

Update on FAA Environment and Energy R&D

To: ASCENT Advisory Committee Mtg

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**Federal Aviation
Administration**



Presentation Outline

- **E&E Portfolio – Background and Overview**
- **ASCENT COE Update**
- **Budget Profile for E&E R&D Portfolio**
- **Summary**

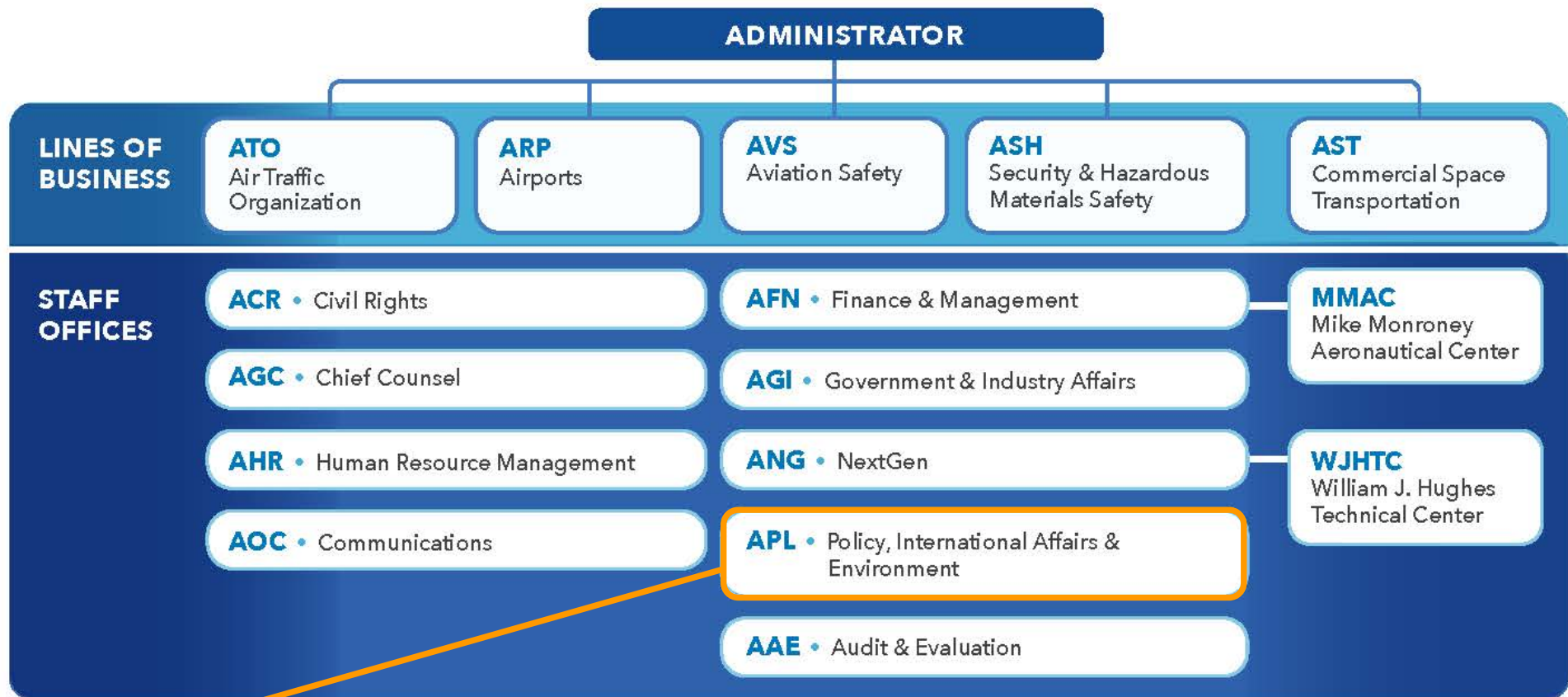


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FAA Organizational Structure

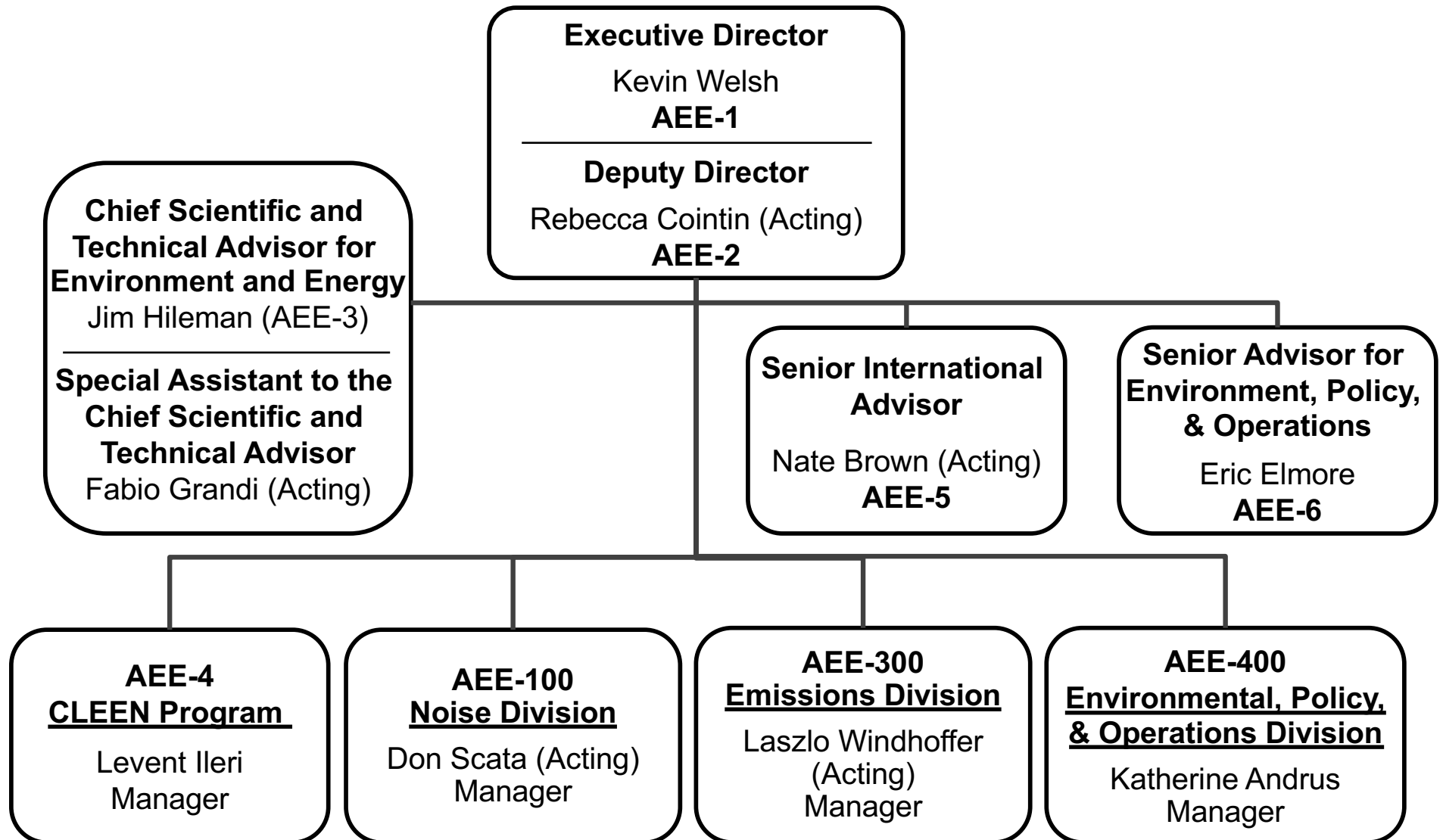


Office of Environment and Energy (AEE)



Federal Aviation
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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

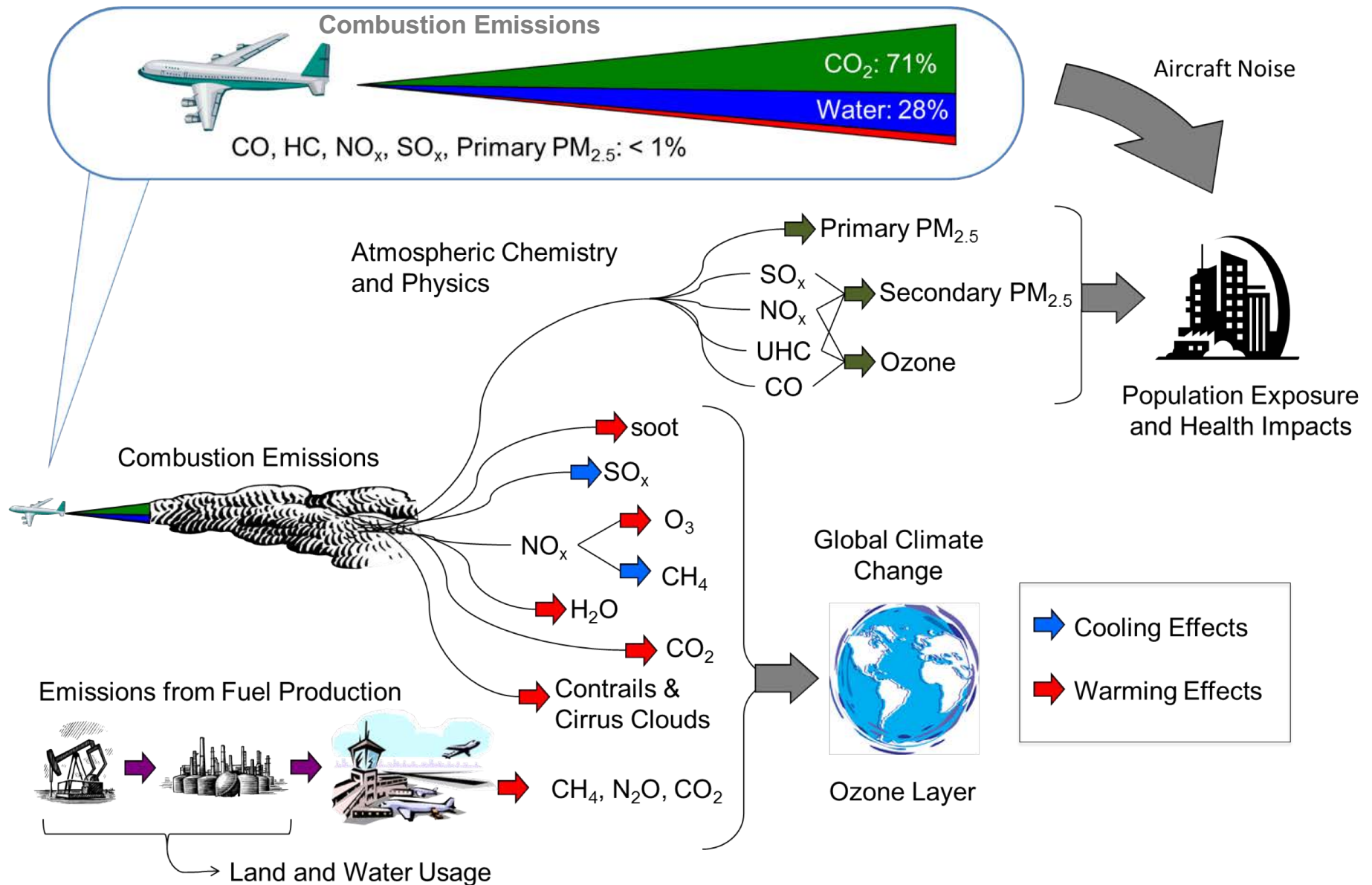
Aviation equipment (aircraft, spacecraft, and related equipment) is largest export sector in U.S. economy accounting for over 8% of total exports.

SOURCE: U.S. International Trade Commission



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Environmental Impacts of Aviation



AEE Mission and Vision

Mission:

To understand, manage, and reduce the environmental impacts of global aviation through research, technological innovation, policy, and outreach to benefit the public

Vision:

Remove environmental constraints on aviation growth by achieving quiet, clean, and efficient air transportation



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

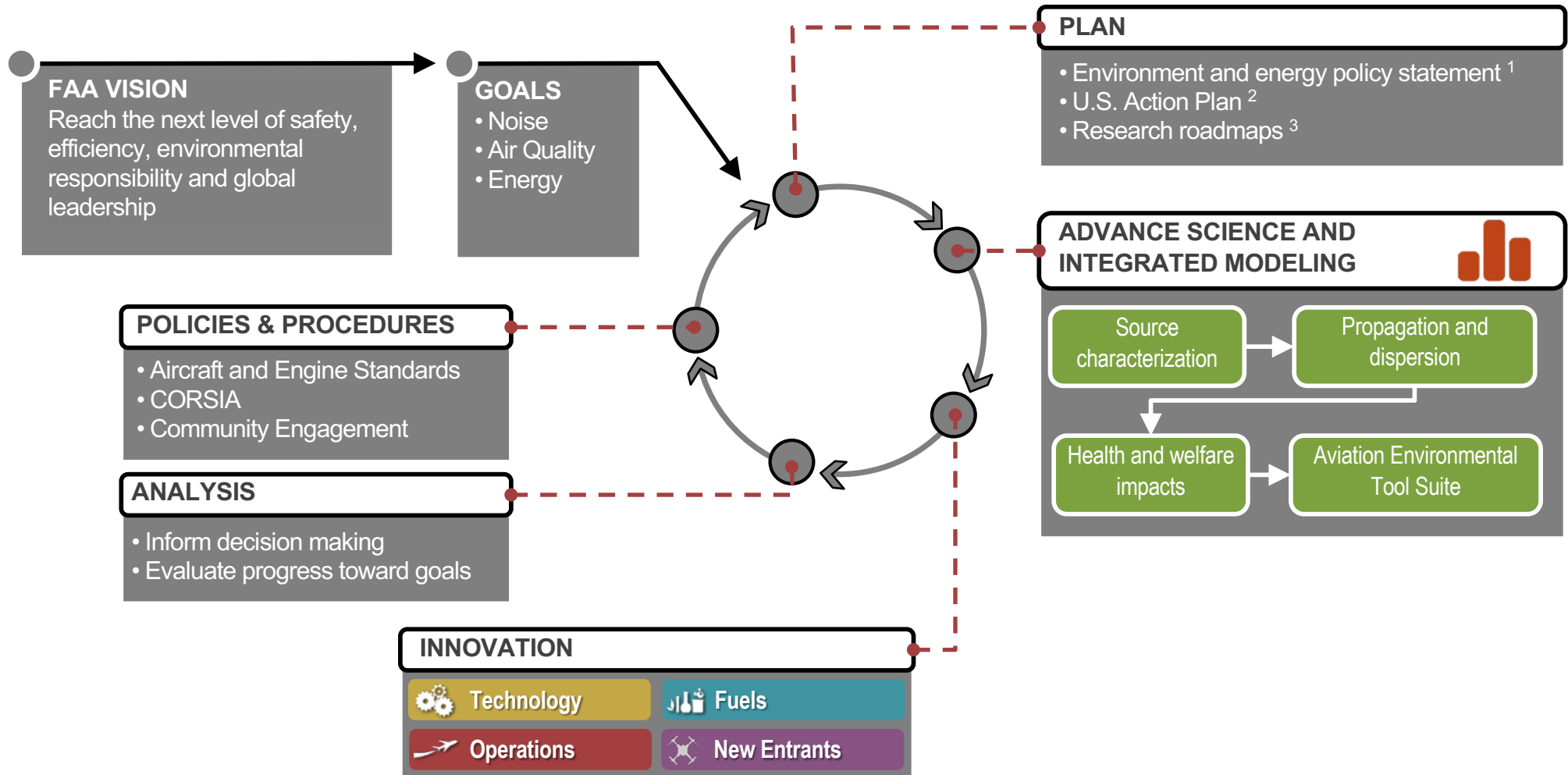


ENERGY

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/enviro_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>



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Environment and Energy (E&E) Research Programs



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



ASCENT Center of Excellence (COE)

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



Additional Efforts

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



Efforts Relating to Aircraft Noise

Understanding Noise

- Improving modeling capabilities
- Examining relationship between noise and annoyance, sleep, cardiovascular health and children's learning
- Evaluating current aircraft, helicopters, commercial supersonic aircraft, unmanned aerial systems, and commercial space vehicles

Outreach

- Enhanced community involvement
- Increase public understanding

Reducing noise at the source

- Aircraft technologies and architecture
- Vehicle operations
- Noise standards

Mitigation

- Noise Compatibility Planning (Part 150)
- Noise-based access restrictions (Part 161)



Efforts Relating to Aircraft Emissions

Understanding Emissions

- Particulate Matter (PM) measurements and modeling
- Improving atmospheric impact modeling capabilities
- Evaluating current aircraft, commercial supersonic aircraft, unmanned aerial systems, and commercial space vehicles

Reducing Emissions at the Source

- Aircraft technologies and architecture
- Modifications to fuel composition
- Vehicle operations
- Engine standard (NO_x and PM standards)

Mitigation

- Alternative fuel sources
- Policy measures (CORSIA)



Efforts Relating to Jet Fuel

Testing

- Support Certification/Qualification testing
- Improve Certification/Qualification process

Analysis

- Environmental sustainability
- Techno-economic analysis
- Future scenarios

Coordination

- Interagency
- Public-Private
- State & Regional
- International

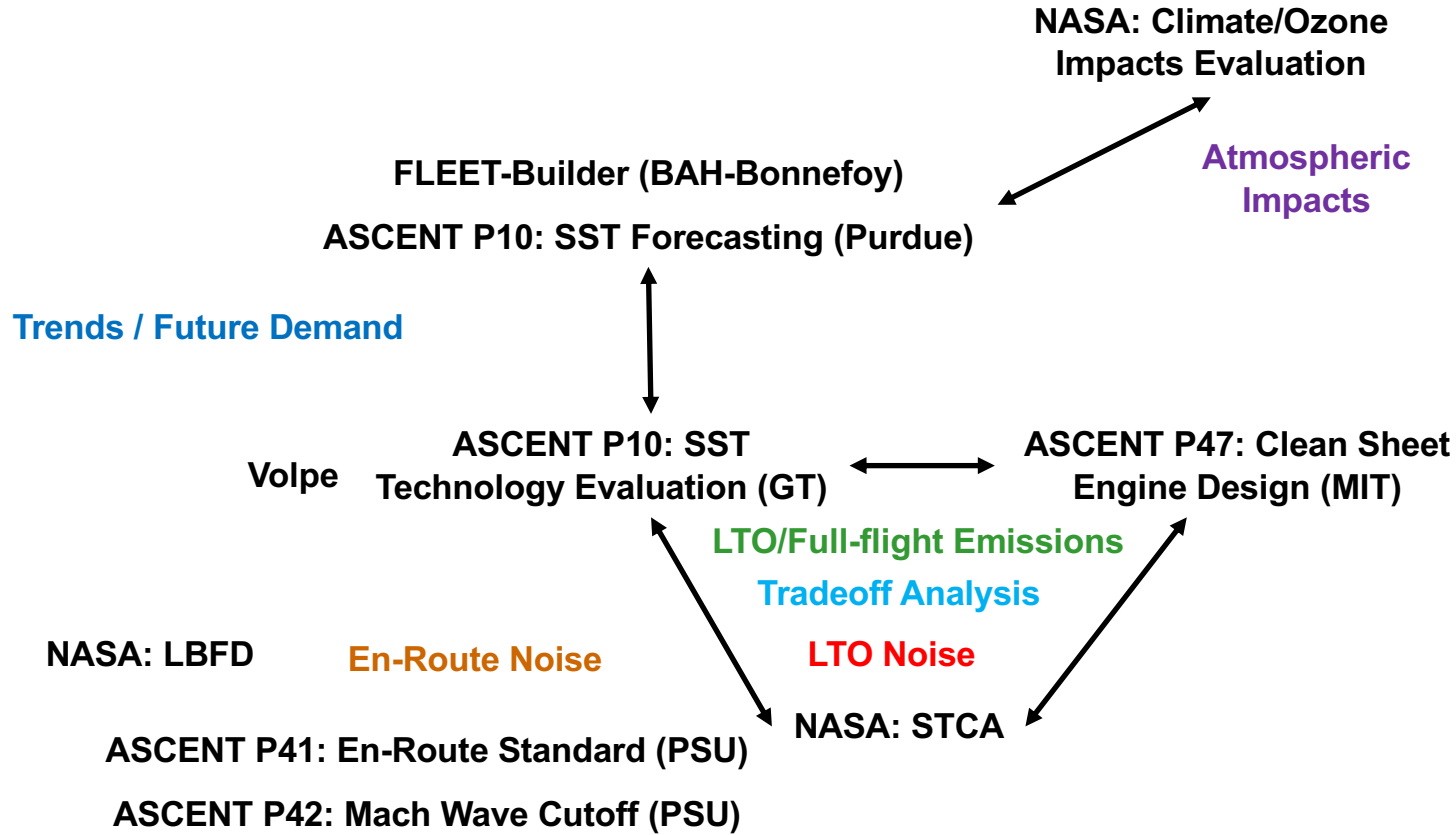


Highlights of Ongoing E&E R&D Efforts

- Much effort on supersonic aircraft
- Considerable emphasis on noise:
 - Research on noise impacts continues
 - Exploring low noise operational procedures (with ATO and APP)
 - Work on helicopter noise is making good progress
 - Thinking how to approach UAS/UAM noise
- Particulate Matter efforts laid foundation for CAEP standard
- Will release AEDT3b - executing long term vision for AEDT
- Alternative jet fuels: CORSIA, CAAFI, and ASTM
- Technology maturation in CLEEN continues and we are setting stage for 3rd Phase of CLEEN
- Considering commercial space noise and emissions via ACRP



Civil Supersonic Transport R&D Efforts (funded)



Other areas of potential FAA SST R&D (not covered above)

- Technology maturation with industry (e.g., FAA CLEEN Phase III)
- Takeoff jet noise evaluation and mitigation
- Operational procedures to mitigate noise
- Emissions impacts evaluation



Outreach Materials

Continuing to maintain/update materials:

- Environment and Energy Tri-Fold
- FAA Environment and Energy Website (faa.gov/go/environment)
- Noise Website (faa.gov/go/aviationnoise)
- CLEEN Website (faa.gov/go/cleen)
- ASCENT Website (ascent.aero)
- CAAFI Website (caafi.org)



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ASCENT Center of Excellence (COE)

Timeline:

- In 2004, FAA established PARTNER Center of Excellence
- In 2013, FAA established Center of Excellence for Alternative Jet Fuels and Environment, a.k.a. Aviation Sustainability Center or ASCENT, that continues work of PARTNER with expanded efforts on alternative jet fuels R&D

COE fulfills requirements:

- P.L.112-95 Sec. 911 - conduct research to assist the development and qualification of jet fuel from alternative sources
- P.L.108-176 Title III Sec. 326 – conduct research to reduce community exposure to civilian aircraft noise and emissions

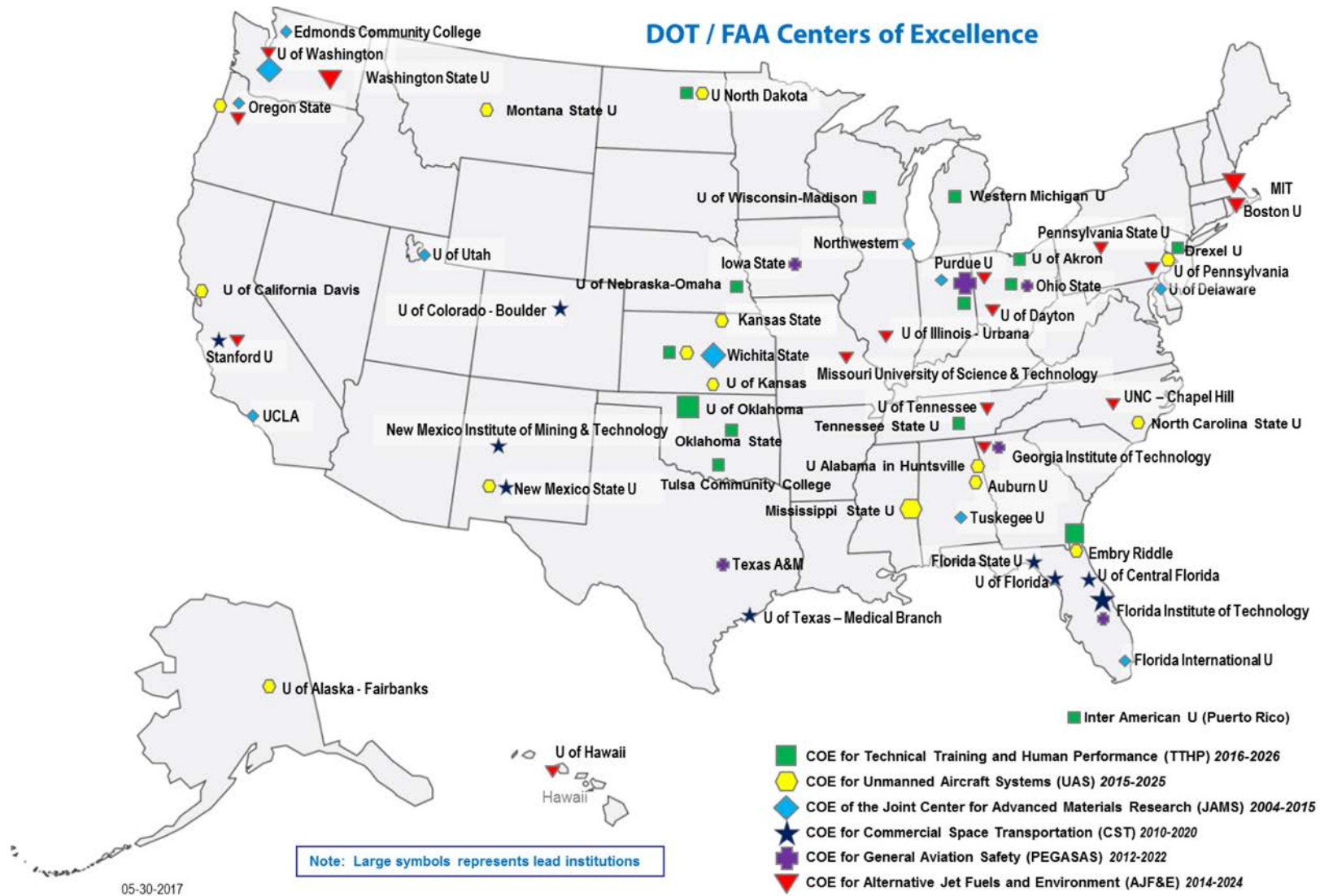
Budget Direction:

- FY2019 budget: FAA directed to use \$15M in RE&D funds for ASCENT
- FY2018 budget: FAA directed to use \$15M in RE&D funds for ASCENT
- FY2016 budget: FAA directed to use \$10.6M in RE&D funds for ASCENT



DOT/FAA Centers of Excellence

(ASCENT is one of 6 active COEs within FAA)



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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)*

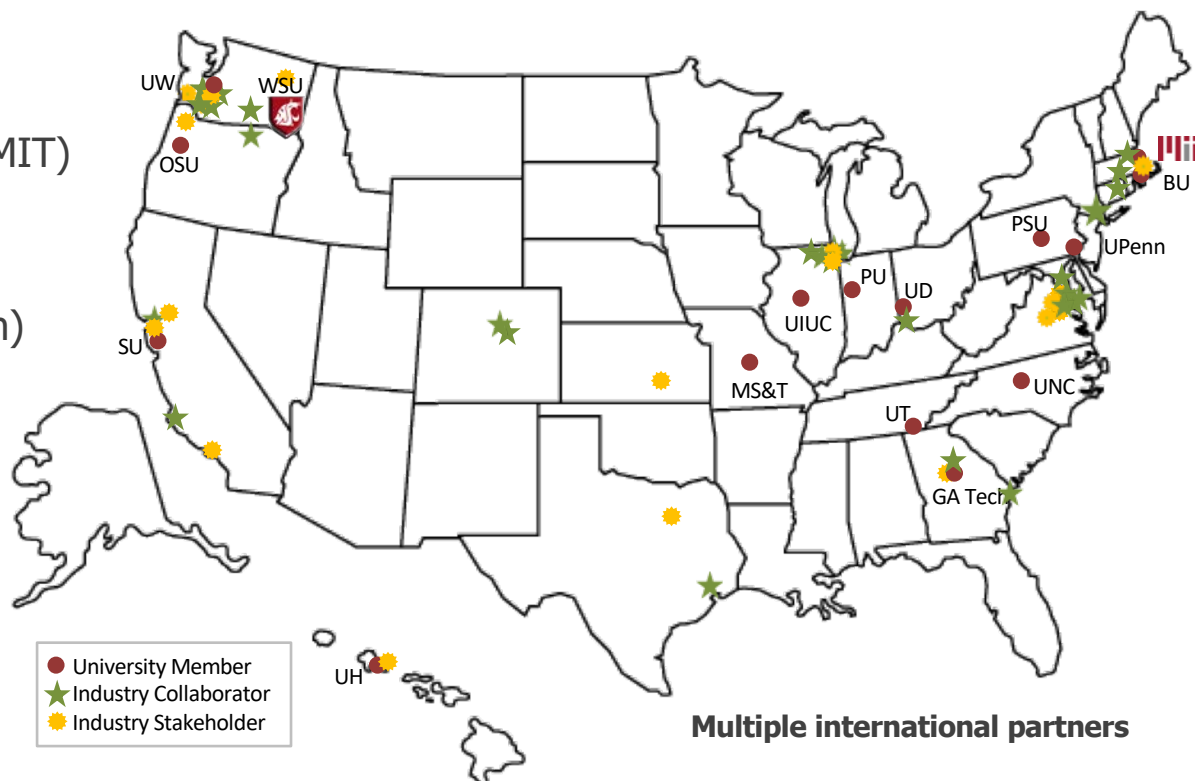
University of North Carolina at Chapel Hill (UNC)

University of Pennsylvania (UPenn)

University of Tennessee (UT)*

University of Washington (UW)*

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



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

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



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ASCENT COE Details



Recent ASCENT Meetings

- Held ASCENT Symposium alongside 2018 CAAFI BGM
- October 22-23 in DC Metro Area (Embassy Suites in Alexandria VA)

ASCENT Report Summary (*Report 4 under review by FAA)

	Report 1	Report 2	Report 3	Report 4*
Time period	9/2013 – 9/2015	10/2015 – 9/2016	10/2016 – 9/2017	10/2017 – 9/2018
Research Projects	50	54	43	32
Publications, Reports, and Presentations	137	119	110	179
Students involved	131	112	105	116
Industry partners	63	70	72	72



DOT/FAA Centers of Excellence Funding Profile

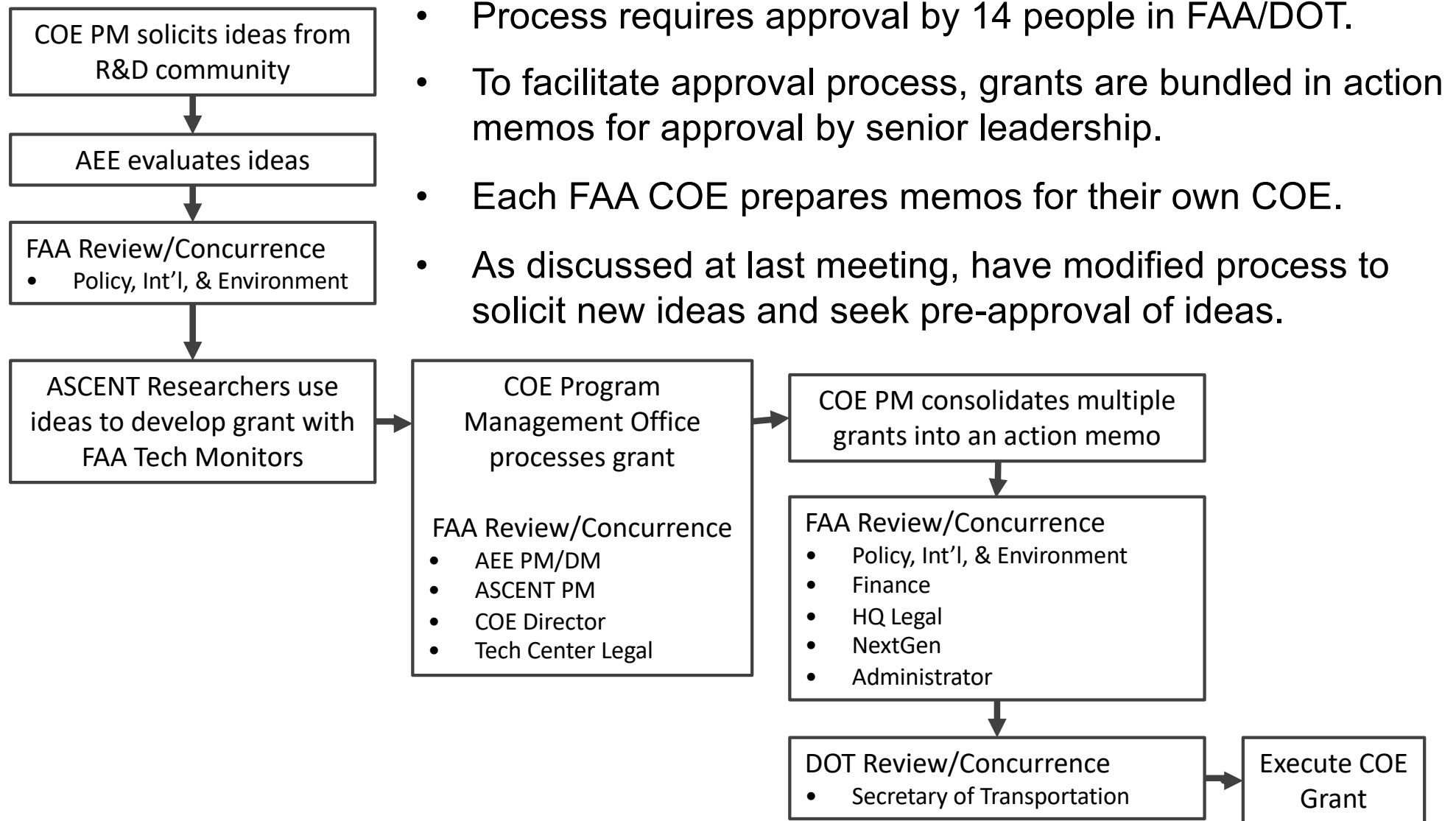
ASCENT typically receives 1/3 of overall COE funding

CENTER OF EXCELLENCE	FY 19 to date	FY 18	FY 17	FY 16	FY 15
Technical Training and Human Performance	\$ -	\$ -	\$ 1,538,757	\$ 5,000,000	\$ -
Unmanned Aircraft Systems	\$ -	\$ 6,106,452	\$ 3,883,711	\$ 3,474,932	\$ 4,763,506
Alternative Jet Fuels and Environment	\$ 3,323,534	\$ 3,170,047	\$ 9,809,723	\$ 9,393,601	\$ 10,598,441
General Aviation	\$ -	\$ 315,964	\$ 3,267,686	\$ 3,697,891	\$ 3,092,624
Commercial Space Transportation	\$ -	\$ 819,879	\$ 1,264,293	\$ 1,191,548	\$ 1,272,864
Joint Center of Excellence for Advanced Materials	\$ 5,203,186	\$ 1,456,658	\$ 4,894,469	\$ 5,639,146	\$ 2,429,612
TOTAL	\$ 8,526,720	\$ 11,869,000	\$ 24,658,639	\$ 28,397,118	\$ 22,157,047

Note: The table captures the year of grant execution; it does not capture the amount of the FY appropriation that is being spent in a given year. For example, ASCENT will be awarded roughly \$15.2M of the FY18 FAA RE&D A13.a and A13.b appropriation, but the universities will receive these funds over the a time period that covers FY18 through FY20.



ASCENT COE Grant Approval Process



ASCENT COE Grant Status

- Grants currently working through approval process (~\$10M of FY18 funding):
 - 24 grants have been approved by Sec. of Transportation (in two separate packages)
 - 9 additional grants are with Assistant Administrator for NextGen for review (in two separate packages)
- Additional grants will enter approval process this spring/summer (~\$20M in FY18/FY19 funding)
 - Considering both existing ASCENT Projects and new project ideas
 - Working with APL-1 to select projects for this funding cycle
 - Will develop full grants for projects that are selected
 - Want universities to receive funding by September



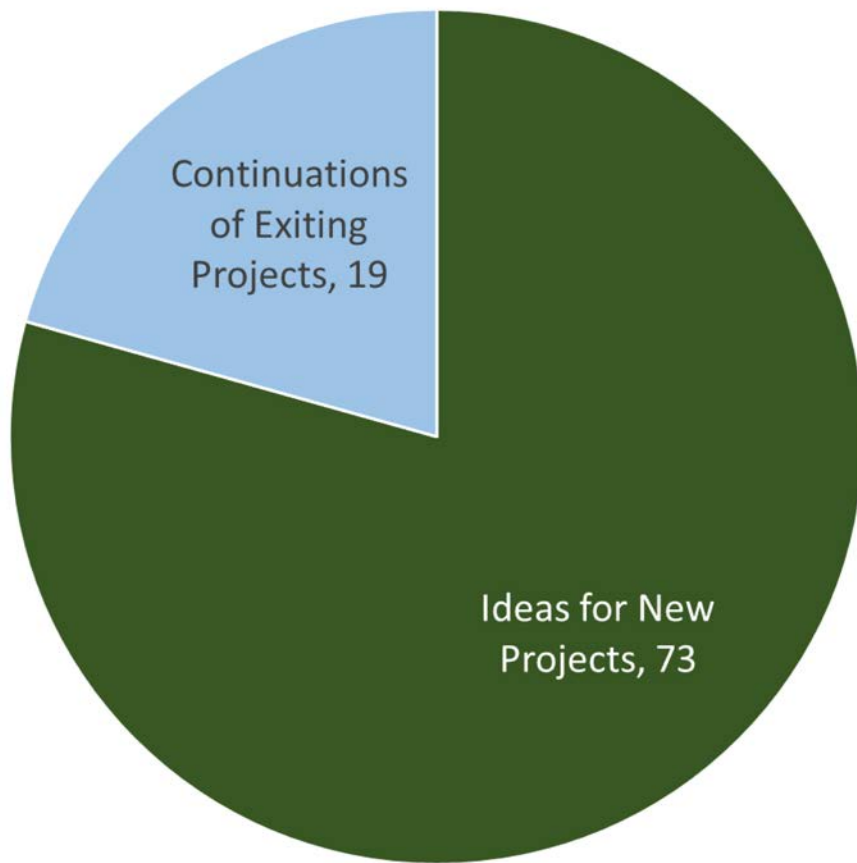
ASCENT COE Project Idea Generation

- Emailed ASCENT and CLEEN R&D Communities seeking new project ideas for innovative solutions to reduce noise, fuel burn, and emissions:
 - Aircraft and engine technologies
 - Both fixed wing and rotorcraft air vehicles at all scales and vehicle speeds
 - Changes in aircraft architecture (e.g., to enable shielding of fan forward engine noise)
 - Vehicle flight management systems and other software systems that are used in air vehicle operations
 - Alternative jet fuels
 - Changes in fuel composition of conventional jet fuels
 - Vehicle flight operations
 - Methods to improve modeling of noise and emissions for air vehicles that could lead to reduction in noise, fuel burn, and emissions
- If idea was not submitted by ASCENT university, it would be submitted to all ASCENT schools through a Notice of Funding Opportunity
- AEE reviewed existing research portfolio to identify potential project extensions

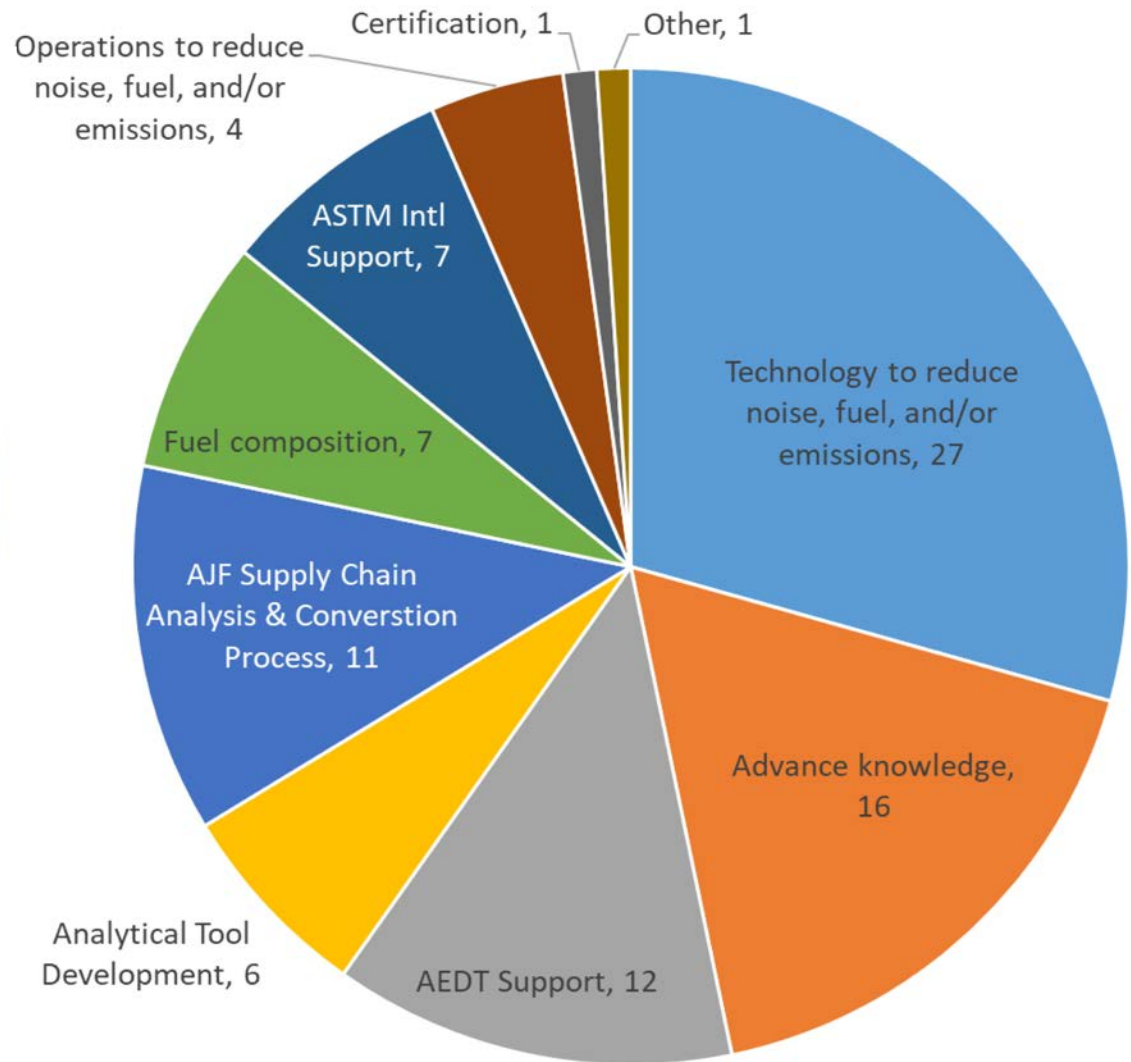


ASCENT COE Projects Ideas

New Ideas / Continuations



Project Types

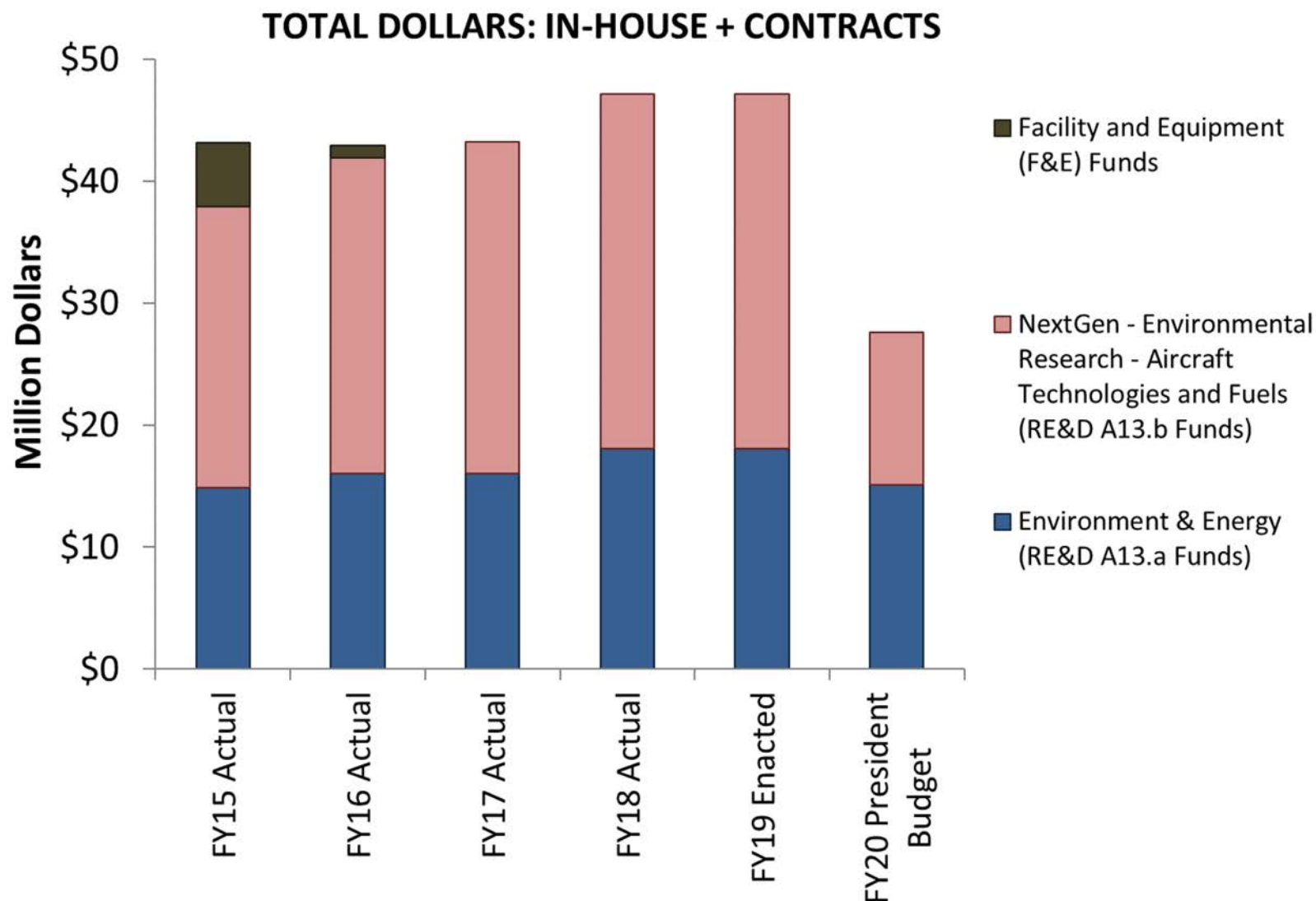


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E&E R&D Budget Profile – FY15-FY20



Environment & Energy R&D Portfolio - FY19

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

- Improve scientific understanding of noise and emissions constraints
- Incorporate scientific knowledge into an integrated analytical tool suite
 - Robust support to the continued development of AEDT
 - Continued support to the development of a fleet forecast tool, FLEET-Builder
 - Starting new effort to develop screening tools to complement AEDT
- Analyze mitigation options for reducing environmental impacts including policy measures and environmental standards
 - ICAO CAEP standards (e.g., LTO noise standard for supersonic aircraft)
 - Low noise operational procedure concepts for aircraft and helicopters
 - Analysis of technology and innovative ideas to reduce noise, fuel burn, and emissions



Environment & Energy R&D Portfolio - FY19

NextGen RE&D (A13.b) Environmental Research

- Accelerate maturation of airframe and engine technologies
 - Technology maturation in partnership with industry via the CLEEN Program – complete CLEEN Phase II with additional options
 - Demonstrate and assess benefits of new aircraft technologies via ASCENT COE
- Advance alternative jet fuels and consider changes in fuel composition
 - Advance ASTM Intl approvals via fuel testing and process improvements
 - Conduct supply chain analyses and support fuel evaluations within CORSIA
 - Coordinate activities of the aviation industry via CAAFI



E&E R&D Portfolio – Efforts under FY20 President Budget

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

- Improve scientific understanding of noise and emissions constraints
- Incorporate scientific knowledge into an integrated analytical tool suite
 - Continued development of AEDT
 - Continued development of screening tools to complement AEDT
- Analyze mitigation options for reducing environmental impacts including policy measures and environmental standards
 - ICAO CAEP standards (e.g., LTO noise standard for supersonic aircraft)
 - Low noise operational procedure concepts for aircraft

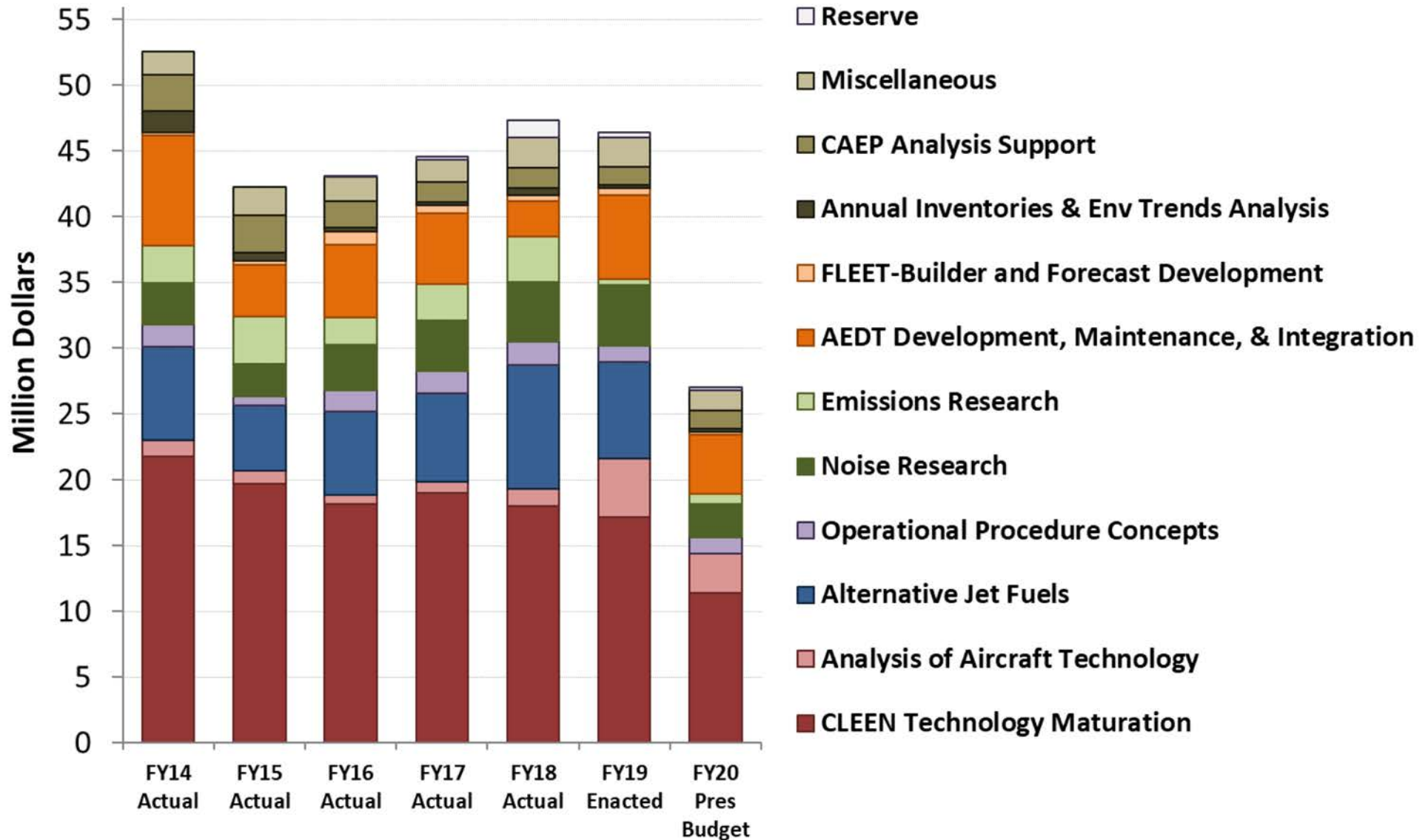
NextGen RE&D (A13.b) Environmental Research

- Accelerate maturation of airframe and engine technologies via Phase III of the CLEEN Program



Environment and Energy Funding

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



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Recent Successes

capabilities and solutions that are helping today

- Aviation Environmental Design Tool (AEDT) being upgraded to better capture actual operations and is being used extensively.
- Measurement technique and data provided foundation for ICAO CAEP PM standard.
- Noise impacts work is starting to deliver results. Community noise survey under review. Starting work on national sleep study.
- 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.
- 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.
- Analytical tools provided foundation for ICAO CAEP Independent Expert review of aircraft technologies for the purpose of setting goals for noise, fuel burn, and NOx emissions.
- Certification of five alternative jet fuel pathways – certification enabled multiple airlines to buy and use biofuels in LAX and elsewhere.
- 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.



Some Questions for the Investigator / Advisory Committee Meetings Later Today

- What are your thoughts on the idea generation process?
- Are there additional ways to capture the good work of ASCENT?
- Could we develop a means to reach out to former/current students/staff at ASCENT/PARTNER to let them know about employment opportunities (we in AEE are hiring and many others are too)?

