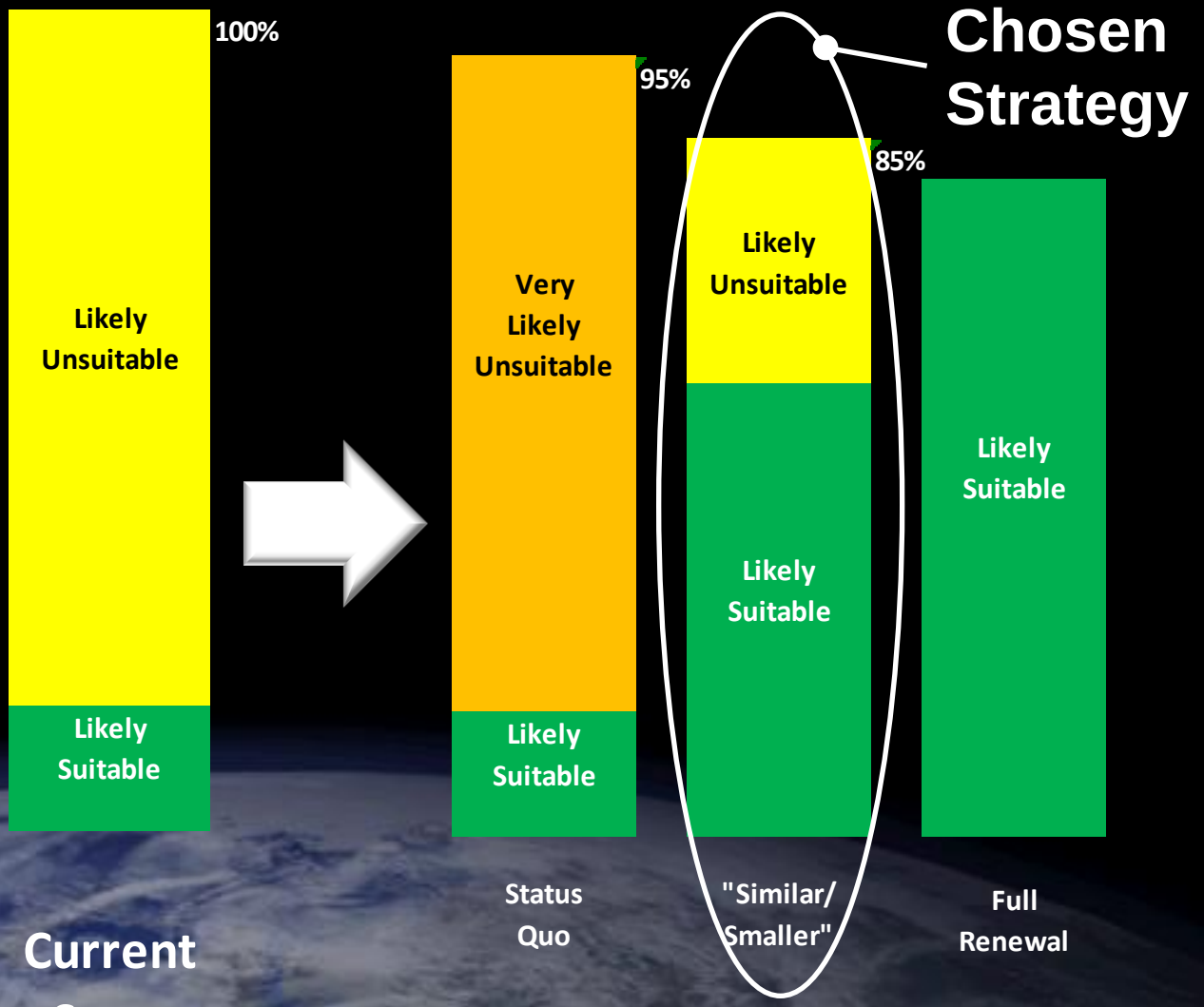
Welcoming Remarks

Dr. Woodrow Whitlow, Jr.

Within 1 year after the date of enactment of this Act, the Administrator shall provide to the appropriate committees of Congress a comprehensive study that, taking into account the long term direction provided by this Act, carefully examines NASA's structure, organization, and institutional assets and identifies a strategy to evolve toward the most efficient retention, sizing, and distribution of facilities, laboratories, test capabilities, and other infrastructure consistent with NASA's missions and mandates. The Administrator should pay particular attention to identifying and removing unneeded or duplicative infrastructure. The Administrator should include in the study a suggested reconfiguration and reinvestment strategy that would conform the needed equipment, facilities, test equipment, and related organizational alignment that would best meet the requirements of missions and priorities authorized and directed by this Act. As part of this strategy, the Administrator should include consideration and application of the findings and recommendations of the National Research Council report, Capabilities for the Future: An Assessment of NASA Laboratories for Basic Research, prepared in response to section 1003 of the National Aeronautics and Space Administration Authorization Act of 2008 (42 U.S.C. 17812).

--NASA Authorization Act of 2010

NASA's Facilities Strategy



"NASA will renew and modernize its facilities to sustain its capabilities, and to accommodate those capabilities in the most efficient facilities set practical."

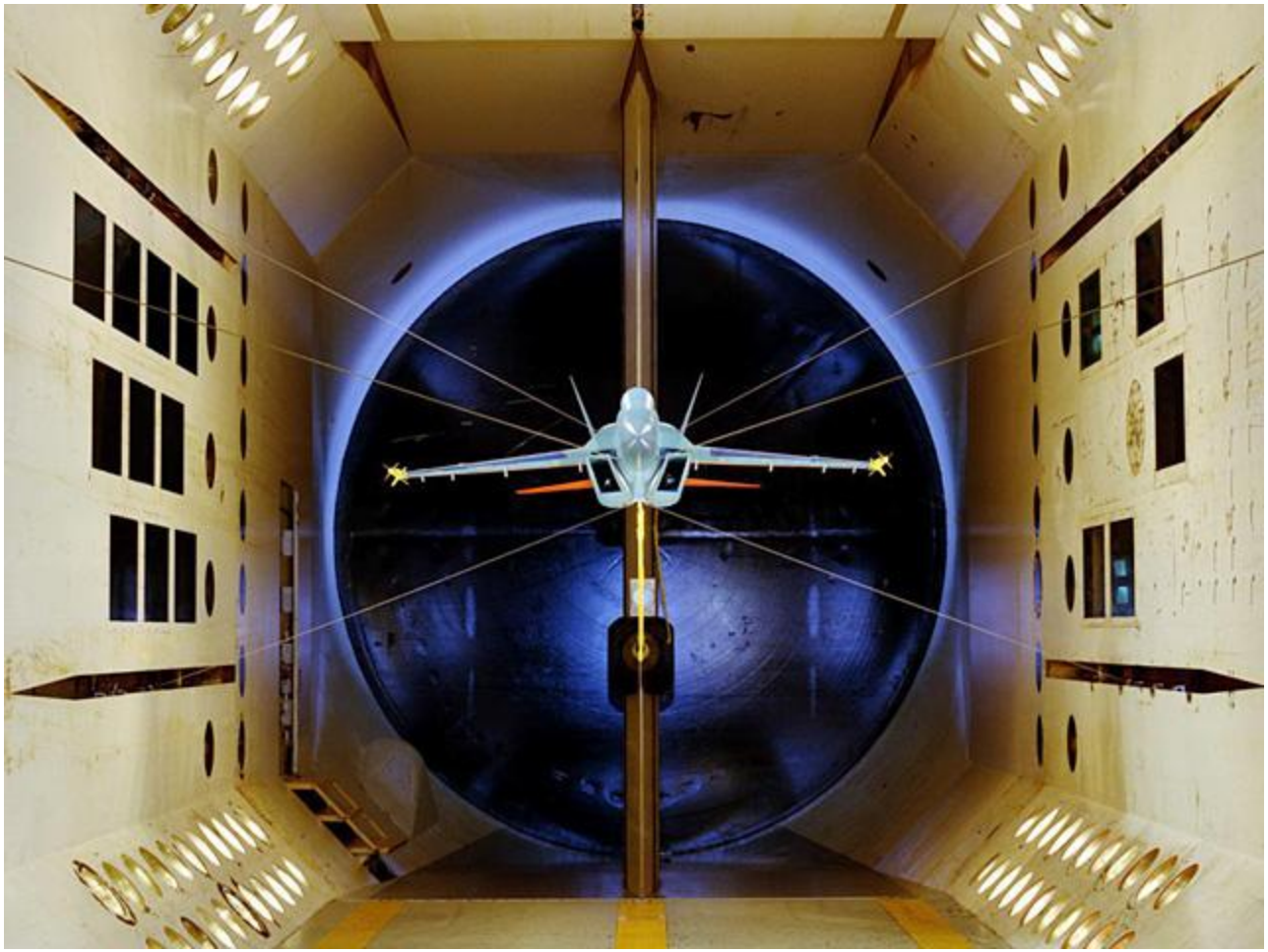
New Institutional Assets are Efficient and Cost-Effective

Kennedy Space Center
Propellants North Building

Langley Research Center New Town

Ames Research Center Sustainability Base

Flutter Testing in the TDT



National Challenges: Why We Do What We Do

Fuel Efficiency

- In 2008, U.S. major commercial carriers burned 19.6B gallons and DoD burned 4.6B gallons of jet fuel.
- At an average price of $3.00/gallon, fuel cost was $73B

Emissions

- 40 of the top 50 U.S. airports are in non-attainment areas that do not meet EPA local air quality standards for particulate matter and ozone
- The fuel consumed by U.S. commercial carriers and DoD releases more than 250 million tons of CO_2 into the atmosphere each year

Noise

- Aircraft noise continues to be regarded as the most significant hindrance to capacity growth in the National Airspace System (NAS).
- FAA's attempt to reconfigure the New York airspace resulted in 14 lawsuits.
- Since 1980, the FAA has invested over $5B in airport noise reduction programs

NASA's Vision For 21st-Century Aircraft

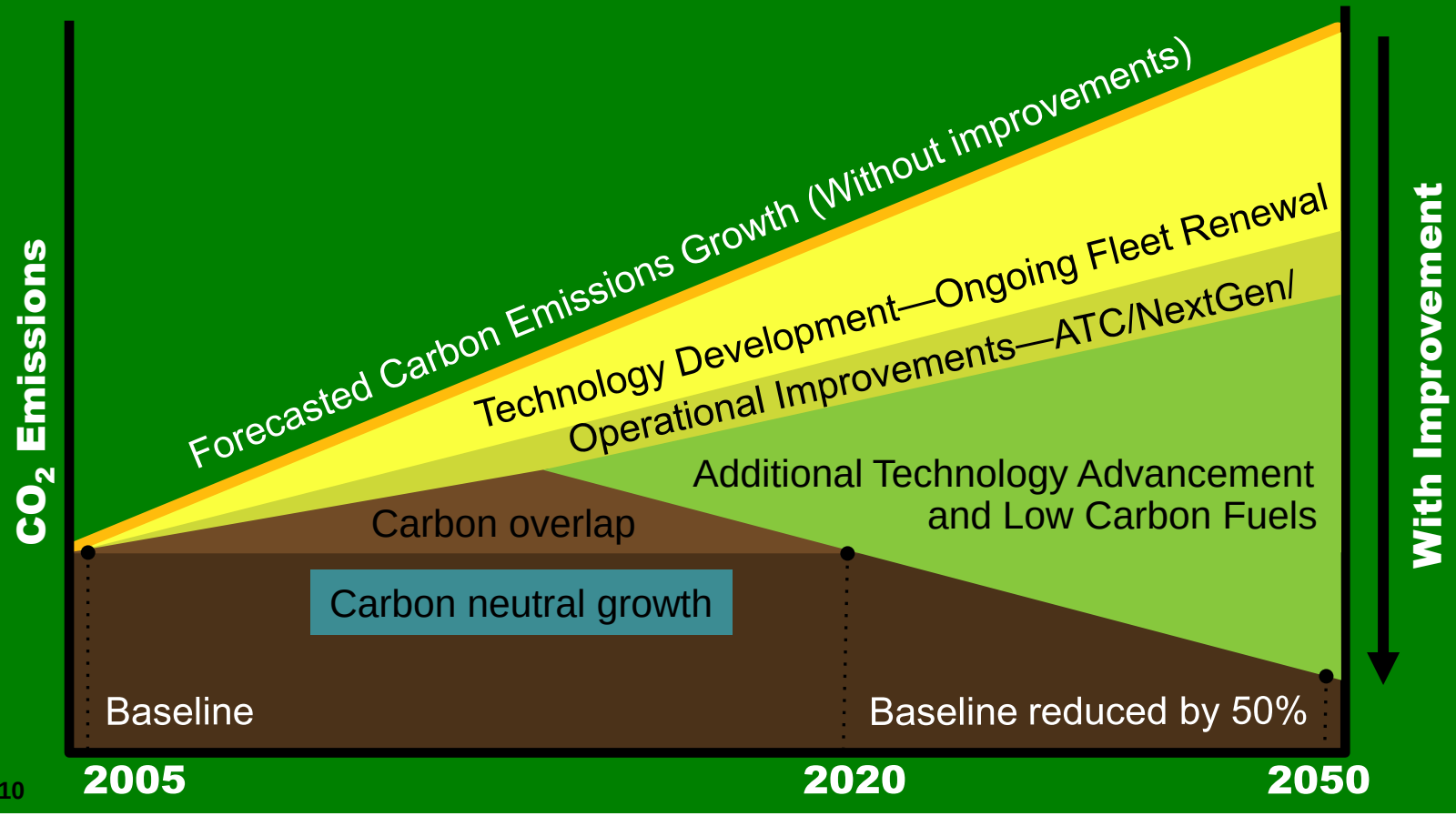
25-Year Goal to Revolutionize Aviation

Reduce Accident Rates: 10x (90%)
Make a safe air transportation system even safer

Reduce Emissions: NO_x 5X (80%), CO_2 2X (50%)
Protect local air quality and our global climate

Future Challenges for Emissions Reduction

By 2050, substantially reduce emissions of carbon and oxides of nitrogen and contain objectionable noise within the airport boundary



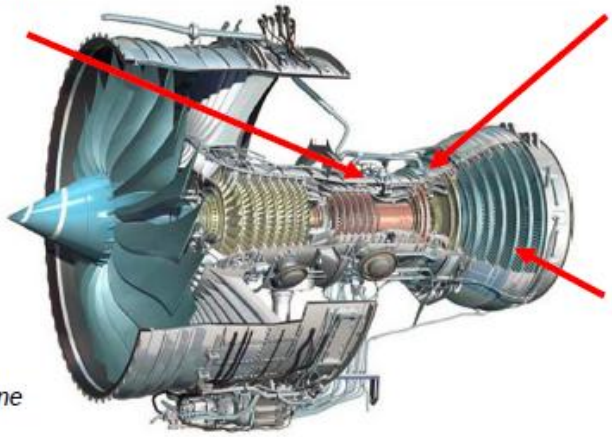
Source: IATA, 2010

FAA CLEEN 2010 - 2014

Rolls-Royce CLEEN Technologies Program
CMC Turbine Blade Tracks

- **Application of advanced CMC turbine materials enables Reduced Fuel Burn in NextGen product applications**
  - Reduction in cooling flow and weight savings in current engine cycles
  - Enables progression toward more advanced engine cycles

<u>Combustion liners</u>
Increased wall temperature
Reduced emissions



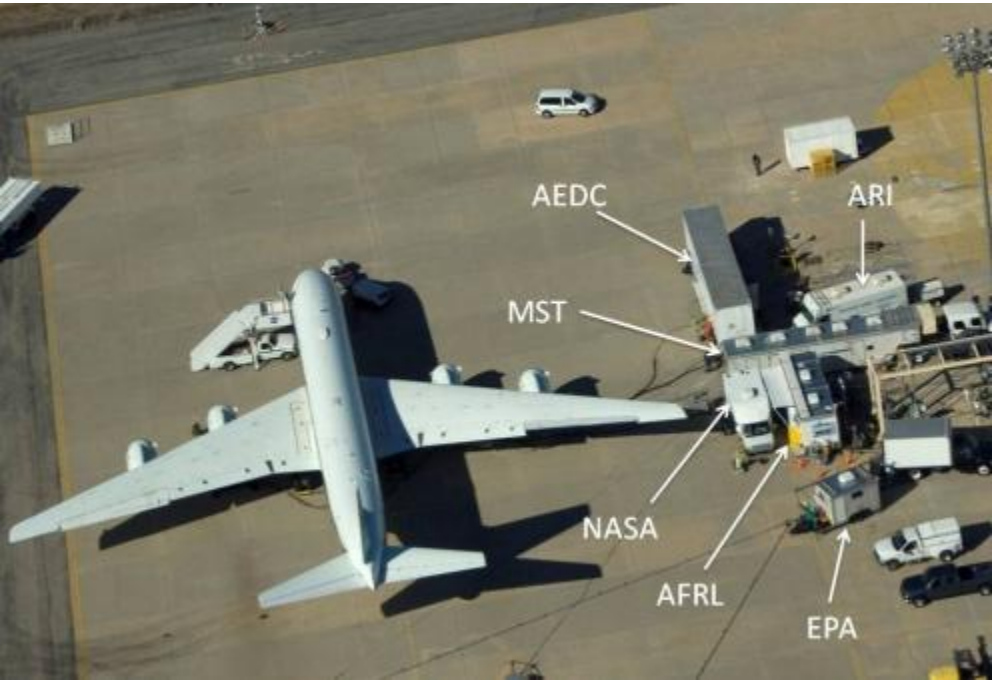
Large Civil 3-Shaft Engine

<u>Blade tracks/shrouds</u>
Increased temperature
Reduced weight
Improved SFC

<u>Airfoils (blades/vanes)</u>
Increased temperature
Reduced weight
Improved SFC

Rolls-Royce

Alternative Aviation Fuels EXperiment AAFEX-I: NASA-led Fischer-Tropsch Fuel Emissions Measurement



Objectives

- Document gaseous and particulate emissions
- Investigate factors that control aerosol formation and growth
- Evaluate new instruments and sampling techniques
- Compare measurements from different groups to establish best practices

NASA-led, 6 participating organizations

- Burned JP-8, coal/natural gas FT, 50/50 blends of FT and JP8 using NASA DFRC DC8 aircraft
- Examined emissions from engine idle to takeoff thrust settings
- Engine runs over wide range of ambient temperature, which affects emissions

Emissions Measurements at Cruise Conditions

Alternative-Fuel Effects on Contrails and Cruise EmiSSions

ACCESS

Hybrid Electric Propulsion
changing the paradigm

Objective

Explore and develop technologies to enable hybrid gas-turbine/electric propulsion architectures

Approach/Challenges

Transmission and Winding Materials

- Room Temperature
- Superconducting

Gas-Turbine/Electric Hybrids

- Dual power source to single propulsor (coupled)
- Single power source to multiple propulsor (decoupled)

Aircraft Power Distribution

- Stable wide-area electrical power distribution

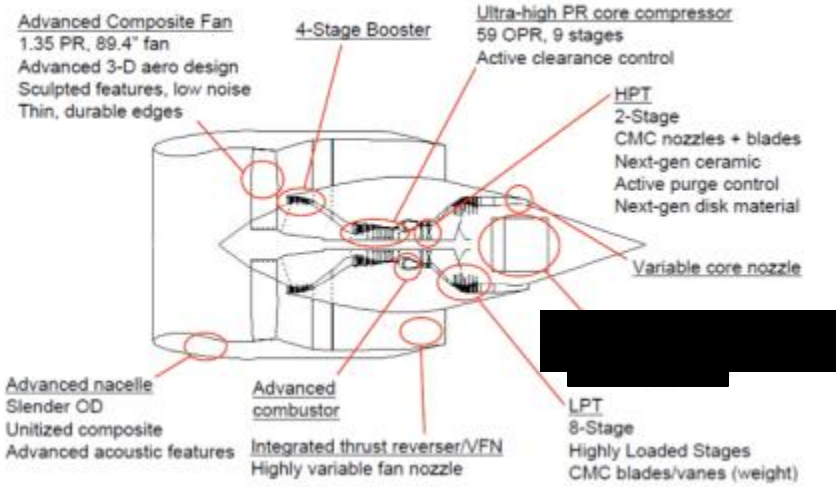
Benefit/Pay-off

- Low noise and zero emission (onboard) electric drives
- Electric transmission to enable decoupled distributed propulsion for higher effective BPR and improved Total Specific energy Consumption (TSEC)

single power source to multiple, decoupled fans

stable, wide area power transmission

dual power to single fan



adv conventional to hybrid to (eventually) all electric

NASA's Vision For 21st-Century Aircraft

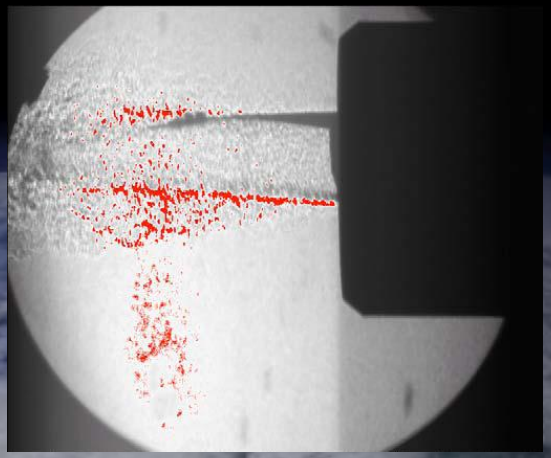
25-Year Goal to Revolutionize Aviation

Reduce Accident Rates: 10x (90%)
Make a safe air transportation system even safer

Reduce Emissions: NO_x 5X (80%), CO_2 2X (50%)
Protect local air quality and our global climate

Reduce Noise: 4X (75%)
Reduce aircraft noise to benefit airport neighbors, the aviation industry, and travelers

High-Temperature Shape Memory Alloys



ERA/CLEEN/GE Open Rotor Tests

OBJECTIVE

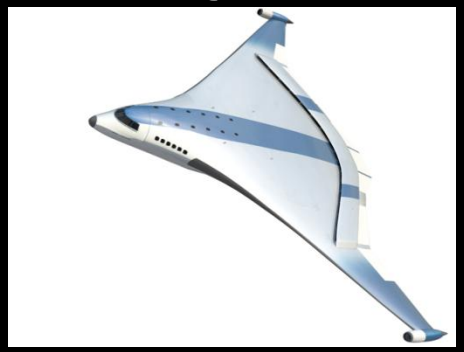
- Explore the design space for lower noise while maintaining the high propulsive efficiency from a counter-rotating open rotor system.

Next Generation Air Transportation Systems

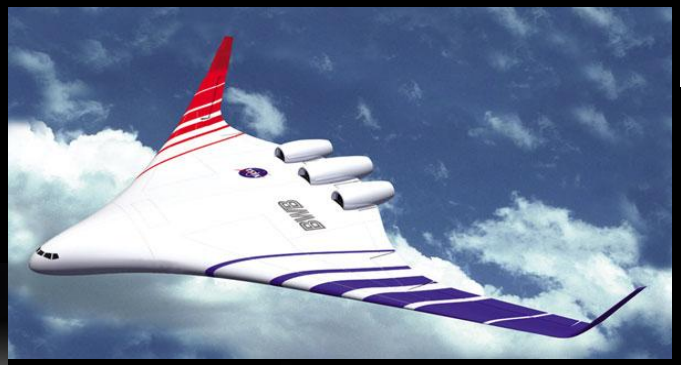
Green Aircraft

Integration of new aircraft and engine technologies to simultaneously reduce fuel burn, noise, and emissions

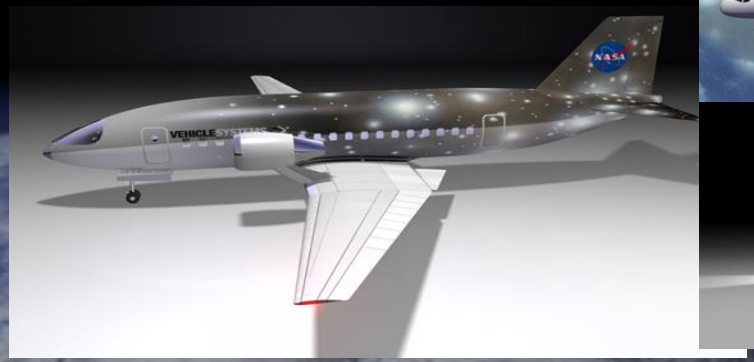
30 years



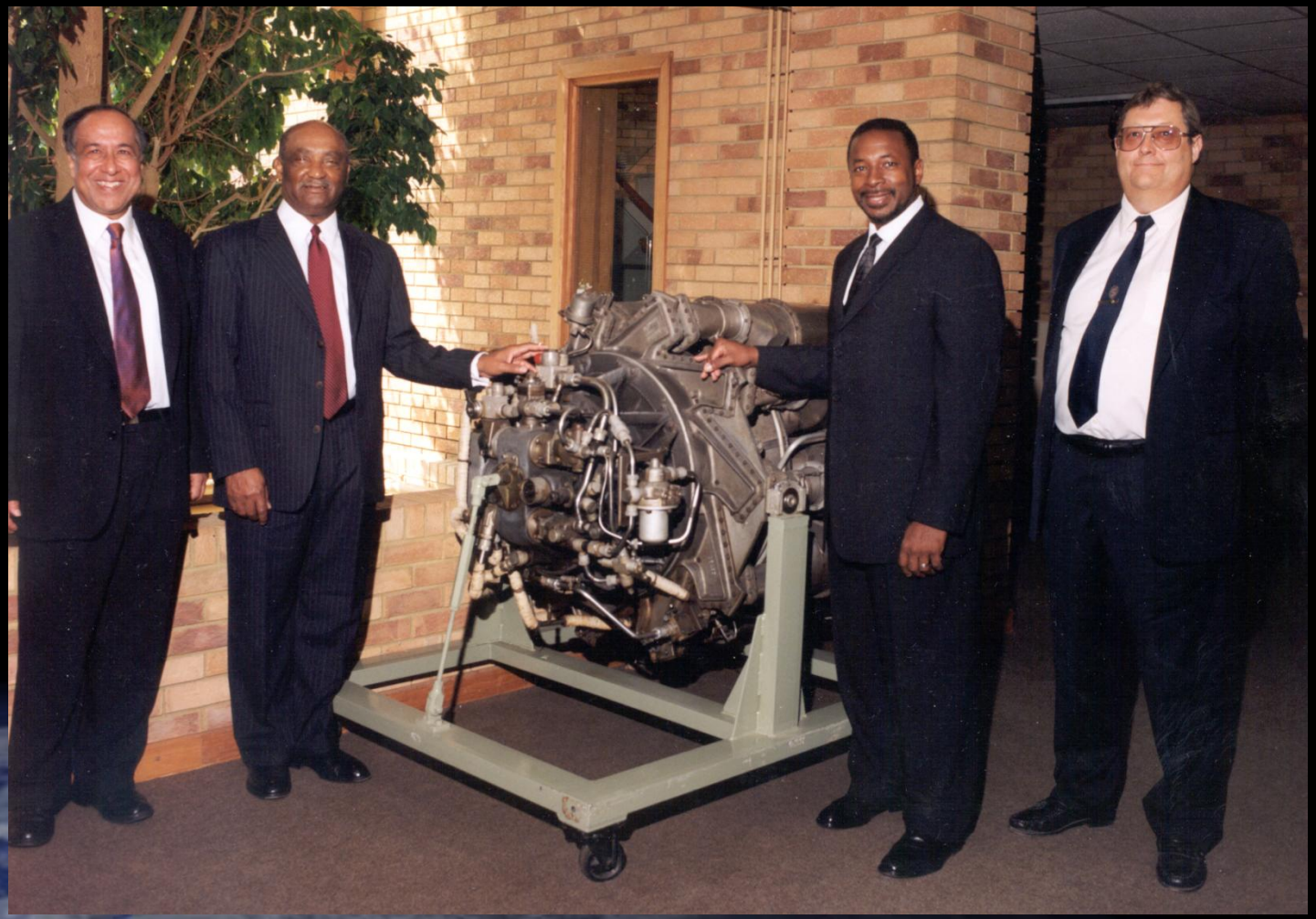
20 years



10 years



Sir Frank Whittle's W2/700 Engine



"IN ITS PRESENT STATE, AND EVEN CONSIDERING THE IMPROVEMENTS POSSIBLE WHEN ADOPTING THE HIGHER TEMPERATURES PROPOSED FOR THE IMMEDIATE FUTURE, THE GAS TURBINE ENGINE COULD HARDLY BE CONSIDERED A FEASIBLE APPLICATION TO AIRPLANES MAINLY BECAUSE OF THE DIFFICULTY IN COMPLYING WITH THE STRINGENT WEIGHT REQUIREMENTS IMPOSED BY AERONAUTICS.

"THE PRESENT INTERNAL COMBUSTION ENGINE EQUIPMENT USED IN AIRPLANES WEIGHS ABOUT 1.1 POUNDS PER HORSEPOWER, AND TO APPROACH SUCH A FIGURE WITH A GAS TURBINE SEEMS BEYOND THE REALM OF POSSIBILITY WITH EXISTING MATERIALS. "

THE COMMITTEE ON GAS TURBINES

appointed by

THE NATIONAL ACADEMY OF SCIENCES

June 10, 1940

Good thing I was too stupid to know this

Frank Whittle

National Aeronautics and Space Administration