NASA ARMD Participation in the CLEEN Program

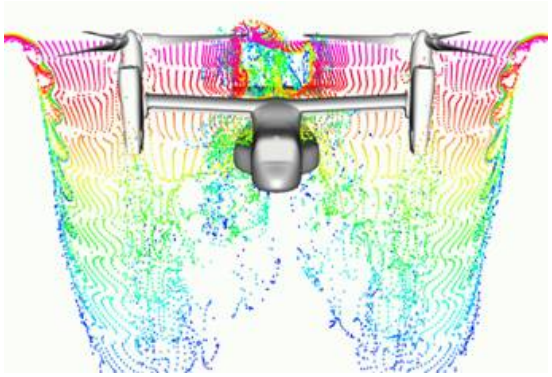
CLEEN Program Market Survey Conference

Washington, DC

May 15, 2008

Juan J. Alonso

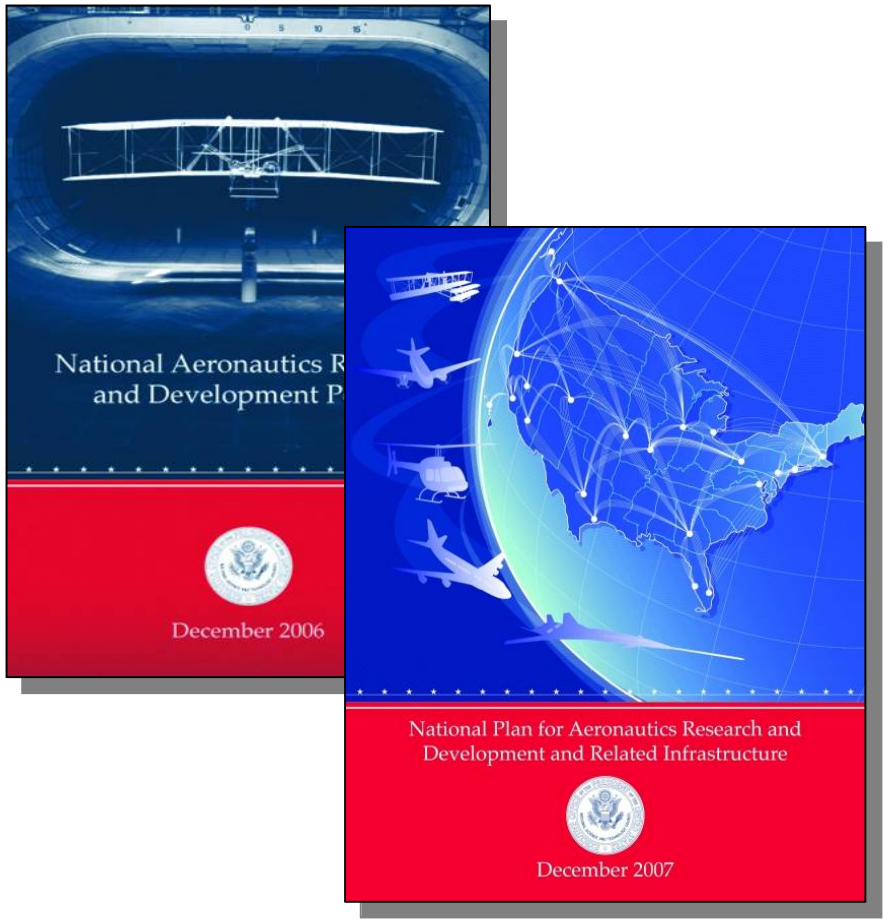
Director, NASA Fundamental Aeronautics Program



CLEEN Addresses National Aeronautics R&D Policy and Plan Objectives

- **Policy**
  - Executive Order signed December 2006
  - Outlines 7 basic principles to follow in order for the U.S. to "maintain its technological leadership across the aeronautics enterprise"
  - Mobility, national security, aviation safety, security, workforce, energy & efficiency, and environment

- **Plan (including Related Infrastructure)**
  - Plan signed by Pres. Bush December 2007
  - Goals and Objectives for all basic principles (except Workforce, being worked under a separate doc)
  - Summary of challenges in each area and the facilities needed to support related R&D
  - Specific quantitative targets where appropriate
  - More detailed document/version to follow later in 2008



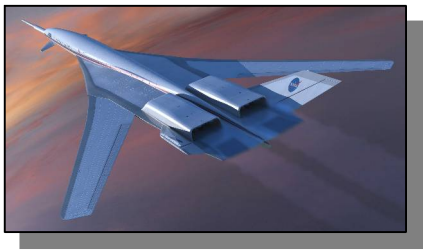
Executive Order, Policy, Plan, and Goals & Objectives all available on the web

For more information visit: http://www.ostp.gov/cs/nstc/documents_reports

NASA Fundamental Aeronautics Program

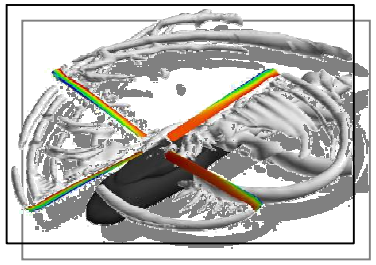
- ***Hypersonics***
  - Fundamental research in all disciplines to **enable very-high speed flight** (for launch vehicles) and **re-entry into planetary atmospheres**
  - High-temperature materials, thermal protection systems, advanced propulsion, aero-thermodynamics, multi-disciplinary analysis and design, GNC, advanced experimental capabilities

- ***Supersonics***
  - **Eliminate environmental and performance barriers** that prevent **practical supersonic vehicles** (cruise efficiency, noise and emissions, vehicle integration and control)
  - Supersonic deceleration technology for **Entry, Descent, and Landing** into Mars



- ***Subsonic Fixed Wing (SFW)***
  - Develop revolutionary technologies and aircraft concepts with highly **improved performance** while satisfying **strict noise and emission constraints**
  - Focus on **enabling technologies**: acoustics predictions, propulsion / combustion, system integration, high-lift concepts, lightweight and strong materials, GNC

- ***Subsonic Rotary Wing (SRW)***
  - Improve **civil potential of rotary wing vehicles** (vs fixed wing) while maintaining their unique benefits
  - Key **advances** in multiple areas through **innovation** in materials, aeromechanics, flow control, propulsion



SFW System Level Metrics

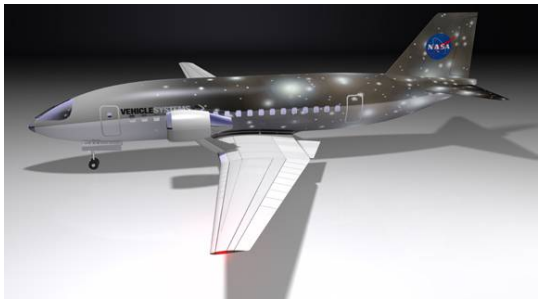
CORNERS OF THE TRADE SPACE	N+1 (2015 EIS) Generation Conventional Tube and Wing (relative to B737/CFM56)	N+2 (2020 IOC) Generation Unconventional Hybrid Wing Body (relative to B777/GE90)	N+3 (2030-2035 EIS) Generation Advanced Aircraft Concepts (relative to user defined reference)
Noise	- 32 dB (cum below Stage 4)	- 42 dB (cum below Stage 4)	55 LDN (dB) at average airport boundary
LTO NOx Emissions (below CAEP 6)	-60%	-75%	better than -75%
Performance: Aircraft Fuel Burn	-33%**	-40%**	better than -70%
Performance: Field Length	-33%	-50%	exploit metro-plex* concepts

** An additional reduction of 10 percent may be possible through improved operational capability

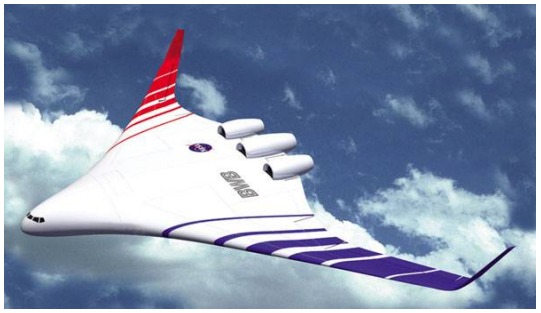
* Concepts that enable optimal use of runways at mutiple airports within the metropolitan areas

EIS = Entry Into Service; IOC = Initial Operating Capability

N+1 Conventional



N+2 Hybrid Wing/Body



N+3 Generation

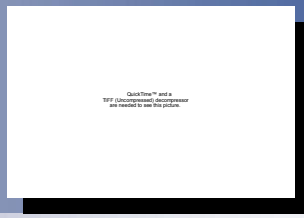
?

FAA / NASA Partnership for CLEEN

- FAA and NASA have a common interest in seeing advanced technologies adopted in the fleet
- Direct relationship between CLEEN and NASA SFW N+1 system level metrics:
  - Noise
  - Emissions
  - Performance
- SFW Project currently conducting research in alternative fuels

Research Hierarchy: Chevron Example

One success story: leading to new products



Boeing 787 with GEnx

Bombardier CRJ-700 with GE CF34

Technologies & Capabilities

Requirements/Needs

System Design

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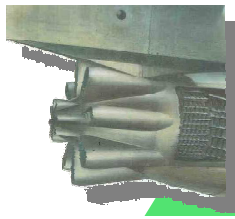
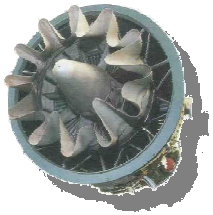
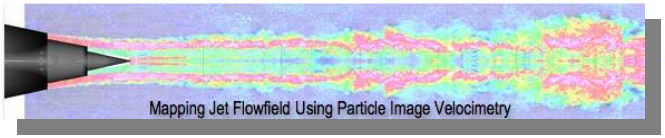
Multi-Discipline Capabilities

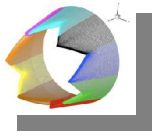


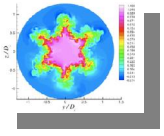
Discipline Level Capabilities

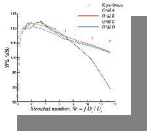


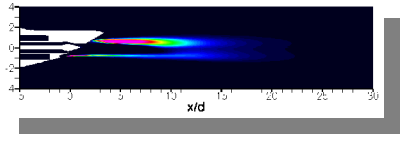
Foundational Physics & Modeling

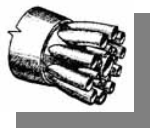












NASA's Role in CLEEN Program

- CLEEN is an FAA program where NASA will be assisting in:
  - Setting the technical direction of the program
  - Creating the solicitation/s and statement/s of work
  - Reviewing proposals and monitoring technical progress
- Because of common interests, personnel in the Subsonic Fixed Wing Project will be working closely with the CLEEN Program Manager, Mr. James Skalecky

NASA Personnel Supporting CLEEN

- NASA FAP will be supporting CLEEN with multiple personnel, some of whom will be determined at a later time
- Discussions that require NASA input should be directed to the Subsonic Fixed Wing Project Team:
  - Fayette Collier, Principal Investigator, *fayette.s.collier@nasa.gov*
  - Rich Wahls, Project Scientist, *richard.a.wahls@nasa.gov*
  - Ruben del Rosario, Project Manager, *ruben.delrosario@nasa.gov*
  - Kimlan Pham, NRA Manager, *kimlan.t.pham@nasa.gov*
- Additional NASA personnel here today include: Anthony Strazisar (HQ), Chi-Ming Lee (Combustion / Alt Fuels), Jim Heidmann (Engine Performance), Dennis Huff (Acoustics), Bill Haller (Systems Analysis)

Learn more about NASA Aeronautics…..

www.aeronautics.nasa.gov

Overview of the entire NASA Aeronautics Program

- Fundamental Aeronautics Program
- Aviation Safety Program
- Airspace Systems Program
- Aeronautics Test Program

www.aeronautics.nasa.gov/fap/index.html

Overview of the entire NASA Fundamental Aeronautics Program

- Subsonic Fixed Wing Project
- Subsonic Rotary Wing Project
- Supersonics Project
- Hypersonics Project

About NASA's NRA Awards .....

http://www.aeronautics.nasa.gov/nra_awards.htm

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- Aviation Safety Program
- Airspace Systems Program

http://www.aeronautics.nasa.gov/nra_awards_fa.htm

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