NASA'S VISION FOR 21ST CENTURY AIRCRAFT

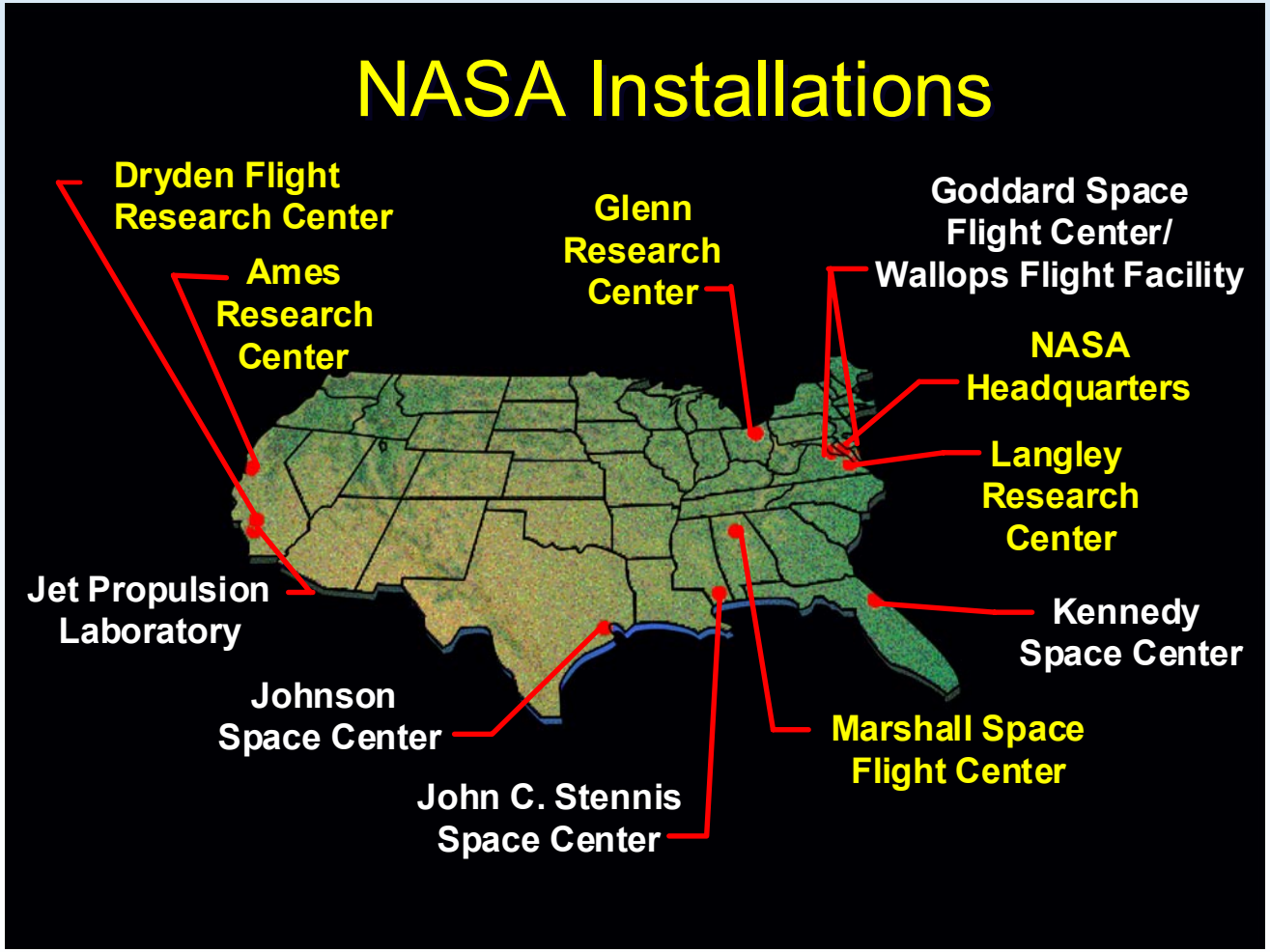
Woodrow Whitlow, Jr.
National Aeronautics and Space Administration
Glenn Research Center
Cleveland, Ohio

NASA's Vision for 21st Century Aircraft

Dr. Woodrow Whitlow, Jr.
October 30, 2001

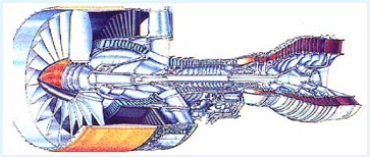
NASA Vision

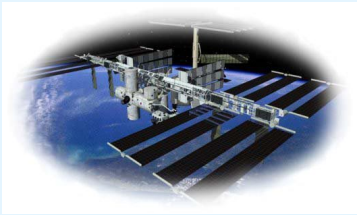
NASA is an investment in America's future. As explorers, pioneers, and innovators, we boldly expand frontiers in air and space to inspire and serve America and to benefit the quality of life on Earth.


NASA Installations
Dryden Flight Research Center
Ames Research Center
Glenn Research Center
Goddard Space Flight Center/ Wallops Flight Facility
NASA Headquarters
Langley Research Center
Jet Propulsion Laboratory
Kennedy Space Center
Johnson Space Center
Marshall Space Flight Center
John C. Stennis Space Center

Research and Technology Products

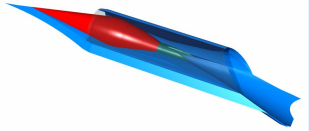
Aeronautics

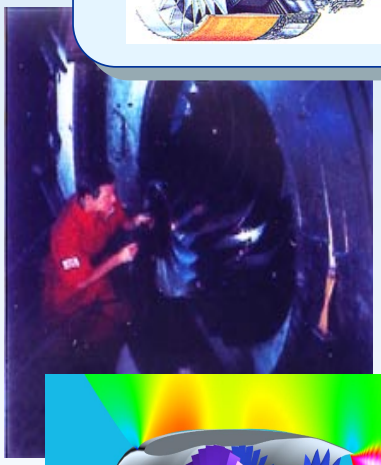


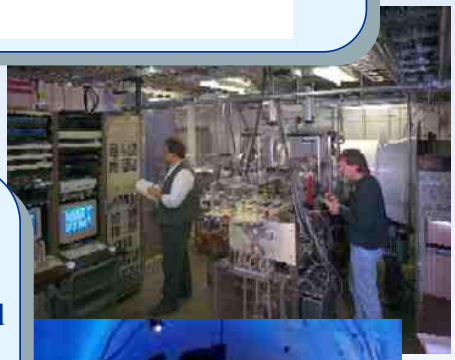


Space

Aerospace

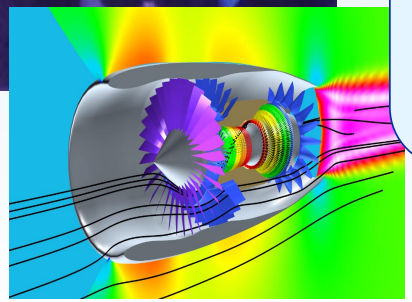






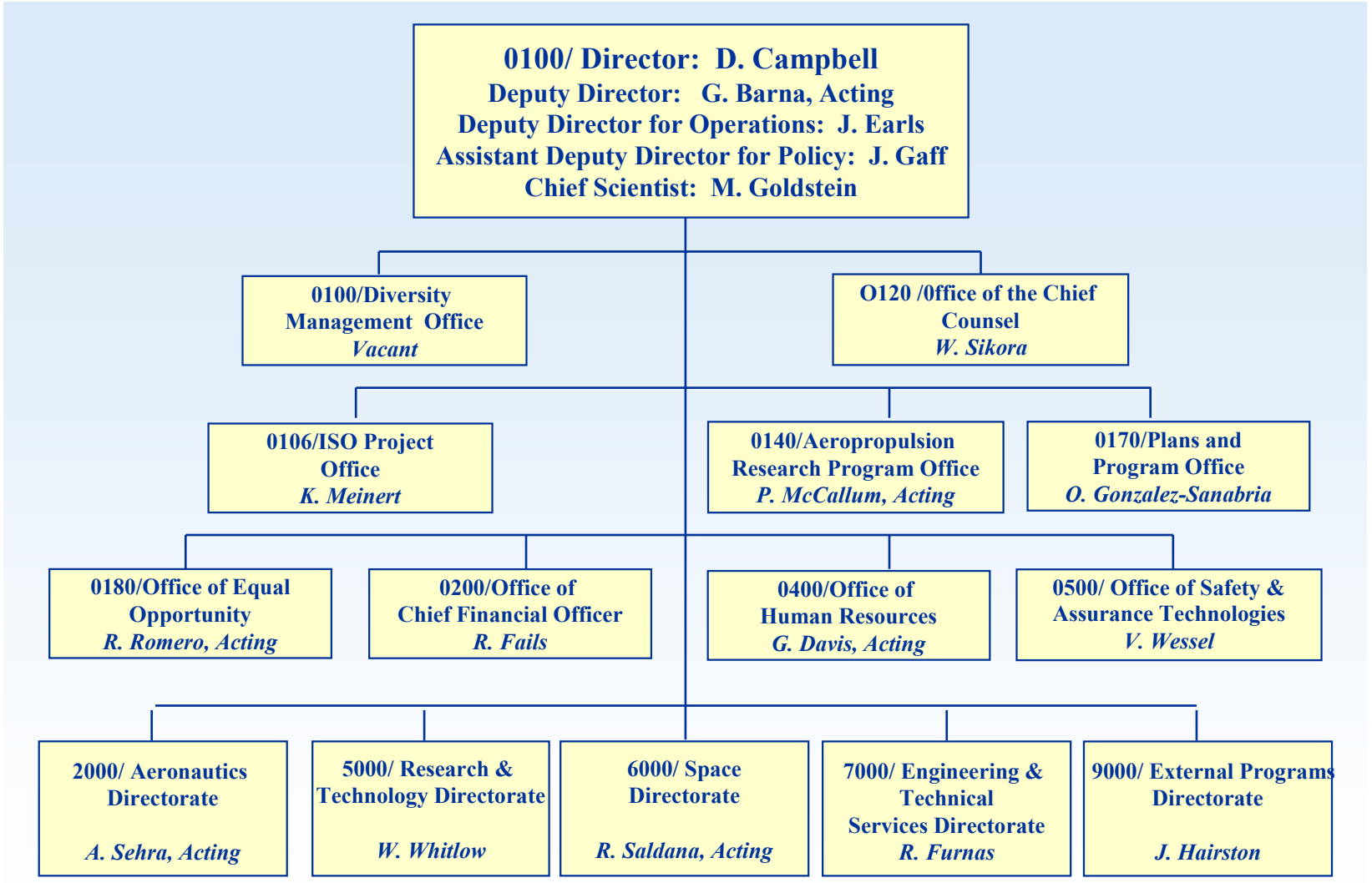
Roles & Missions

- Lead Center for Aeropropulsion
- Lead Center for Aerospace Power
- Microgravity Sciences Fluids & Combustion Lead
- Electric Propulsion Lead
- Space Communication Technology Lead
- Center of Excellence in Turbomachinery



Core Competencies

Aeropropulsion	Fluids & Combustion
Aerospace Power & Electric Propulsion	Aerospace Communications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Chief Scientist: M. Goldstein
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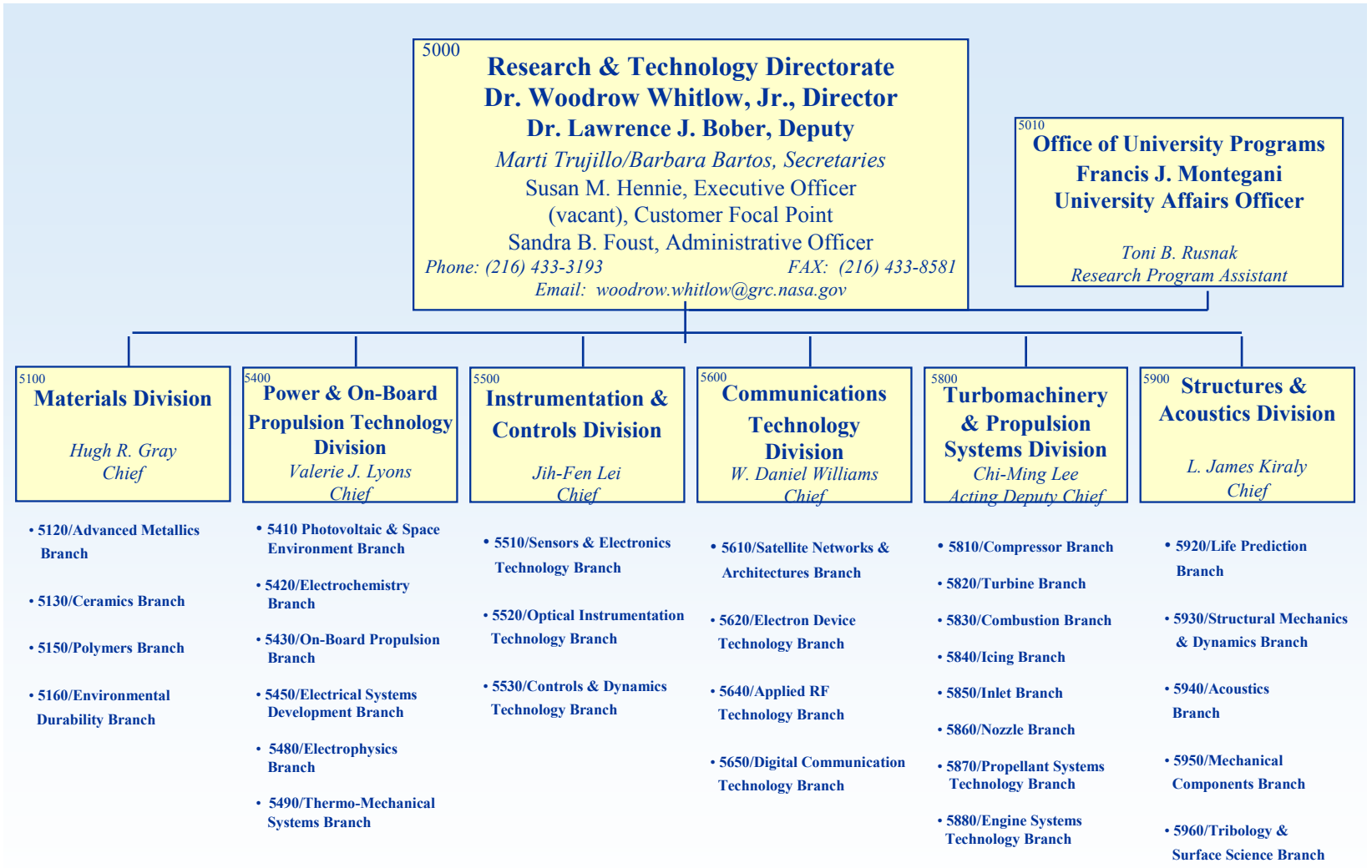
5000
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Dr. Lawrence J. Bober, Deputy
Marti Trujillo/Barbara Bartos, Secretaries
Susan M. Hennie, Executive Officer
(vacant), Customer Focal Point
Sandra B. Foust, Administrative Officer
Phone: (216) 433-3193
FAX: (216) 433-8581
Email: woodrow.whitlow@grc.nasa.gov
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University Affairs Officer
Toni B. Rusnak
Research Program Assistant
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• 5640/Applied RF Technology Branch
• 5650/Digital Communication Technology Branch
5800
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Acting Deputy Chief
• 5810/Compressor Branch
• 5820/Turbine Branch
• 5830/Combustion Branch
• 5840/Icing Branch
• 5850/Inlet Branch
• 5860/Nozzle Branch
• 5870/Propellant Systems Technology Branch
• 5880/Engine Systems Technology Branch
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• 5940/Acoustics Branch
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Future Plans

- Advanced aero, space, & aerospace propulsion systems
- Nanotechnology & nanostructural engineering
- Biomedical engineering & biotechnology
- Information, data, & communications technology
- Advanced health monitoring devices
- Diagnostic instruments and controls
- Longer life, lower cost, lightweight turbomachinery
- Computationally designed materials & structures
- Improved modeling, analysis, & computational methods
- Advanced aerospace power systems

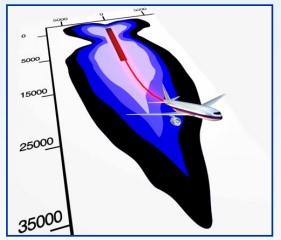
Aviation Blueprint

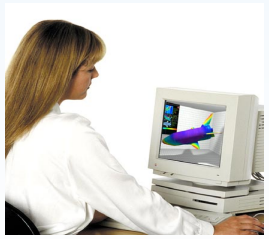
The Vision

What if we created an entire New Era of Aviation?

- Vastly improved System Safety & Capacity
- Revolutionary Vehicle Performance
- Good Neighbor - Airports
- Clean and Quiet - Airplanes
- On demand mobility - Freedom
- Military air-superiority
- Skilled Workforce & Revolutionary Tools





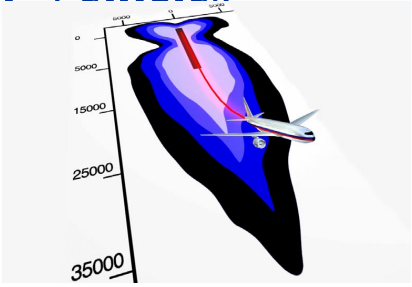



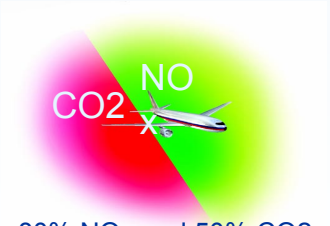

The next Century of Aviation

Revolutionary Vehicles

Revolutionary New Vehicles Needed That Solve Barriers and Open new Opportunities to Unconstrained Mobility

- Noise Reduction
- Reduce Emissions and Fuel Burn
- Improved Safety
- Reduced Wing Tip Vortices
- Increased Speed of Air Travel
- Ability to get People and Cargo in and out of Very Short Airfields
- Sustained Military Air Superiority
- To enable Personal Air Vehicles

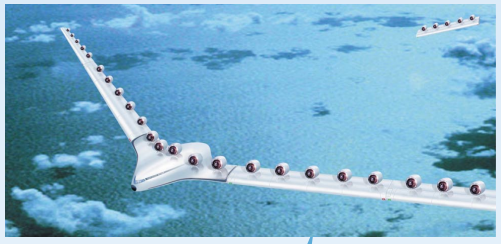




- 80% NOx and 50% CO2 reduction
- 100% NOx and CO2 reduction for revolutionary concepts

Aviation Blueprint

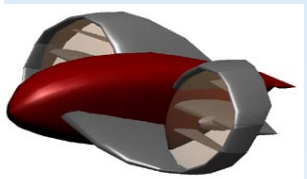
Revolutionary Vehicles - Multiple Paths Common Technology



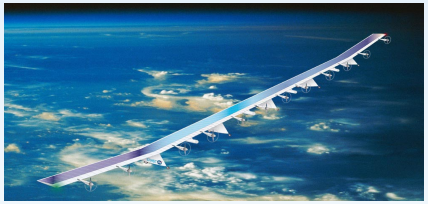
Long-Haul Transport

XSTOL Cargo Carrier

Environmentally friendly Supersonic Travel



Personal Air Vehicles

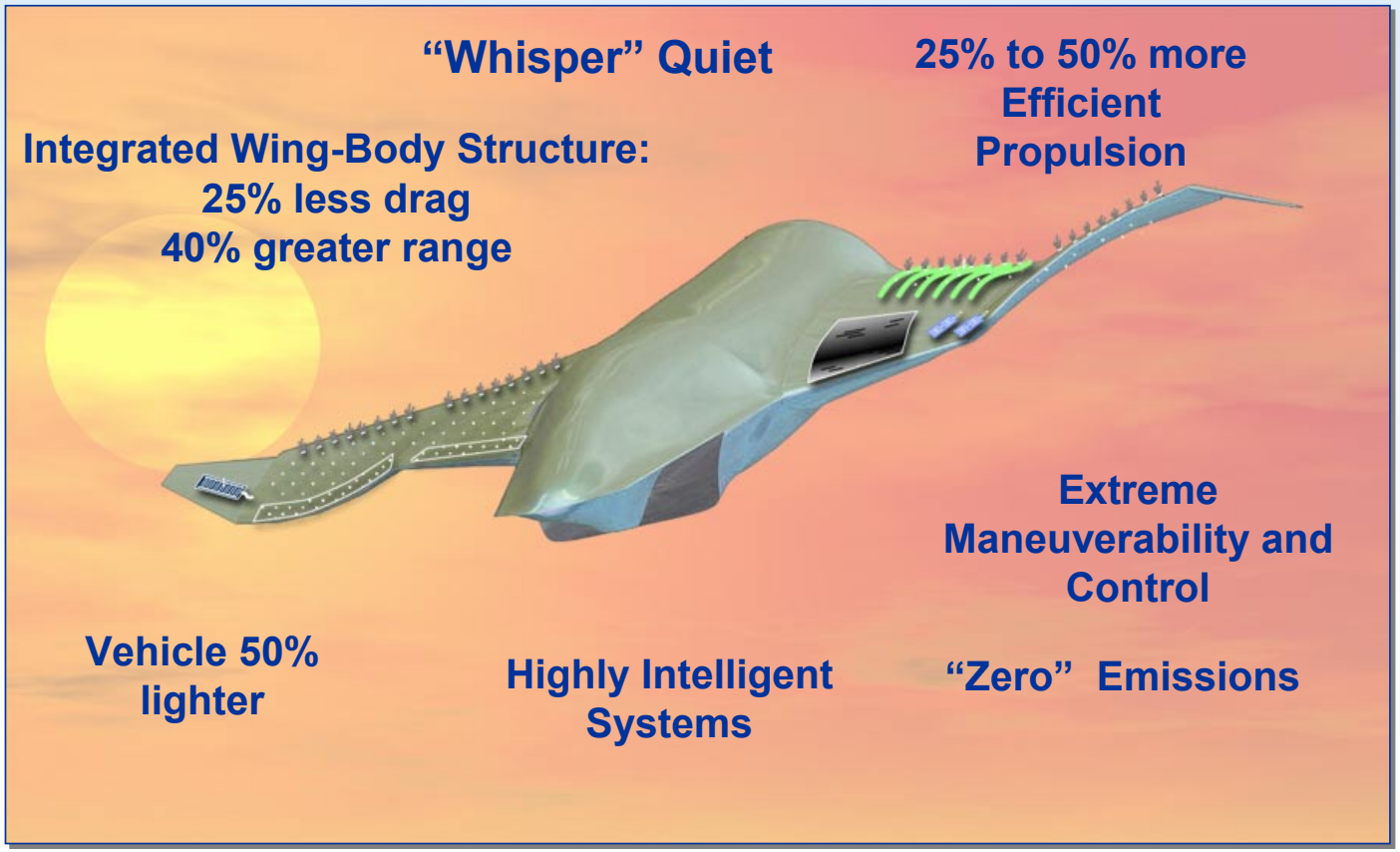


Extreme Long Duration Flight

Extreme Maneuverability and Control

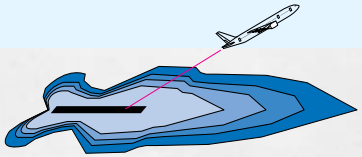
MicroAir Vehicles

Aviation Blueprint — *Attributes of Future Flight Vehicles*



Aviation Blueprint — Revolutionary Vehicles

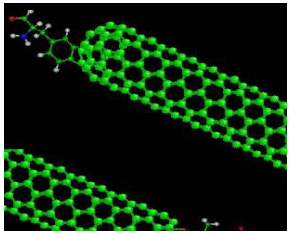
Next generation Transportation breaks the mold in the evolutionary approach to technology



Revolutionary vehicle concepts are required to meet the stringent noise and emission requirements of the future vision

Bio-inspired vehicle concepts utilize active wing shaping and control to optimize vehicle performance through out the flight envelope

Next generation Transportation uses advanced propulsion systems fully integrated with the structure and uses alternate energy sources

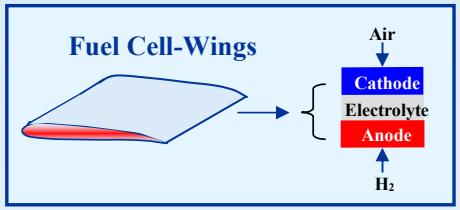


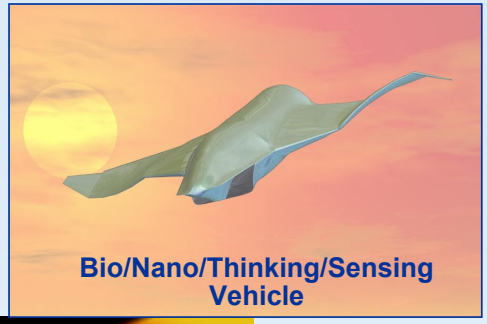
Revolutionary Bio and Nano technology provides “feather weight” structures and distributed sensors

Advanced Aerospace Propulsion

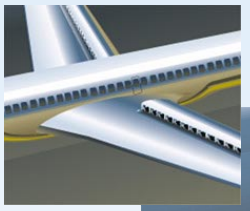
Advanced Technology Development

Electrically Powered Propulsion



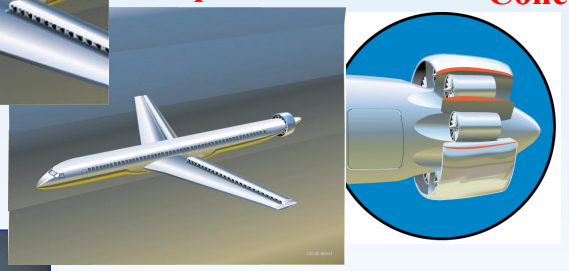


Vehicle Flow Control

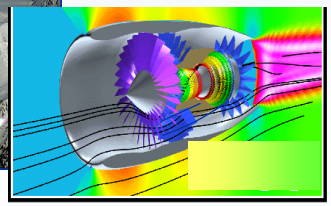


Distributed Propulsion

Advanced Concepts



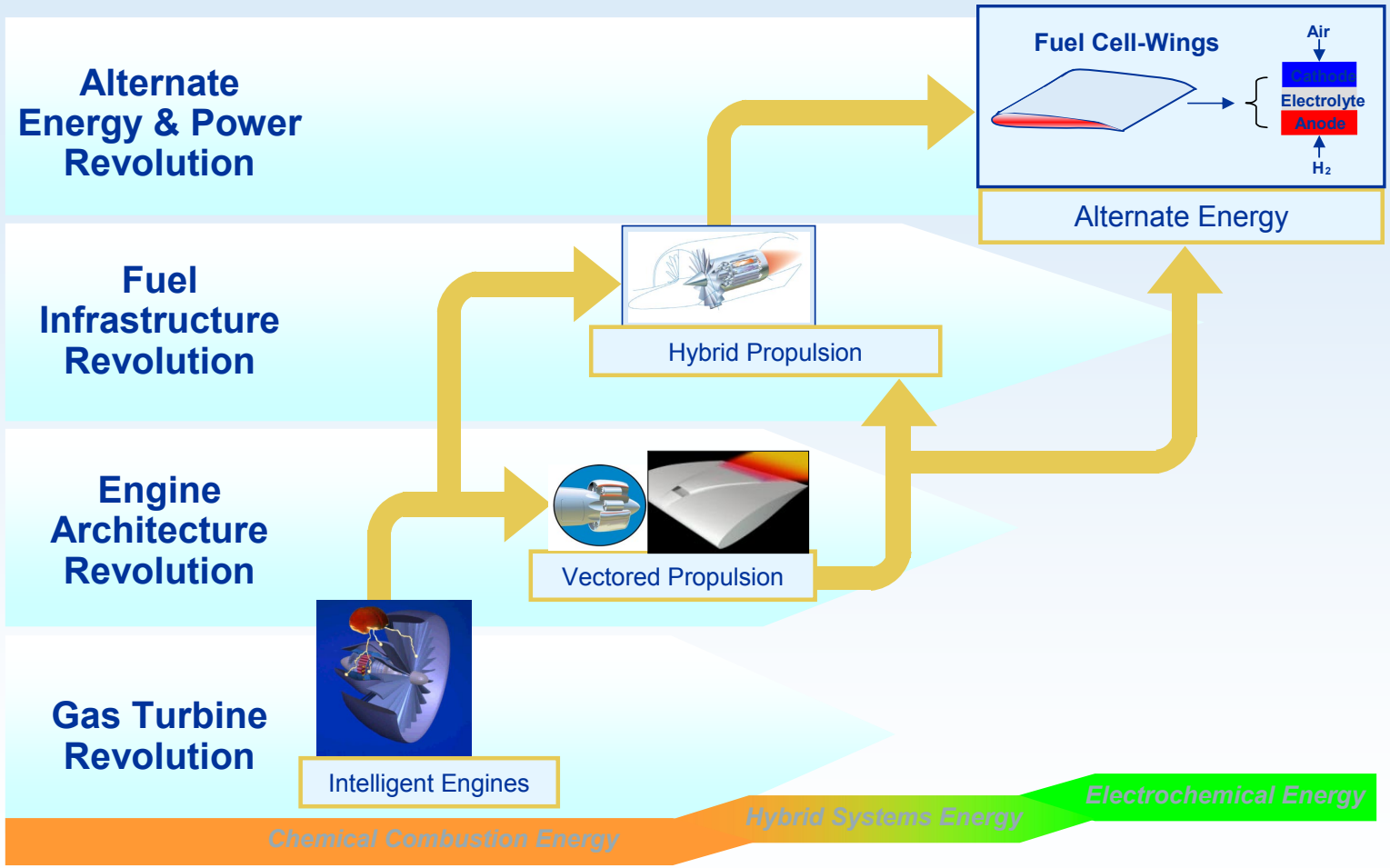
Airframe - Propulsion Integration



Advanced High-bypass Turbine

Time

Aeropropulsion – NASA's Future Direction

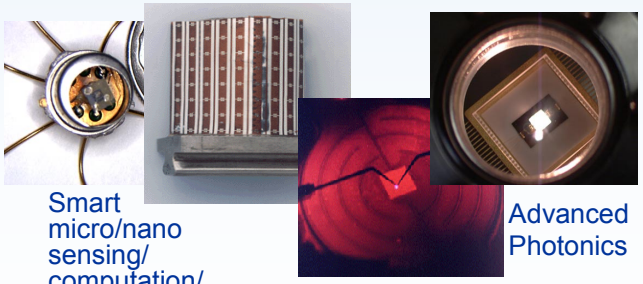


Gas Turbine Revolution

Variable Capability, Ultra High Bypass Ratio Intelligent Engines: Fundamental Technologies

Intelligent Engine System Asset Management

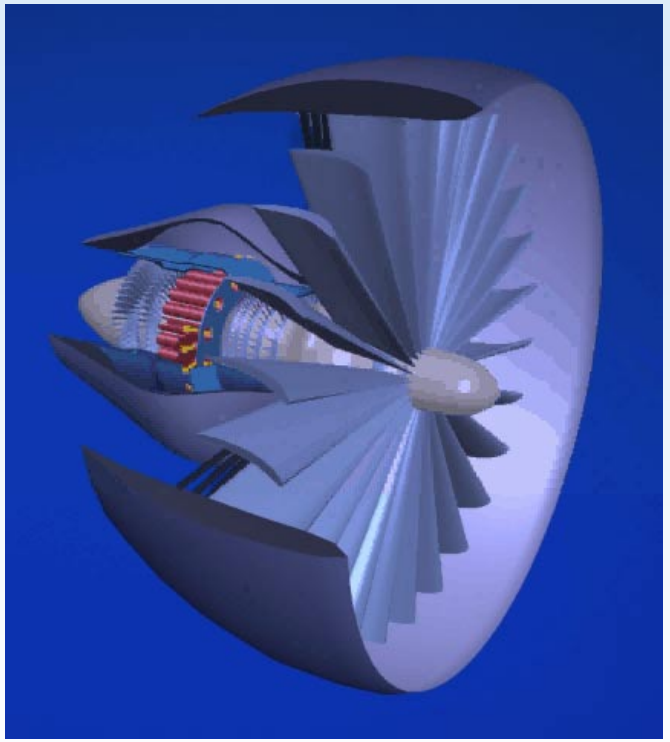
- Embedded micro- and nano-sensors
- Coupled simulation and data-feedback health/performance management
- Autonomic engine control strategies



Smart micro/nano sensing/ computation/ actuation

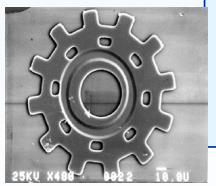
Advanced Photonics

Advanced Electronics

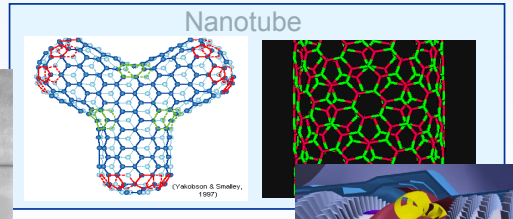


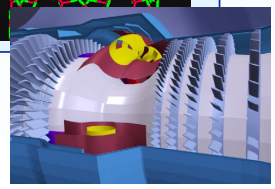
Variable Capability, Ultra High Bypass Ratio Intelligent Engines: Fundamental Technologies

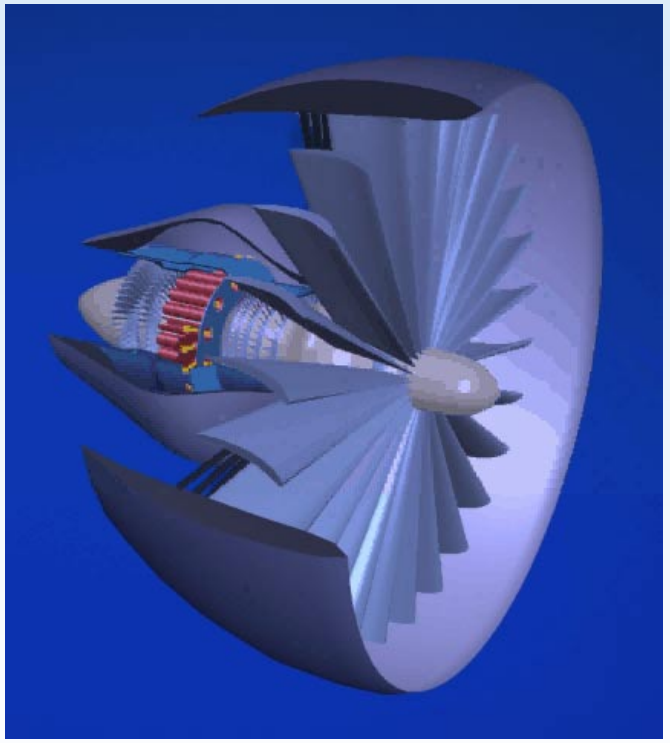
- Micro-Flow Management
- Acoustic Masking
- Innovative Combustion Strategy
- Morphing Structures
- Adaptive Structures
- Adaptive Engine Cycles



Micromachined actuator



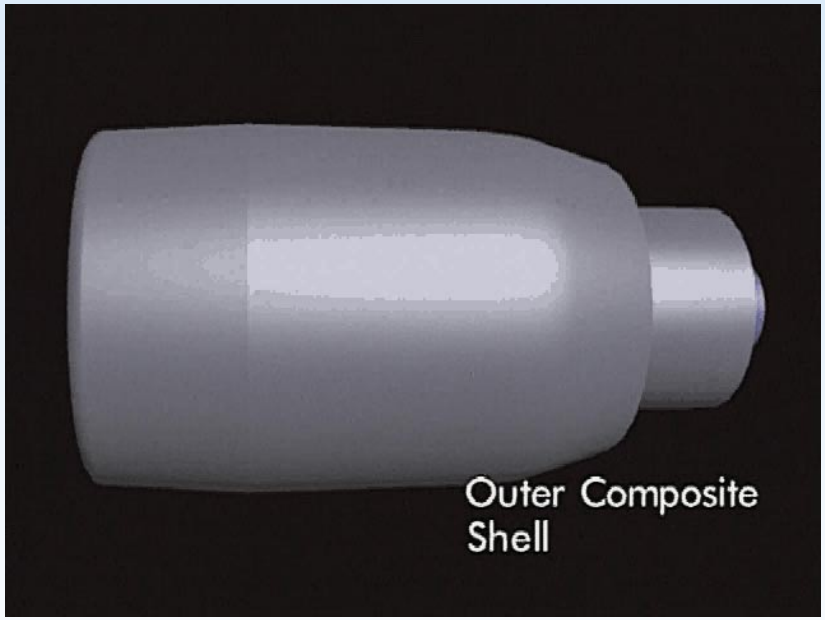


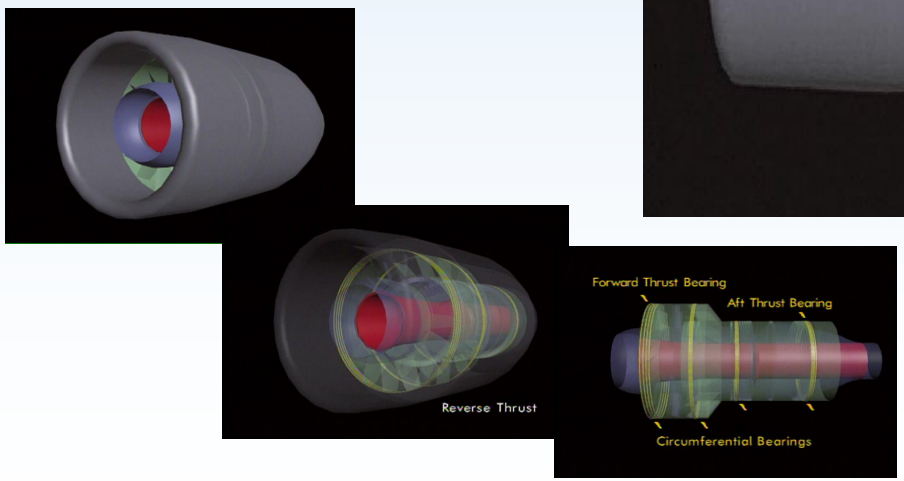


Variable Capability, Ultra High Bypass Ratio Intelligent Engines: Fundamental Technologies

Exoskeletal Engine

- Outer shell rotating
- All composite engine
- Magnetic bearings

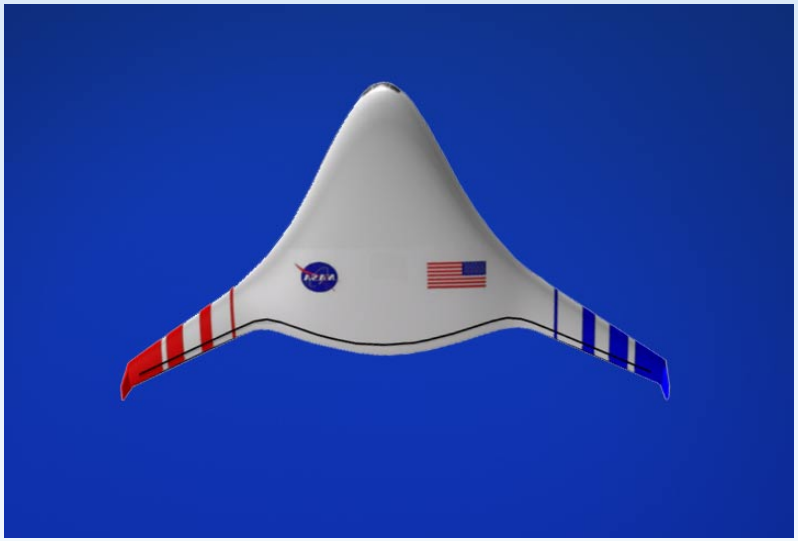


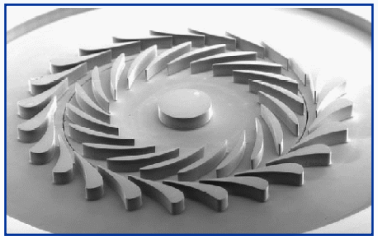


Distributed Vectored Propulsion

Distributed Engines

- Multiple low-cost, low power engines deployed along wing
- Distributed thrust and thrust vectoring
- Aircraft boundary layer ingestion
- Micro-turbine engines distributed over aircraft wings



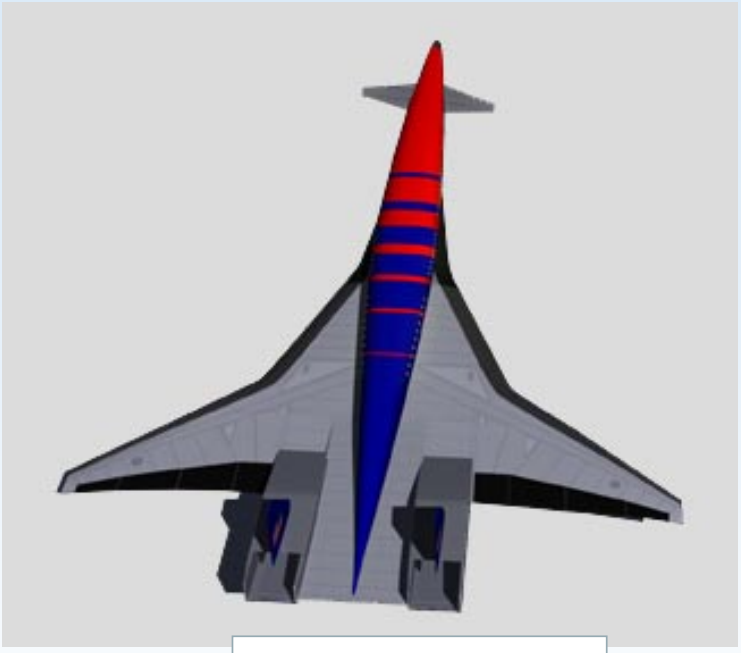


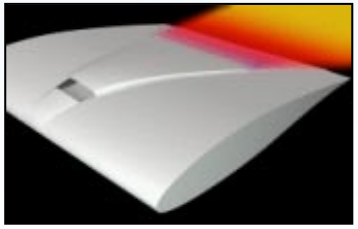
SiC Micro Turbine

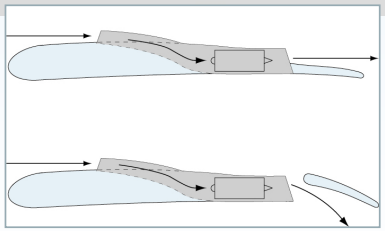
Distributed Vectored Propulsion

Distributed Exhaust

- High aspect-ratio nozzles embedded in the wing trailing edge
- Ducted Polymer Matrix Composite (PMC) nozzles
- Embedded inlets & nozzles employing flow-control



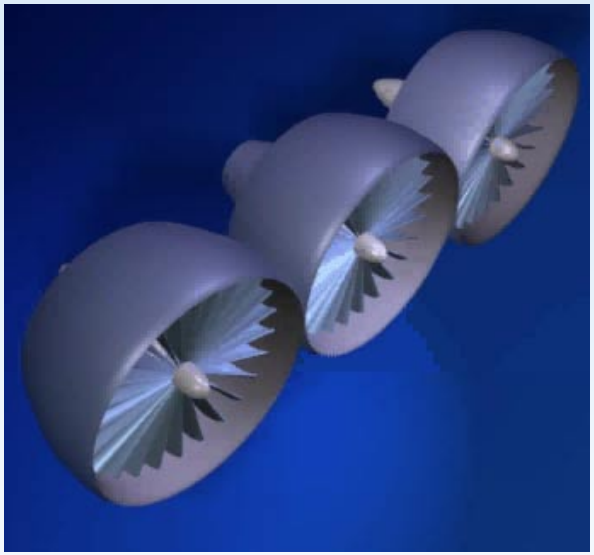




Distributed Vectored Propulsion

Multi-Fan Core

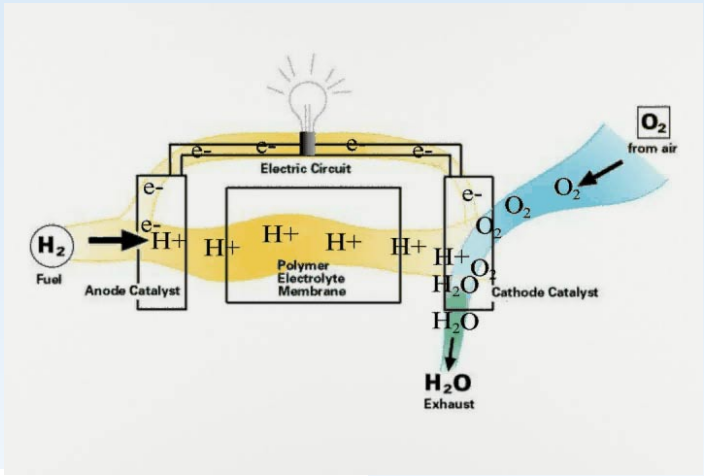
- High-efficiency core powering multiple fans
- Advanced mechanical power transmission



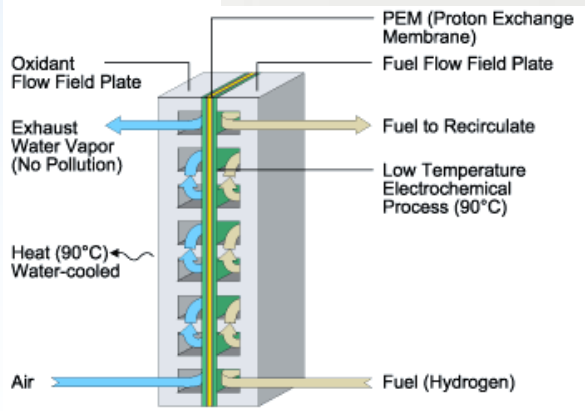
Alternative Energy Propulsion

Fuel Cell Powered Electric Propulsion System

- Proton Exchange Membrane (PEM) Fuel Cell
- Zero NOx and HC emissions
- Water emission or use of chemical reformer



Basic Hydrogen PEM fuel cell operation and hardware



Alternative Energy Propulsion

Potential Fuel Cell Enabled Electric Propulsion