NASA Glenn Research Center

75 Years of Innovation

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

Who Is NASA Glenn Today?

Lewis Field (Cleveland)

- 350 acres
- 1626 civil servants and 1511 contractors
- 66% of workforce are scientists and engineers

Plum Brook Station (Sandusky)

- 6500 acres
- 11 civil servants and 102 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

- 43 to Glenn
- 38 to Glenn partners (fiscal years 2010 to 2013) as of July 25, 2013

NASA Software of the Year

- 5 Glenn awards in the past 15 years

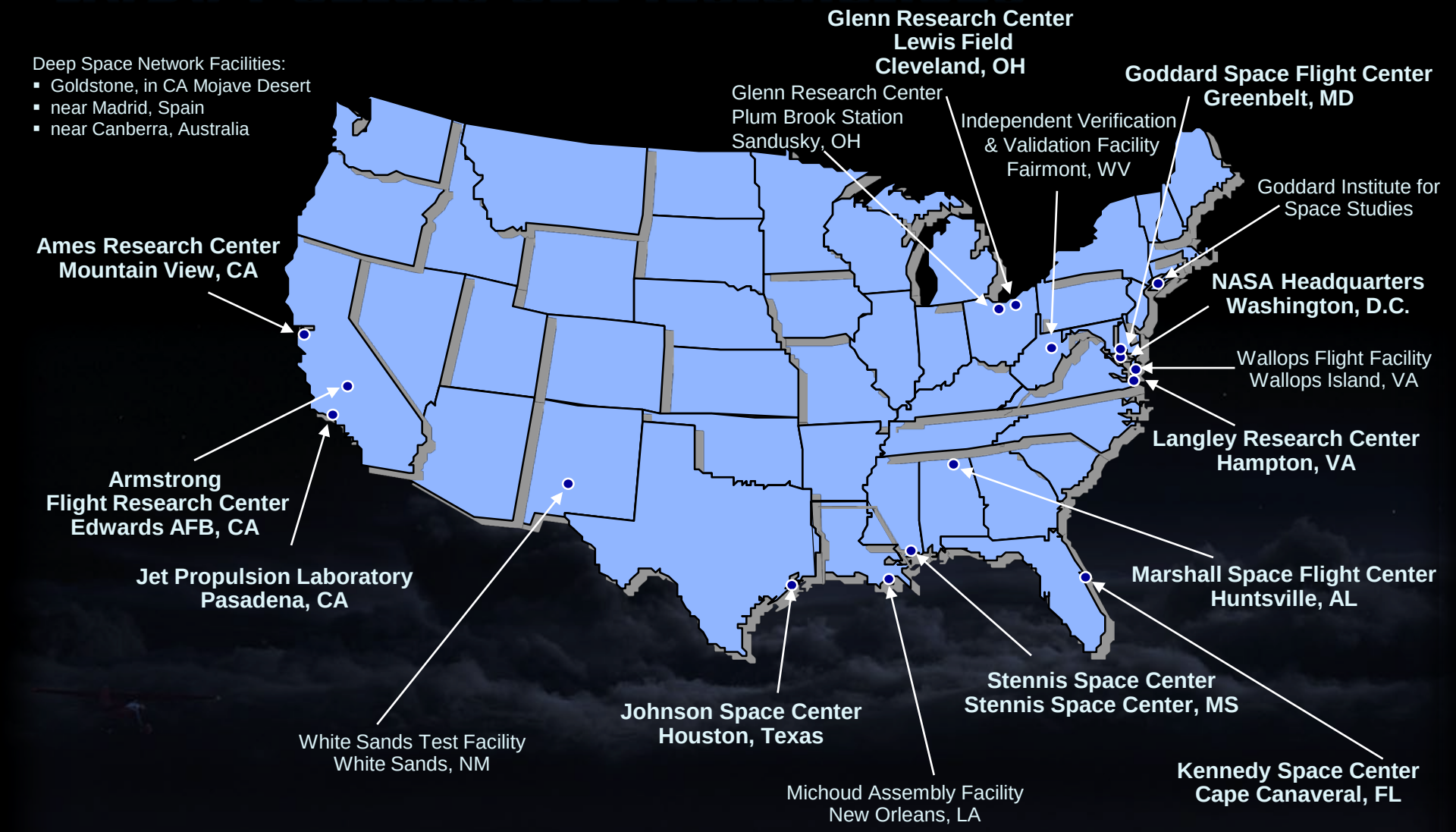
FLCs

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

Presidential Rank (2005 to 2011)

- 17 Meritorious
- 4 Distinguished

NASA Centers and Installations

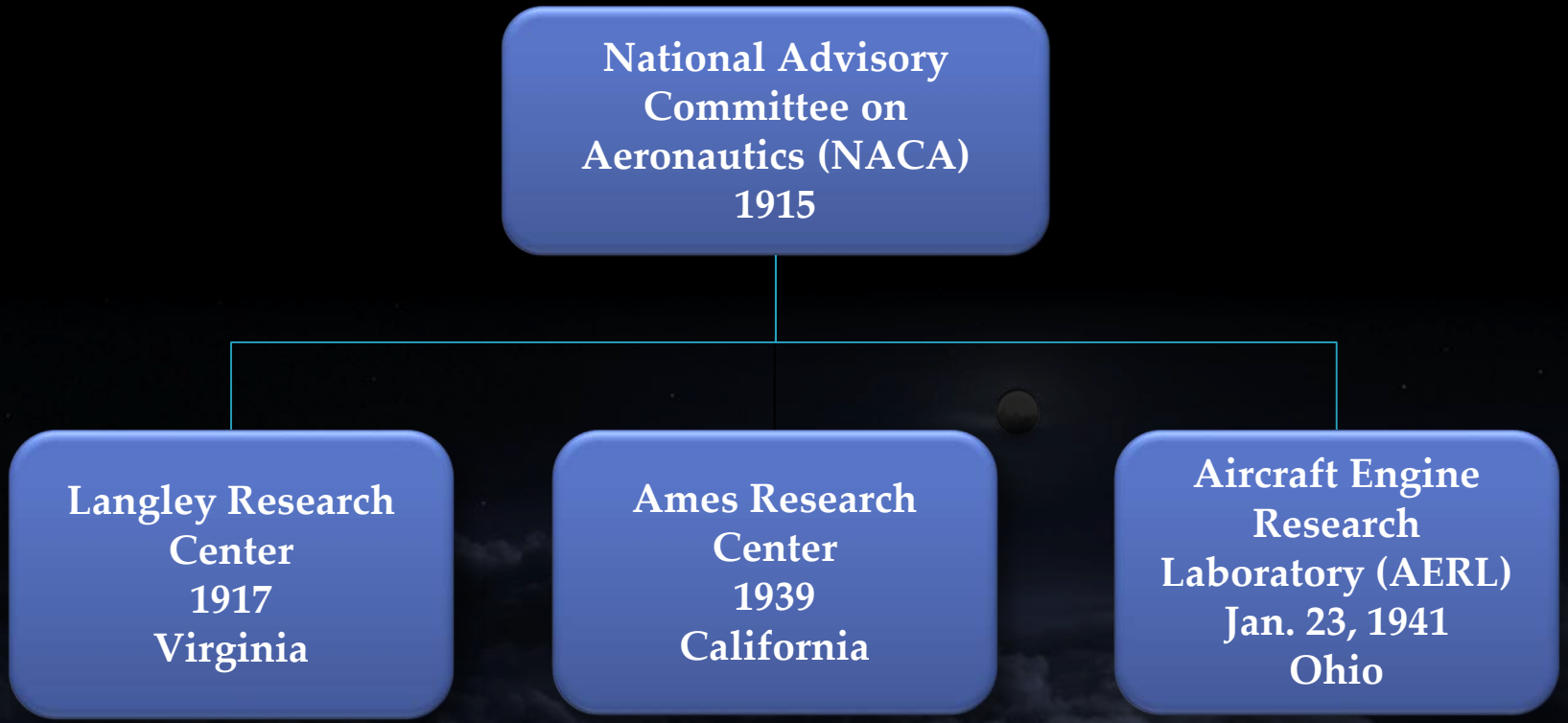


A century ago…

…it shall be the duty of the Advisory Committee for Aeronautics to supervise and direct the scientific study of the problems of flight with a view to their practical solution…

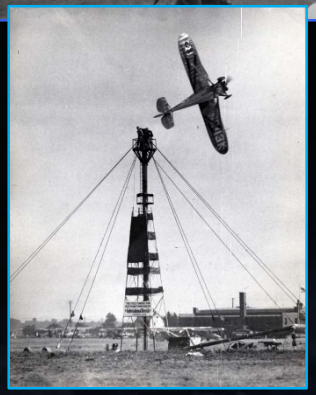
Act of Congress, approved March 3, 1915

Birth of U.S. Aeronautics Research



THE NACA RESEARCH FACILITIES

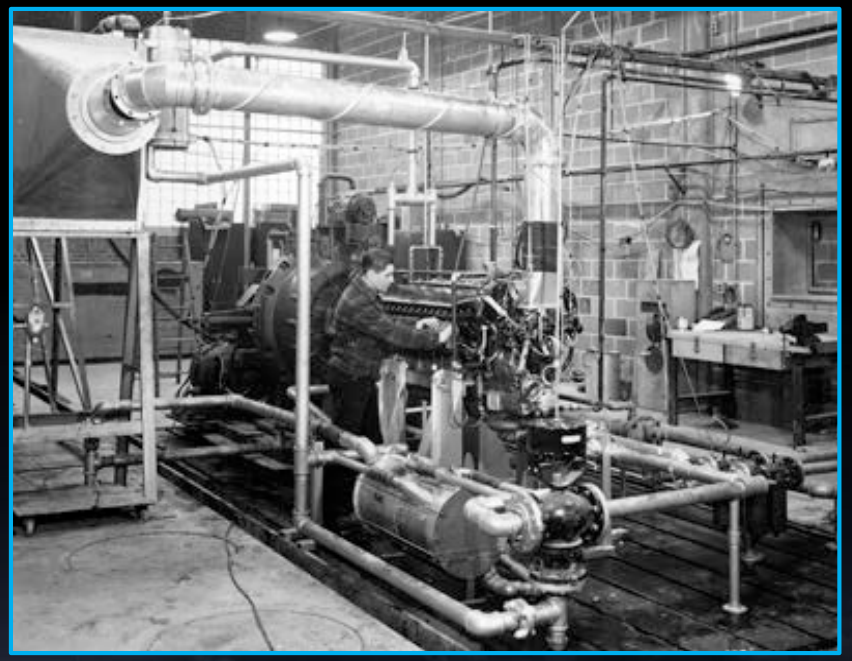
The Roots of NASA Glenn



The Roots of NASA Glenn

The Roots of NASA Glenn

NASA Glenn Goes to War



AERL OPEN FOR THE BUSINESS

NASA Glenn Goes to War

1942: INITIATION OF RESEARCH CEREMONY ENGINE PROPELLER RESEARCH BUILDING

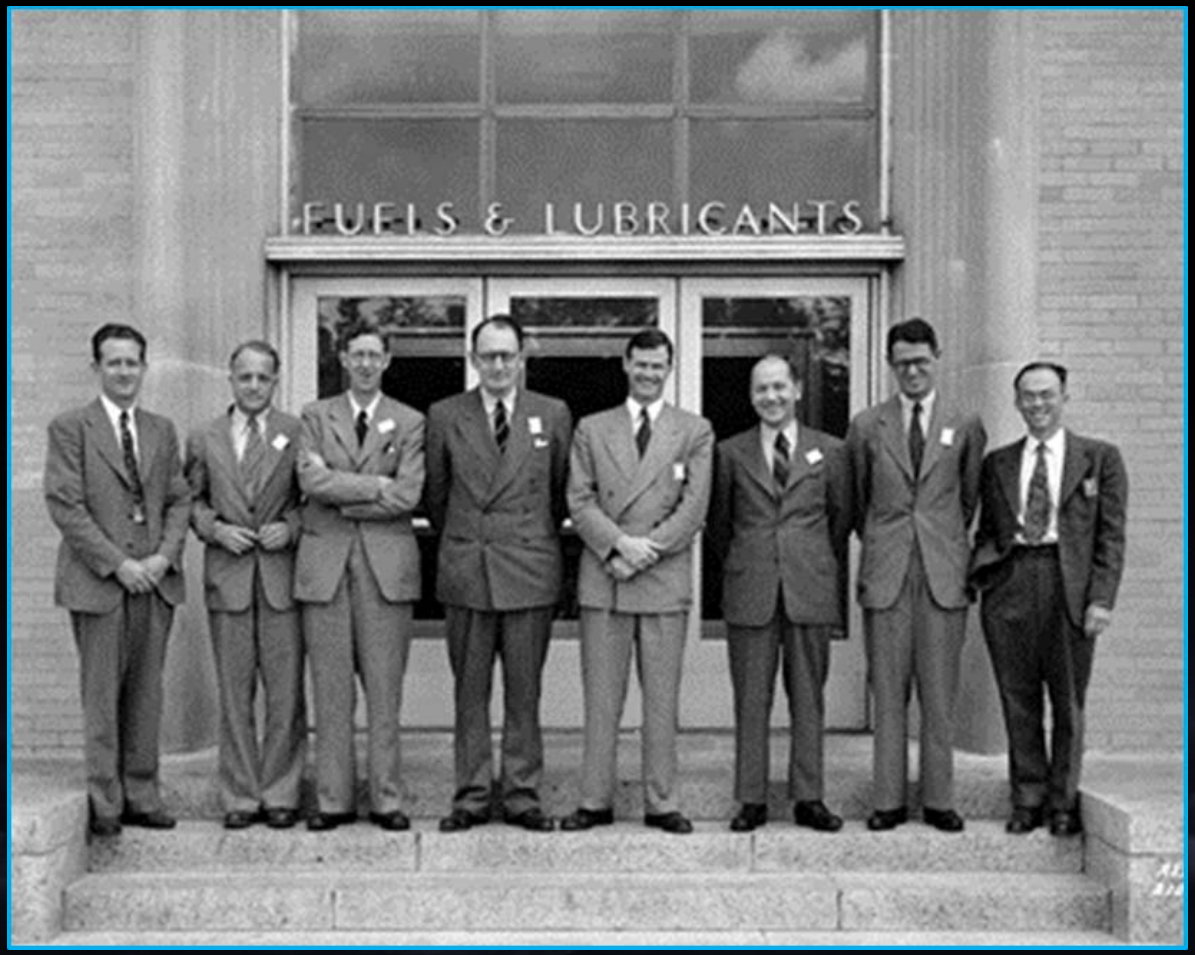
NASA Glenn Goes to War

AERL IS OFFICIALLY DEDICATED

NASA Glenn Goes to War

IN-FLIGHT AERONAUTICS RESEARCH

NASA Glenn Goes to War



THE AERL WELCOMES VISITORS

NASA Glenn Goes to War

ALTITUDE WIND TUNNEL, ONE OF A KIND

NASA Glenn Goes to War

ALTITUDE WIND TUNNEL, FIRST PROJECT

NASA Glenn Goes to War

FLYING LABORATORY

THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS ESTABLISHED BY THE U. S. GOVERNMENT IN 1915, IS OFFERING EMPLOYMENT TO MEN AND WOMEN COLLEGE STUDENTS IN ALL FIELDS OF ENGINEERING, MATHEMATICS AND PHYSICS WHO WILL GRADUATE WITHIN THE NEXT 8 MONTHS

It offers
A Career in Aeronautical Research
Permanent Activity
Freedom from Monotony

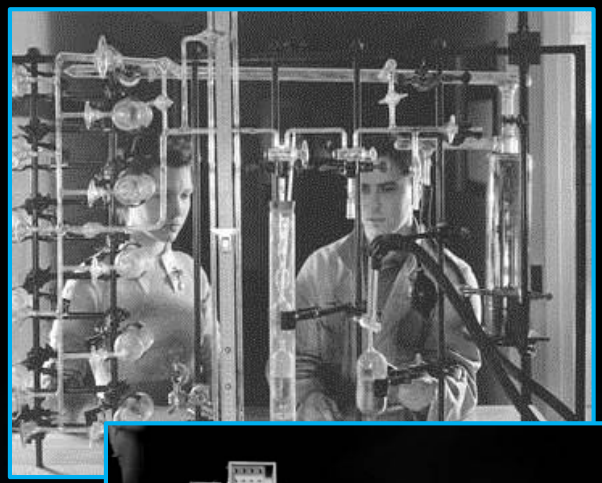
YOU ARE INVITED TO ARRANGE WITH YOUR PLACEMENT DIRECTOR FOR A PERSONAL INTERVIEW WITH OUR REPRESENTATIVE ON _____ 1944, AT ____ M. IN _____

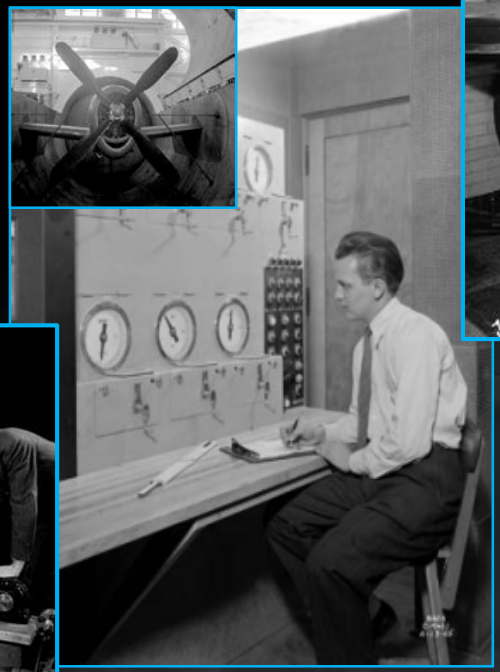
AMES AERONAUTICAL LABORATORY	LANGLEY MEMORIAL AERONAUTICAL LABORATORY	AIRCRAFT ENGINE RESEARCH LABORATORY
MOFFETT FIELD, CAL.	HAMPTON, VA.	CLEVELAND, O.

AERL 2415

RESEARCH EMPLOYMENT OPPORTUNITIES

NASA Glenn Goes to War



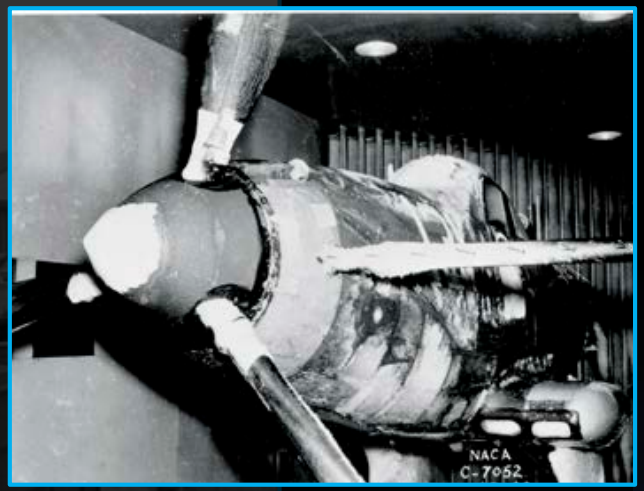


TACKLING WARTIME RESEARCH IN MANY AREAS

NASA Glenn Goes to War

B-29 IN-FLIGHT & GROUND RESEARCH

NASA Glenn Goes to War



ICING RESEARCH TUNNEL

NASA Glenn: a New Direction

NASA Glenn: A New Direction

George W. Lewis
NACA Director of Aeronautical Research
1924 - 1947

LEWIS FLIGHT PROPULSION LABORATORY

NASA Glenn: Enters The Jet Age

LEWIS FLIGHT PROPULSION LABORATORY

NASA Glenn: Furthering Aircraft Safety

LEWIS FLIGHT PROPULSION LABORATORY

NASA Glenn: Preparing For Space

LEWIS RESEARCH CENTER
ROCKET ENGINE TEST FACILITY

NASA Glenn: On The Path to Space

LEWIS RESEARCH CENTER
MULTIPLE-AXIS SPACE TEST INERTIA FACILITY

NASA Glenn: On The Path to Space

LEWIS RESEARCH CENTER
MERCURY TO CENTAUR

NASA Glenn: Transitions

NASA Glenn: Transitions

LEWIS RESEARCH CENTER AND PLUM BROOK STATION

NASA Glenn: Reordering Priorities

LEWIS RESEARCH CENTER
SPACE SHUTTLE TO TURBO PROP TO ICING

NASA Glenn: Going Green

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

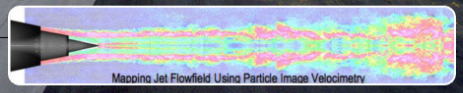
TRL 7 (2001-2005)
- Validation of concept in flight
- Flight tests, final design

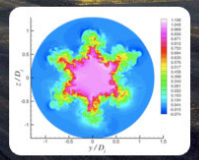
TRL 6 (1998-2000)
- Full scale tests for acoustics and aerodynamics
- Static engine tests

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

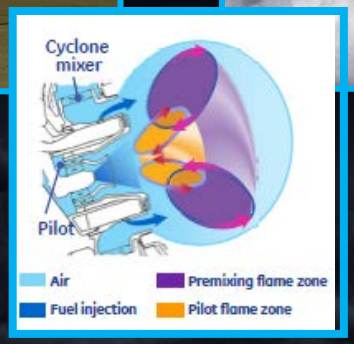
TRL 1-2 (1980s)
- Fundamental investigations of air-mixing devices (tabs, chevrons, etc.)
- No specific application, basic research in fluid physics





LEWIS RESEARCH CENTER
CHEVRON NOZZLES—FROM IDEA TO DEPLOYMENT

NASA Glenn: Going Green



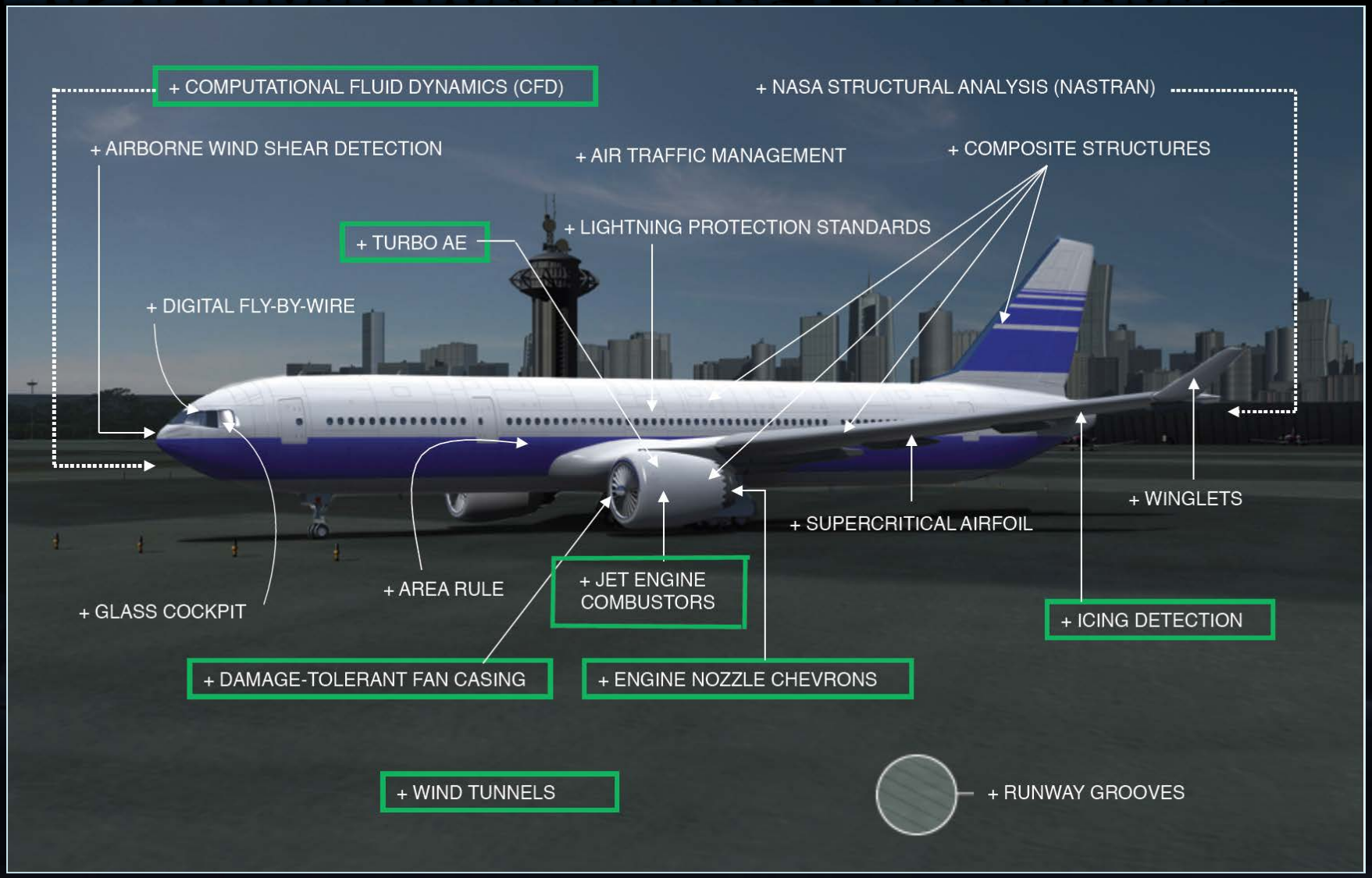
GLENN RESEARCH CENTER TAPS—FROM IDEA TO DEPLOYMENT

NASA Glenn: Advancing Aeronautics

GLENN RESEARCH CENTER
SUPERSONICS, BIOFUELS, ICING AND UAS

NASA Glenn: Looking to The Future

NASA Glenn Aeronautics Contributions



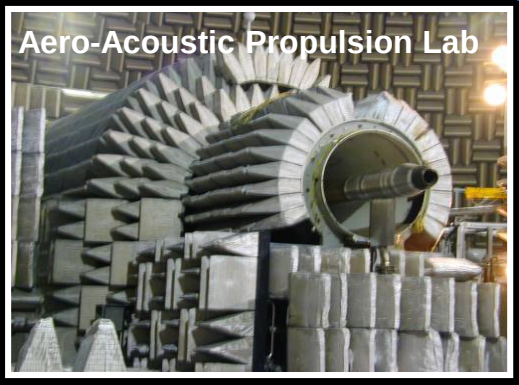
NASA Glenn: Unique Aero Facilities

Subsonic Propulsion Wind Tunnels

- Noise suppression
- Inlet/Airframe integration
- STOVL hot gas ingestion

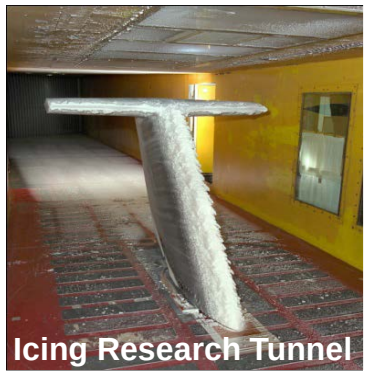
Transonic and Supersonic Propulsion Wind Tunnels

- Advanced propulsion concepts
- Inlet/Airframe Integration
- Internal/external aerodynamics



Engine Acoustic Research Facility

- Fan/nozzle acoustics research
- Simulate hot engine nozzles in flight
- Aerodynamic and Aeroacoustic measurements capabilities



Largest Icing Tunnel in US

- Aircraft icing certification
- Ice protection systems development
- Icing prediction/code validation

NASA’s only altitude full-scale engine facility

- Jet Engine Icing Research
- Engine operability/performance
- Nozzle-engine integration/development

Over 50 Versatile Engine Component Facilities

- Combustor and Heat Transfer
- Compressor and Turbine
- Inlets and Nozzles

So, Who Is NASA Glenn today?