrated tool suite and analyses provided the scientific data used to support the decision making for the ICAO CAEP CO_2 standard
- Emissions measurements provided foundation for ICAO CAEP PM standard
- Alternative fuels scenarios were adopted by ICAO CAEP for future trends assessment and years of research being leveraged in the LCA methodology that will be used to include alternative fuels in global market based measure for international aviation
- Federal Alternative Jet Fuel Strategy has been released showing coordinated plan for federal government R&D investments
- ASCENT CLEEN aircraft and engine technologies appearing in next generation of aircraft with FMS technologies retrofitted into today's fleet - reduces noise, emissions and fuel use for many years to come
- Certification of five alternative jet fuel pathways – certification enabled United Airlines to buy and use biofuel at LAX as well as purchases by Gulfstream
- Aviation Environmental Design Tool being used extensively

Questions for Tomorrow:

- Are there R&D areas within the E&E Portfolio that should be lower / higher priority?

- Are there R&D areas that AEE is not examining that should be added to the E&E Portfolio?

- What do you see coming on the horizon regarding E&E that may require future R&D efforts?

Online Materials

FAA Environment and Energy

- http://www.faa.gov/go/environment

Center of Excellence (COE) Program

- University research on alt jet fuels and environment
- http://ascent.aero and http://partner.aero

Continuous Lower Energy, Emissions and Noise (CLEEN)

- Reduce aircraft fuel burn, emissions and noise through technology & advance alternative jet fuels
- http://www.faa.gov/go/cleen

Commercial Aviation Alternative Fuels Initiative (CAAFI)

- Coalition that focuses the efforts of commercial aviation to engage the emerging alternative fuels industry
- http://caafi.org