

# FY 2016 Environment and Energy Program Proposal

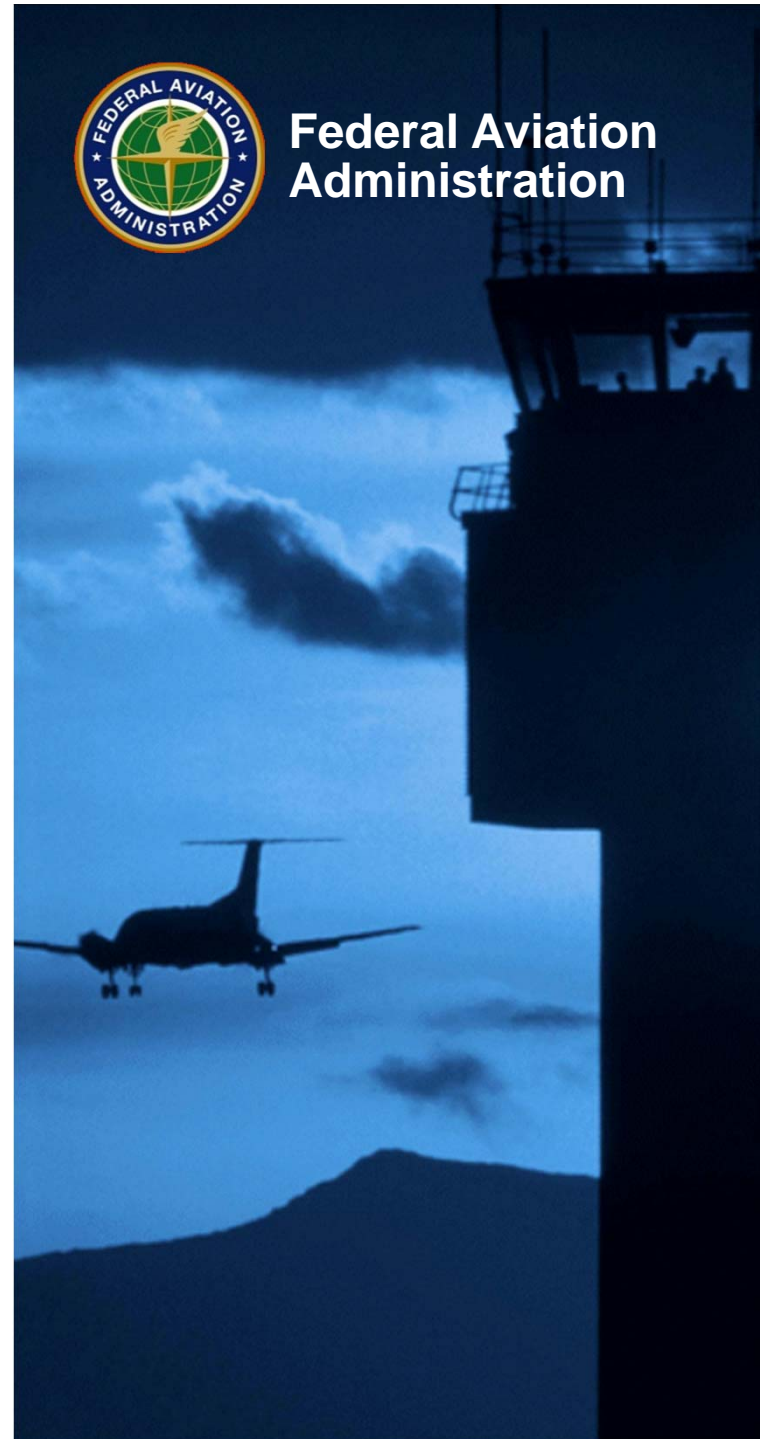
To: REDAC E&E Subcommittee

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Chief Scientific & Technical  
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Date: March 25, 2014



**Federal Aviation  
Administration**



# Presentation Outline

- **Environment and Energy Portfolio Overview**
- **Financial Summary**
  - PPT Financial Summary Table
  - PPT 5-Year Financial Plan Table
- **Quad Charts**
- **Summary**



# Aviation Environmental Challenges



- Aviation impacts community noise, air quality, water quality, energy usage, and climate change
- Environmental impacts from aviation emissions could pose a critical constraint on capacity growth



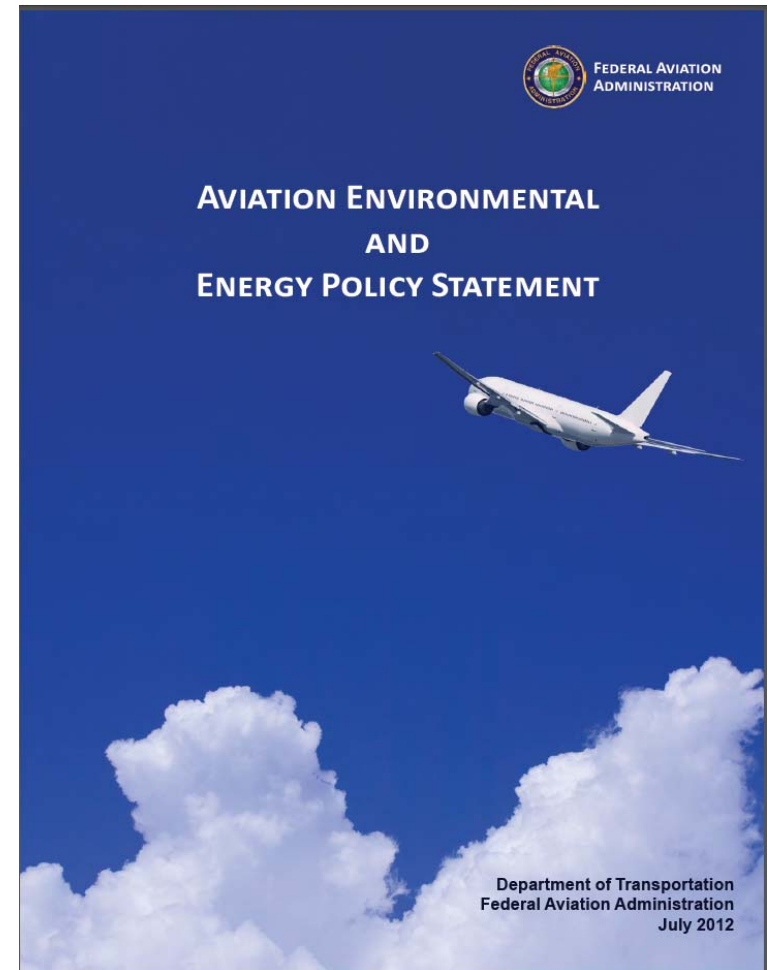
# Vision and Principles

## 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.



# Environment & Energy Goals

Aspect	Goal
<b>Noise</b>	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.
<b>Air Quality</b>	Achieve an absolute reduction of significant air quality health and welfare impacts attributable to aviation, notwithstanding aviation growth.
<b>Energy</b>	Improve National Airspace System (NAS) energy efficiency and develop and deploy alternative jet fuels for commercial aviation.
<b>Climate</b>	Limit the impact of aircraft CO <sub>2</sub> emissions on the global climate by achieving carbon neutral growth by 2020 compared to 2005, and net reductions of the climate impact from all aviation emissions over the longer term (by 2050).



# AEE Research Overview

## **Characterize the Problem and Assess Risk:**

- Improve our scientific understanding of E&E constraints
- Incorporate this scientific knowledge into an integrated tool suite that can characterize the system, assess the risk and inform development of potential mitigation options

## **Develop mitigation solutions:**

- Airframe and engine technologies
- Sustainable alternative jet fuels
- Clean, quiet and energy efficient operational procedures
- Environmental standards and policy measures

## **Manage system performance:**

- Integrated analysis that engages a wide range of stakeholders to understand the current and future state of the aviation system
- Utilize knowledge to provide guidance on system-wide environmental improvements

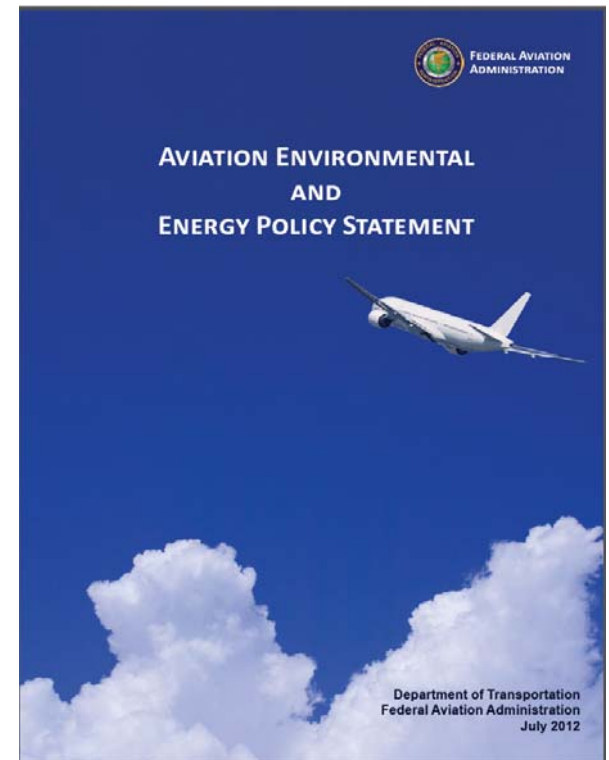


# Environment & Energy Strategy

*Environmental protection that allows sustained aviation growth*

## NextGen Five-Pillar Environmental Approach

- P1: Improved Scientific Knowledge and Integrated Modeling
- P2: New Aircraft Technologies
- P3: Sustainable Alternative Aviation Fuels
- P4: Air Traffic Management Modernization and Operational Improvements
- P5: Policies, Environmental Standards, and Market Based Measures



# Mapping of Environmental Goals and Pillars

<div><div><i>Goals</i></div><div>↓</div></div>	<i>Pillars</i> →		P1		P2	P3	P4	P5
	Scientific Knowledge	Integrated Modeling	Aircraft Technologies	Alt Jet Fuel	ATM Mod & Ops Imprvment	Policy Measures		
<b>NOISE:</b> Reduce significant noise impact	X	X	X		X	X		
<b>AIR QUALITY:</b> Reduce significant air quality impact	X	X	X	X	X	X		
<b>ENERGY:</b> Improve NAS energy efficiency	X	X	X	X	X	X		
<b>ENERGY:</b> Develop sustainable alternative fuels	X	X		X		X		
<b>CLIMATE:</b> Reduce GHG emissions and their impacts	X	X	X	X	X	X		

***E&E Program addresses Environmental Goals through the NextGen Five Pillar Approach.***





# AEE Research Objectives

1. Resolve key E&E questions relating to the environmental impacts of aircraft noise and emissions and provide sound scientific data to inform policy making relating to aviation's energy use and environmental impacts.
2. Develop and implement integrated aviation environmental tool suite that can evaluate environmental impacts of aviation and potential mitigation options.
3. Identify solutions that will reduce environmental impacts and/or improve energy efficiency.
4. Investigate E&E effects of solutions with aviation environmental tool suite.
5. Accelerate solution maturation with our partners in government, industry and academia.
6. Analyze environmental and economic impacts, trade-offs and cost-benefit assessments of both domestic and international policy options and scenarios.
7. Evaluate progress toward E&E goals and develop research roadmaps that resolve identified gaps with solutions.

**Mitigation Concepts:**

- Aircraft Technology
- Alternative Jet Fuels
- ATM Modernization / Ops Improvements



# Research Programs



## Center of Excellence (COE) Program



- Focused on university research
- All PARTNER projects coming to an end in 2014



## Continuous Lower Energy, Emissions and Noise (CLEEN)

- CLEEN I: 2010-2015
- CLEEN II: 2015-2020
- Reduce aircraft fuel burn, emissions and noise through technology & advance alternative jet fuels



## Additional Research Efforts

- Volpe Transportation Center
- Contract mechanisms (e.g., SEMRS, PEARS)



# PARTNER COE support of AEE Research

## 48 PARTNER Projects:

- Noise
- Emissions measurements
- Climate and air quality analysis and modeling
- Aircraft and engine technology assessment
- Operational procedures
- Alternative jet fuels
- Policy analysis

## Financial Support:

- Sponsors: FAA, TC, USAF, DLA-E, EPA, and NASA
- \$62.8M from sponsors
- \$46.0M cost share\*
- Cost share requirement led to significant collaboration among PARTNER schools, industry and international research programs

\* Through June 2013, a total non-federal cost share of \$46.0M has been contributed to PARTNER



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# Aviation Sustainability Center (ASCENT) Overview

- Partnership among universities, commercial firms, and government laboratories to conduct research and education
- Expands environment and energy research carried out by PARTNER to address alternative jet fuel research request in 2012 FAA Modernization and Reform Act
- COE brings together expertise of PARTNER COE with USDA AFRI Regional Bioenergy Coordinated Agriculture Projects (CAPS) and SunGrant Initiative
- Award announcement: September 13, 2013
- Duration: five years; renewable once (ten year total)
- Funding: at least \$4 million annually from FAA plus 100% cost share requirement
- Sponsor engagement: U.S. government agencies (FAA, USDA, DoE, DoD, EPA, NASA) and Transport Canada



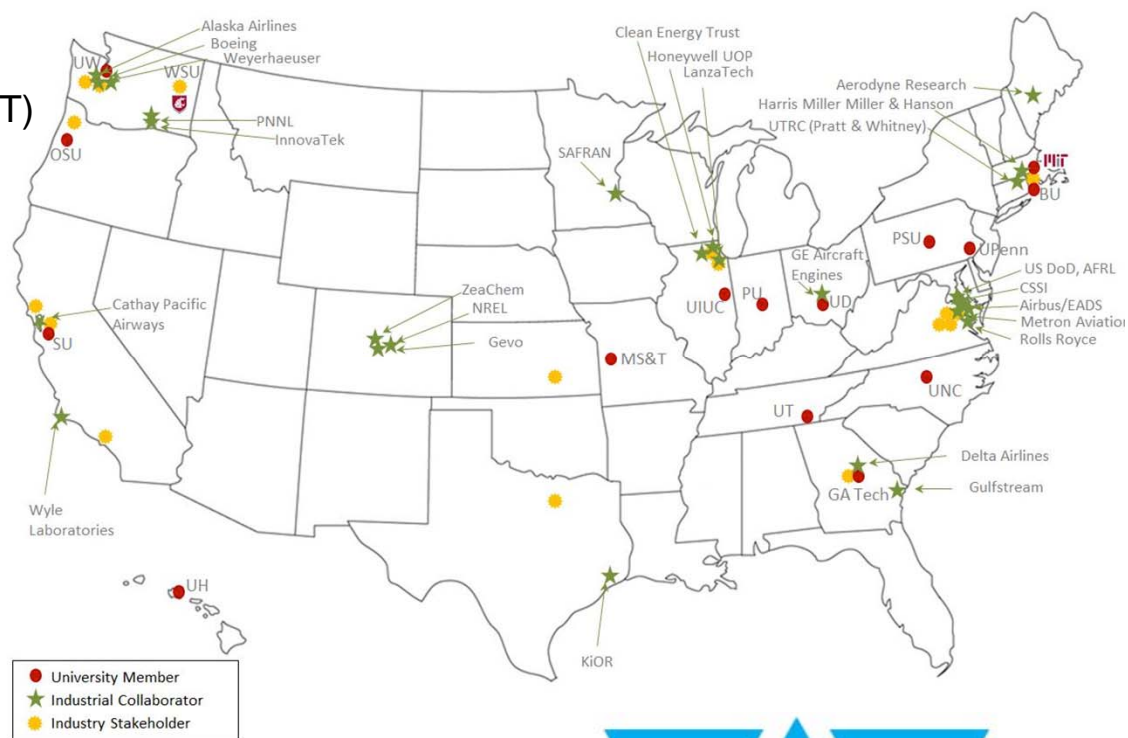
# FAA CENTER OF EXCELLENCE FOR ALTERNATIVE JET FUELS & ENVIRONMENT

## Lead Universities:

- Washington State University (WSU)\*
- Massachusetts Institute of Technology (MIT)

## Core Universities:

- Boston University (BU)
- Georgia Institute of Technology (Ga Tech)
- Missouri University of Science and Technology (MS&T)
- Oregon State University (OSU)\*
- Pennsylvania State University (PSU)\*
- Purdue University (PU)\*
- Stanford University (SU)
- University of Dayton (UD)
- University of Hawaii (UH)\*
- University of Illinois at Urbana-Champaign (UIUC)\*
- University of North Carolina at Chapel Hill (UNC)
- University of Pennsylvania (UPenn)
- University of Tennessee (UT)\*
- University of Washington (UW)\*



\* Denotes USDA NIFA AFRI-CAP Leads and Participants & Sun Grant Schools

ASCENT Website: <http://ascent.aero>



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# Roadmaps: Tracking Research Needs

## Roadmap and Plan Update

- Modify roadmaps and plans to resolve gaps with identified solutions

## Roadmap and Plan Development

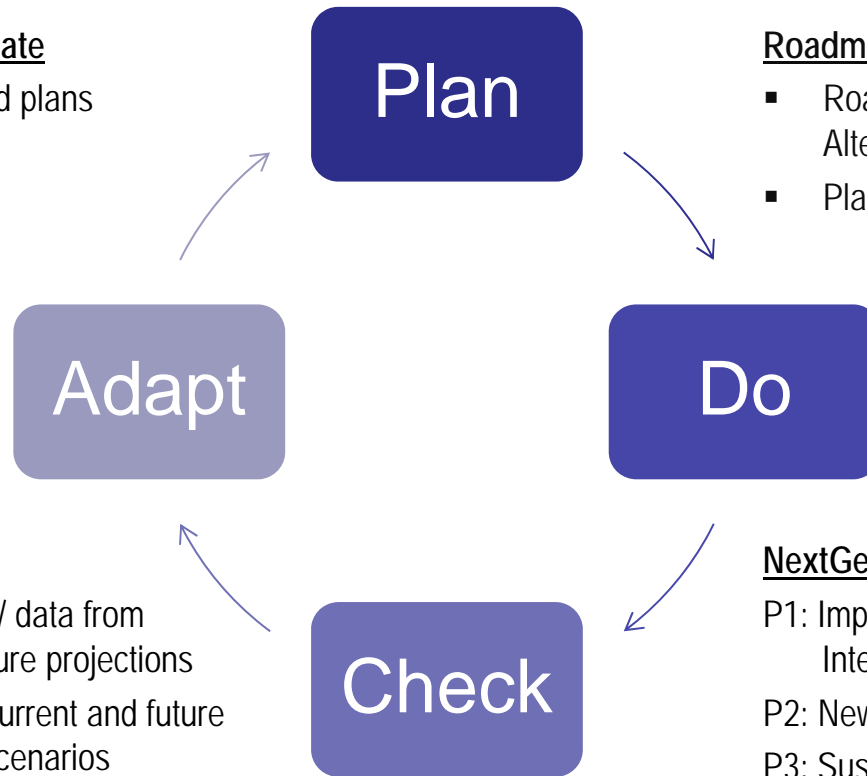
- Roadmaps: Noise, Emissions, Operations, Alternative Fuels, Tools/Analysis and CLEEN
- Plans: US Climate Action Plan

## Evaluation

- Compile information / data from stakeholders and future projections
- Evaluate system in current and future years under varied scenarios
- Compare results against E&E Goals
- Identify gaps and potential solutions

## NextGen 5 Pillar Approach

- P1: Improved Scientific Knowledge and Integrated Modeling
- P2: New Aircraft Technologies
- P3: Sustainable Alternative Aviation Fuels
- P4: Air Traffic Management Modernization
- P5: Policies, Environmental Standards, and Market Based Measures



## Process for going from a research need to proposal submission\*

This approach is meant to provide equal opportunity to all COE universities in planning and being a part of a project team

1. AEE will create a solicitation that identifies a research project with a title, short description, an estimate of available funds, period of performance, project manager(s) (or PM), and a deadline for the Notice of Intent (NOI) to be received by the PM.
2. Division Manager (DM) will update AEE ASCENT project tracking spreadsheet with solicitation information (including number).
3. PM will communicate the solicitation to COE Co-Directors with cc provided to DM and AEE-3.
4. The COE Co-Directors will communicate the solicitation with all COE universities, sponsors, and Advisory Committee members. The COE Co-Directors will ask the COE universities to develop a NOI to submit a full proposal to meet the objectives identified in the solicitation. Sponsors and Advisory Committee members are welcome to provide comments on the solicitation to the ASCENT Community (AEE, other sponsors, universities, and/or Advisory Committee members) as they see fit.
5. One or more PIs may take a lead, form teams of researchers from COE universities (may invite non-COE researchers as appropriate) and develop a draft proposal that will serve as a NOI to submit a full proposal. The draft proposal should include the team members (university and non-university collaborators), approach description (not to exceed two pages), expected deliverables, timeline and preliminary project cost. These must be submitted to the COE Co-Directors by the deadline from the first step (send email to both cavalieri@wsu.edu and rjhans@mit.edu).
6. The COE Co-Directors will review draft NOI and then submit to the PM without any filtration.
7. PM will review the draft proposal(s) and communicate internally with Division Manager and AEE-3 (and others, as needed) and down-select (if more than 1 draft proposals were submitted) to final team(s).
8. PM will work with lead PI to develop a full proposal following ASCENT template. Multiple projects may also be funded on same topic.
9. PI will submit the final full proposal via Grants.gov and AEE will approve the proposal for funding.
10. PM and project team will convene regular telecons, discuss progress and interim results prior to any presentation/publication.

\* Process applies to AEE funds and is subject to revision.



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# ASCENT Notice of Intent Requests

Listed in anticipated order of when request will be issued

Research Area	NOI Requests	Status	Solicitation Areas
Alt Jet Fuel Supply Chain Analysis	1	Closed	1,2
Emissions Measurements and Analysis	3	1 Closed, 2 more forthcoming	7, 10
Noise	7	Open	6, 10
Aircraft Technology Assessment	3	2 Open, 1 more forthcoming	8, 10
Analysis to support Environmental Standard Setting	1+	Forthcoming	10
Air Quality and Climate Modeling	5+	Forthcoming	7, 10
Operational Procedures	2	Forthcoming	9, 10
Alt Jet Fuel Testing	2+	Forthcoming	4-5
Alt Jet Fuel Environmental and Economic Sustainability Analysis	1+	Forthcoming	1-3





# Continuous Lower Energy, Emissions and Noise (CLEEN) Phase II



- **FAA R&D Program:**
  - Reduce aircraft fuel burn, emissions and noise through technology & advance alternative jet fuels
  - Public private partnership with 1:1 minimum cost share requirement
- **CLEEN I: 2010-2015 (\$125M FAA Funding)**
  - Boeing, GE, Honeywell, Rolls Royce, and Pratt & Whitney
  - Developing technologies for new aircraft and retrofits to today's fleet
  - Advancing alternative jet fuel use through certification testing
- **CLEEN II: 2015-2020 (\$100M FAA Funding)**
  - Following model of first phase of CLEEN program
  - Solicitation expected in mid-2014
  - Had planned for \$15M per year of NextGen RE&D and \$5M per year of NextGen F&E funding = \$20M per year total funds

## Research & Methods

```
graph TD; A([Aircraft Noise & Impacts]) --> B([Local to NAS-wide environmental assessment capability]); C([Engine Emissions & Impacts]) --> B; B --> D([Standards and Policies]); B --> E([Green Aircraft and Engine Technologies]); B --> F([Energy and Environmentally Efficient ATM and Operational Procedures]); D --> G([Integrated Environmental Strategy for NextGen]); E --> G; F --> G; E --- H([Alternative Jet Fuels]); F --- I([NextGen Environmental Analysis]);
```

The diagram illustrates the integrated environmental strategy for NextGen, showing the flow from assessment capability to research and finally to the integrated strategy.

**Local to NAS-wide environmental assessment capability** is the central hub, receiving input from **Aircraft Noise & Impacts** and **Engine Emissions & Impacts**.

This hub leads to **Standards and Policies**, which then branches into two main research areas:

- Green Aircraft and Engine Technologies** (including **Alternative Jet Fuels**)
- Energy and Environmentally Efficient ATM and Operational Procedures** (including **NextGen Environmental Analysis**)

Both research areas feed into the final outcome, **Integrated Environmental Strategy for NextGen**.

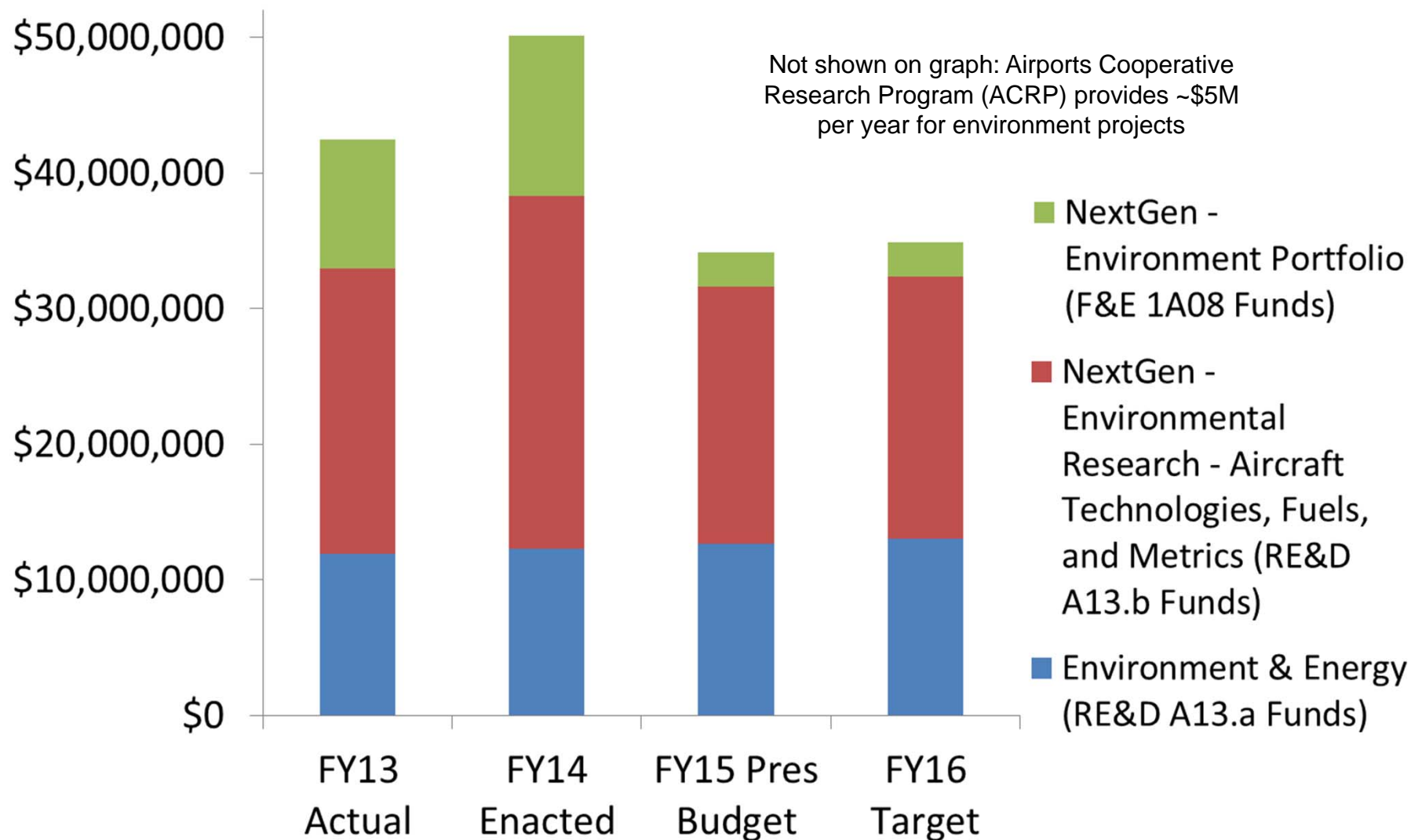


# FY14-16 Financial Summary

	FY 14 Enacted		FY 15 Request		FY 16 Target	
<i>Program Title</i>	<i>In-House</i>	<i>Contracts</i>	<i>In-House</i>	<i>Contracts</i>	<i>In-House</i>	<i>Contracts</i>
<b>Base Program (Funding Appropriation)</b>						
A13.a. Environment and Energy (R,E&D)	2,277,480	12,322,520	2,260,000	12,661,000	1,883,531	13,002,264
<b>NextGen Program (Funding Appropriation)</b>						
A13.b. NextGen Environmental Research – Aircraft Technologies, Fuels and Metrics (R,E&D)	960,000	26,019,000	535,000	18,979,000	421,276	19,386,762
Above Target Request (CLEEN and Alternative Jet Fuels)						5,000,000
1A08D (F&E) NextGen Environment Portfolio		11,841,814		2,500,000		2,500,000
<b>NextGen Subtotal</b>	<b>3,237,480</b>	<b>37,860,814</b>	<b>535,000</b>	<b>21,479,000</b>	<b>421,276</b>	<b>21,886,762</b>
With Above Target Request						26,886,762
<b>PPT Total</b>	<b>3,237,480</b>	<b>50,183,334</b>	<b>2,795,000</b>	<b>34,140,000</b>	<b>2,304,807</b>	<b>34,889,026</b>
With Above Target Request						39,889,026



# FY13-16 Financial Summary



# FY16-20 5-Year Financial Plan

Program	Out-Year Contract Dollars				
	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Base Program (Funding Appropriation)					
A13.a. Environment & Energy	13,002,264	13,429,798	13,738,858	14,165,323	14,591,496
NextGen Program (Funding Appropriation)					
A13.b. NextGen Environment & Energy-Aircraft Technologies, Fuels and Metrics (R,E&D)	19,386,762	19,889,469	20,263,667	20,765,836	21,267,797
Above Target Request (CLEEN and Alternative Jet Fuels)	5,000,000	10,000,000	5,000,000		
1A08D (F&E) NextGen Environment Portfolio	2,500,000	2,500,000	2,500,000	2,500,000	2,500,000
NextGen Subtotal	21,886,762	22,389,469	22,763,667	23,265,836	23,767,797
With Above Target Request	26,886,762	32,389,469	27,763,667		
PPT Total	34,889,026	35,819,267	36,502,525	37,431,159	38,359,293
With Above Target Request	39,889,026	45,819,267	41,502,525		



# Core RE&D Program (A13.a) - Environment & Energy

## FAA Strategic Plan

- Deliver Benefits Through Technology and Infrastructure
- Enhance global leadership

## Need

- Characterize environmental and energy challenges
- Develop and implement mitigation solutions
- Enhance international leadership on environment and energy matters

## FY 2016 Milestones

- Advance the understanding of noise impacts on social welfare and health
- Refine methods and tools to estimate impacts of aviation emissions on air quality in the vicinity of the airport.
- Develop new standards and methodologies to quantify and assess the impact of aircraft noise and aviation emissions
- Analyze mitigation options for reducing environmental impacts including policy measures and standards being developed at ICAO CAEP

## Research Goals

- Advance scientific understanding of aviation noise and emissions and their environmental, health and welfare impacts to inform decision-making and enable solution development
- Develop engine exhaust emissions and noise measurement protocols and expand database for aircraft engine emissions and noise certification
- Develop, implement, and use integrated aviation environmental tool suite to evaluate energy and environmental impacts of aviation and potential mitigation options
- Analyze environmental and economic impacts, trade-offs and cost-benefit assessment of both domestic and international policy options and scenarios

## Out Year Funding Requirements

	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
<b>Funding Target (\$000)</b>	<b>13,002</b>	<b>13,430</b>	<b>13,739</b>	<b>14,165</b>	<b>14,591</b>



# NextGen RE&D Program (A13.b) - Environmental Research - Aircraft Technologies, Fuels, and Metrics

## FAA Strategic Plan

- Deliver Benefits Through Technology and Infrastructure
- Enhance global leadership

## Need

- Characterize environmental and energy challenges
- Develop and implement mitigation solutions
- Enhance international leadership on environment and energy matters

## FY 2016 Milestones

- Demonstrate CLEEN Ultra High Bypass Ratio Gear Turbo Fan Technology.
- Demonstrate CLEEN FMS technologies to reduce fuel burn and noise.
- Demonstrate and assess CLEEN II technologies that can reduce noise, emissions, and energy use.
- Assess the environmental and economic sustainability of renewable alternative turbine engine fuels.
- Evaluate novel alternative jet fuels to ensure their compatibility with existing aircraft and fueling infrastructure.
- Refine estimates of aircraft contribution to climate change

## Research Goals

- Via the CLEEN Program, demonstrate certifiable aircraft and engine technology that reduces noise levels, landing and takeoff cycle (LTO) nitrogen oxide emissions, and fuel burn.
- Overcome barriers to the development and deployment of sustainable “drop-in” alternative jet fuels.
- Improve the quantification of aviation environmental impacts to enable solution development.

## Out Year Funding Requirements

	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
<b>Funding Target (\$000)</b>	<b>19,387</b>	<b>19,889</b>	<b>20,264</b>	<b>20,766</b>	<b>21,268</b>
<b>Above Target Request</b>	<b>5,000</b>	<b>10,000</b>	<b>5,000</b>		

**In Spring 2013, the REDAC E&E Subcommittee “strongly endorsed the AEE above-target funding request for the continuation of the CLEEN/alternative fuels programs at the highest possible level.” A similar recommendation was made in 2012. This above target request would accelerate the maturation of aircraft technologies and alternative jet fuels that would help to mitigate aviation’s impact on the environment.**



# NextGen F&E (1A08D) - Environment Portfolio

## FAA Strategic Plan

- Deliver Benefits Through Technology and Infrastructure
- Enhance global leadership

## Need

- Characterize environmental and energy challenges
- Develop and implement mitigation solutions
- Enhance international leadership on environment and energy matters

## FY 2016 Milestones

- Evaluate progress towards meeting NextGen environmental goals with identification of performance gaps and mitigation solution needs.
- Enhance Aviation Environmental Design Tool (AEDT) capabilities.
- Further integrate NextGen simulation models and data with aviation environmental tools.

## Research Goals

- Utilize the NextGen EMS framework to evaluate progress towards aviation environmental and energy goals and to aid in developing new mitigation options.
- Develop environmental assessment capabilities that are integrated with NAS design tools, simulation models and performance monitoring systems.
- Develop surface, departure, en route, and arrival operational procedures and ATM-related technologies that could reduce noise, emissions, and fuel burn.

## Out Year Funding Requirements

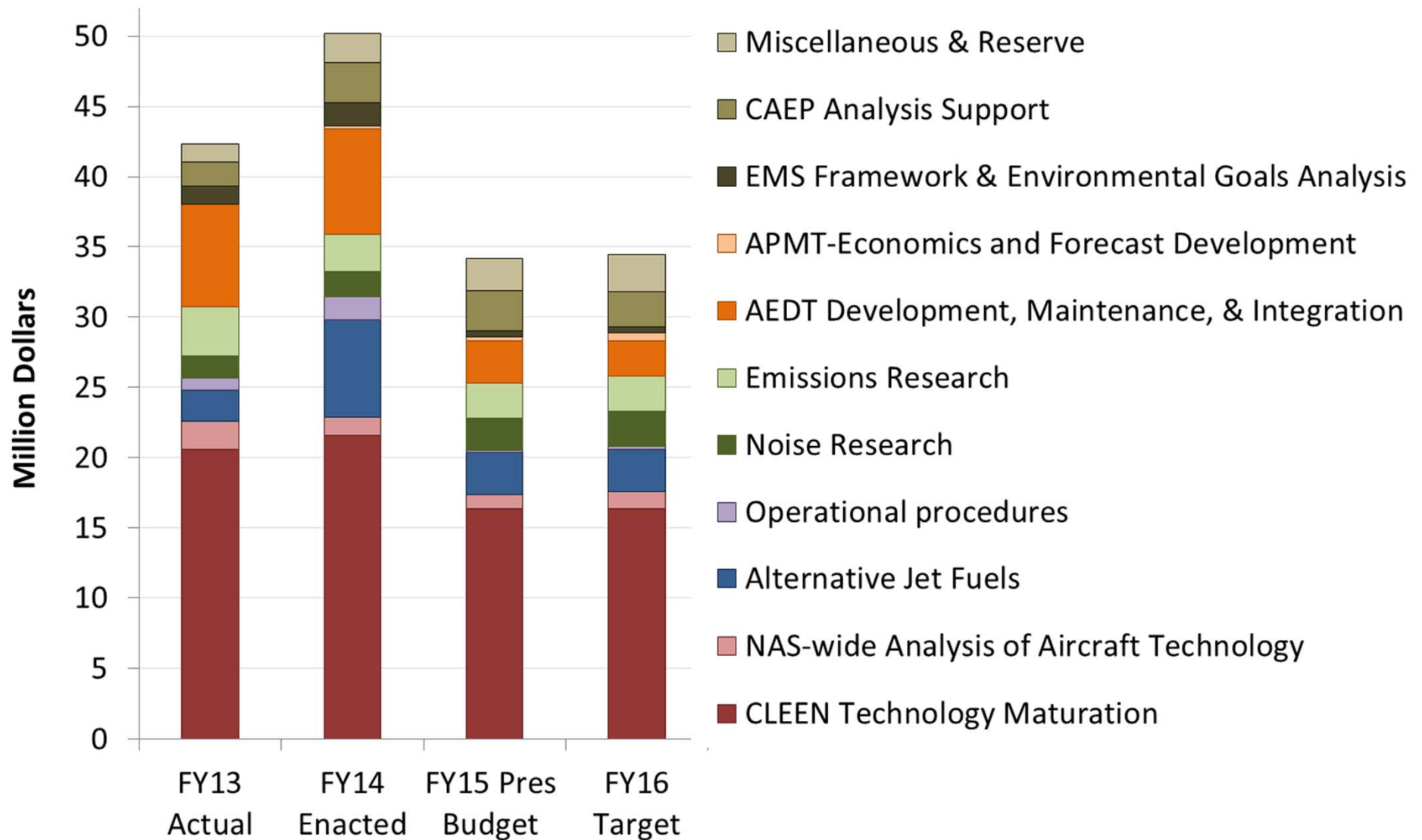
	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
Funding Target (\$000)	2,500	2,500	2,500	2,500	2,500
CIP Request (\$000)	9,900	8,700	8,300	8,000	-
Shortfall (\$000)	-7,400	-6,200	-5,800	-5,500	-

The drastic reduction in requested F&E funds will limit the number of technological options available to address environmental constraints facing aviation





# Environment and Energy Program Funding



# Summary

- Noise, emissions and the need for a sustainable and secure energy supply remain critical issues facing the growth of aviation
- Have had success in developing capabilities and solutions that are helping today
  - 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
  - Certification of two alternative jet fuel pathways – certification enabled United Airlines to sign agreement to buy and use biofuel at LAX
  - Collaborative surface control – successfully tested at Boston Logan airport and will be tested at New York LaGuardia airport – potential integration with surface portfolio
  - Aviation Environmental Design Tool being used for OAPM assessments – new integrated regulatory and compliance tool for noise and emissions will reduce costs
  - Integrated tool suite and analyses are supporting international environmental standard setting for noise and emissions
- Standing up new programs (ASCENT, SEMRS, and CLEEN II)
- **Reduced funding limits our ability to develop solutions that could prevent environment from being a constraint on aviation growth – above target request would help to overcome this**

