About OMICS Group

OMICS Group International is an amalgamation of Open Access publications and worldwide international science conferences and events. Established in the year 2007 with the sole aim of making the information on Sciences and technology 'Open Access', OMICS Group publishes 400 online open access scholarly journals in all aspects of Science, Engineering, Management and Technology journals. OMICS Group has been instrumental in taking the knowledge on Science & technology to the doorsteps of ordinary men and women. Research Scholars, Students, Libraries, Educational Institutions, Research centers and the industry are main stakeholders that benefitted greatly from this knowledge dissemination. OMICS Group also organizes 300 International conferences annually across the globe, where knowledge transfer takes place through debates, round table discussions, poster presentations, workshops, symposia and exhibitions.

About OMICS Group Conferences

OMICS Group International is a pioneer and leading science event organizer, which publishes around 400 open access journals and conducts over 300 Medical, Clinical, Engineering, Life Sciences, Pharma scientific conferences all over the globe annually with the support of more than 1000 scientific associations and 30,000 editorial board members and 3.5 million followers to its credit.

OMICS Group has organized 500 conferences, workshops and national symposiums across the major cities including San Francisco, Las Vegas, San Antonio, Omaha, Orlando, Raleigh, Santa Clara, Chicago, Philadelphia, Baltimore, United Kingdom, Valencia, Dubai, Beijing, Hyderabad, Bengaluru and Mumbai.

NASA Glenn: 75 Years & Beyond



Advancing Innovative Technologies For Aerospace Applications

James M. Free
Director, Glenn Research Center
Cleveland, Ohio

@NASAglenn

NASA Glenn: 75 Years & Beyond

Advancing Innovative Technologies For Aerospace Applications

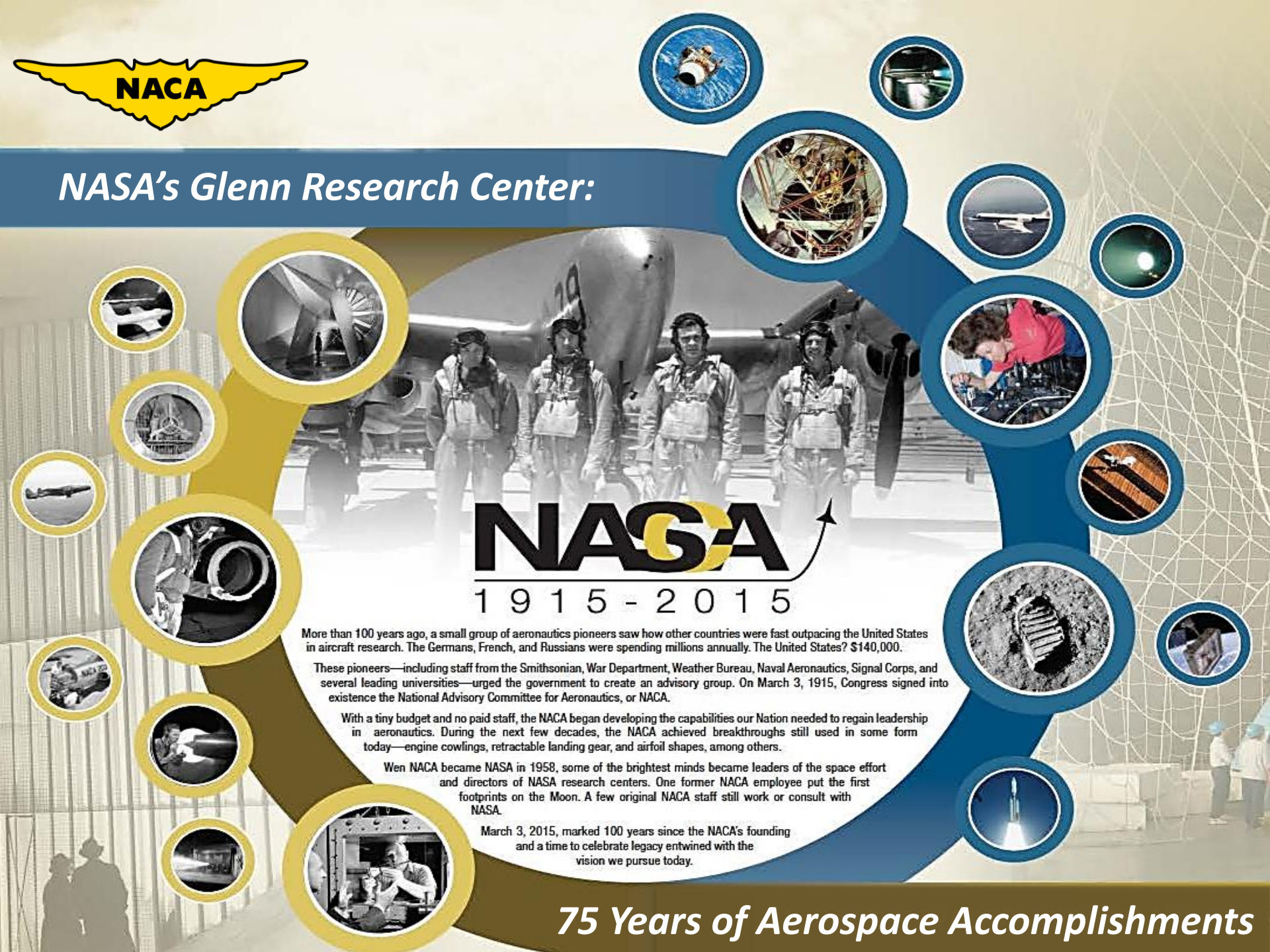
- 75 years of aerospace research at NASA Glenn Research Center
- NASA Mission and NASA Glenn research
- The pursuit of advanced technologies
- Looking to the future
- Closing thoughts



We've come so far. Yet, we have so far to go.

NACA

NASA's Glenn Research Center:



NASA
1915-2015

More than 100 years ago, a small group of aeronautics pioneers saw how other countries were fast outpacing the United States in aircraft research. The Germans, French, and Russians were spending millions annually. The United States? $140,000.

These pioneers—including staff from the Smithsonian, War Department, Weather Bureau, Naval Aeronautics, Signal Corps, and several leading universities—urged the government to create an advisory group. On March 3, 1915, Congress signed into existence the National Advisory Committee for Aeronautics, or NACA.

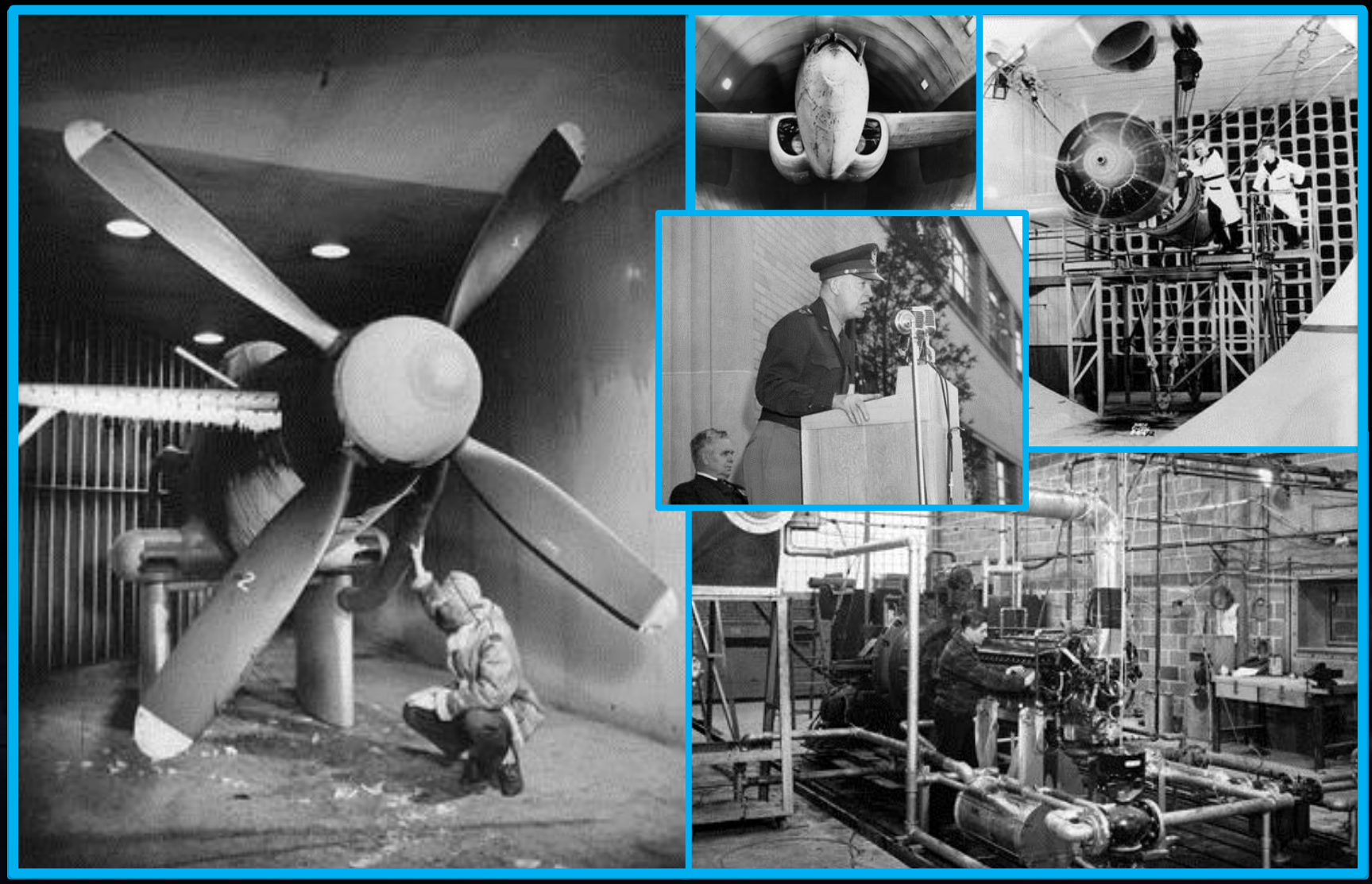
With a tiny budget and no paid staff, the NACA began developing the capabilities our Nation needed to regain leadership in aeronautics. During the next few decades, the NACA achieved breakthroughs still used in some form today—engine cowlings, retractable landing gear, and airfoil shapes, among others.

Wen NACA became NASA in 1958, some of the brightest minds became leaders of the space effort and directors of NASA research centers. One former NACA employee put the first footprints on the Moon. A few original NACA staff still work or consult with NASA.

March 3, 2015, marked 100 years since the NACA's founding and a time to celebrate legacy entwined with the vision we pursue today.

75 Years of Aerospace Accomplishments

NASA Glenn: 75 Years & Beyond

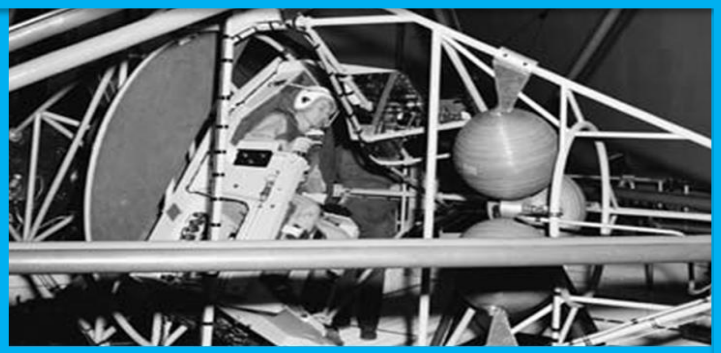


NASA Glenn: 75 Years & Beyond



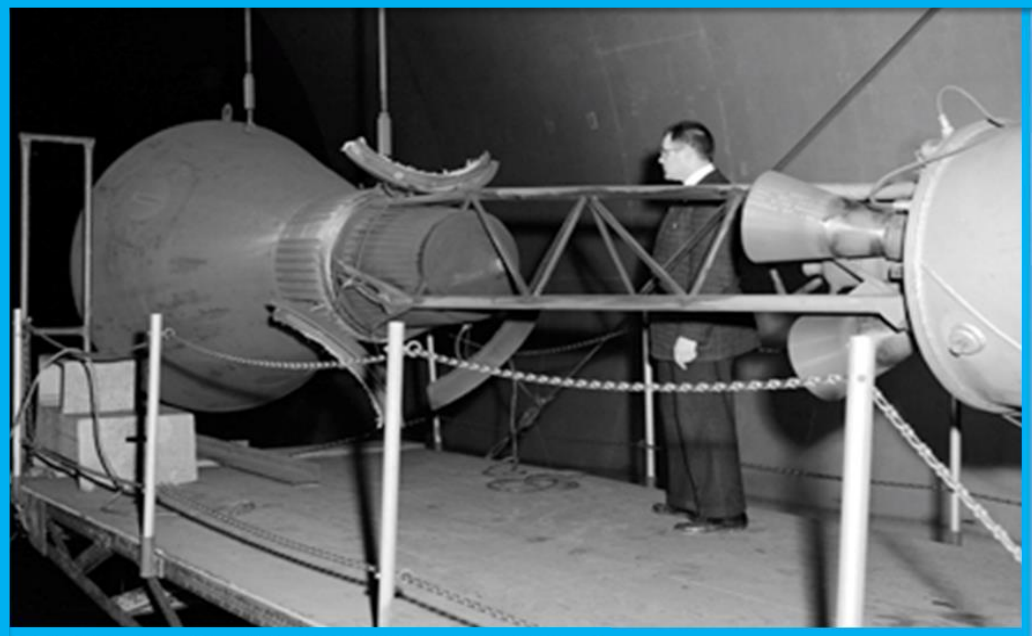
NASA Glenn: 75 Years & Beyond

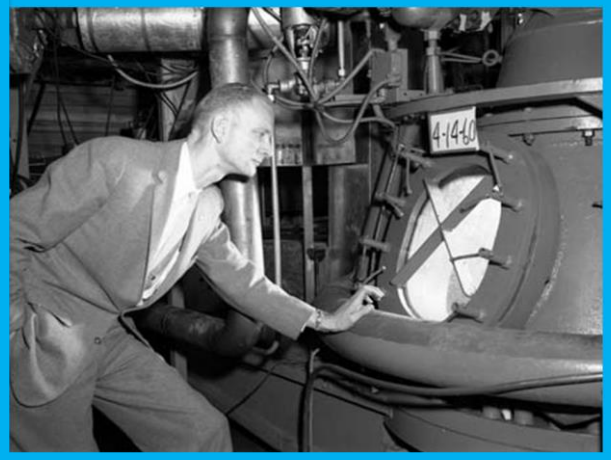






NASA Glenn: 75 Years & Beyond









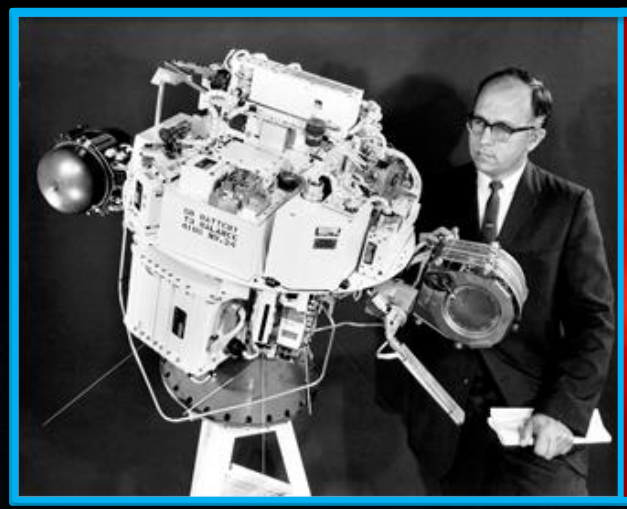
NASA Glenn: 75 Years & Beyond

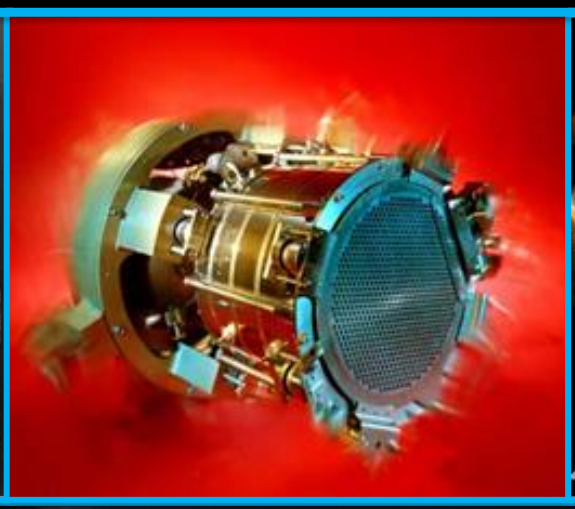


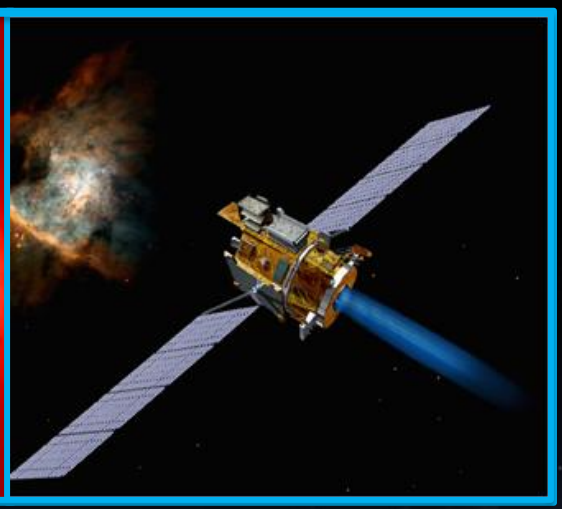




NASA Glenn: 75 Years & Beyond







NASA Glenn: 75 Years & Beyond

Technology Readiness Level (TRL) Process

NASA's quest to make jet engines quieter led to the development of chevrons, which moved relatively quickly through the TRL process to be deployed into the commercial marketplace.



TRL 8-9 (2005-now)

- Certification by the Federal Aviation Administration
- Deployed into market





TRL 7 (2001-2005)

- Validation of concept in flight
- Flight tests, final design



TRL 6 (1998-2000)

- Full scale tests for acoustics and aerodynamics
- Static engine tests



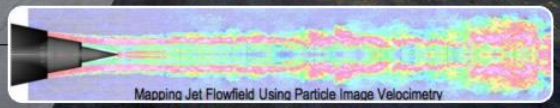
TRL 4-5 (1995-1997)

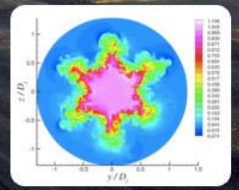
- Model tests for acoustics and aerodynamics
- Sub-scale model tests



TRL 3 (Early 1990s)

- Applications to small nozzles and airfoils
- Lab tests, concept on paper





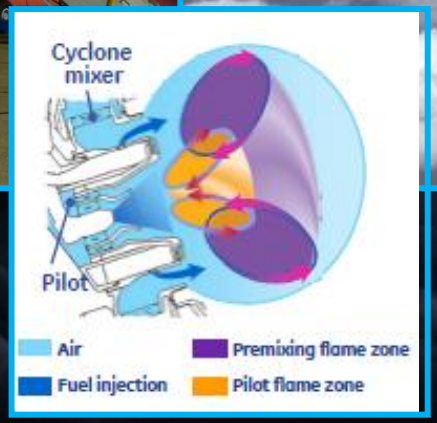
TRL 1-2 (1980s)

- Fundamental investigations of air-mixing devices (tabs, chevrons, etc.)
- No specific application, basic research in fluid physics

NASA Glenn: 75 Years & Beyond







National Aeronautics and Space Administration

NASA Aeronautics Programs

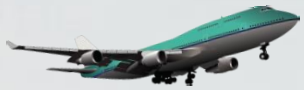
Advanced Air Vehicles Program

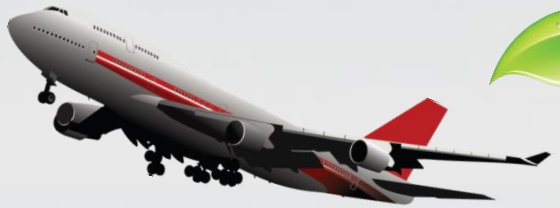
Integrated Aviation Systems Program

Airspace Operations and Safety Program

Transformative Aeronautics Concept Program











NASA Aeronautics Research Six Strategic Thrusts









Safe, Efficient Growth in Global Operations

- Enable full NextGen and develop technologies to substantially reduce aircraft safety risks



Innovation in Commercial Supersonic Aircraft

- Achieve a low-boom standard



Ultra-Efficient Commercial Vehicles

- Pioneer technologies for big leaps in efficiency and environmental performance



Transition to Low-Carbon Propulsion

- Characterize drop-in alternative fuels and pioneer low-carbon propulsion technology



Real-Time System-Wide Safety Assurance

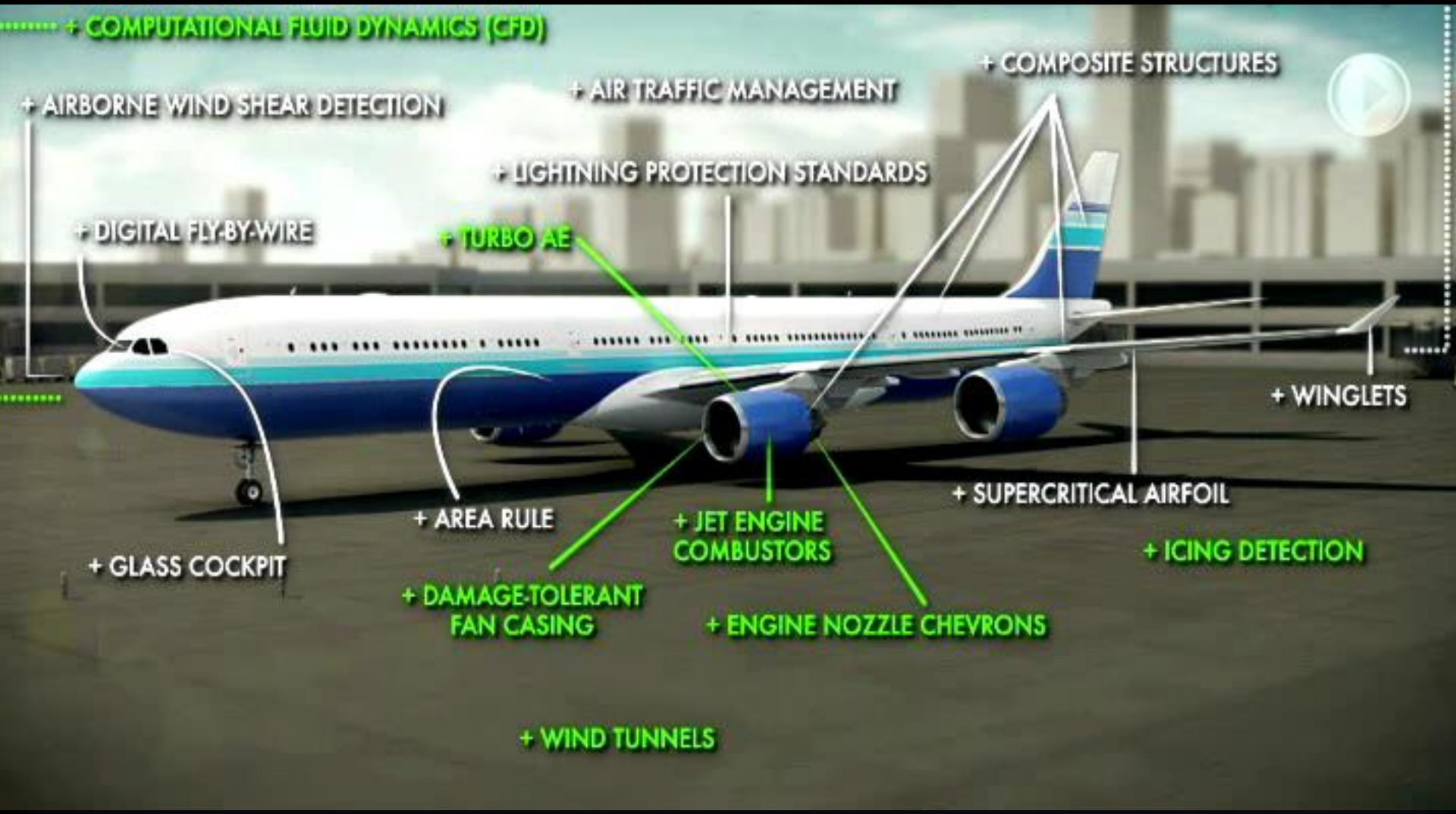
- Develop an integrated prototype of a real-time safety monitoring and assurance system



Assured Autonomy for Aviation Transformation

- Develop high impact aviation autonomy applications

Advancing Innovative Technologies for Aeronautics Achievements



Glenn Core Competencies

Air-Breathing Propulsion



In-Space Propulsion and Cryogenic Fluids Management



Physical Sciences and Biomedical Technologies in Space



Communications Technology and Development



Power, Energy Storage and Conversion



Materials and Structures for Extreme Environments



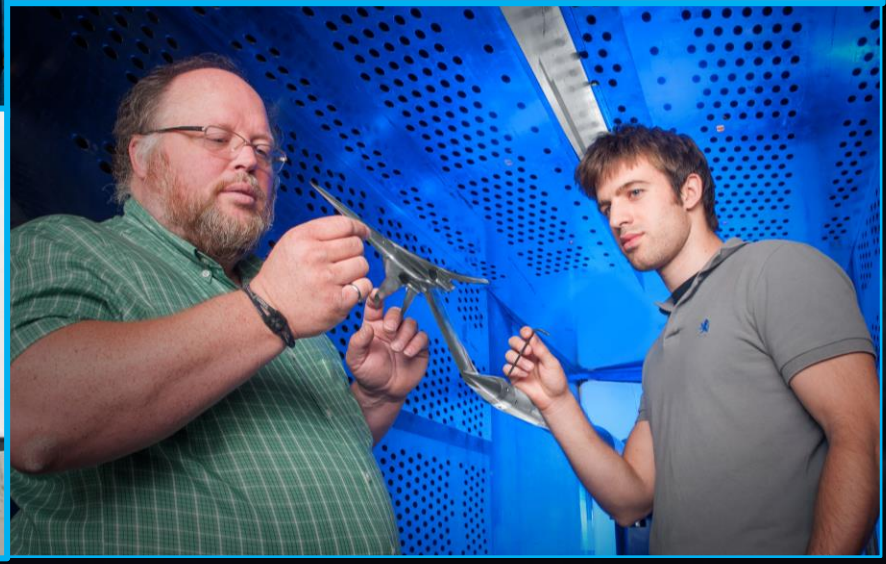


Advancing Innovative Technologies for Aerospace Achievements









Advancing Innovative Technologies for Aeronautics Achievements



Advancing Innovative Technologies for Aeronautics Achievements

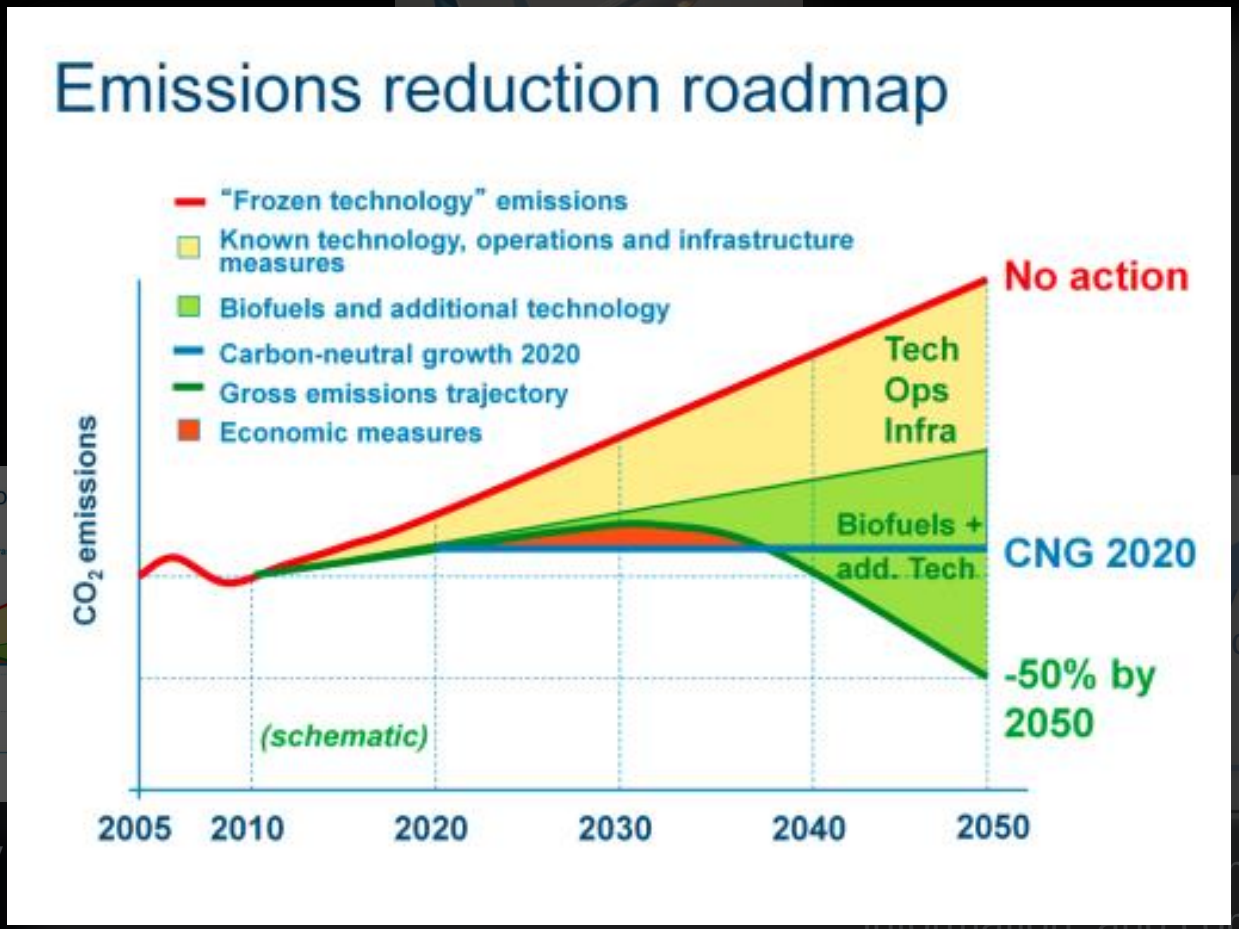


The Pursuit of Advanced Technologies



The Pursuit of Advanced Technologies

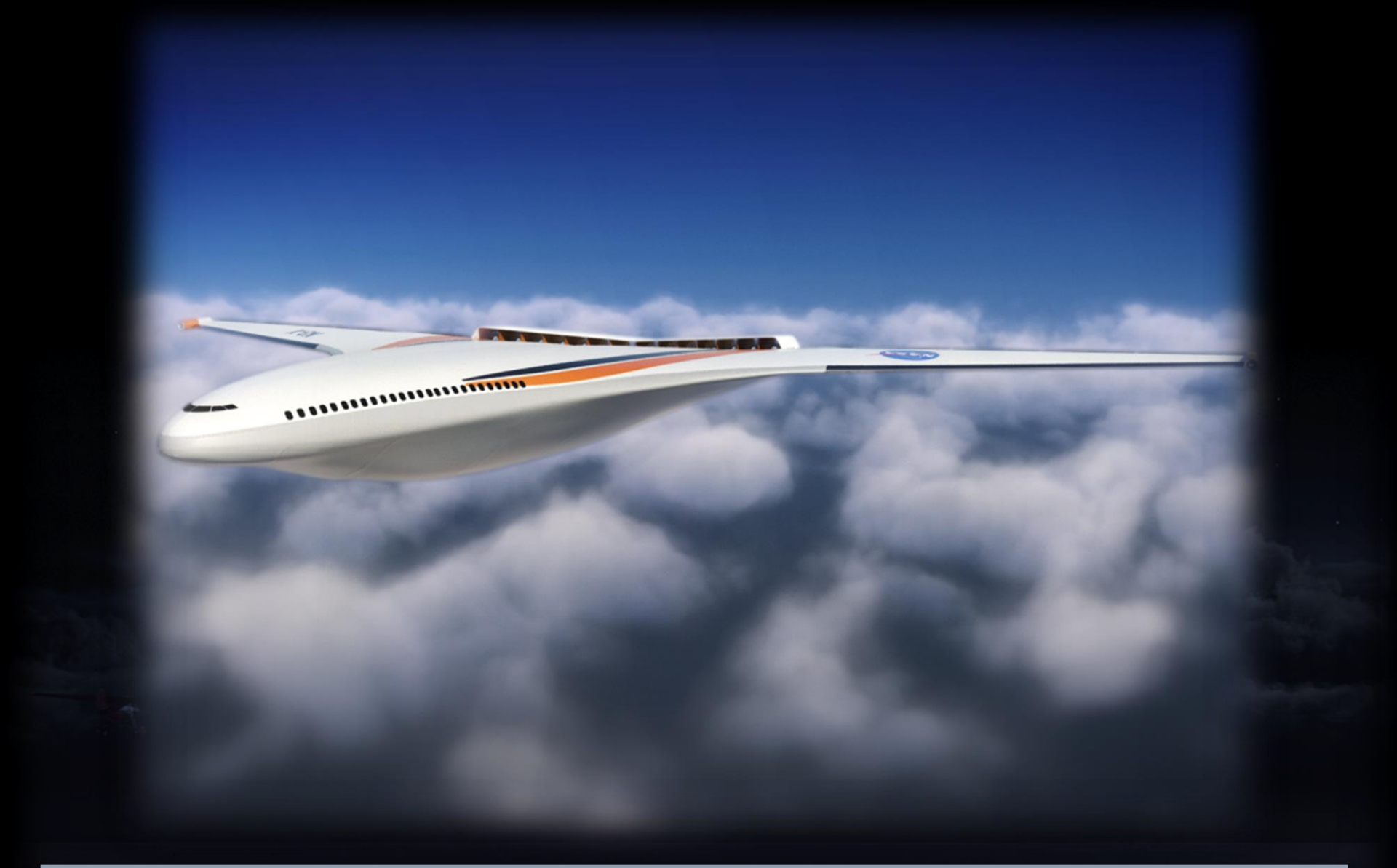
Three mega-drivers emerge



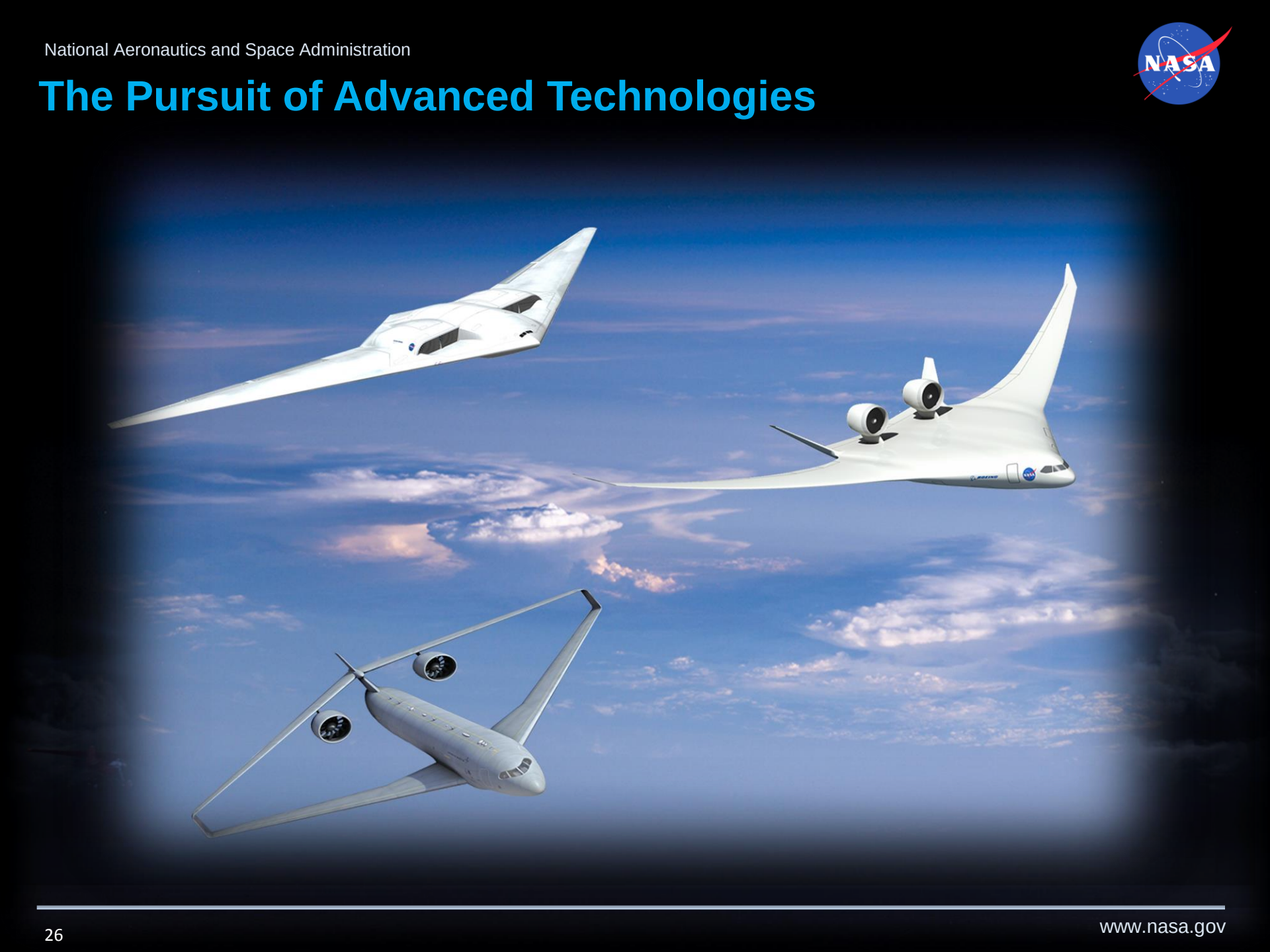
Severe energy
climate issues
enormous affordability and sustainability challenges.

mation,
information, and communication technologies enable opportunity for safety-critical autonomous systems.

The Pursuit of Advanced Technologies



The Pursuit of Advanced Technologies



The Pursuit of Advanced Technologies

Projected Timeframe to Tech. Readiness Level 6

Power Level for Electrical Propulsion

Technologies benefit more electric and hybrid-electric aircraft architectures:

- High-power density electric motors replacing hydraulic actuation
- Electrical component and transmission system weight reduction

Superconducting Machines



- Turbo/hybrid electric distributed propulsion 300 PAX

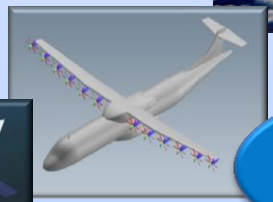


>10 MW



5 to 10 MW

- Hybrid electric 150 PAX
- Turboelectric 150 PAX



2 to 5 MW class

- Hybrid electric 100 PAX regional
- Turboelectric distributed propulsion 150 PAX
- All electric 50 PAX regional (500 mile range)



1 to 2 MW class

- Hybrid electric 50 PAX regional
- Turboelectric distributed propulsion 100 PAX regional
- All-electric, full-range general aviation

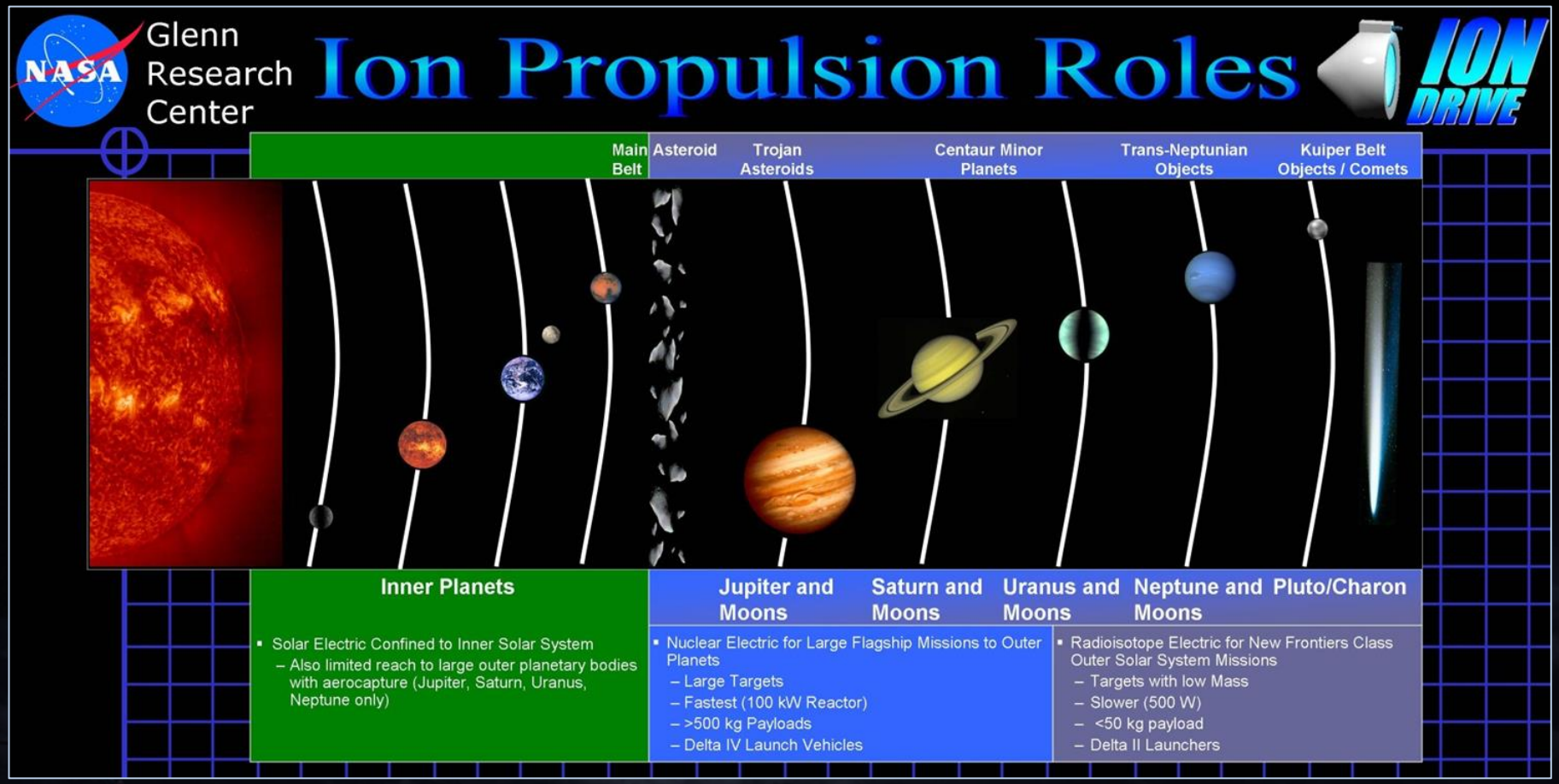


kW class

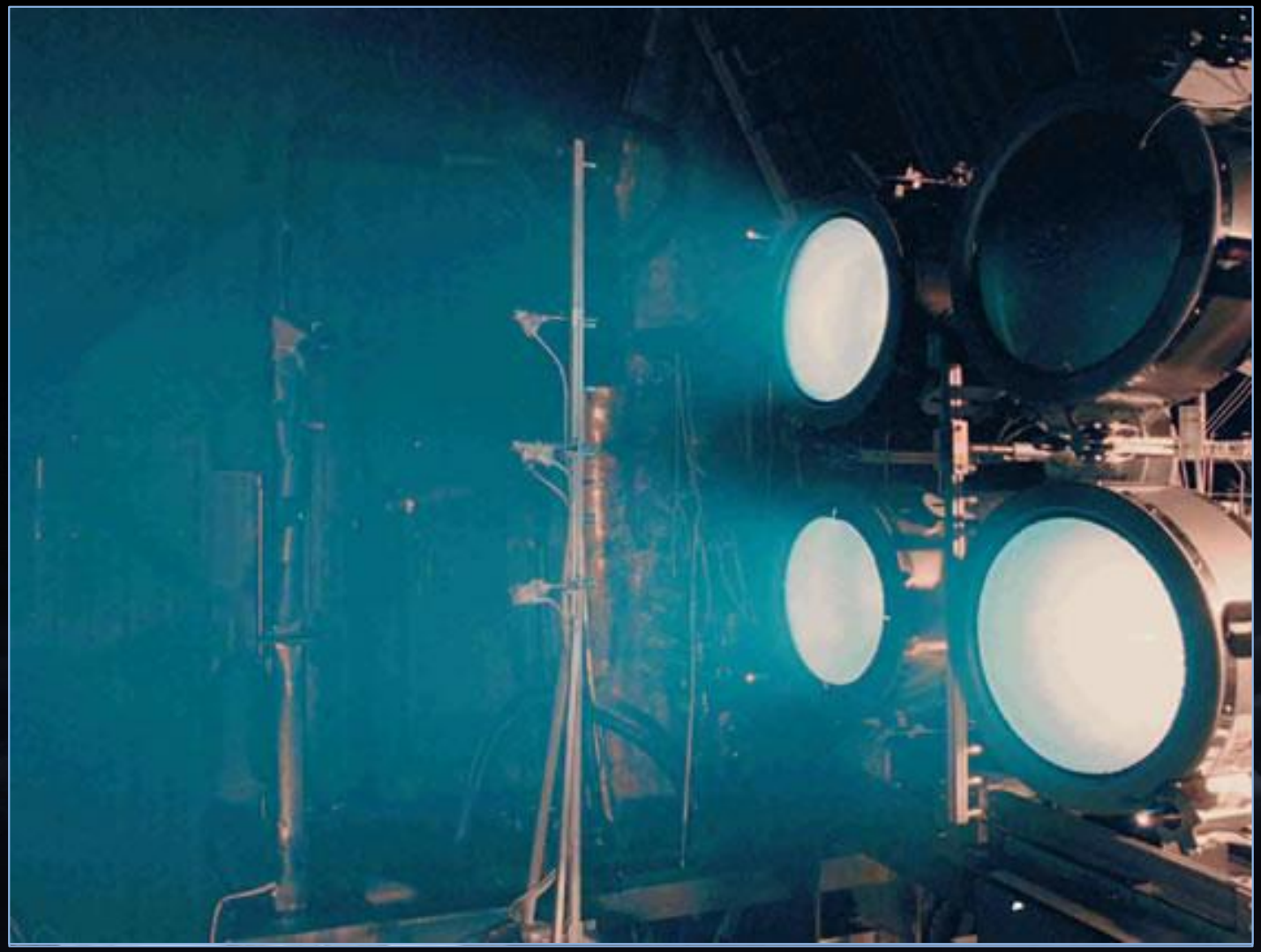
- All-electric and hybrid-electric general aviation (limited range)

Today | 10 Year | 20 Year | 30 Year | 40 Year

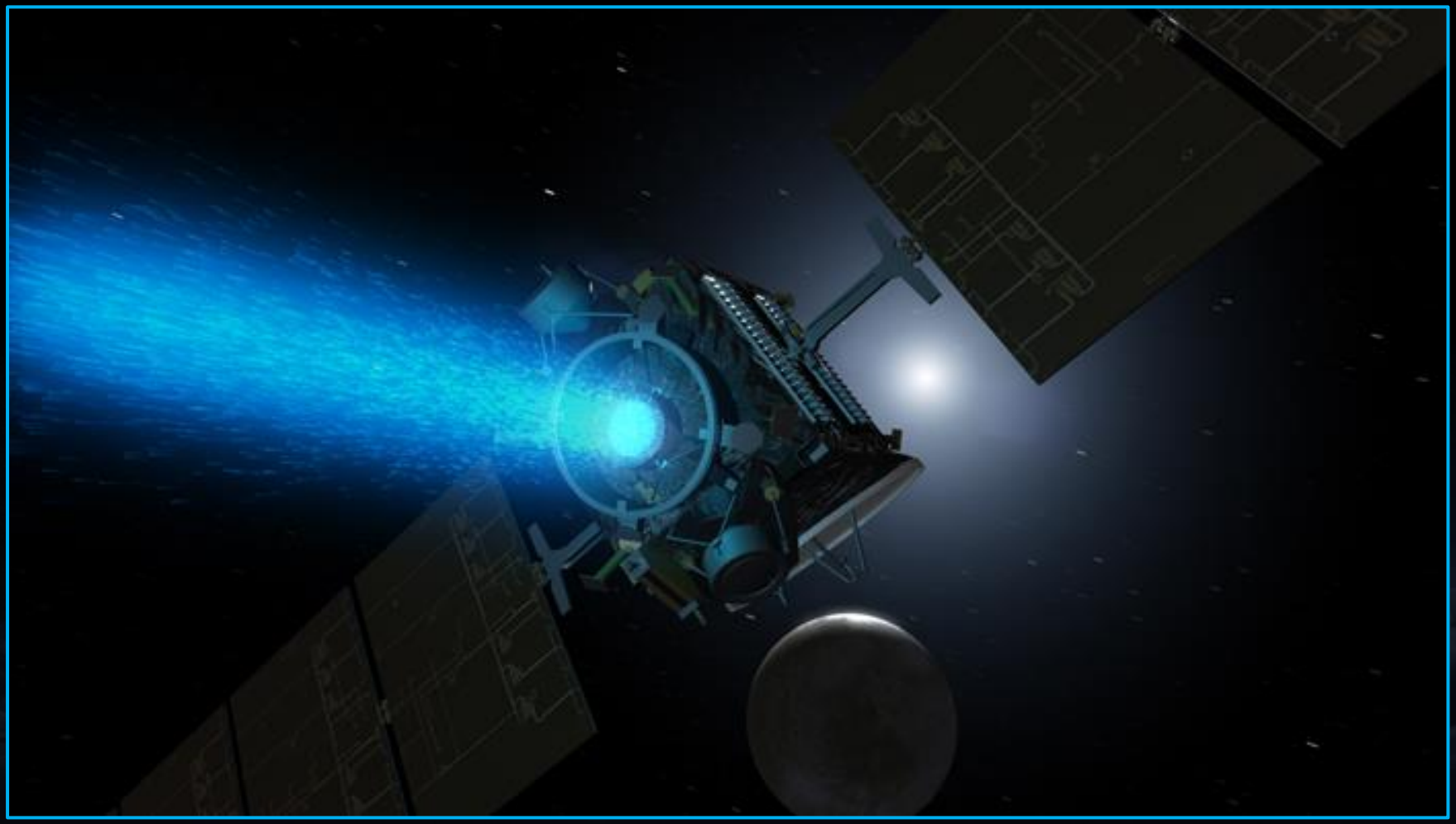
The Future: Propulsion for Deep Space Exploration



The Future: Propulsion for Deep Space Exploration



The Future: Propulsion for Deep Space Exploration

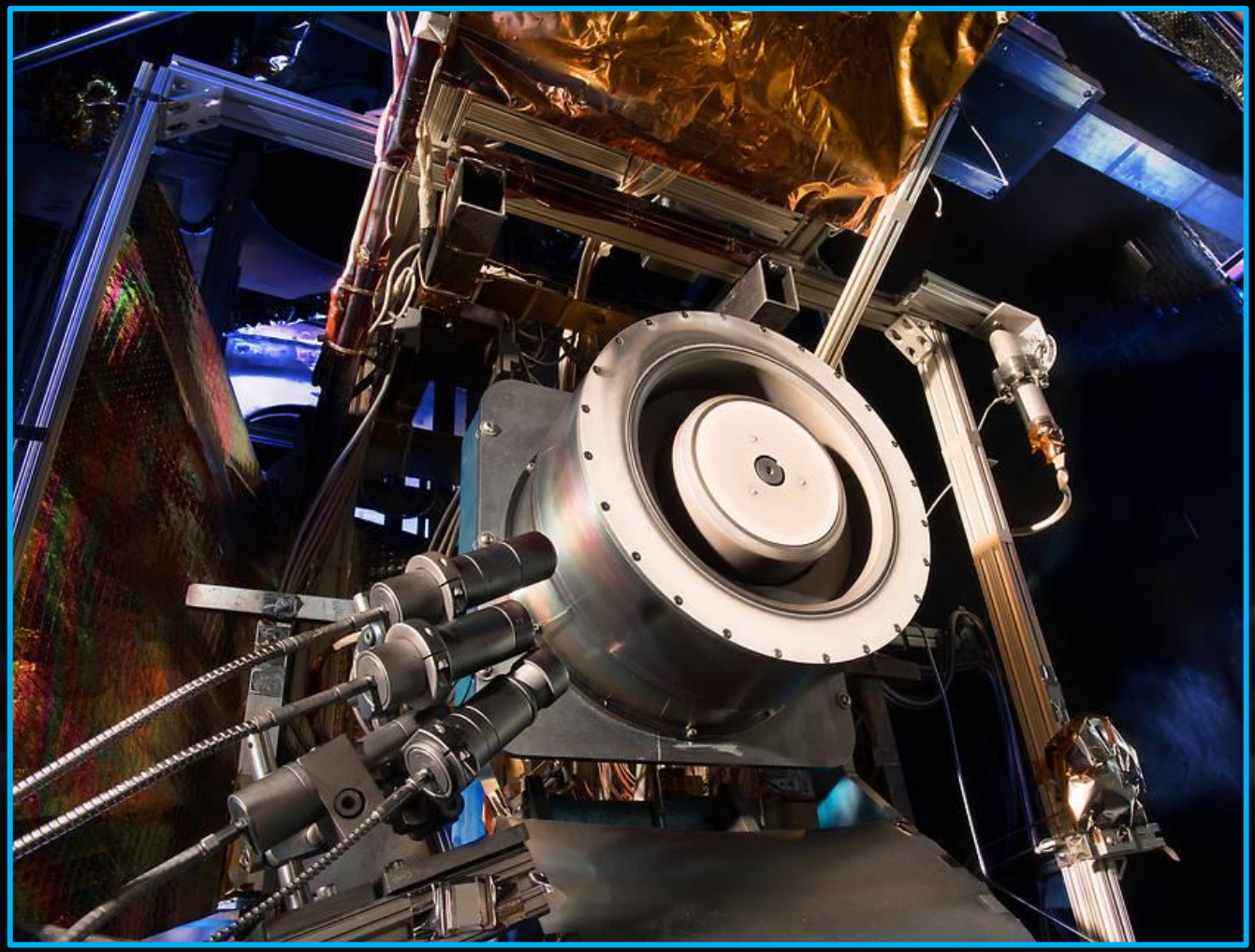


The Future: Propulsion for Deep Space Exploration

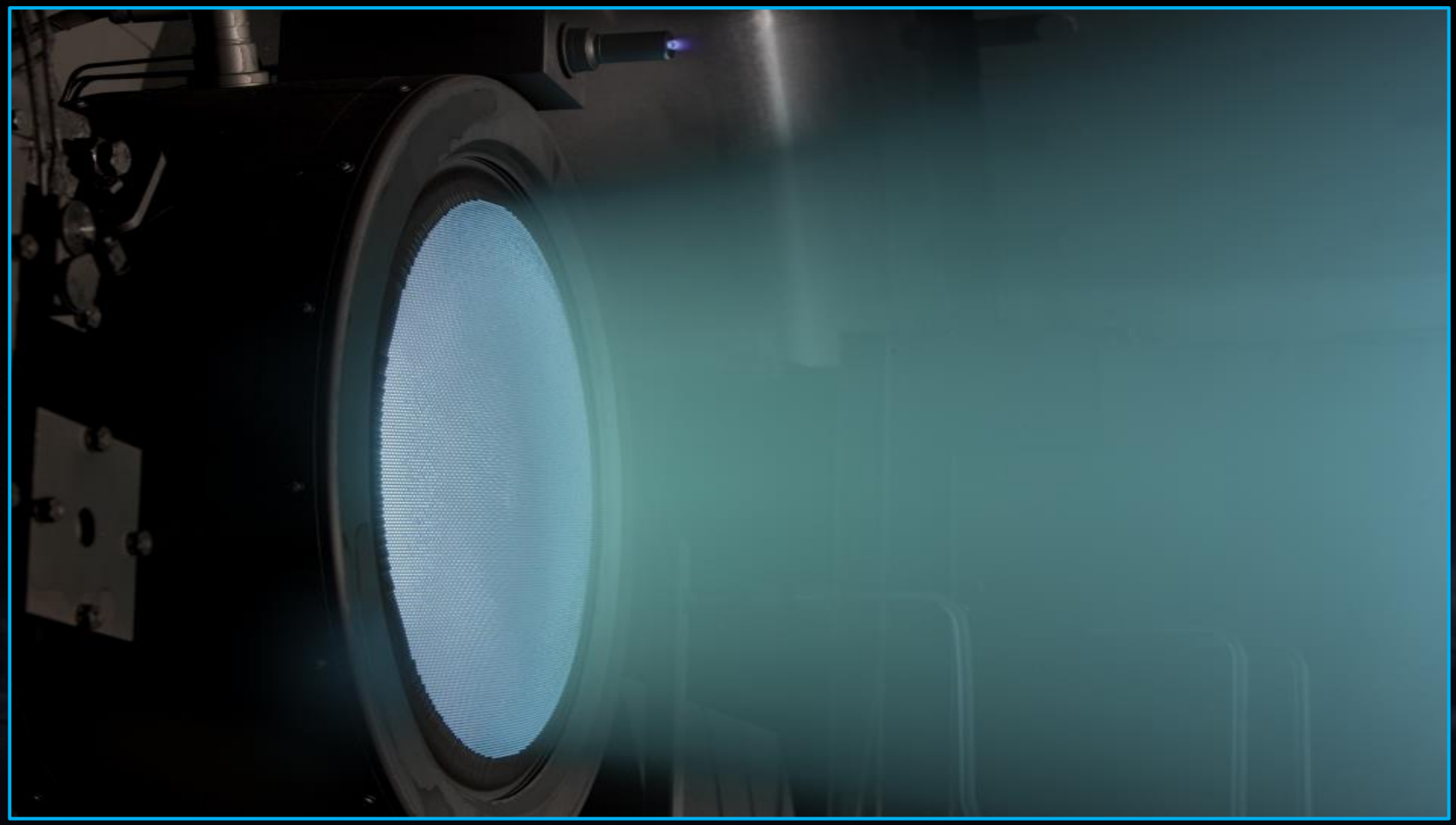


Test firing of GRC's GEN2 AE in
Aerospace Corporation's EP2 Chamber

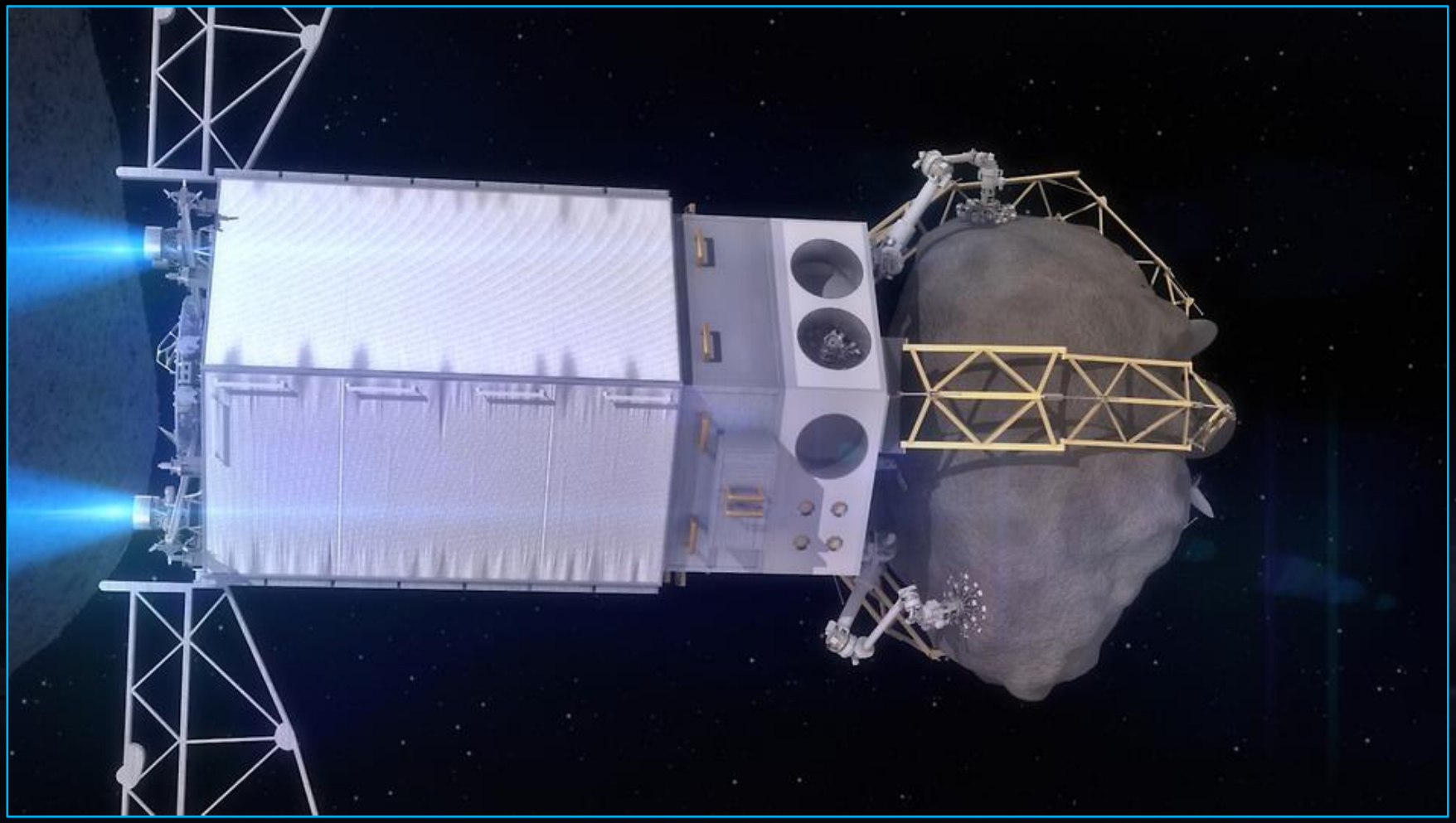
The Future: Propulsion for Deep Space Exploration



The Future: Propulsion for Deep Space Exploration



The Future: Propulsion for Deep Space Exploration



Who is NASA Glenn?





Lewis Field (Cleveland)

- 350 acres
- 1546 civil servants and 1560 contractors
- 66% of workforce are scientists and engineers

Plum Brook Station (Sandusky)

- 6500 acres
- 18 civil servants and 97 contractors

NASA Glenn Awards and Recognition



R&D 100 Awards (1966 to 2014)—Glenn has 118, highest in the Agency in these disciplines

- Aeropropulsion systems
- In-space propulsion systems
- Aerospace communications
- Power and energy conversion



Colliers

- Contributions to airline accident reduction (2008)
- Advance turboprop technology (1987)
- Thermal ice prevention systems (1946)



Emmy

- Contributions to the Communications Technology Satellite (1987)



Patents (FY 2010 – 2013)

(as of July 25, 2013)

- 43 to Glenn
- 38 to Glenn partners



NASA Software of the Year

- 5 Glenn awards in the past 15 years



FLCs

- Federal Laboratory Consortium (FLC) Excellence in Technology Transfer (2009 and 2011)



Presidential Rank (2005 to 2011)

- 17 Meritorious
- 4 Distinguished


Glenn Research Center
Lewis Field
Please Drive Safely
Glenn Research Center
FOR THE BENEFIT