

# Environment and Energy R&D Portfolio Overview

To: ASCENT Advisory Committee Mtg  
By: Dr. Jim Hileman  
Chief Scientific & Technical  
Advisor for Environment and Energy  
Office of Environment and Energy  
Date: October 22, 2019



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# Presentation Outline

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

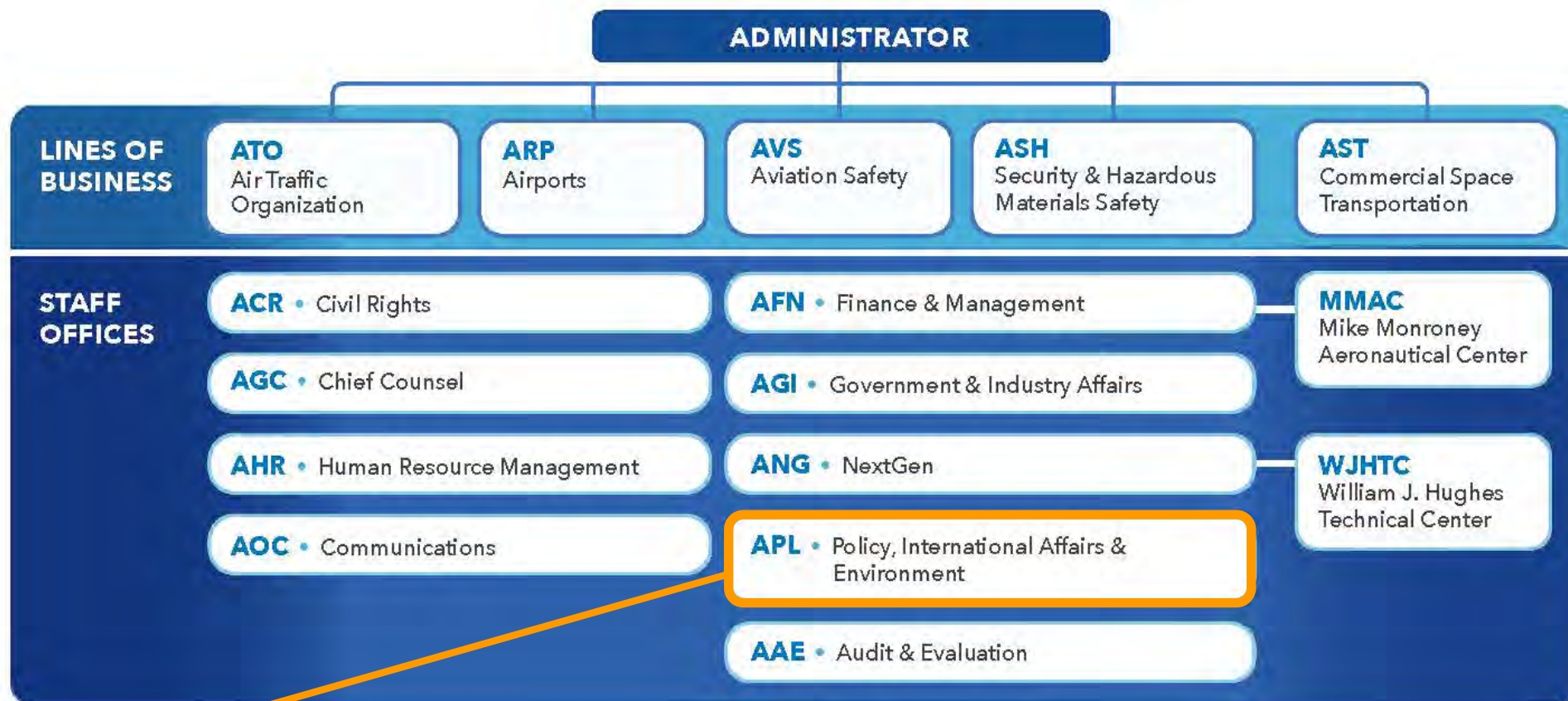


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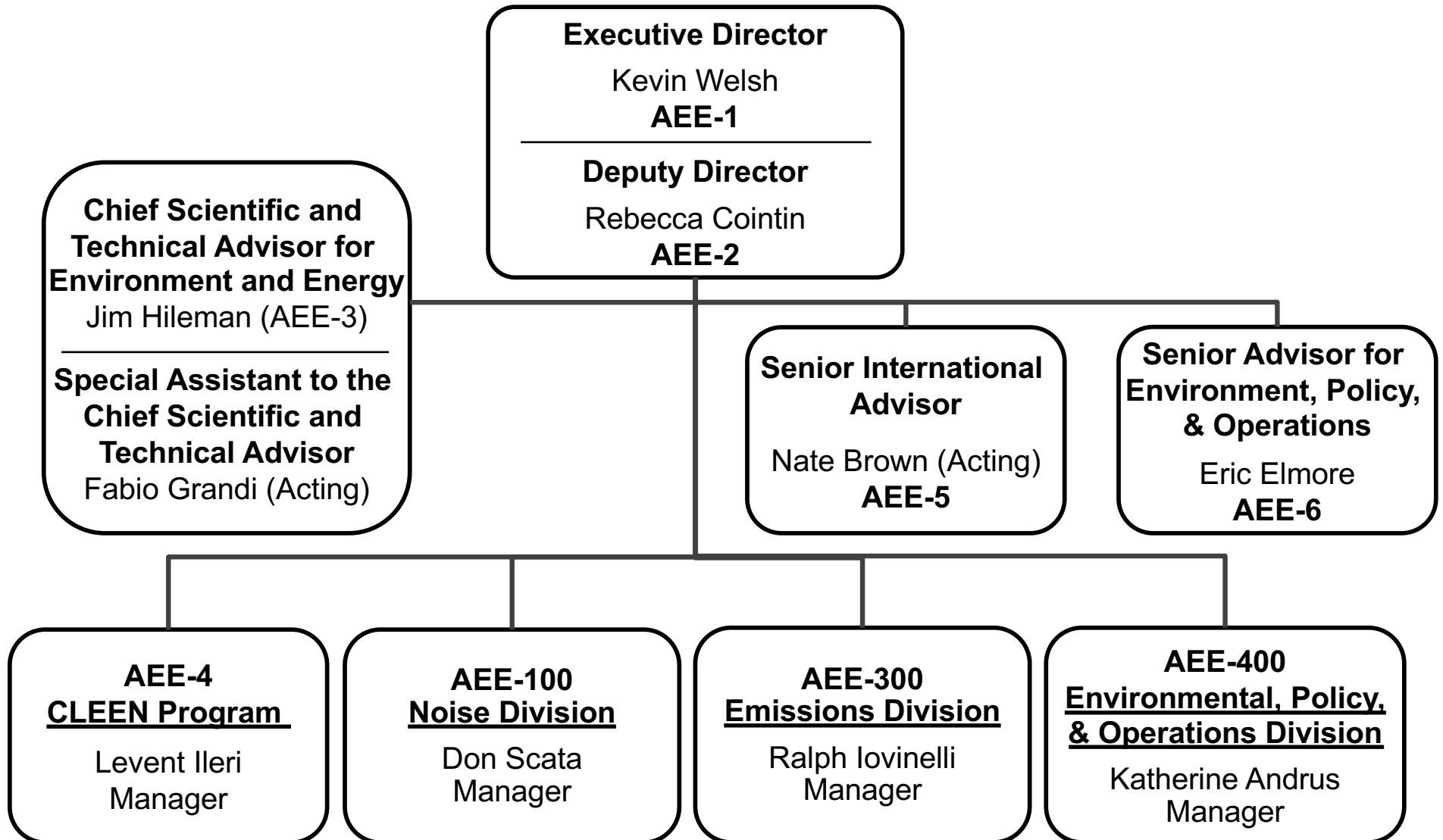
# FAA Organizational Structure



Office of Environment and Energy (AEE)



# Office of Environment and Energy (AEE)



# 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**

U.S. civil aviation manufacturing trade balance (exports-imports)

SOURCE: FAA Air Traffic Organization

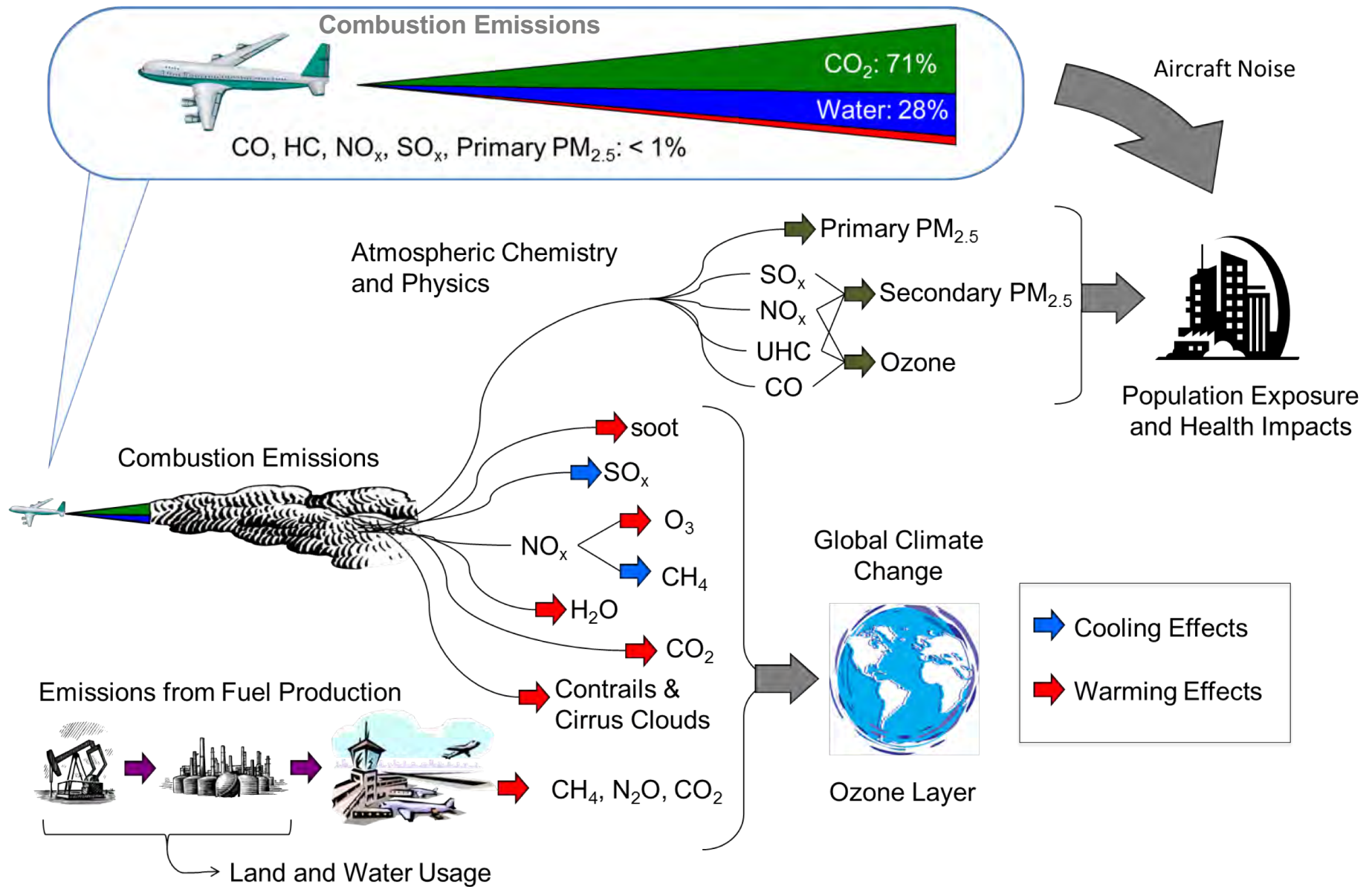
*Aviation equipment (aircraft, spacecraft, and related equipment) is largest export sector in U.S. economy accounting for over 8% of total exports.*

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

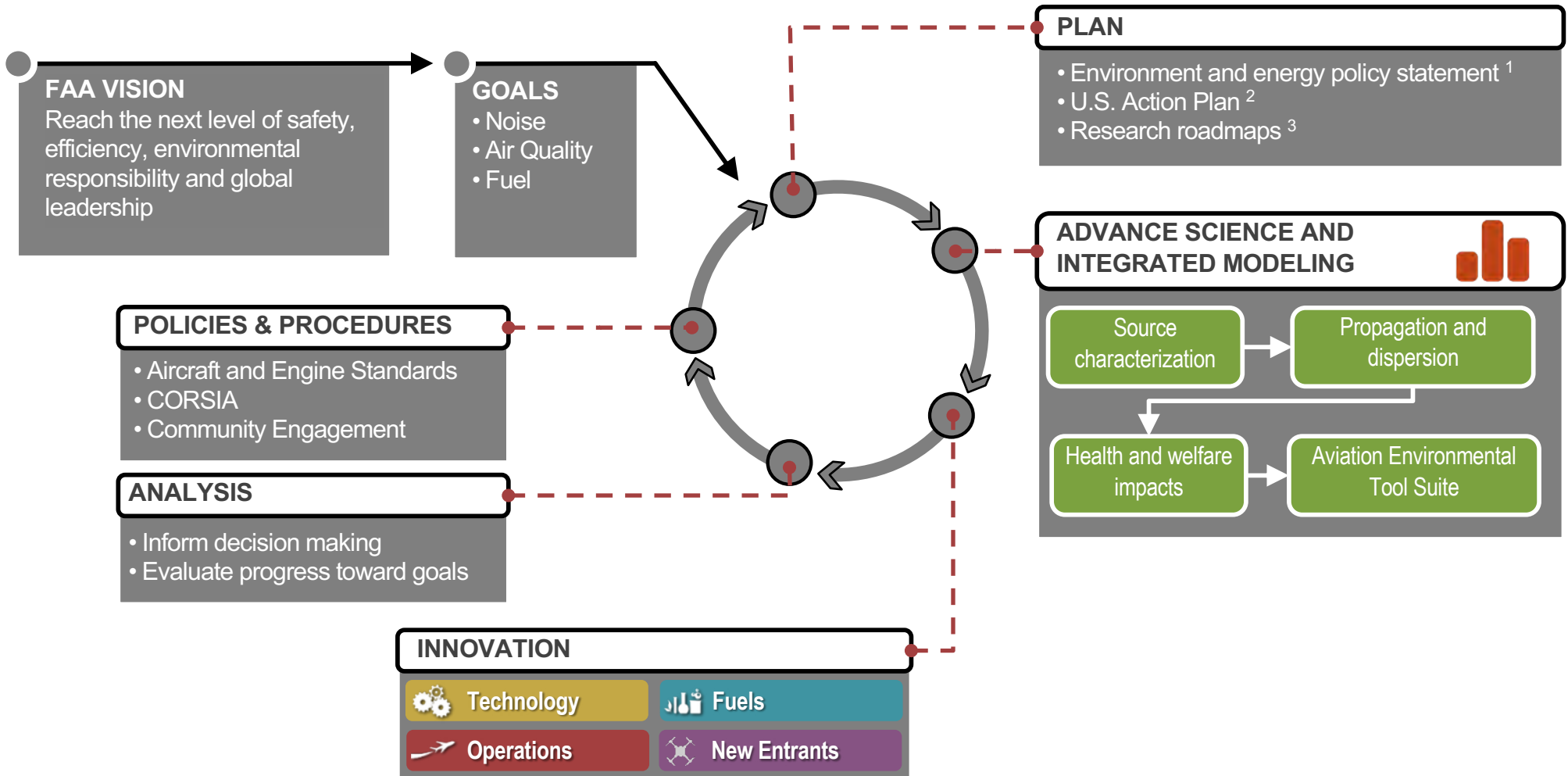


### FUEL

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](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](http://www.icao.int/environmental-protection/Pages/ClimateChange_ActionPlan.aspx)
3. Environment and Energy Website: <http://www.faa.gov/go/environment>



# 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



# Emerging Aircraft Types

- **Supersonic Aircraft**
  - Much interest by manufacturers to begin producing aircraft capable of flying Mach 1+
  - FAA announced two rulemakings regarding supersonics
    - Clarification of the process to apply for a special flight authorization to fly over Mach 1 in the U.S. (previously released NPRM)
    - Development of landing and take off noise certification process (expected in March 2020)
  - Have directed substantial R&D efforts to supersonic aircraft
- **Unmanned Aircraft Systems (UAS)**
  - Research has started to understand the potential noise impacts of UAS and to develop appropriate noise certification process for UAS
  - Currently working with Volpe to leverage the UAS Integration Pilot Program (IPP)
- **Urban Air Mobility (UAM)**
  - Looking to build on helicopter R&D efforts with new ASCENT project
- **Commercial Space**
  - Focus is on providing information on appropriate methodologies to use for noise modeling for the National Environmental Policy Act (NEPA)



# 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
- Optimized operations and procedures
- 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 (NOx and PM standards)

## Mitigation

- Alternative fuel sources
- Policy measures (CORSA)



# Efforts Relating to Jet Fuel

## Testing

- Support Certification/Qualification testing to ensure fuels are safe for use
- Improve Certification/Qualification process to reduce the time and resources required to ensure fuels are safe for use

## Analysis

- Environmental sustainability to ensure fuels are properly credited under the ICAO Carbon Offsetting and Reduction Scheme (CORSA)
- Techno-economic analysis to understand how to reduce costs
- Future scenarios

## Coordination

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



# Efforts Relating to Aircraft Technology

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

- FAA led public-private partnership with 100% cost share from industry
- 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

	Phase I	Phase II	Phase III*
Time Frame	2010-2015	2016-2020	2021-2025
FAA Budget	~\$125M	~\$100M	TBD
Noise Reduction Goal	25 dB cumulative noise reduction cumulative to Stage 5 <i>and/or reduces community noise exposure (new goal for Phase III)</i>		
Fuel Burn Goal	33% reduction	40% reduction	-20% re: CAEP/10 Std.
NO <sub>x</sub> Emissions Reduction Goal	60% landing/take-off NO <sub>x</sub> emissions	75% landing/take-off NO <sub>x</sub> emissions (-70% re: CAEP/8)	
Particulate Matter Reduction Goal			Reduction relative to CAEP/11 Std
Entry into Service	2018	2026	2031
*The information for the third phase of the CLEEN Program is notional as the FAA is in the process of developing the final solicitation.			



For more information on CLEEN program: <http://www.faa.gov/go/cleem>

CLEEN III Industry Day: <https://faaco.faa.gov/index.cfm/announcement/view/32134>

CLEEN III Solicitation: <https://faaco.faa.gov/index.cfm/announcement/view/31885>

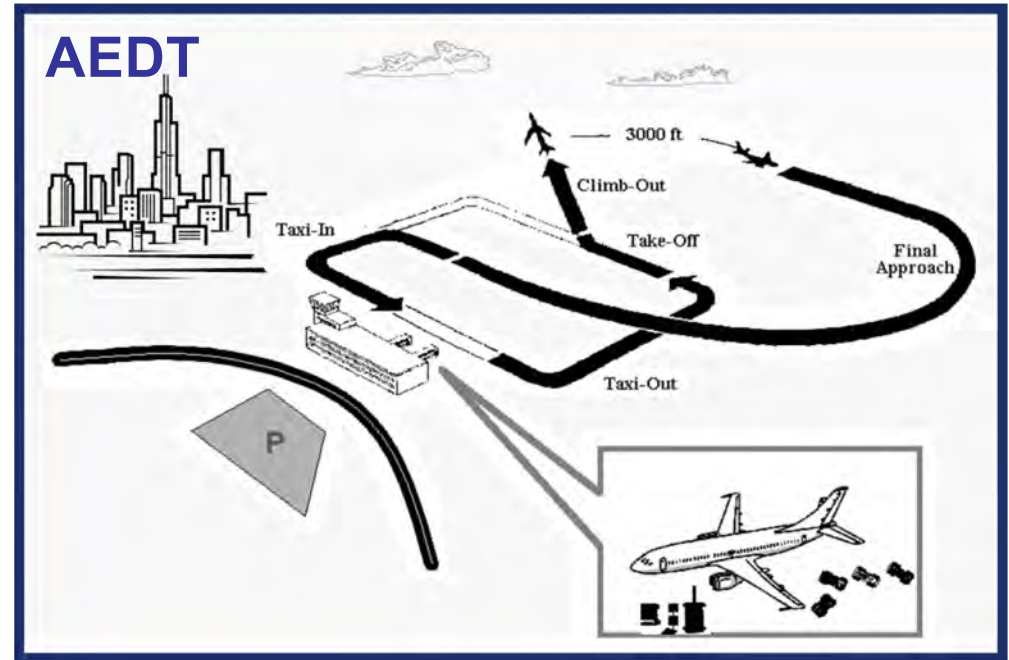


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# Aviation Environmental Design Tool (AEDT)

- Computes noise, fuel burn and emissions simultaneously
- Can analyze airport, regional, national, and global scales
- Required for all regulatory actions
- Also in use by 428 international users from 36 countries



## AEDT Development Plan

- Current version of tool, AEDT3b, has latest performance functionality (BADA4)
  - Improves capabilities at lower noise levels
  - Improves takeoff weight and thrust modeling
  - Improves aircraft performance module
- Laying ground work for AEDT4 with a planned 2022 release

# Modeling to Support Decision-Making

- Aviation environmental policies affect noise and emissions which have varied environmental impacts. Using the aviation environmental tool suite to assess the impacts of noise and emissions for policy assessment.

- Tool suite informing decision making:

*Fuel Composition*

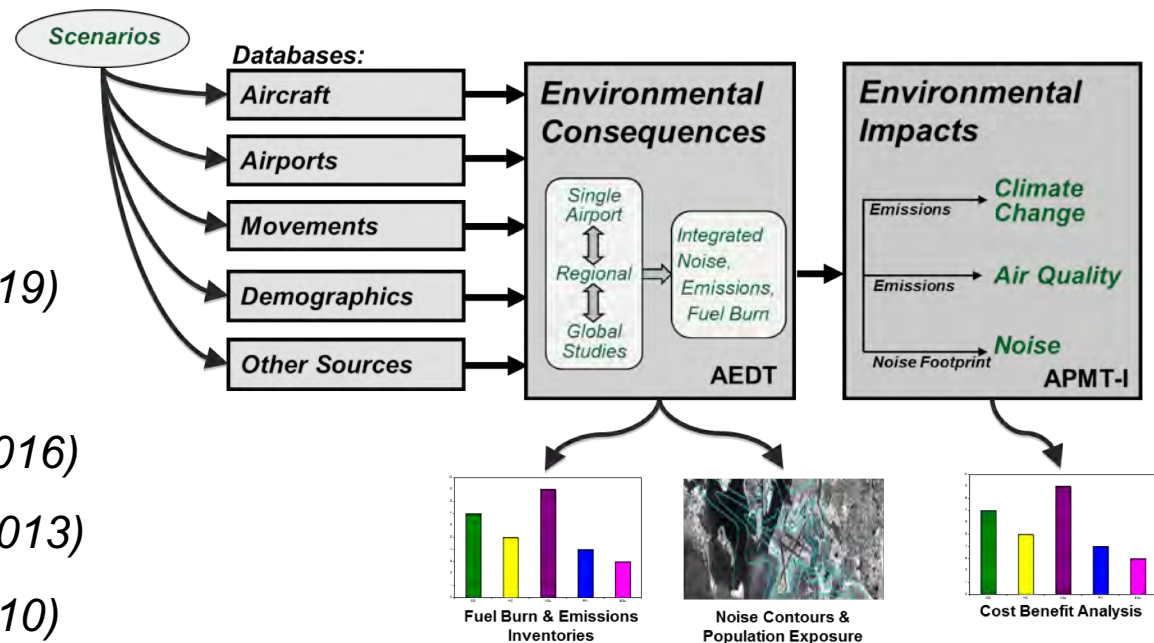
*CAEP/11 PM Standard (2019)*

*CORSIA (2019)*

*CAEP/10 CO<sub>2</sub> Standard (2016)*

*CAEP/9 Noise Standard (2013)*

*CAEP/8 NO<sub>x</sub> Standard (2010)*



- Utilize Volpe Center and ASCENT Center of Excellence universities to assist FAA in developing data to inform decision making

# Highlights of Ongoing R&D Efforts (E&E Portfolio)

- 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
- We released 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 3<sup>rd</sup> Phase of CLEEN
- Commercial space noise and emissions – on the radar



# Outreach Materials

## Continuing to maintain/update materials:

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



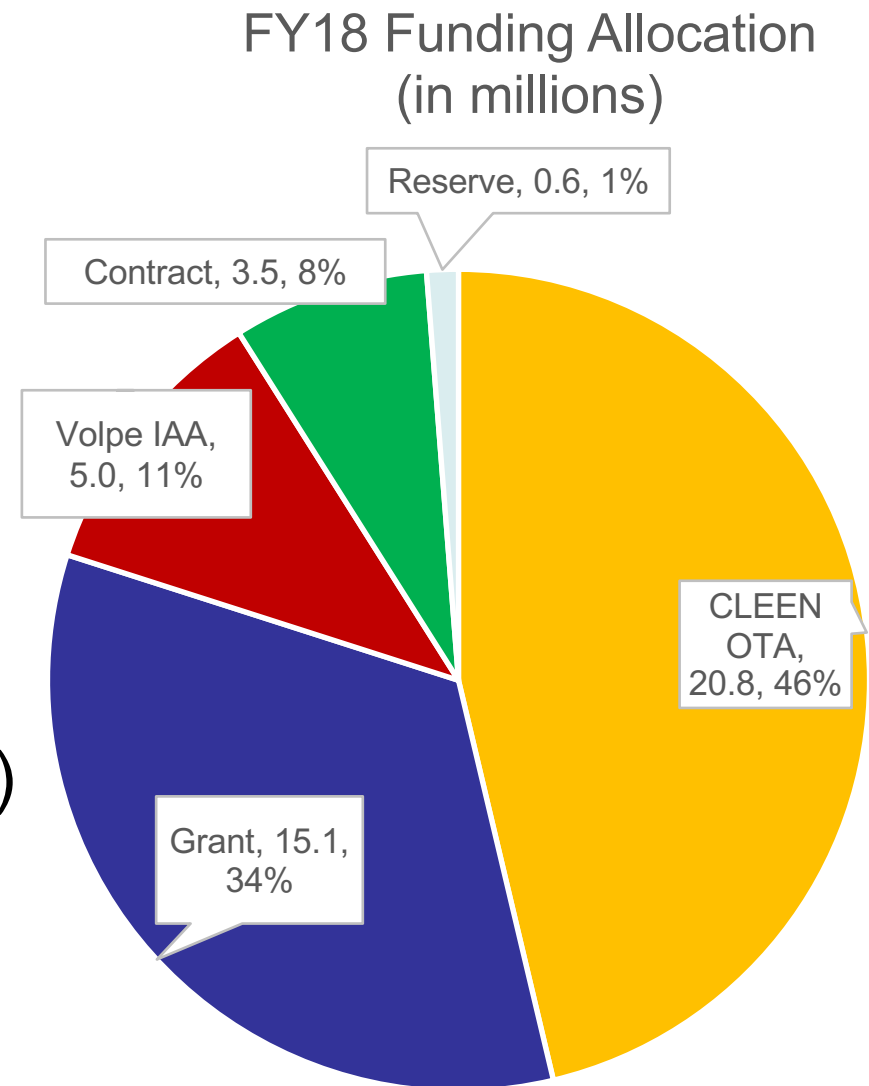
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# FY18 Funding Allocation – by Mechanism

- Primarily use three funding mechanisms to conduct R&D
- Contracts
  - CLEEN
  - PEARS-II
  - SEMRS
- Grants
  - ASCENT COE
- Inter Agency Agreement (IAA)
  - Volpe Center
- Have had challenges with contracts, grants, and IAA



# 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



# ASCENT Center of Excellence (COE)

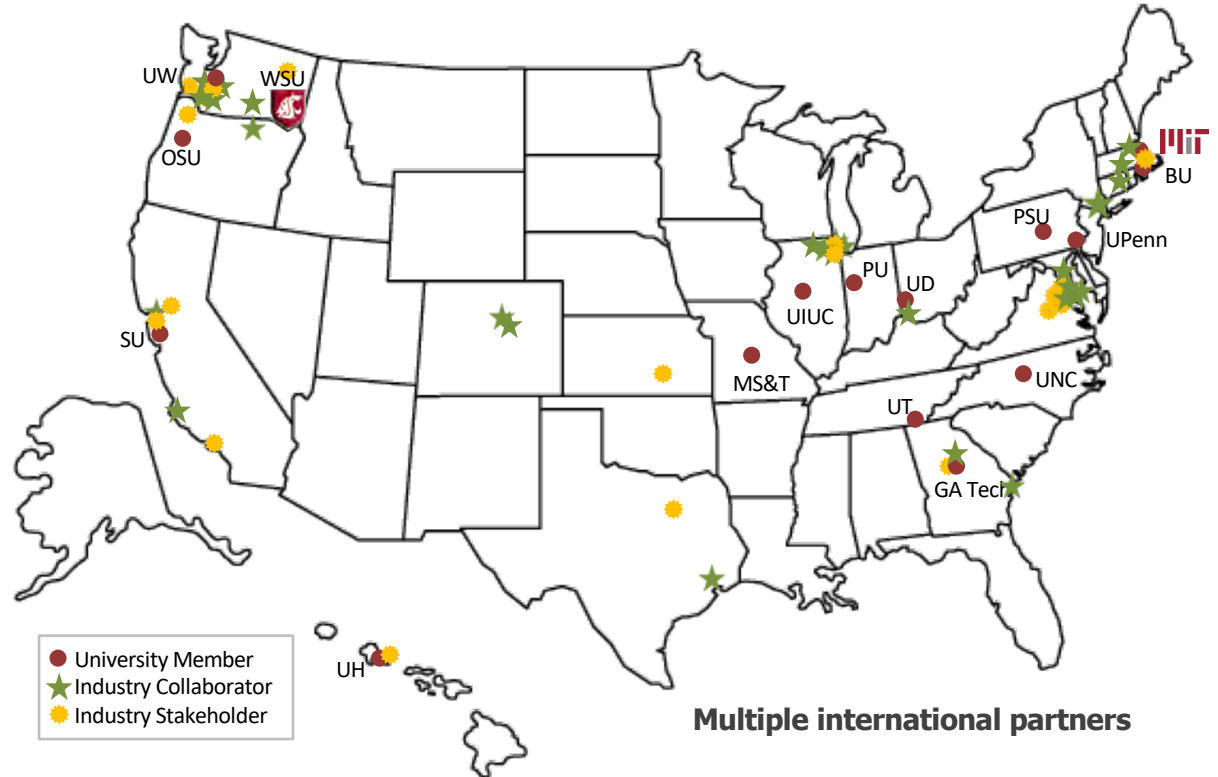


## Lead Universities:

- 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)\*



Multiple international partners

## 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, continues PARTNER with expanded efforts on alt fuels

## 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



## ASCENT Leadership

- Mike Wolcott of WSU - Director
- John Hansman of MIT - Co-Director
- Carol Sim of WSU - Assistant Director

## Coming ASCENT Meetings

- October 22-23 in Alexandria, VA (this meeting)
- Mar 31-Apr 2 in Savannah, GA

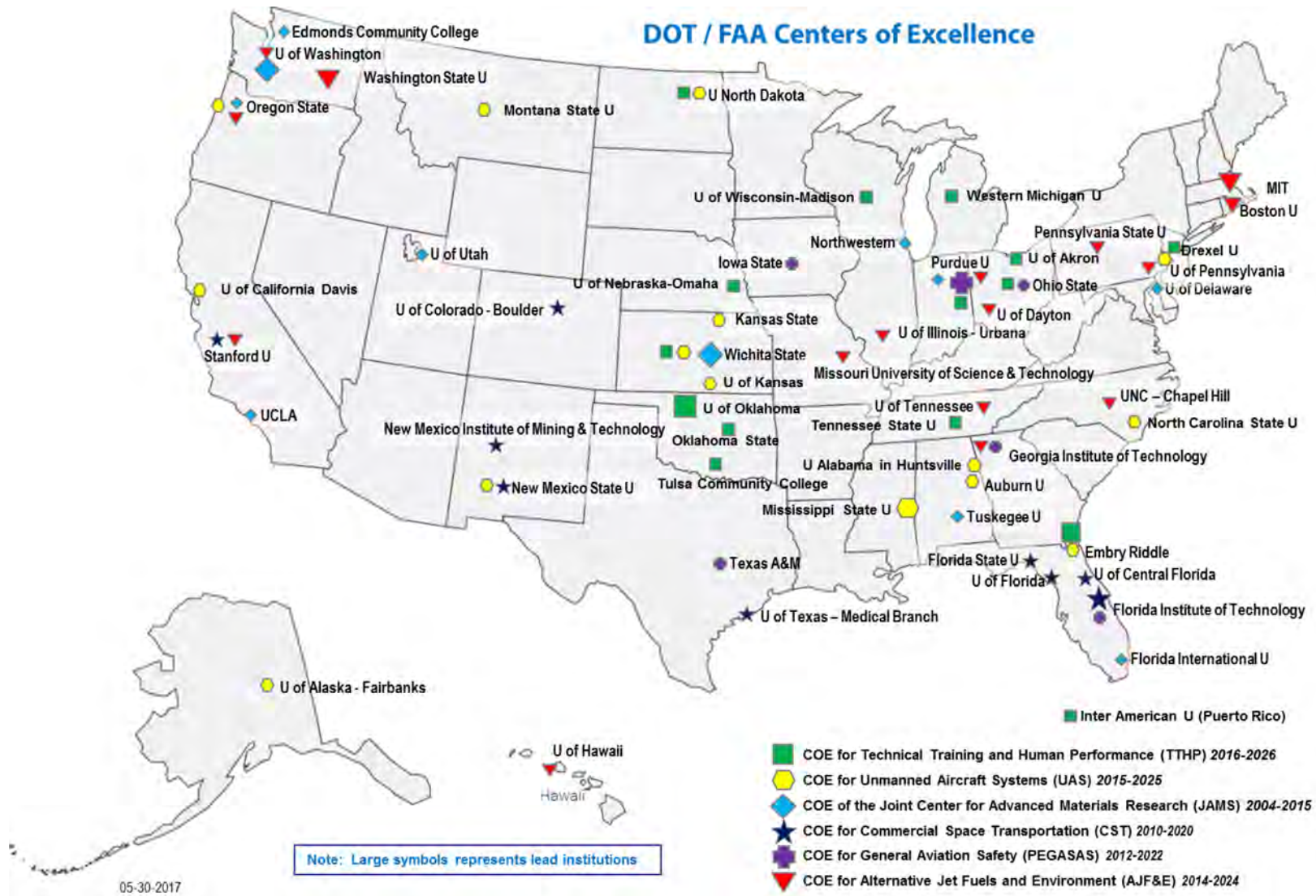
	Report 1*	Report 2	Report 3	Report 4
Time period	9/2013 – 9/2015	10/2015 – 9/2016	10/2016 – 9/2017	10/2017 – 9/2018
Research Projects	50	54	43	32
Publications, Reports, and Presentations	137	119	110	179
Students involved	131	112	105	116
Industry partners	63	70	72	72

\* ASCENT Annual Tech Reports available for download at: <https://ascent.aero/resources>



# DOT/FAA Centers of Excellence

(ASCENT is one of 6 active COEs within FAA)



# DOT/FAA Centers of Excellence Funding Profile

Depending on year, ASCENT has received 1/4 to 1/2 of overall COE funding

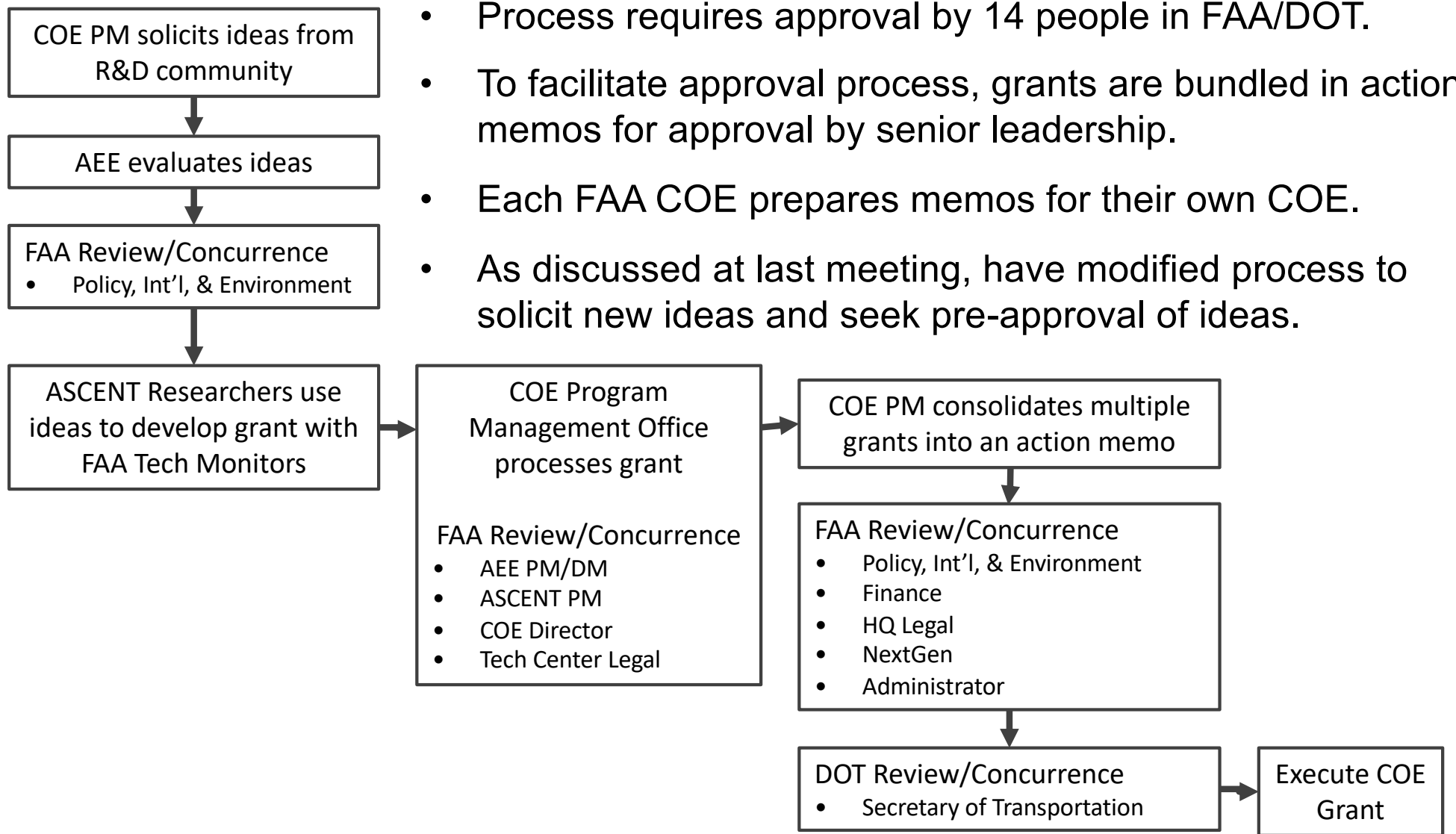
CENTER OF EXCELLENCE	FY 19 to date	FY 18	FY 17	FY 16	FY 15
Technical Training and Human Performance	\$ 1,976,527	\$ -	\$ 1,538,757	\$ 5,000,000	\$ -
Unmanned Aircraft Systems	\$ 3,532,507	\$ 6,106,452	\$ 3,883,711	\$ 3,474,932	\$ 4,763,506
Alternative Jet Fuels and Environment	\$ 7,685,041	\$ 3,170,047	\$ 9,809,723	\$ 9,393,601	\$10,598,441
General Aviation	\$ 1,547,360	\$ 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
<b>TOTAL</b>	<b>\$19,944,621</b>	<b>\$11,869,000</b>	<b>\$24,658,639</b>	<b>\$28,397,118</b>	<b>\$22,157,047</b>

## Notes:

- Data in table correct as of 10/24/2019.
- 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.
- Additional FY19 grants being processed.



# ASCENT COE Grant Approval Process



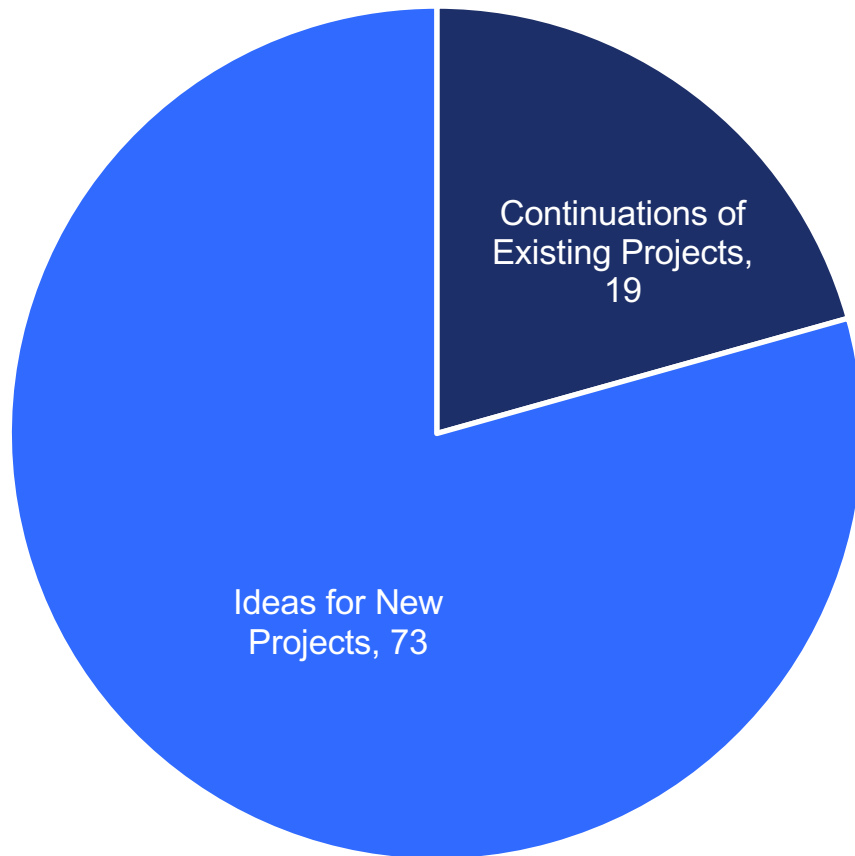
# ASCENT COE Project Idea Generation

- 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 an idea was not submitted by ASCENT university, it was submitted to all ASCENT schools through a Notice of Funding Opportunity
- AEE reviewed existing research portfolio to identify potential project extensions

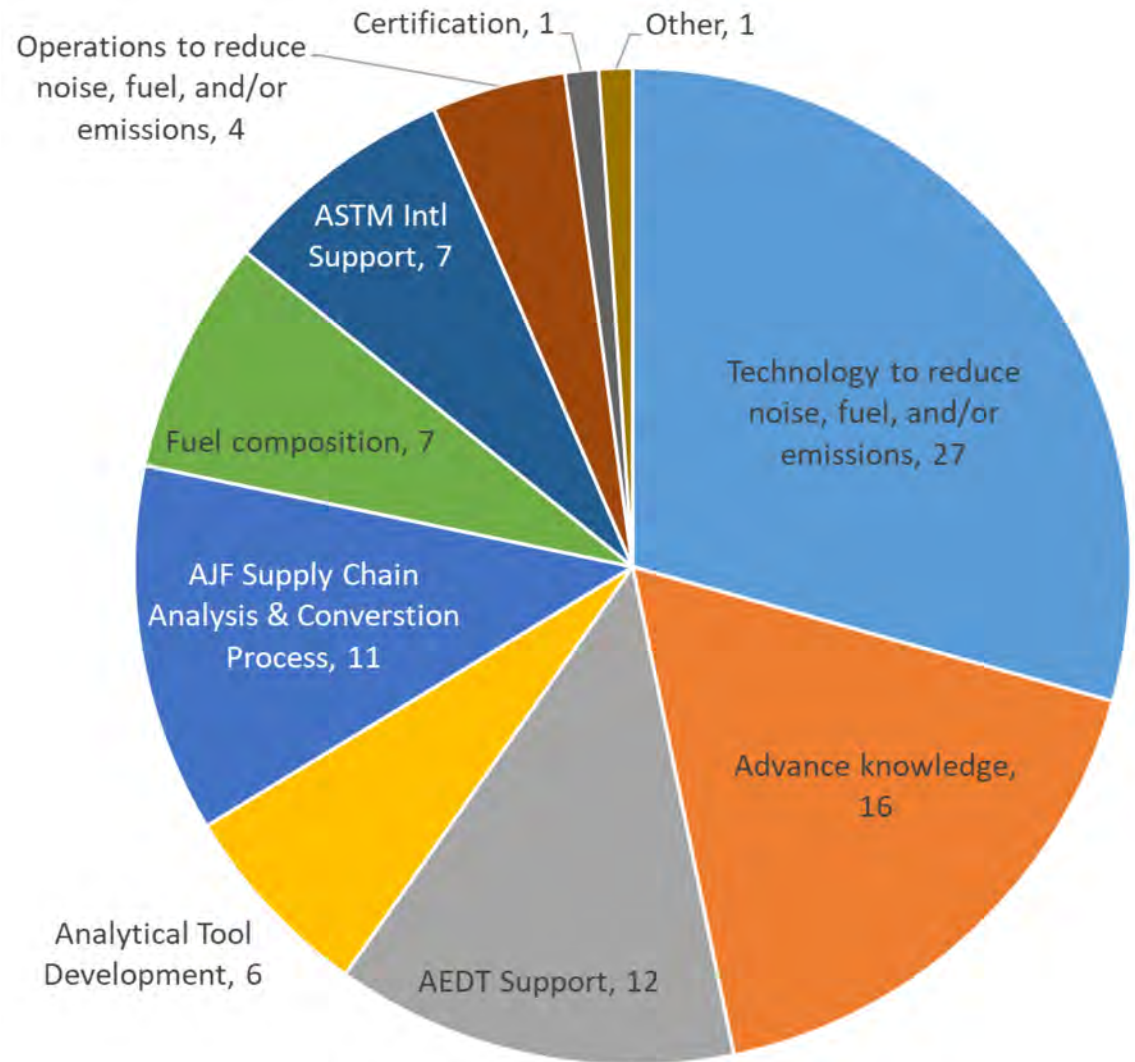


# ASCENT COE Projects Ideas

## New Ideas / Continuations



## Project Types



# Timeline of Grant Approvals

See Separate COE Project Status Document

Action Memo	# of Grants	Total Funds	APL Signature	S-1 Signature
FY2018 #1	9	\$2.8M	6/10/18	9/24/18
FY2019 #1	15	\$3.3M	10/11/18	3/29/18
FY2019 #2	8	\$2.6M	11/28/18	5/31/19
FY2019 #3	1	\$1.7M	3/21/19	6/14/19
<i>Implementing new process (APL approved project ideas between 7/19 and 9/19)</i>				
FY2020 #1	26	\$12.4M	8/28/19	TBD
FY2020 #2	3	\$2.0M	TBD	TBD
FY2020 #3	8	\$3.9M	TBD	TBD
<i>Remaining ideas under consideration (selected by AEE for consideration by APL)</i>				
TBD	4	\$1.3M	TBD	TBD



# Projects selected for FY19/20 Memos (Using FY18/19 Funding)

## Subsonic Technology Evaluation / Development

Project	University (State)	Work Description	Amount
P2 - Re-Examination of Engine to Engine PM Emissions variability using an ARP Reference Sampling and Measurement System	Missouri University of Science and Technology (MO)	Quantify the effects of ambient atmospheric conditions and fuel composition on particulate matter (a.k.a. soot) from aircraft engines.	\$1,217,221 (FY19 Memo)
P48 - Analysis to Support the Development of an Engine nvPM Emissions Standard	Massachusetts Institute of Technology (MA)	Assess the costs and benefits of implementing an aircraft engine non-volatile particulate matter (nvPM) standard.	\$200,000 (FY19 Memo)
P69 - Transitioning a research nvPM mass calibration procedure to operations	Missouri University of Science and Technology (MO)	Validate an advanced calibration method that reduces the time needed for nvPM mass instrument calibration and also reduces measurement uncertainty during certification.	\$830,000 (FY20 Memo)
P61: Noise Certification Streamlining	Georgia Institute of Technology (GA)	Examine the process of noise certification and develop a streamlined approach that is flexible enough for current, emerging, and future air vehicles.	\$250,000 (FY20 Memo)
P37 - Continuous Lower Energy Emissions and Noise (CLEEN) II Aircraft Technology Modeling and Assessment	Georgia Institute of Technology (GA)	Assess the reductions in fuel consumption, emissions, and noise that could result from the fleet-wide introduction of CLEEN technologies.	\$170,000 (FY19 Memo) \$ 240,000 (FY20 Memo)
P50 - Over-Wing Engine Placement Evaluation	Georgia Institute of Technology (GA)	Analyze potential reduction in fuel burn and noise from changing the placement of aircraft engines on modern aircraft.	\$ 590,000 (FY20 Memo)
P51 - Combustion concepts for next-generation aircraft engines	Massachusetts Institute of Technology (MA)	Analyze combustion concepts that could be used to reduce particulate matter emissions from future aircraft engines.	\$ 300,000 (FY20 Memo)
P55 - Noise Generation and Propagation from Advanced Combustors	Georgia Institute of Technology (GA)	Conduct experiments and analysis to develop analytical tools that can be used by industry to reduce the noise generated by combustors in modern jet engines.	\$ 1,499,984 (FY20 Memo)
P56 - Turbine Cooling Through Additive Manufacturing	Pennsylvania State University (PA)	Conduct experiments and analysis to determine how new manufacturing techniques could be used to improve the fuel efficiency of modern jet engines.	\$ 400,000 (FY20 Memo)
P63 - Parametric Noise Modeling For Boundary Layer Ingesting Propulsors	Georgia Institute of Technology (GA)	Identify, develop, and validate a parametric fan noise module for a generic boundary layer ingesting gas turbine engine.	\$300,000 (FY20 Memo)
P64 - Alternative Design Configurations to meet Future Demand based on Constrained Airport Capacities	Georgia Institute of Technology (GA)	Investigate alternative design configurations to meet the forecasted passenger demand of the future while minimizing the environmental footprint.	\$250,000 (FY20 Memo)
P68 - Combustor Wall Cooling Concepts for Dirt Mitigation	Pennsylvania State University (PA)	Develop more effective combustor wall cooling concepts for operation in "dirty" environments.	\$150,000 (FY20 Memo)





# Projects selected for FY19/20 Memos (Using FY18/19 Funding)

## Supersonic Technology Evaluation / Development

Project	University (State)	Work Description	Amount
P10 - Aircraft Technology Modeling and Assessment	Georgia Institute of Technology (GA)	Evaluate supersonic aircraft technologies and evolution of the fleet in response to the introduction of these technologies to support decision making by the FAA in ICAO CAEP.	\$ 650,000 (FY20 Memo)
	Purdue University (IN)		\$ 1,200,000 (FY20 Memo)
P41 - Identification of Noise Acceptance Onset for Noise Certification Standards of Supersonic Airplane	Pennsylvania State University (PA)	Support development of certification processes for future civilian supersonic aircraft	\$ 114,815 (FY19 Memo)
P42 - Acoustical Model of Mach Cut-off Flight	Pennsylvania State University (PA)	Evaluate the feasibility of Mach Cut-off Flight as a means to enable supersonic flight over land.	\$ 222,116 (FY20 Memo)
P47 - Clean Sheet Supersonic Aircraft Engine Design and Performance	Massachusetts Institute of Technology (MA)	Analyze performance of gas turbine engines specifically designed for use on civil supersonic aircraft.	\$ 390,000 (FY19 Memo)
P57 - Support for Supersonic Aircraft Noise Efforts in ICAO CAEP	Pennsylvania State University (PA)	Support development of certification processes for future civilian supersonic aircraft	\$ 170,000 (FY19 Memo)
P59: Jet Noise Modeling to Support Low Noise Supersonic Aircraft Technology Development	University of Illinois (IL)	Use state-of-the-art multi-fidelity modeling approaches and experiments to improve jet noise modeling to enable improved designs for reduced noise civil supersonic jet transports.	\$ 250,000 (FY19 Memo)
	Stanford University (CA)		\$ 400,000 (FY20 Memo)
	Pennsylvania State University (PA)		\$ 200,000 (FY20 Memo)
	Georgia Institute of Technology (GA)		\$ 800,000 (FY20 Memo)



# Projects selected for FY19/20 Memos (Using FY18/19 Funding)

## Jet Fuels Analysis and CORSIA Support

Project	University (State)	Work Description	Amount
P1 - Alternative Jet Fuel Supply Chain Analysis	Washington State University (WA)	Provide scientific data and analysis to support the evaluation of fossil and renewable jet fuels for potential inclusion in the ICAO Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).	\$ 510,918 (FY19 Memo) \$ 525,001 (FY20 Memo)
	Massachusetts Institute of Technology (MA)		\$ 575,000 (FY19 Memo) \$ 400,000 (FY20 Memo)
	Purdue University (IN)		\$ 400,000 (FY19 Memo) \$ 523,000 (FY20 Memo)
	University of Tennessee (TN)	Evaluate regional alternative jet fuel supply chains in terms of their potential for domestic fuel production and rural economic development.	\$ 260,000 (FY19 Memo) \$ 250,000 (FY20 Memo)
	Pennsylvania State University (PA)		\$207,623 (FY19 Memo)
	University of Hawaii		\$200,000 (FY19 Memo)
P39 - Naphthalene Removal Assessment	Massachusetts Institute of Technology (MA)	Assess the costs and benefits of reducing the naphthalene content in jet fuel.	\$350,000 (FY19 Memo)
P52 - Comparative assessment of electrification strategies for aviation	Massachusetts Institute of Technology (MA)	Analyze the relative economic and environmental benefits of using electricity to power future aircraft via batteries versus liquid fuels produced from electricity.	\$ 300,000 (FY20 Memo)



# Projects selected for FY19/20 Memos (Using FY18/19 Funding)

## Jet Fuels Testing

Project	University (State)	Work Description	Amount
P25 - Shock Tube and Flow Reactor Studies of the Kinetics of Jet Fuels (National Jet Fuels Combustion Program: Area #1)	Stanford University (CA)	Develop experimental database to test and refine computer models of jet fuel chemistry and its impact on combustion.	\$110,000 (FY19 Memo)
P27 - Advanced Combustion (National Jet Fuels Combustion Program: Area #3)	Georgia Institute of Technology (GA)	Characterize how jet fuel composition affects the likelihood that combustion gas turbine engines would stop.	\$30,000 (FY19 Memo)
P29 - Atomization Tests and Models (National Jet Fuels Combustion Program: Area #5)	Purdue University (IN)	Use experiments to understand how fuel composition affects spray properties within a combustor.	\$120,000 (FY19 Memo)
P31 - Alternative Jet Fuel Test and Evaluation to support the ASTM International Approval Process	University of Dayton (OH)	In collaboration with industry, conduct combustion testing of novel drop-in jet fuels to ensure they are safe for use.	\$199,966 (FY19 Memo) \$ 1,926,434 (FY20 Memo)
P33 - Alternative Fuels Test Database Library	University of Illinois (IL)	Develop a comprehensive database of test results that have been conducted on jet fuels with varied chemical composition.	\$ 130,000 (FY19 Memo) \$ 130,000 (FY20 Memo)
P34 - National Jet Fuels Combustion Program – Overall Program Integration and Analysis	University of Dayton (OH)	Characterize how jet fuel composition affects the likelihood that combustion gas turbine engines would stop.	\$ 582,983 (FY20 Memo)
P65 -Fuel Testing Approaches for Rapid Jet Fuel Pre-screening to enable Fast Track Approvals of Alternative Jet Fuels in ASTM International	University of Dayton (OH)	Establish a formal tiered fuel prescreening process to provide very early indications of candidate fuel blend limits and operability pitfalls.	\$260,000 (FY20 Memo)
	University of Illinois (IL)		
P66 - Evaluation of Engine Fuel Burn and Thermal Management Benefits with Use of High Thermal Stability Fuels	University of Dayton (OH)	Evaluate potential improvements in jet engine fuel burn when fuels with high thermal stability are used as coolants.	\$185,000 (FY20 Memo)
P67 - Impact of Fuel Heating on Combustion Performance and Emissions for a Lean Dome Combustor	Purdue University (IN)	Investigate the effects of heated fuel on combustion performance and the level of emissions for a modern, lean burn combustor.	\$250,000 (FY20 Memo)



# Projects selected for FY19/20 Memos (Using FY18/19 Funding)

## Operational Procedures to Reduce Noise

Project	University (State)	Work Description	Amount
P23 - Analytical Approach for Quantifying Noise from Advanced Operational Procedures	Massachusetts Institute of Technology (MA)	Use noise analysis framework to develop advanced operational procedure concepts.	\$ 250,000 (FY19 Memo) \$ 250,000 (FY20 Memo)
P38 - Rotorcraft Noise Abatement Procedures Development	Pennsylvania State University (PA)	Develop rotorcraft noise abatement procedures through computational and analytical modeling.	\$ 150,000 (FY19 Memo) \$ 150,000 (FY20 Memo)
P44 - Aircraft Noise Abatement Procedure Modeling and Validation	Massachusetts Institute of Technology (MA)	Validate noise reductions from advanced operational flight procedure concepts that use modified configurations and reduced speed.	\$350,000 (FY19 Memo)
P49 - Urban Air Mobility Noise Reduction Modeling	Pennsylvania State University (PA)	Extend helicopter noise modeling efforts to urban air mobility vehicles to identify means for noise reduction.	\$ 280,000 (FY20 Memo)



# Projects selected for FY19/20 Memos (Using FY18/19 Funding)

## AEDT Development Support

Project	University (State)	Work Description	Amount
P19 - Development of Aviation Air Quality Tools for Airport Specific Impact Assessment - Air Quality Modeling	University of North Carolina (NC)	Improve modeling tools that are used as a part of mandatory National Environmental Policy Act (NEPA) reviews.	\$ 300,000 (FY19 Memo) \$ 350,064 (FY20 Memo)
P36 - Parametric Uncertainty Assessment for AEDT	Georgia Institute of Technology (GA)	Provide a robust uncertainty evaluation of the AEDT to inform future development of the tool.	\$300,000 (FY19 Memo)
P40 - Quantifying Uncertainties in Predicting Aircraft Noise in Real-World Situations	Purdue University (IN)	Understand and quantify uncertainties in the prediction of noise from aircraft operations that accounts for real-world situations such as actual weather conditions.	\$85,000 (FY19 Memo)
	Penn. State University (PA)		\$170,000 (FY19 Memo)
P43 - Noise Power Distance Re-Evaluation	Georgia Institute of Technology (GA)	Develop an improved noise prediction architecture for the AEDT.	\$ 220,000 (FY19 Memo) \$ 200,000 (FY20 Memo)
P45 - Takeoff / Climb Analysis to Support AEDT Aircraft Performance Module Development	Georgia Institute of Technology (GA)	Provide data and methods to improve the aircraft weight and takeoff thrust modeling capabilities within the AEDT	\$175,000 (FY19 Memo)
P46 - Surface Analysis to support AEDT APM Development	Massachusetts Institute of Technology (MA)	Identify and evaluate methods for improving taxi performance modeling in the AEDT to better reflect actual operations.	\$ 75,000 (FY19 Memo) \$ 200,000 (FY20 Memo)
P53 - Validation of low exposure noise modeling by open source data management and visualization systems integrated with AEDT	Stanford University (CA)	Use AEDT to improve noise prediction methods in an open-source overflight analysis tool and leverage noise monitor data and Stanford software expertise to improve AEDT capabilities.	\$ 169,903 (FY20 Memo)
P54 - AEDT Evaluation and Development Support	Georgia Institute of Technology (GA)	Identify and evaluate methods that could be used to improve the performance modeling within AEDT to better reflect actual operations.	\$ 700,000 (FY20 Memo)
P60: Analytical Methods for Expanding the AEDT Aircraft Fleet Database	Georgia Institute of Technology (GA)	Improve the accuracy of AEDT noise and emissions modeling of aircraft not currently in the Aircraft Noise and Performance (ANP) database.	\$150,000 (FY20 Memo)
P62: Noise Model Validation for AEDT	Georgia Institute of Technology (GA)	Assess the accuracy of AEDT in calculating noise in both the vicinity of airports as well as further afield	\$350,000 (FY20 Memo)
	Penn .State University (PA)		

# Projects selected for FY19/20 Memos (Using FY18/19 Funding)

## Environmental Impact Examination

Project	University (State)	Work Description	Amount
P3: Cardiovascular Disease and Aircraft Noise Exposure	Boston University (MA)	Evaluate impacts of civil aircraft noise on health in terms of heart disease.	\$1,729,286 (FY19 Memo)
P18: Community Measurements of Aviation Emissions Contributions to Ambient Air Quality	Boston University (MA)	Examine community air quality measurements to determine the contributions of aircraft to ground based concentrations.	\$1,299,991 (FY20 Memo)
P22: Evaluation of FAA Climate Tools	University of Illinois (IL)	Use state-of-the-art geophysical models of the earth system to evaluate costs and benefits of technologies that could enable supersonic aviation.	\$ 200,000 (FY20 Memo)
P58: Improving Policy Analysis Tools to Evaluate Aircraft Operations in the Stratosphere	Massachusetts Institute of Technology (MA)	Use state-of-the-art science to improve existing analytical tools to enable rapid assessments of the effects of high altitude emissions on the atmosphere.	\$ 500,000 (FY20 Memo)

## Other Projects

Project	University (State)	Work Description	Amount
P0 - Program Office for Center of Excellence for Alternative Jet Fuels and Environment	Washington State University (WA)	Provide program office support for the Center of Excellence for Alternative Jet Fuels and Environment.	\$390,911 (FY19 Memo) \$ 399,713 (FY20 Memo)
P8 - Outreach Project	Pennsylvania State University (PA)	Provide educational information on aviation noise to stakeholders through the NoiseQuest website	\$30,000 (FY19 Memo)



# Next Steps on ASCENT Grants

- Working to develop and process FY20 action memos
- Working with APL to get decision on four remaining project ideas (these ideas are largely focused on fuels and technology development)
- Once we have decision on the four remaining projects, will notify all of ASCENT that this round of idea solicitation is closed
- Do not intend to solicit another round of project ideas
  - Many of the projects that are listed above are multi-year efforts and, if funded, would use \$14M of the FY2020 budget
  - We continue to be interested in good ideas so please do share them, but we will not send out a formal solicitation



# Presentation Outline

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





# Recent Successes

## capabilities and solutions that are helping today

- Noise research continues. Community noise survey under review. Starting work on national sleep study. Resumed work to understand potential health impacts of noise.
- Analytical framework was used to develop operational procedure concepts for Boston Logan that could provide noise reduction. Work is continuing to evaluate communication tools, develop additional concepts, and evaluate potential for broader use.
- Aviation Environmental Design Tool (AEDT) being upgraded to better capture actual operations and is being used extensively.
- Measurement technique and data provided foundation for new ICAO CAEP nvPM engine standard that will replace the existing smoke number standard in 2023.
- Analytical tools provided foundation for ICAO CAEP Independent Expert review of aircraft technologies for the purpose of setting goals for noise, fuel burn, and NO<sub>x</sub> emissions.
- Provided critical analytical support to the development of Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).
- Research efforts were critical for the inclusion of sustainable aviation fuels within CORSIA.
- Certification of five alternative jet fuel pathways – certification has enabled multiple airlines to buy and use sustainable aviation fuels in LAX and elsewhere.
- CLEEN aircraft and engine technologies appearing in new aircraft with FMS technologies retrofitted into today's fleet. Will reduce noise, emissions, and fuel use for decades to come.
- Research efforts are paving the way for the re-introduction of supersonic aircraft.

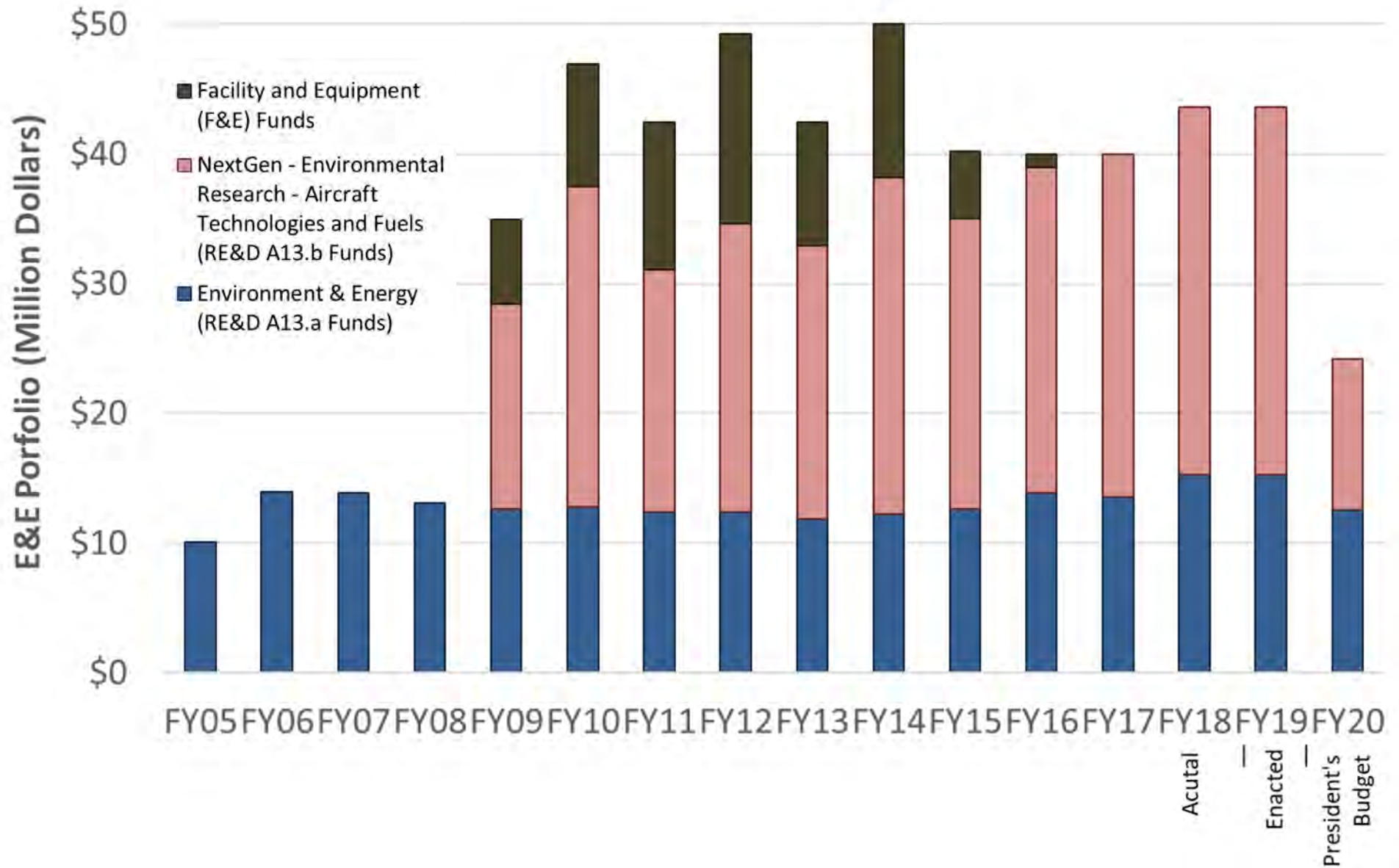


# Presentation Outline

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# Funding Profile - E&E Portfolio (Contract Funding)

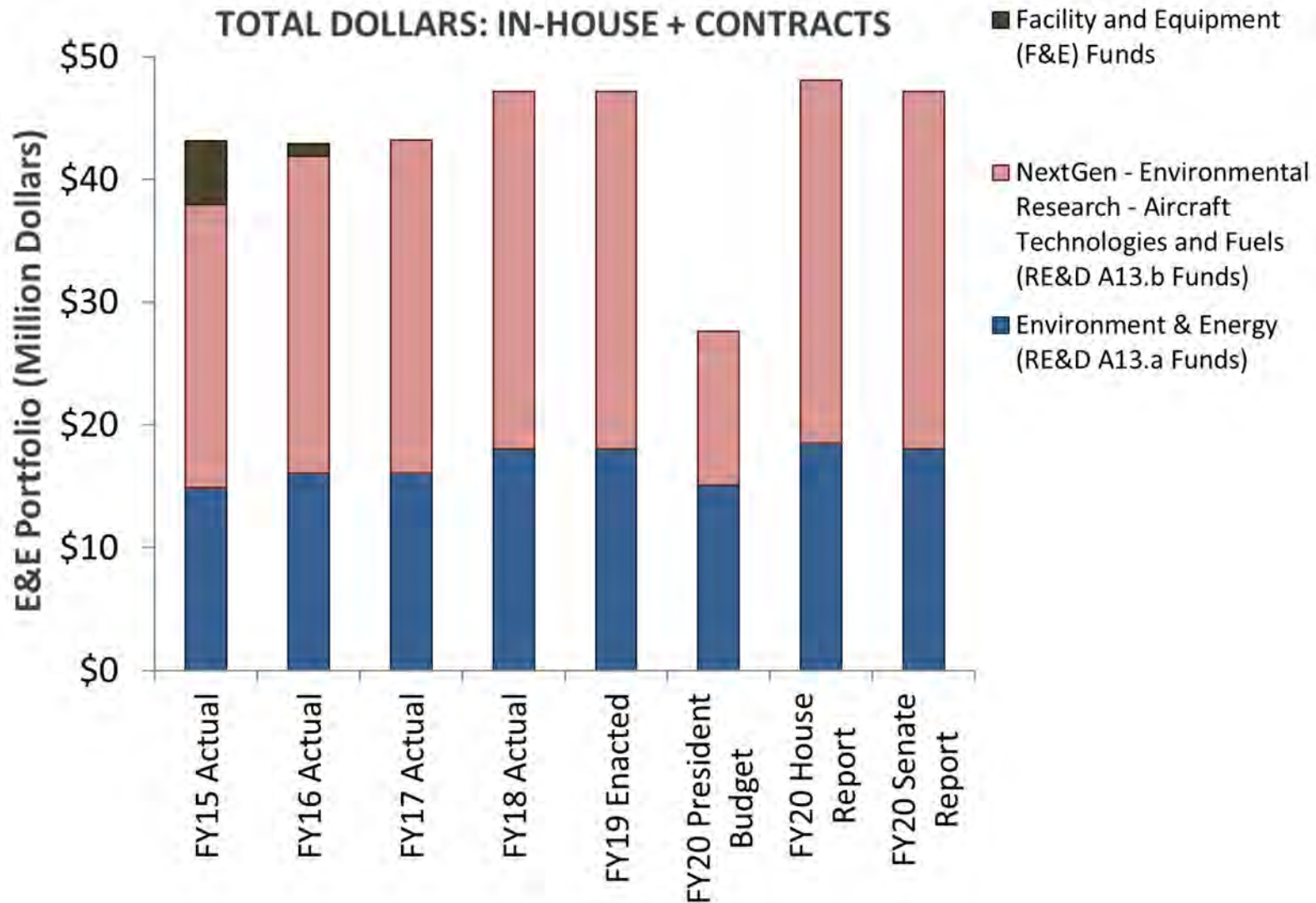


**Not shown on graph:**

- Airport Technology Research has ~\$1.5M/year for noise/environment projects
- Airports Cooperative Research Program (ACRP) provides ~\$5M/year for environment projects



# 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
  - Continuing 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)*

