FY 2020 Environment and Energy Program Proposal

To: REDAC E&E Subcommittee

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Office of Environment and Energy

Date: March 7, 2018

Presentation Outline

- E&E Portfolio – Background and Overview
- Update on Outreach Material Development
- ASCENT COE Update
- E&E Portfolio within the new NARP
- Budget Profile for E&E Portfolio
- Quad Charts for A13.a and A13.b
- Summary

Economic Benefits of Aviation

5.1% of U.S. GDP

10.6 Million
U.S. jobs

$1.6 Trillion
in U.S. economic activity annually

$59.9 Billion
of U.S. Trade Balance (exports-imports)

SOURCE: FAA Air Traffic Organization

Aviation equipment (aircraft, spacecraft, and related equipment) is largest export sector in U.S. economy accounting for over 8% of total exports.

SOURCE: U.S. International Trade Commission

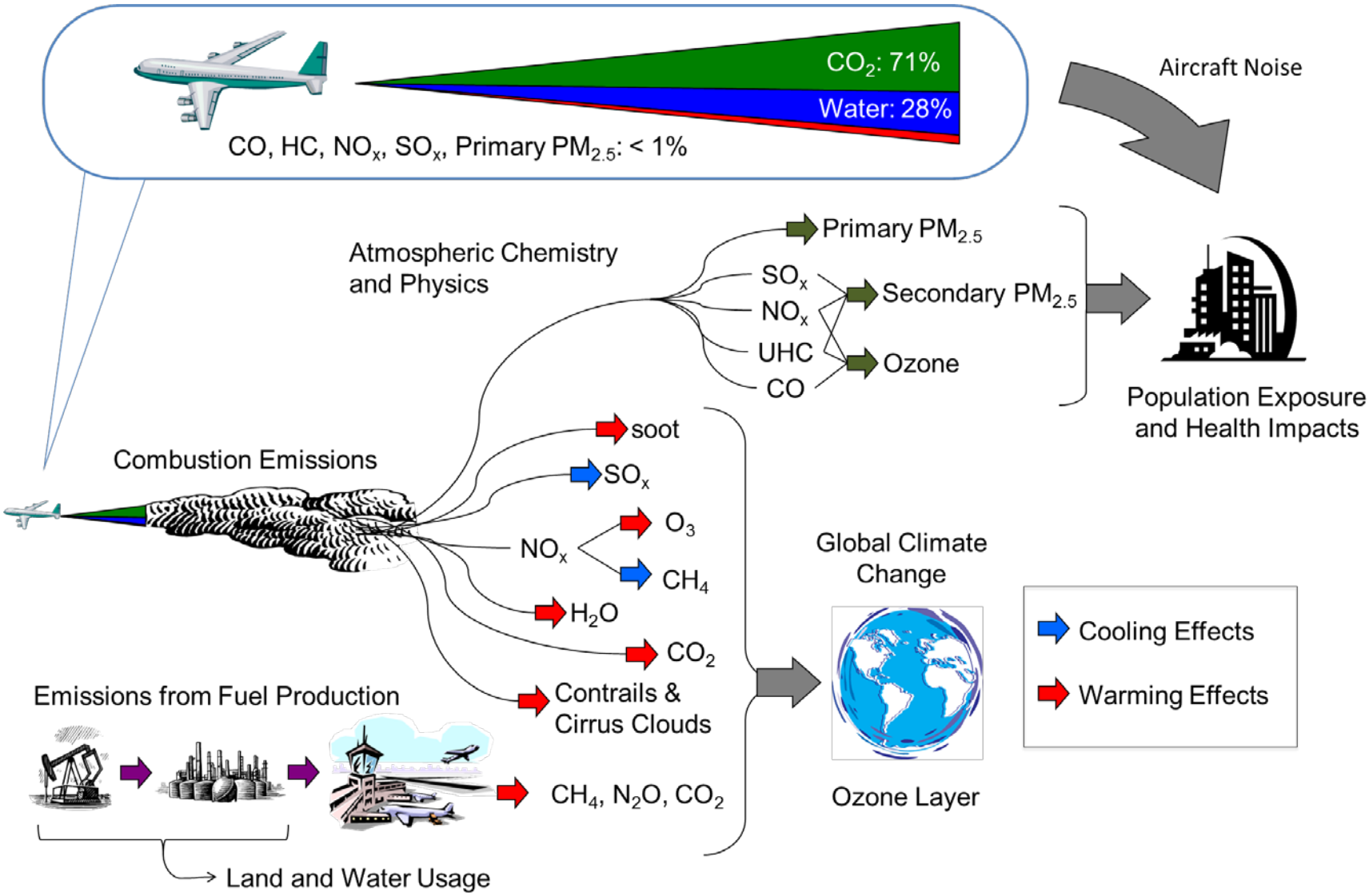
Benefits to Regional and Local Economies

- Aviation is a critical link for people, goods and services coming in and out of communities
- Access to aviation can be a vital reason that some companies use when choosing to locate offices, manufacturing and/or distribution facilities; and
- Passenger and cargo service can be crucial for community access and time-critical delivery services ranging from mail and packages to pharmaceuticals, biotech devices and computer components.

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

Environmental Impacts of Aviation



Environmental Protection that Allows Sustained Aviation Growth

ENVIRONMENT AND ENERGY GOALS

NOISE

Reduce the number of people exposed to significant noise around U.S. airports

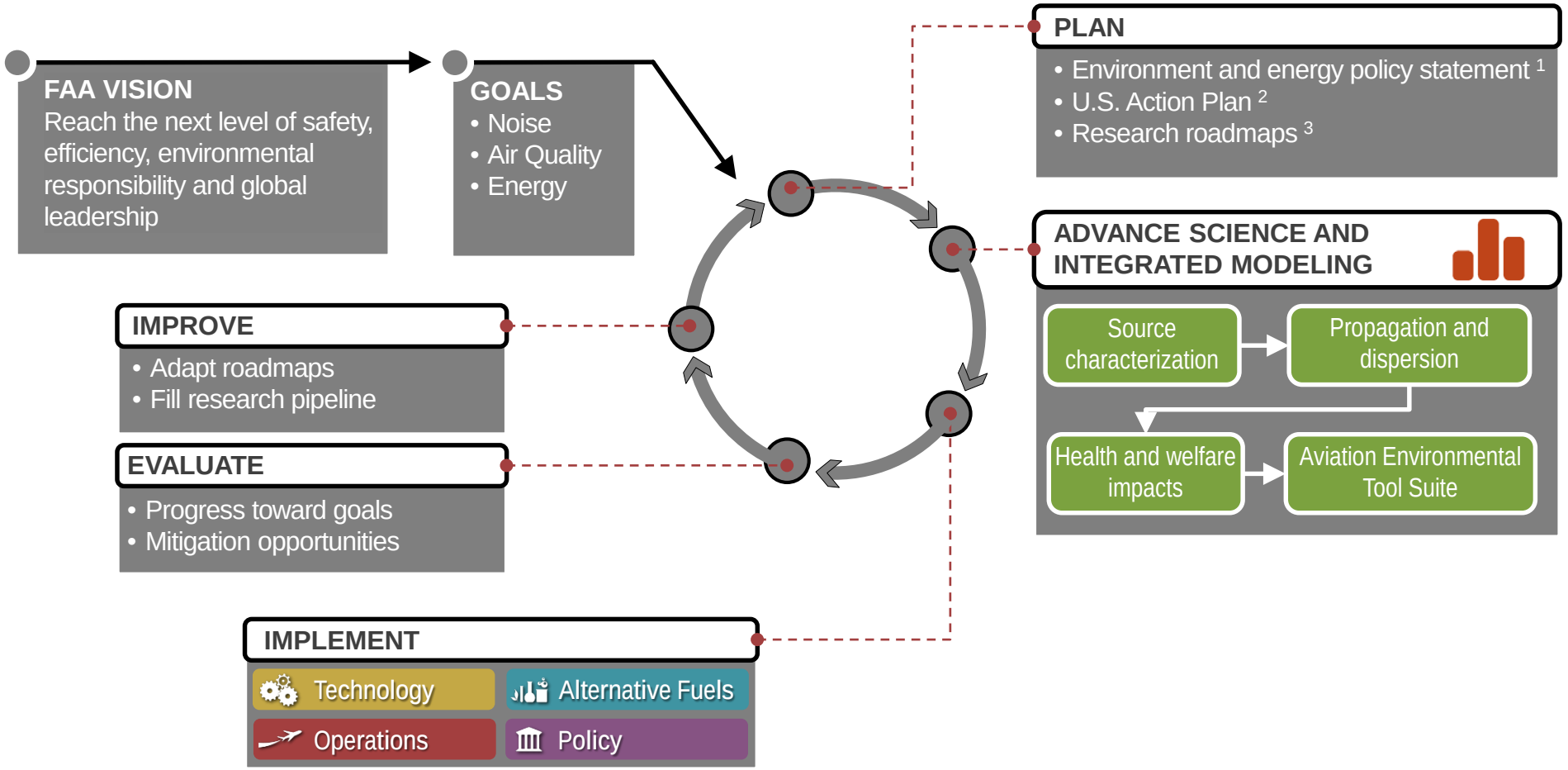
AIR QUALITY

Reduce significant air quality impacts attributable to aviation

ENERGY

Achieve net fuel burn reduction by 2020 relative to a 2005 baseline and deploy sustainable aviation fuels.

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/environmentalprotection/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

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

Addressing the Aircraft Noise Challenge

- **Understanding Impact of Noise**
  - Improving modeling capabilities
  - Examining relationship between noise and annoyance, sleep, cardiovascular health and children's learning.
  - Evaluating current aircraft, helicopters, emerging civil supersonic aircraft and commercial space vehicles, and drones.
- **Outreach**
  - Increase public understanding
  - Community engagement
- **Mitigation**
  - Land use planning and related measures
  - Vehicle operations
  - Airframe and engine technology
  - Aircraft architecture

Addressing Aircraft Emissions

- **Understanding Impacts**
  - Particulate Matter (PM) measurements and modeling
  - Improving air quality and climate modeling capabilities
  - Evaluating current aircraft, commercial supersonic aircraft, unmanned aerial systems, and commercial space vehicles
- **Mitigation**
  - Vehicle operations
  - Alternative fuels
  - Airframe and engine technology
  - Aircraft architecture
  - Engine standard (CAEP PM standard)
  - Policy measures (CORSIA)

Highlights on Ongoing Efforts in E&E Portfolio

- Considerable emphasis on noise:
  - Research on noise impacts is going well
  - Utilizing FAA-Massport MOU to explore low noise operational procedures in collaboration with ATO
  - Work on helicopter noise is making good progress
  - Examining UAS noise - certification and evaluation tool
- Growing efforts on supersonic aircraft
- Particulate Matter efforts in CAEP continue
- Executing long term vision for AEDT
- Alternative jet fuels: CAAFI, ASTM, and CAEP
- Technology maturation in CLEEN continues and we are setting stage for 3rd Phase of CLEEN
- Considering commercial space noise and emissions

Forward Outlook for E&E Portfolio

- FY18 Budget
  - Operating under a Continuing Resolution
  - Differences in FY18 funding between President Budget and the levels from the House and Senate Appropriation Reports
- FY19 Budget
  - President Budget has a step change reduction in funding levels
  - Developing appropriate plans to accommodate this change

- Due to budget uncertainty:
  - Working with two funding levels that bound likely funding levels
  - Requiring considerable additional time
  - Staffing could be a challenge

Outreach Materials

In the process of updating/developing the following:

- Environment and Energy Tri-Fold
- ASCENT Website & Handout
- Noise Website
- CLEEN Fact Sheet and Website
- CAAFI Website
- NextGen Environment and Energy Website
- FAA Environment and Energy Website

Noise Technology Workshops

- FAA working with Institute of Noise Control Engineering, National Academy of Engineering, NASA and Volpe Center

- May 8-9, 2017 Workshop (Hosted by National Academies)
  Technology for a Quieter America: Commercial Aviation, A New Era
- Final report: https://inceusa.org/publications/technology-for-a-quieter-america/
- Workshop / report themes:
  - Importance of commercial aviation to U.S. economy.
  - What it will take for U.S. to maintain global leadership in aviation.
  - Specific, forward-looking topic on more environmentally friendly aircraft designs.
- Workshop / report focus:
  - Required step-changes in aircraft engineering technology will need flight demonstrations, significantly increased funding, and public-private partnerships.
  - Changes are needed for continued U.S. global leadership and positive trade balance.
  - Aviation technology investments in Europe and China now significantly exceed those in U.S.

- Dec 13-14, 2018 Workshop (Hosted by National Academies)
  UAS and UAV (Drone): Noise Emissions and Noise Control Engineering Technology

Research Programs

ASCENT Center of Excellence (COE)

- COE for Alternative Jet Fuel and Environment
- Cost share research with universities

Continuous Lower Energy, Emissions and Noise (CLEEN)

- Reduce aircraft fuel burn, emissions and noise through technology & advance alternative jet fuels
- Cost share partnership with industry

Additional Efforts

- Commercial Aviation Alternative Fuels Initiative (CAAFI)
- Contract mechanisms (e.g., SEMRS, PEARS, PEARS-II)
- Volpe Transportation Center

ASCENT Center of Excellence (COE)

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)*

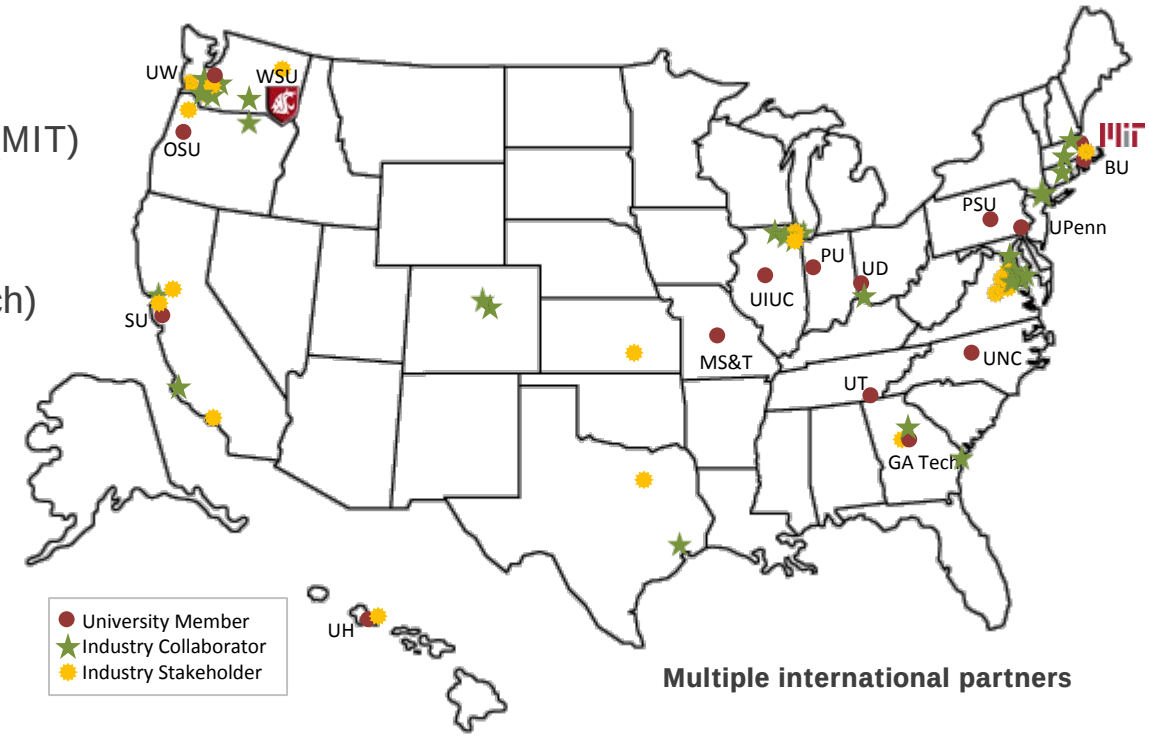
University of Illinois at Urbana-Champaign (UIUC)*

University of North Carolina at Chapel Hill (UNC)

University of Pennsylvania (UPenn)

University of Tennessee (UT)*

University of Washington (UW)*



Advisory Committee - 58 organizations:

5 airports
4 airlines
7 NGO/advocacy
9 aviation manufacturers
11 feedstock/fuel manufacturers
22 R&D, service to aviation sector

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

For more information:
https://ascent.aero/

ASCENT COE Update (1 of 2)

- **Three New Research Projects (NFOs in read-ahead materials)**

  2018-A: Validation of Aircraft Noise Abatement Procedure Modeling

  2018-B: Noise Estimation Tool for New Entrants

  2018-C: Clean Sheet Supersonic Engine Design and Performance

- **Annual Tech Report**
  - Available from https://ascent.aero/resources/
  - Report #3 being reviewed by COE Management

	Report 1	Report 2
Time period	9/2013 – 9/2015	10/2015 – 9/2016
	50	54
Publications, Reports, and Presentations	137	119
Industry partners	63	

ASCENT COE Update (2 of 2)

ASCENT Leadership

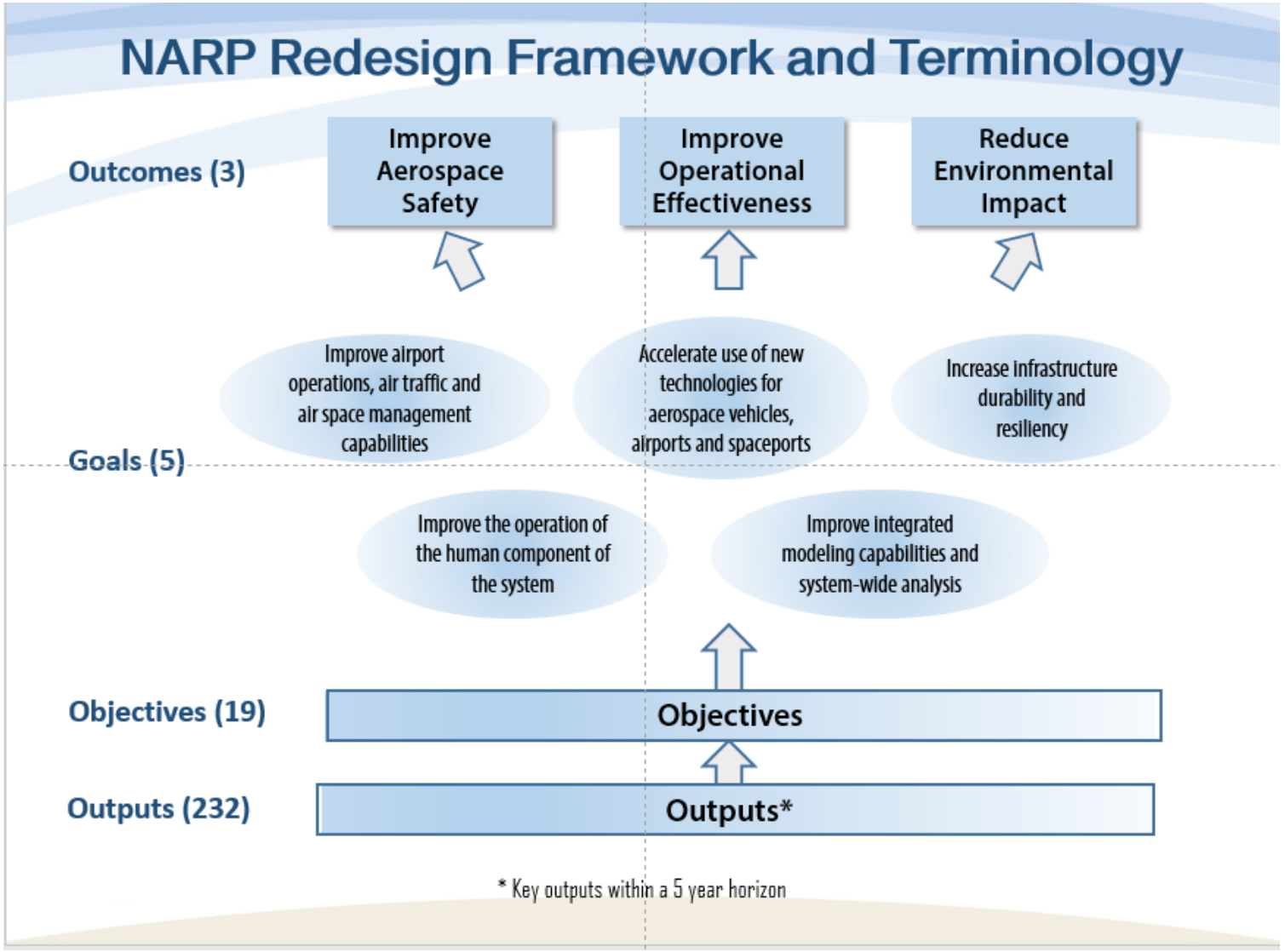
- Mike Wolcott of WSU continues as the Director
- John Hansman of MIT continues as the Co-Director
- Carol Sim of WSU is new Assistant Director (she was formerly Director of Environmental Affairs for Alaska Airlines) – fills role previously held by John Gardner

Meeting Update

- Spring 2018 ASCENT Meeting – April 3-4, 2018 (Cambridge, MA)
- Autumn 2018 ASCENT Meeting – Oct 9-10, 2018 (Alexandria, VA)
- 5 Year Symposium -seeking Special Sessions at:
  - CAAFI Biennial General Meeting Dec 3-6, 2018 (DC Area)
  - ACI-AAAE Annual Meeting (TBD)

Receiving increased requirements for grant approvals

2017-2018 National Aviation Research Plan (NARP)



Goal 1: Improve Airport Operations, Air Traffic, and Air Space Management Capabilities

Objective 1g: Noise and Emission

Identify and develop tools, methods, and procedures and/or requirements for the aerospace community to reduce the noise and emissions from aerospace vehicle operations.

Output	Collaborators	Long Term R&D	Fiscal Year					
			18	19	20	21	22	23
Report describing advanced operational procedural concepts that could reduce community noise exposure while maintaining safe flight operations and guidance for air space planners on how these concepts could be incorporated.	Industry, NASA, MITRE, ASCENT COE, Massport		X	X	X	X	X	X
Report on the operational feasibility of conducting steeper approaches in the NAS in order to reduce noise.	MITRE		X					
Develop updated correction factors for ASTM E966 (Standard Guide for Field Measurements of Airborne Sound Insulation of Building Facades and Facade Elements) that are more suitable for aircraft noise applications.			X					

Goal 2: Accelerate use of new technologies for aerospace vehicles and airport/spaceports

Objective 2a: Applied Innovation

Identify and demonstrate new aerospace vehicle and airport/spaceport technologies that could be adopted by the aerospace community to improve safety, increase efficiency, and reduce environmental impacts.

Output	Collaborators	Long Term R&D	Fiscal Year					
			18	19	20	21	22	23
Report on Continuous Lower Energy, Emissions and Noise Phase II (CLEEN II) activities to demonstrate certifiable aircraft and engine technologies and to enable industry to expedite introduction of these technologies into current and future aircraft.	Industry, NASA, DOD		X	X	X			
Report on Continuous Lower Energy, Emissions and Noise Phase III (CLEEN III) activities to demonstrate certifiable aircraft and engine technologies to expedite introduction of these technologies into current and fuure aircraft.	Industry, NASA, DOD	YES			X	X	X	X
Assessment report on the environmental benefits of the Continuous Lower Energy Emissions and Noise Phase II airframe and engine technologies (CLEEN II).	Industry, NASA, DOD, ASCENT COE				X			

Goal 2: Accelerate use of new technologies for aerospace vehicles and airport/spaceports

Objective 2c: Alternative Fuels

Identify and evaluate alternative fuels that provide equivalent safety and improved performance relative to conventional fuels.

Output	Collaborators	Long Term R&D	Fiscal Year					
			18	19	20	21	22	23
Research report with potential means to streamline the American Society for Testing and Materials (ASTM) international approval process for alternative jet fuels.	Industry, USG, int'l stakeholders, ASCENT COE		X					
Research report that examines whether changing the composition of conventional jet fuels is cost beneficial in regards to environmental impacts, health effects, capital costs, and operator costs.	Industry, NASA, DOD, int'l stakeholders, ASCENT COE		X					
Research report with lifecycle greenhouse gas emissions values for alternative jet fuels for use by the International Civil Aviation Organization (ICAO) Committee on Aviation Environmental Protection (CAEP).Technical analyses will be conducted on the use of alternative jet fuels from feedstock production, transportation, fuel production, and combustion in the engine.	Industry, USG, int'l stakeholders, ASCENT COE		X					
Data collection and research reports for the approval of at least one alternative jet fuel type per year by ASTM International.	Industry, USG, int'l stakeholders, ASCENT COE	YES	X					

Goal 2: Accelerate use of new technologies for aerospace vehicles and airport/spaceports

Objective 2d: Data Analysis

Provide data and analyses to decision-makers to inform development of guidance, standards, and policy measures.

Output	Collaborators	Long Term R&D	Fiscal Year					
			18	19	20	21	22	23
Reports that summarize experimental data that was acquired, and analyses that were performed, to inform the development of an engine particulate matter (PM) emissions standard in the International Civil Aviation Organization (ICAO) Committee on Aviation Environmental Protection (CAEP).	Industry, USG, int'l stakeholders, ASCENT COE		X	X				
Reports that summarize analyses that were performed to inform the development of the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) within ICAO CAEP.	Industry, USG, int'l stakeholders		X	X				
Reports that summarize data and analyses that are used to inform the development of new noise and emissions standards in ICAO CAEP.	Industry, USG, int'l stakeholders				X	X	X	

Goal 5: Improve integrated modeling capabilities and system-wide analysis

Objective 5a: Aerospace System

Identify and develop a sufficient scientific understanding of aerospace systems to enable the aerospace community's development of solutions to enhance safety, improve efficiency, and reduce environmental impacts.

Output	Collaborators	Long Term R&D	Fiscal Year					
			18	19	20	21	22	23
Conduct a national sleep study to collect nationally representative data on the relationship between aircraft noise exposure and residential sleep disturbance	Univ. of Pennsylvania, HMMH	YES	X				X	
Report on the reassessment of current metrics relative to community exposure to aircraft noise using the most recent annoyance information collected at U.S. airports.	USG		X	X				
Reports summarizing research on technologies to reduce supersonic aircraft noise, the public reaction to advanced supersonic aircraft noise, and procedures needed to certify aircraft noise to create the body of knowledge to support the development of en-route noise standards for airplanes that exceed Mach 1.	Industry, USG, int'l stakeholders, ASCENT COE		X	X	X	X	X	X
Report on the analysis findings from the National Civil Airport Aircraft Noise Annoyance Survey telephone data.				X				

Goal 5: Improve integrated modeling capabilities and system-wide analysis

Objective 5c: System Performance

Identify and develop tools, methods, studies, reports, and assessments for use by the aerospace community that evaluate, in an integrated manner, the system-wide performance, and impacts of new and existing aerospace vehicles, air traffic concepts, and airport/spaceport operations.

Output	Collaborators	Long Term R&D	Fiscal Year					
			18	19	20	21	22	23
Aviation Environmental Design Tool (AEDT) Version 3 with improved aircraft performance modeling capabilities including noise, emissions, and fuel burn estimation methodologies.	Industry, USG, int'l stakeholders, ASCENT COE		X					
Advanced emissions modeling capabilities that leverage the latest national and international research.	ASCENT COE		X					
Improved analytical capabilities of aviation environmental analysis tools by expanding the computational models for aircraft performance, noise and emissions source generation processes, and noise and emissions propagation processes.	Industry, USG, int'l stakeholders, ASCENT COE				X	X	X	X
Quantitative analyses through modeling of the change in fuel use and emissions that could result from changes in aircraft technology, operational procedures and alternative fuel use.	Industry, USG, ASCENT COE		X			X		

Environment & Energy Portfolio
(Work items within Enacted FY17 Budget and President's FY18 Budget)

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

- 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

- Accelerate maturation of airframe and engine technologies
- Advance sustainable alternative jet fuels (zeroed out in FY19 budget)

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

Airport Technology Research (ATR)

ATR Overview:

- Three Research Programs Areas (RPA): Airport Safety, Pavement and Airport Environment
- All three RPAs presented to Airports Subcommittee

Environmental Efforts within ATR:

- Airport noise research started in FY12
- Expanded to cover broader environmental research in FY16

Collaborative effort among Tech Center, Office of Airports, and Office of Environment and Energy

Briefing provided by Tom Cuddy

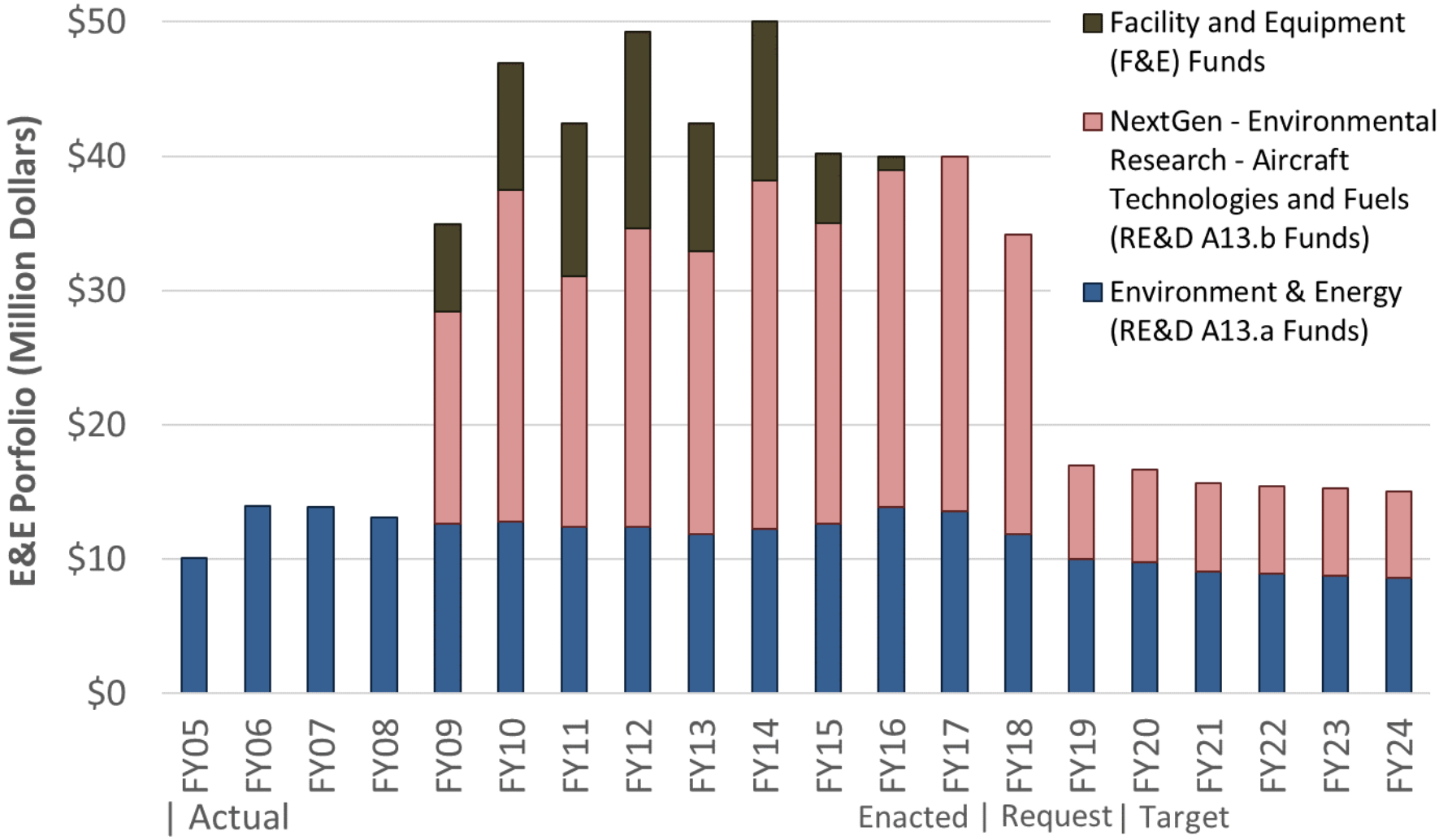
E&E Portfolio Financial Summary

	FY 17 Enacted		FY 18 Request		FY 19 Target		FY 20 Target	
Program Title	*In-House*	*Contracts*	*In-House*	*Contracts*	*In-House*	*Contracts*	*In-House*	*Contracts*
Base Program (Funding Appropriation)								
A13.a. Environment & Energy	2,425,000	13,588,000	2,624,000	11,873,000	1,588,000	10,000,000	1,253,498	9,745,413
NextGen Program (Funding Appropriation)								
A13.b. NextGen Environment & Energy-Aircraft Technologies and Fuels (R,E&D)	775,000	26,399,000	834,000	22,317,000	587,000	7,000,000	390,145	6,934,120
PPT Total	3,200,000	39,987,000	3,458,000	34,190,000	2,175,000	17,000,000	1,643,643	16,679,533

E&E Portfolio 5-Year Financial Plan

Program	Out-Year Contract Dollars				
	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
Base Program (Funding Appropriation)					
A13.a. Environment & Energy	9,745,413	9,091,556	8,934,552	8,773,032	8,606,866
NextGen Program (Funding Appropriation)					
A13.b. NextGen Environment & Energy-Aircraft Technologies and Fuels (R,E&D)	6,934,120	6,551,264	6,523,510	6,494,971	6,465,626
PPT Total	16,679,533	15,642,820	15,458,062	15,268,003	15,072,492

Twenty Year Funding Profile
E&E Portfolio (Contract Funding)

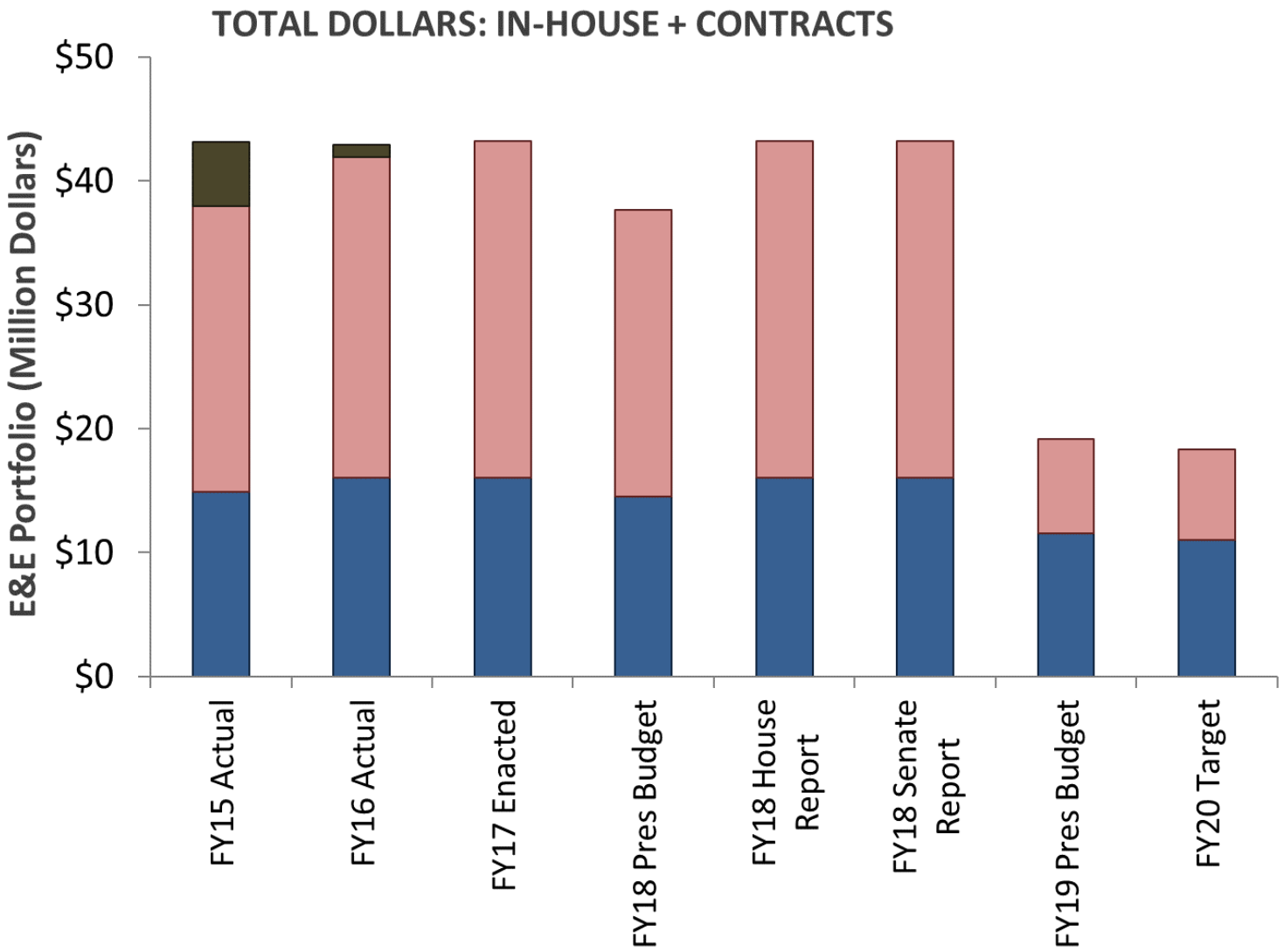


Not shown on graph:

Airport Technology Research has ~$1.5M/year for noise/environment projects

Airports Cooperative Research Program (ACRP) provides ~$5M/year for environment projects

FY15-20 Funding Profile for E&E Portfolio



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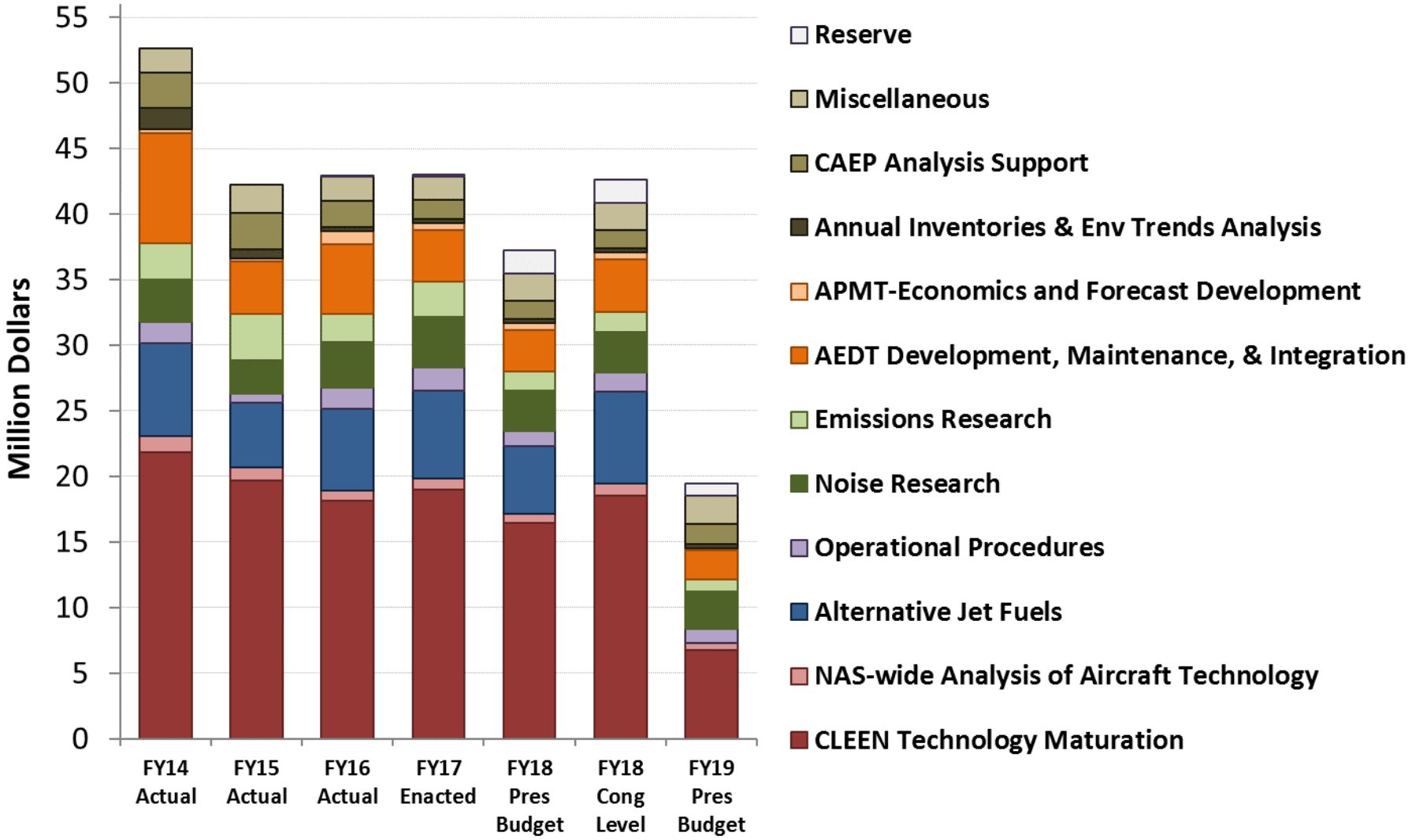
Not shown on graph:
Airport Technology Research has ~$1.5M/year for noise/environment projects
Airports Cooperative Research Program (ACRP) provides ~$5M/year for environment projects

Environment and Energy Funding

Includes: RE&D, F&E, ATR, Operations, and non-FAA funds (e.g., other US Government and Transport Canada)



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

Alignment to FAA NARP

- Goal 1f: Noise and Emissions
- Goal 2d: Data Analysis
- Goal 5a: Aerospace System
- Goal 5c: System Performance

FY 2020 Milestones

- Advance the understanding of noise impacts on social welfare and health.
- Improve ability to model the air quality and climate impacts of aviation emissions.
- Enhance the aviation environmental tool suite to improve our ability to calculate environmental consequences and impacts of aviation.
- Analyze mitigation options for reducing environmental impacts including policy measures and standards.
- Develop improved certification methods

Funding Profile (Contracts)

FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24
13,588	11,873	10,000	9,745	9,092	8,935	8,773	8,607

Summary of Changes with FY19+ Budget

Work will be Slowed on the Following

- Noise enhancements for analytical tools to support design of reduced noise operational procedure concepts
- Screening tool development to streamline environmental approval process
- Environmental analysis to support new entrants (e.g., supersonic aircraft, unmanned aerial systems, and commercial space vehicles)
- Quantifying aviation contributions to fine particulate matter emissions in communities

Work will be Stopped on the Following

- Development of analytical tools for evaluating impacts of emissions on air quality and climate change – will hand intellectual leadership to overseas institutions and will limit our ability to conduct cost-benefit analysis to support international standard setting
- Operational procedure development for lower noise helicopter operations – work would have delivered benefits to those living near/in metro areas and those near/in park lands

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

Alignment to FAA NARP

- Goal 2a: Applied Innovation
- Goal 2c: Alternative Jet Fuels (through FY2018)

FY 2020 Milestones

- Initiate Phase 3 of the CLEEN Program (using FY20 funds)
- CLEEN Program Phase 3: ~$33M over 5 years

Funding Profile (Contracts)

FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24
26,399	22,317	7,000	6,934	6,551	6,524	6,495	6,466

Summary of Changes with FY19+ Budget

Work will be Delayed and Slowed Dramatically in CLEEN

- Funding to initiate Phase 3 of the CLEEN Program will not occur until FY2020 (instead of FY2019)
- Funding for Phase 3 of CLEEN Program (2020-2025) will be one-fourth that of Phase 1 of CLEEN Program (2010-2015)

Work will be Stopped on Alternative Jet Fuel Development

- Testing - knowledge about fuel composition and its impact on engine operability would have been developed and transitioned to standard setting bodies to support certification/qualification of jet fuels from alternative sources
- Analysis - knowledge about the entire supply chain would have been used to support development of domestic and international standards for jet fuels from alternative sources
- Commercial Aviation Alternative Fuels Initiative (CAAFI) - knowledge would have been shared across the full breadth of jet fuel and aviation stakeholders to support the development of jet fuels from alternative sources
- ASCENT COE – dramatic reduction in number of students being trained on issues of importance to aviation industry

Recent Successes

capabilities and solutions that are helping today

- Noise impacts work is starting to deliver results. Community noise survey nearing completion. Published report on pilot phase of aircraft noise sleep impacts study. Starting work on national sleep study.
- Provided critical analytical support to development of Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).
- Alternative fuels scenarios adopted by ICAO CAEP for future trends assessment and research efforts instrumental for alternative fuel inclusion within CORSIA.
- Measurement technique and data providing foundation for ICAO CAEP PM standard.
- Integrated tool suite and analyses provided the scientific data used to support the decision making for the ICAO CAEP CO_2 standard.
- 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 multiple airlines to buy and use biofuels in LAX and elsewhere.
- Aviation Environmental Design Tool (AEDT) being used extensively.
- Analytical framework was used to develop operational procedure concepts for Boston Logan that could provide noise reduction. Work is continuing to develop additional concepts and evaluate potential for broader use.