

# Rolls-Royce CLEEN II Program Overview



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CLEEN Consortium Public Day Charts, Virtual Meeting

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**B-52J**

**Ready To Deliver.**



**V-280**



## Who We Are

Rolls-Royce is a leading power & propulsion systems company.

We pioneer cutting-edge technologies that deliver clean, safe and competitive solutions to meet our planet's vital power needs.



**World-Class Engineers & Manufacturers**



**Innovators**



**Digital Pioneers**





## What We Do

Rolls-Royce is tightly focused into **three operating businesses.**



### Civil Aerospace



### Power Solutions



### Defense





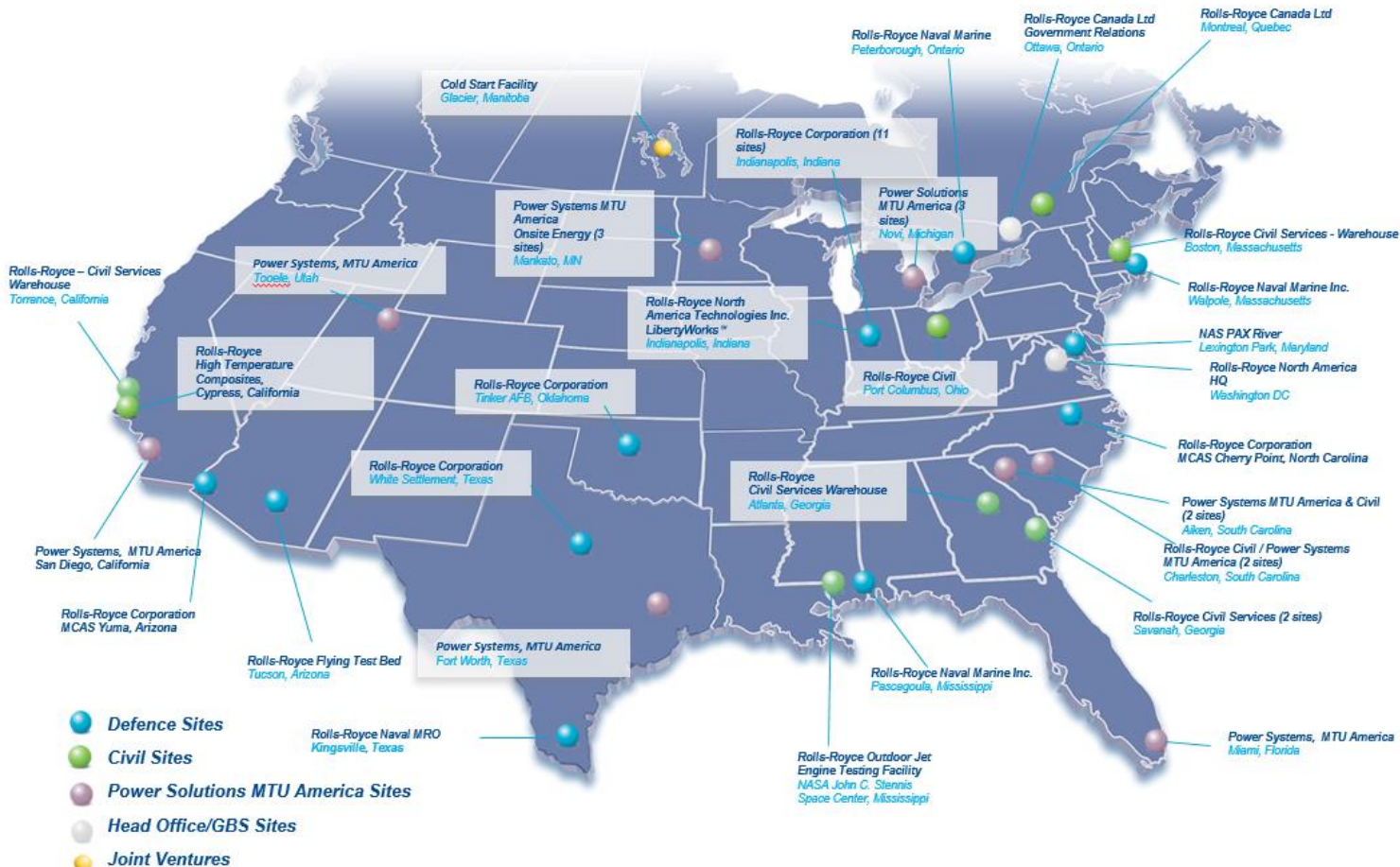


## Our Footprint

Rolls-Royce directly employs more than **5,200 diverse high-skill US teammates** and supports tens of thousands of jobs across our downstream network (\$1.6B Annual US Supplier Spend).

Since 2015, we have invested more than **\$1B in our US facilities.**

We also operate a number of University Technology Centers (UTCs) in the US, and support several apprentice and workforce development programs at our flagship sites.





## We're investing in our US facilities

More than \$1B invested in US facilities and capabilities since 2015 to serve the future needs of our customers.



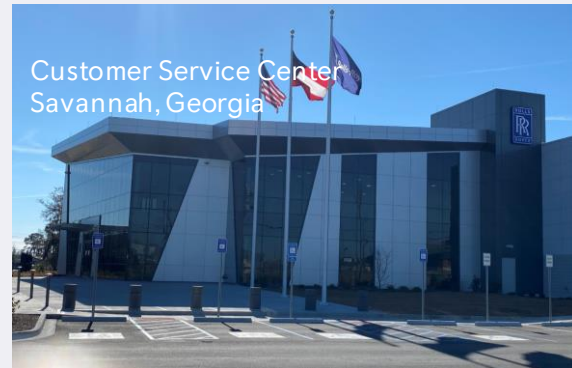
Revitalization project  
Indianapolis, Indiana



New MRO facility  
Walpole, Massachusetts



Functional microgrid  
Aiken, South Carolina



Customer Service Center  
Savannah, Georgia



New MRO facility  
Aiken, South Carolina



Upgraded Naval Marine Foundry  
Pascagoula, Mississippi





## NetZero

We are committed to achieving **NetZero carbon** across our value chain, while still delivering leading technologies to our civilian and defense customers.

Rolls-Royce Will:

- ✓ Reach NetZero carbon from our operations by 2030
- ✓ Reach 75%+ of R&D spending invested in NetZero technology by 2025
- ✓ Reach NetZero carbon across our value chain by 2050



Electric Flight



Sustainable Fuels



Small Modular Reactors



Microgrids



Industry-Leading Battery Technology





## Civil Aerospace

Our Civil Aerospace group is a major manufacturer of high-performance aircraft engines.

Our Civil Aerospace group is a major manufacturer of aircraft engines, **leading the wide body commercial and business jet propulsion markets.**

All-in production Civil Aero engines will be certified 100% Sustainable Aviation Fuel Compatible by 2023.



# 385+ Million

Flight Hours on  
Rolls-Royce Engines







## Defense

We are the **engine market leader** in **transport and patrol aircraft**, and power a broad range of engines for **combat aircraft** and **helicopters**.

Rolls-Royce is the only fielded **tilt-rotor** and **STOVL** aircraft propulsion provider for the US military.

Rolls-Royce is also the **primary propeller supplier for the US Navy** and a pioneer aero-derivative marine engines for the DoD.



16,000+  
Military Engines In Service

# Flight Demo of Boeing Short Nacelle

## FAA CLEEN II

### Aviation Week & Space Technology

February 15, 2023

- Guy Norris

### **“Boeing Short-Inlet Flight Tests Show Potential to Cut Big Fan Drag”**

- **Ground testing conducted under Boeing CLEEN II Contract**
  - Boeing baseline and short nacelles
  - Rolls-Royce Trent 1000 Engine
  - Testing at Rolls-Royce outdoor facility at NASA Stennis
  - Successfully completed to TRL 6
- **Follow-on flight testing under RRC CLEEN II Contract**
  - Testing moved to Rolls-Royce 747 Flying Test Bed to evaluate angle of attack effects to TRL 7
  - Flight completed on 8 September 2022





# Flight Demo of Boeing Short Nacelle

## FAA CLEEN II

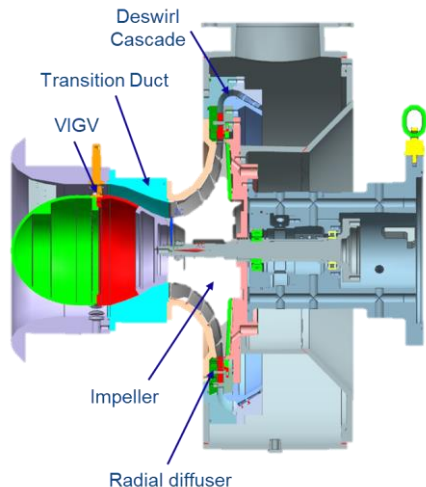
- Back-to-back testing conducted on the Rolls-Royce 747 Flying Test Bed at Tucson, AZ to TRL 7
- Data analysis and final reporting in process
- Thanks for the Boeing, Rolls-Royce, and FAA collaboration team on this fuel burn reduction technology





# Rolls-Royce CLEEN III Program

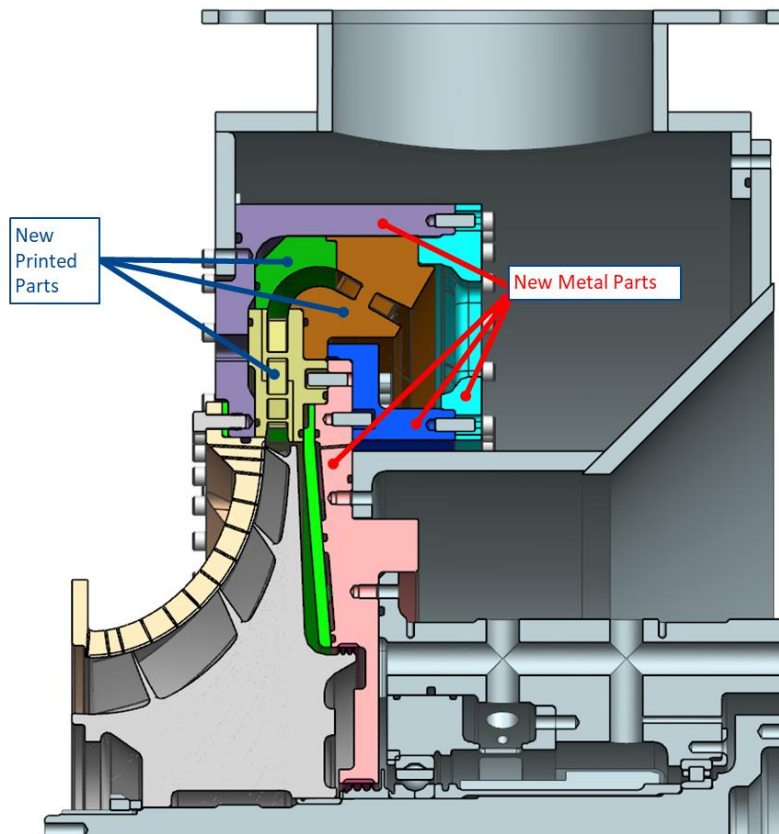
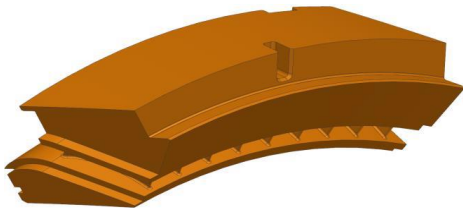
## CSTAR Gen2 Rig



- Rolls-Royce is developing advanced centrifugal compressor stage technologies to improve the performance of a high overall pressure ratio axial-centrifugal compression system.
- The goal of the work is to improve both component efficiency and surge margin while reducing the physical size of the machine.
  - Combined centrifugal stage efficiency target: 0.3% (~0.3% Fuel Burn)
  - Combined centrifugal surge margin target: +2%
  - Engine performance model will be used to calculate engine and fleet level impact
- The effort includes design, fabrication, and assessment of candidate technologies, including testing in the Centrifugal Stage for Aerodynamic Research (CSTAR) rig at Purdue University.
- Through this approach, concepts are progressed from TRL3 to TRL5.

# CSTAR GEN2.5 CF Compressor Rig

- Rig allows for inexpensive printing of downstream diffuser and deswirler geometries
- Sectors are printed from high temperature capable polymer
- Enables optimization of the diffuser and deswirler as a system
- Diffuser technologies to be studied include injection holes and end wall contouring
- Deswirl technologies to be studied include vane configuration and 3D geometry

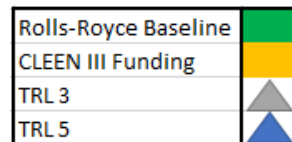
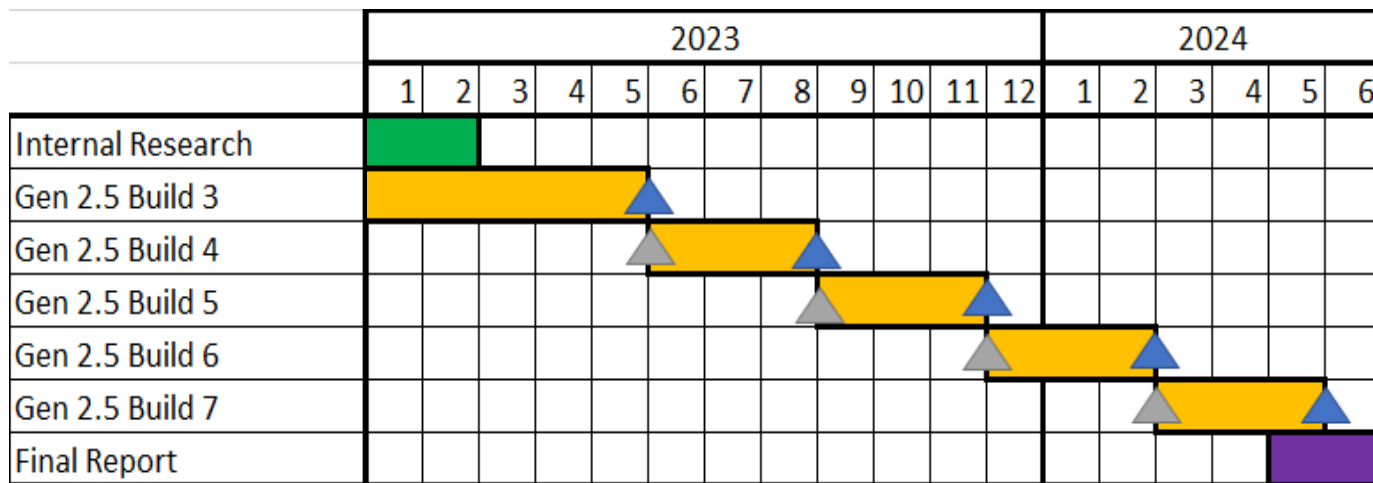


**CSTAR Gen2.5 Rig**



# CLEEN III CSTAR Test Sequence

Testing will continue through Q2 2024



Aerodynamic technologies which are successful will be considered TRL5 at program conclusion.



