

CLEEN (Continuous Lower Energy, Emissions and Noise) Program

Program Overview and Coordination with NASA

Presented to: NASA Green Aviation Summit

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By: Federal Aviation Administration
Office of Environment and Energy

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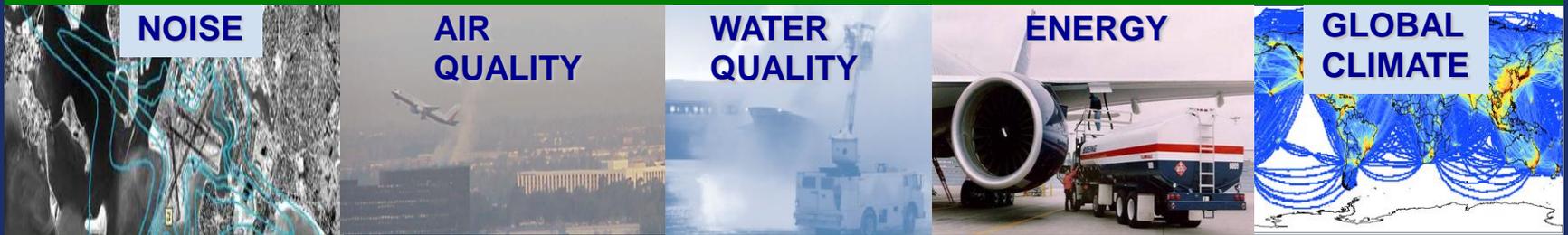


Federal Aviation
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Aviation Environmental Goals and Challenges

NextGen goal to increase mobility is dependent upon addressing & mitigating aviation environmental impacts & dealing with related energy issues



NextGen environmental goals

- Absolute reduction of significant **community noise** and **air quality** emissions impacts
- Improve NAS **energy** efficiency and, supply of and access to, alternative fuel sources
- Achieve carbon neutral growth by 2020 compared to 2005 baseline for **climate change**
- Reduce significant aviation impacts associated with **water quality**

5-Pillar approach to develop solutions

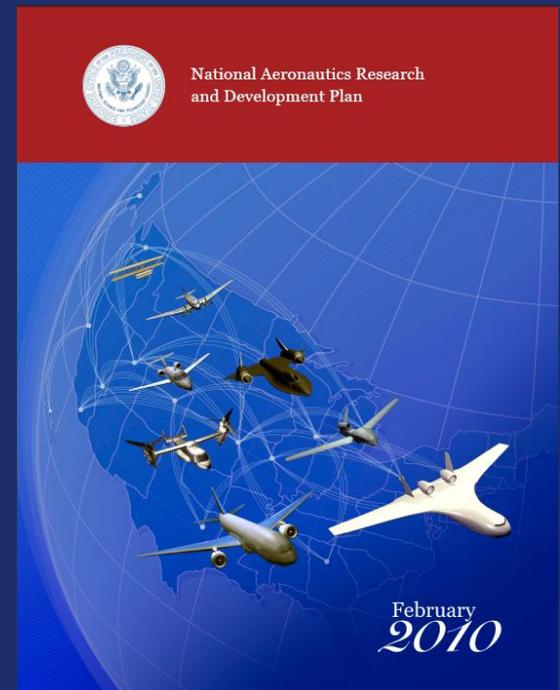
- P1 Improved science and modeling
- P2 Accelerated maturation of new aircraft technologies
- P3 Renewable fuels
- P4 Accelerated ATM Improvements and Efficiencies
- P5 Policies, Environmental Standards, Market Based Measures and Environmental Management System

Key FAA Environment & Energy R&D Initiatives

- Development of Integrated Analytical Models
 - EDS: Environmental Design Space
 - AEDT: Aviation Environmental Design Tool
 - APMT: Aviation environmental Portfolio Management Tool
- **CLEEN: Continuous Lower Energy, Emissions and Noise**
- CAAFI: Commercial Aviation Alternative Fuels Initiative
- ACCRI: Aviation Climate Change Research initiative
- AEC: Aviation Emissions Characterization Roadmap
- Noise Research Framework
- Operations Research Framework
- Environmental Management System

FAA CLEEN Program

- Address NextGen environmental goals in partnership with industry
- Mature and demonstrate promising energy efficient, clean and quiet technologies
- Advance sustainable alternative fuels for aviation
- Assess technology suitability for retrofit or re-engine
- Meet national R&D goals



CLEEN Program Goals

Develop and demonstrate (TRL 6-7) certifiable aircraft technology

	N+1 (2015) CONVENTIONAL CONFIGURATION RELATIVE TO 1998	N+2 (2020-25) UNCONVENTIONAL CONFIGURATION RELATIVE TO 1998	N+3 (2030-35) ADVANCED CONCEPTS RELATIVE TO 2005
NOISE	-32 dB cum below Stage 4	-42 dB cum below Stage 4	-71 dB cum below Stage 4
LTO NOX EMISSIONS (BELOW CAEP 6)	-60%	-75%	better than -75%
AIRCRAFT FUEL BURN	-33%	-50%	better than -70%

CLEEN Program Goals (continued)

Advance use of “drop-in” alternative fuels in aircraft systems focusing on renewable options

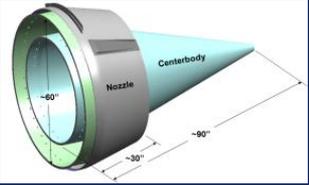
- No compromise in safety
- Successful demonstration
- Quantification of environmental impacts, costs and benefits



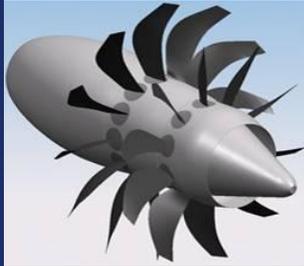
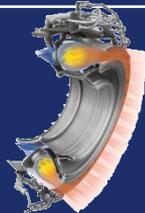
CLEEN Timeframe and Funding

- Timeframe: CY 2010-2014
- Total Budget: \$125M (1:1 Cost Share)
- Market Research Conference: May 2008
- Solicitation released: May 12, 2009
- Solicitation closed: July 21, 2009
- Awards Completed: June 22, 2010
- CLEEN Companies: Boeing, GE, Honeywell, P&W and Rolls-Royce

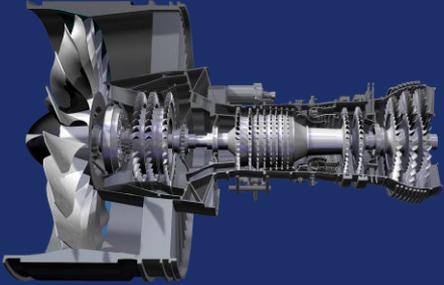
CLEEN Technologies

Company	Technology	Goal Impact	
Boeing	<p>Ceramic Matrix Composite Acoustic Nozzle</p>		Fuel-burn
	<p>Adaptable Trailing Edges</p>		Noise
	<p>Fuel system material swell & fuel absorption</p>		Fuel-burn
		Noise	
		Alt Fuels	

CLEEN Technologies

Company	Technology	Goal Impact
GE	Open Rotor 	Fuel-burn Noise
	TAPS II Lean Combustor 	Emissions
	Flight Mgt System /Air Traffic Mgt System Optimization	Fuel-burn Noise

CLEEN Technologies

Company	Technology	Goal Impact
Honeywell	Engine weight reduction; high T3 impeller; advanced materials	Fuel-burn
	100% HRJ & bio-aromatic assessments & flt test	Alt Fuels
P&W	Ultra-high Bypass Ratio Geared Turbo Fan 	Fuel-burn
		Emis-sions
		Noise

CLEEN Technologies

Company	Technology	Goal Impact
Rolls-Royce	Dual wall turbine blade	Fuel-burn
	Ceramic Matrix Composite turbine blade tracks	Fuel-burn
	HRJ Characterization & flight test of alternative fuel (business jet)	Alt Fuels
	Engine tests of future alternative fuels (twin-aisle aircraft)	Alt Fuels

FAA/NASA Coordination

NASA has provided support to FAA on CLEEN, including:

- Market Research Conference
- Helping to develop solicitation
- Serving on proposal evaluation panel
- Participating in kick-off meetings

FAA/NASA Coordination (cont)

FAA has provided support to NASA on ISRP/ERA, including:

- Participating in ISRP/ERA program reviews
- Participating in N+2 Advanced Vehicle Concepts Bidders conference
- Serving on proposal evaluation panel

FAA/NASA Coordination (cont)

Continued coordination going forward, including:

- CLEEN Consortium
- CLEEN data sharing with NASA
- FAA and NASA program reviews
- Continuation of biweekly telecons to coordinate programmatic and technical issues
- Future workshops

Summary

- FAA R&D initiatives addressing NextGen and National R&D environment and energy goals
- CLEEN Program is off and running
- FAA and NASA are coordinating closely in environment and energy research



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