



# CLEEN III

## **HONEYWELL CLEEN PHASE III**

### **Consortium Public Session**

**May 3, 2023**

Contractor Name: Honeywell International Inc.  
Address: 111 S. 34<sup>th</sup> Street  
Phoenix, Arizona 85072-2181

# HONEYWELL OVERVIEW

~110,000 employees | ~919 sites | Headquarters in Charlotte, N.C. | Fortune 100

## Aerospace



Our products are used on virtually every commercial and defense aircraft platform worldwide and include aircraft propulsion, cockpit systems, satellite communications, and auxiliary power systems.

## Building Technologies



Our products, software, and technologies are in more than 10 million buildings worldwide, helping customers ensure their facilities are safe, energy efficient, sustainable, and productive.

## Performance Materials and Technologies



We develop advanced materials, process technologies, automation solutions, and industrial software that are revolutionizing industries around the world.

## Safety and Productivity Solutions



We improve enterprise performance, worker safety and productivity with automated material handling, voice scanning mobile computing tech, software solutions, personal protective equipment and sensing technology.

## Honeywell Connected Enterprise (HCE)

Established in 2018, HCE's focus is on software development, bringing scale and capability across all of Honeywell

*A Global Diversified Technology Company*

# HONEYWELL AEROSPACE

Our products and services are found on virtually every commercial, defense and space aircraft.

We build aircraft engines, cockpit and cabin electronics, wireless connectivity systems, mechanical components and more, and connect many of them via our high-speed Wi-Fi offerings.

Our solutions create healthier air travel, more fuel-efficient and better-maintained aircraft, more direct and on-time flight arrivals, safer skies and airports and more comfortable flights.



**~30**

Research &  
Development  
Facilities



**~24,000**

Employees



**~9,000**

Engineers and  
Technologists



**~3,000**

Global Software  
Engineers



**~10,000**

Active Patents  
and Applications



**10,000+**

Customers



**400+**

Platforms



**SERVICE &  
SUPPORT**

Extensive Network  
When and  
Wherever Needed



# ENGINES & POWER SYSTEMS

100K+

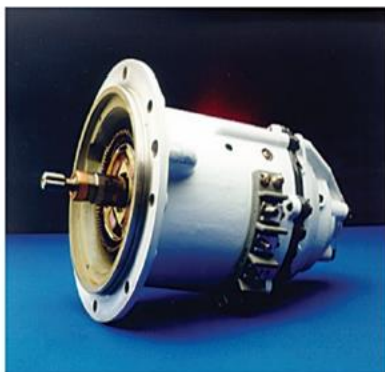
Auxiliary Power Units Delivered Since 1959



PROPULSION  
ENGINES



AUXILIARY POWER



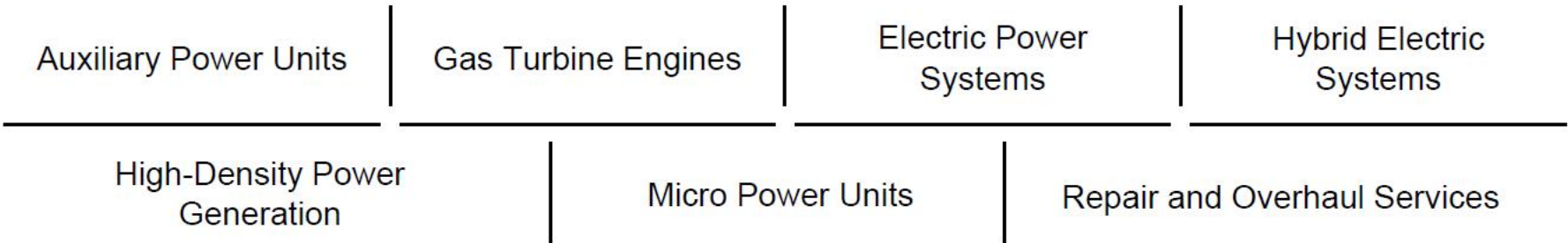
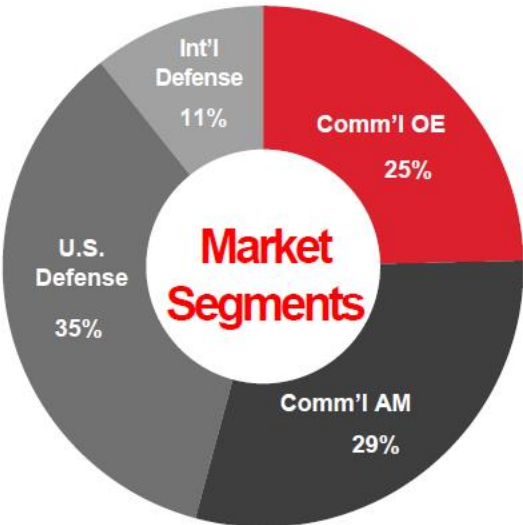
ELECTRIC POWER  
GENERATION



HYBRID  
PROPULSION



MICRO POWER



72K+

Engines Delivered Since 1959

# SUSTAINABILITY: TWO DECADES OF EXPERIENCE TO HELP US ALL MEET OUR PLEDGES



**>90%**

**REDUCTION**

in greenhouse  
gas intensity  
since 2004



**~3,000**

**ACRES**

remediated and  
restored as valuable  
community assets



**>70%**

**IMPROVEMENT**

in energy  
efficiency  
since 2004



**160**

**MILLION GALLONS**

of water saved in  
water-stressed  
areas since 2013



**~6,100**

**SUSTAINABILITY**

projects since  
2010



**55**

**MILLION CARS**

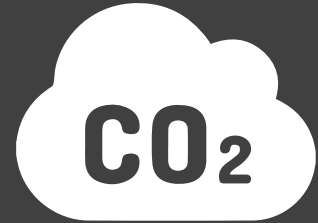
the equivalent removed  
from the road for one year,  
thanks to Honeywell  
Solstice® offerings

## **SUSTAINABLE AVIATION FUEL (SAF)**

Substituting SAF for Jet-A fuel at Phoenix Engines Campus

PHOENIX, Jan. 30, 2023 /PRNewswire/ -- Honeywell (NASDAQ: HON) recently received its first delivery of sustainable aviation fuel at its Phoenix Engines campus. The fuel will support development and production testing of auxiliary power units (APUs) and propulsion engines at the site, along with testing of fielded units from Honeywell's repair and overhaul facility.

Honeywell



## **CARBON NEUTRALITY**

We pledge to be carbon  
neutral in all our facilities  
and operations

**BY 2035**

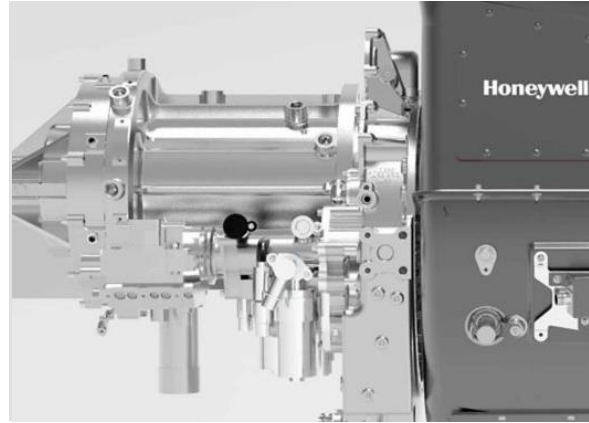
# AEROSPACE SUSTAINABILITY PRODUCTS



**SUSTAINABLE  
AVIATION FUEL (SAF)**



**HYDROGEN  
FUEL CELL**



**ELECTRIC  
POWER**



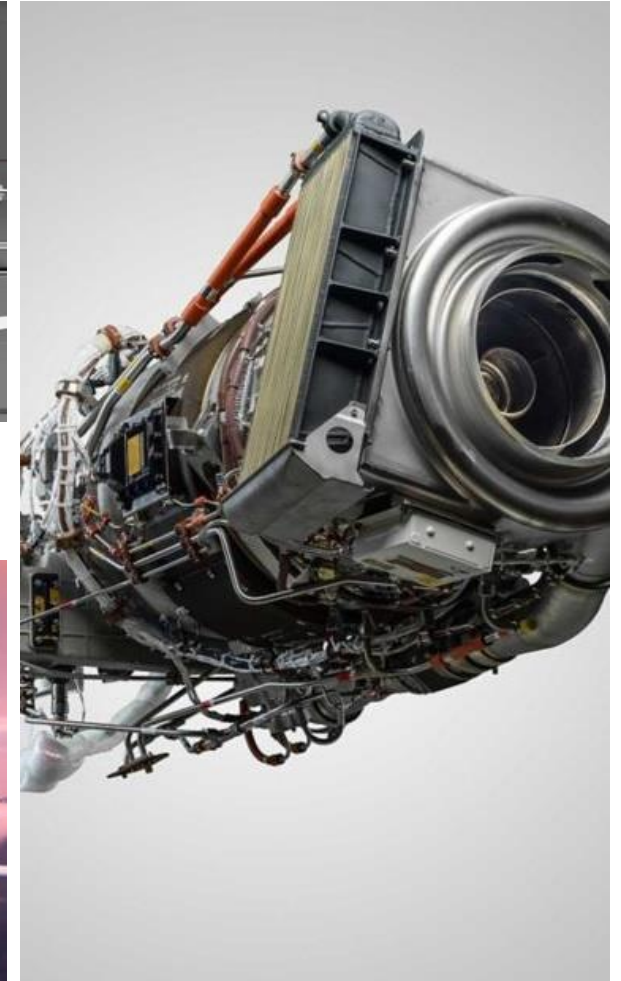
**GENERATORS &  
TURBOGENERATORS**



**ELECTRIC  
PROPULSION**



**HONEYWELL FORGE  
FLIGHT EFFICIENCY**



**AIRCRAFT AUXILIARY  
POWER UNIT (APU)**



# ENGINES PRODUCT LINES

## *Turbofan Engines*

3,000 to 10,000 lb thrust

**PLATFORMS:**

**Commercial business jets**  
**Military trainers**



## *Turboprop Engines*

575 to 1,600 shp

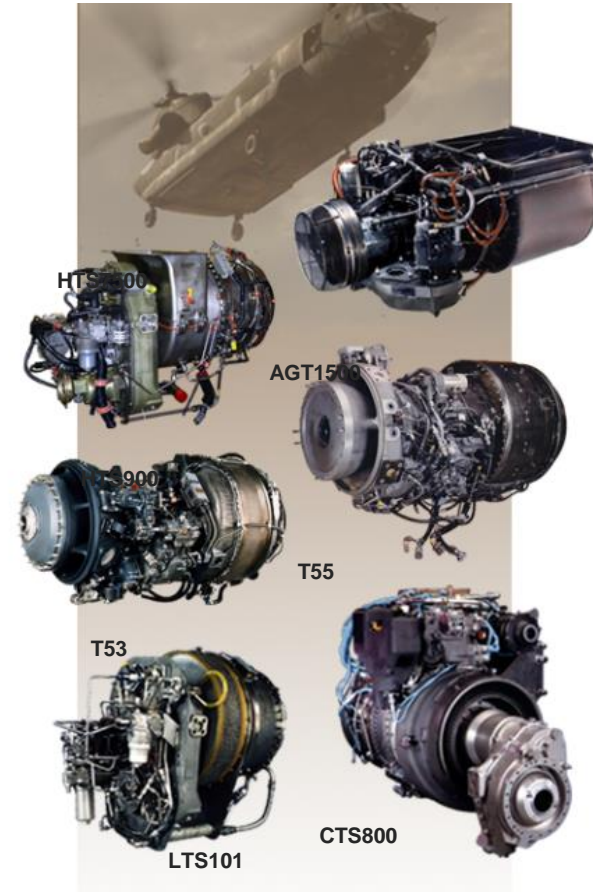
**Commercial turboprops**  
**Military UAV**



## *Turboshaft Engines*

500 to 5,200 shp

**Military & commercial helo/rotorcraft**  
**Military surface vehicles/tanks**



***Strong Legacy and Product Mix, Over 72,000 Turbine Engines Delivered***

# HONEYWELL'S NEXT GENERATION TURBOFAN WILL LEVERAGE EXPERIENCE AND CLEEN III TECHNOLOGIES



- State-of-the-art (SOA) Performance
- Industry Leading Dispatch Reliability
- Excellent Value: Cost, Performance and Durability
- Versatile Technology for the Business Aviation Market
- Seven Aircraft Applications
  - > 2900 engines in service
  - > 9 million cumulative flight hours
  - > 5 million cumulative flight cycles

Bombardier  
CL300



2004

Gulfstream  
G280



2012

Bombardier  
CL350



2014

Embraer  
Legacy 450/500



2014 - 2015

Cessna  
Longitude



2018

Embraer  
Praetor 500/600



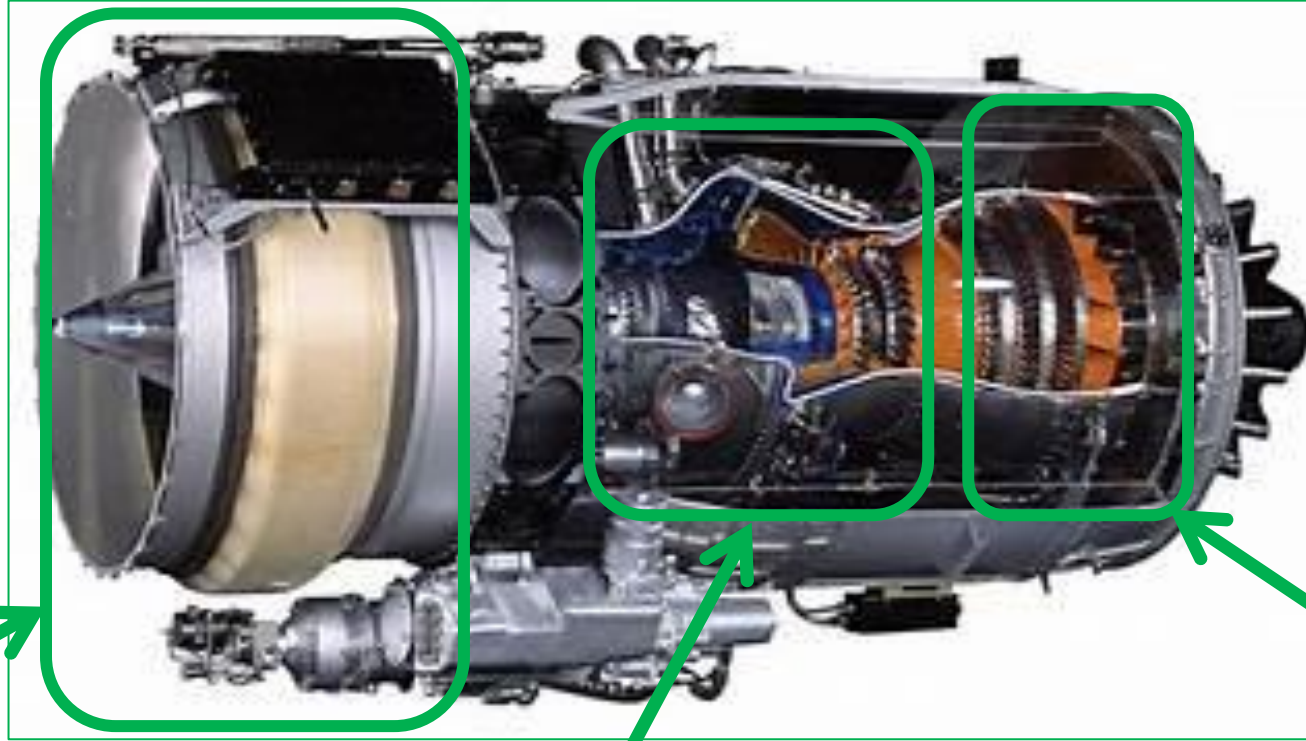
2019

***CLEEN III Technologies Enhance Future Product Capabilities***



# HONEYWELL CLEEN III TECHNOLOGIES

Honeywell and the FAA under the CLEEN program are maturing advanced propulsion engine technologies to reduce fuel burn, emissions and noise.



***Highly Efficient Fan  
Module***

***Efficient High-Pressure Green Core  
(Compressor-Combustor-HP Turbine)***

***High Work / High Lift  
Low Pressure Turbine***

***Enable Lower Fuel Burn (CO<sub>2</sub>), Noise & Emissions (NO<sub>x</sub>, nvPM)***

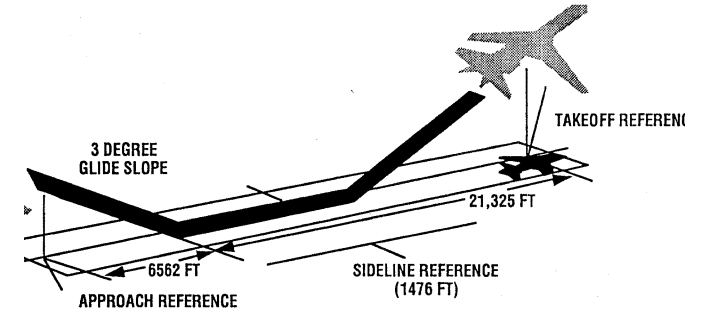
# SUPPORTING MISSION/FLEET BENEFIT ASSESSMENT FOR TSFC, EMISSIONS, & NOISE

- 1) Generate cycle-based benefit predictions for CLEEN engine
  - *System Preliminary Design Completed*
- 2) Aircraft Manufacturer to quantify benefit for aircraft mission
- 3) Provide to Georgia Tech for fleet wide technology benefit assessment

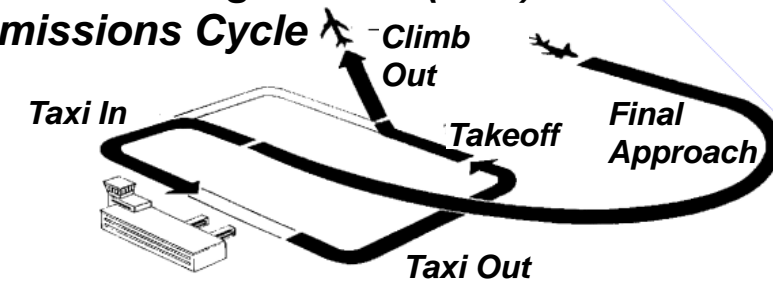
*Generate Engine TSFC, Emissions and Noise Prediction and Measured Technology Benefits*



## *Fleet Benefits Assessments*



## *ICAO Landing/Takeoff (LTO) Emissions Cycle*



## *Aircraft Mission Benefit Assessment*

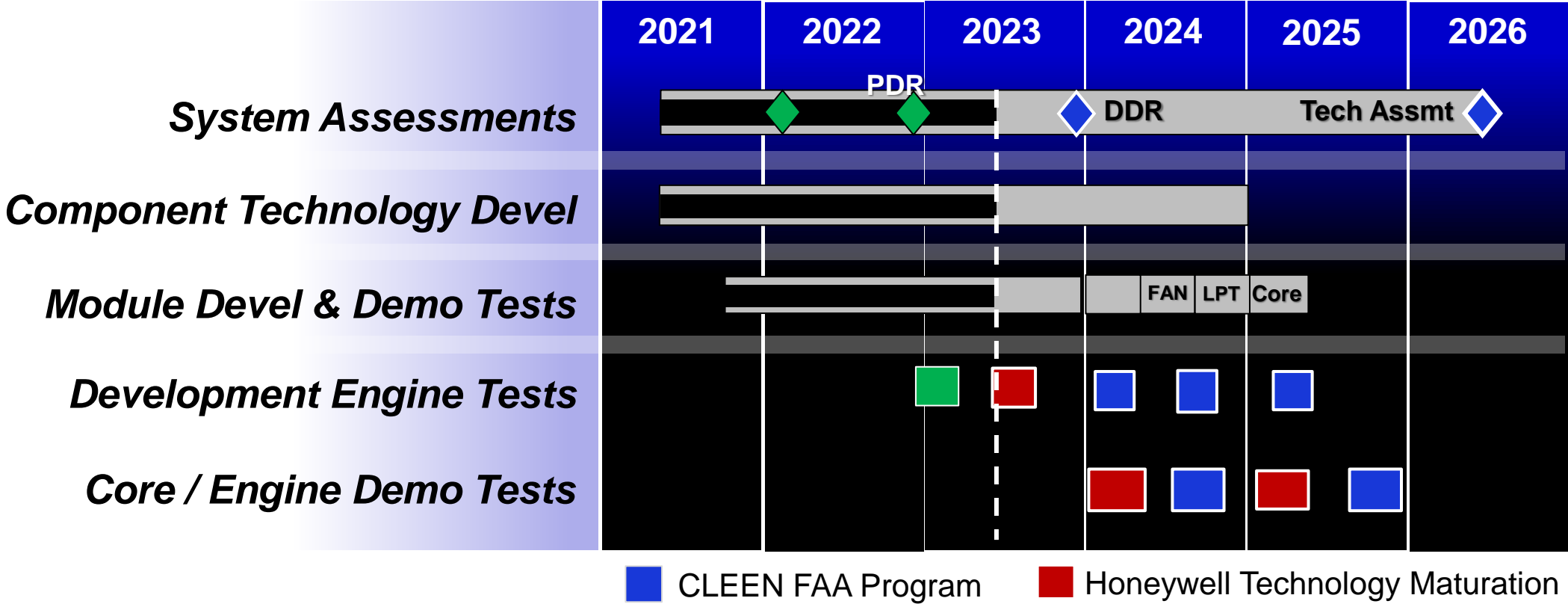


*Quantifying Global Benefit of CLEEN III Technology*

# HONEYWELL CLEEN III TECHNOLOGY PLAN



**TRL 3** **TRL 4** **TRL 5** **TRL 6**  
TRL ~ Technical Readiness Level



**Technology Maturation Progressing to Core / Engine System Demonstrations**



# CLEEN III PROGRAM SUMMARY

- Multiple innovative technologies are being developed with FAA support to achieve lower fuel burn, reduced noise and lower emissions
- Significant progress achieved to date on component technology and advanced material demonstrations and engine system optimization
- **CLEEN III Technology Status:**
  - Fan Module design complete. Proceeding with Fan Rig design and fab.
  - Core Engine Component Technology designs are complete for; Advanced High-Pressure Compressor, Combustor and High-Pressure Turbine. Core Engine design and fab in process.
  - Low-Pressure Turbine Module design complete. LPT Rig design in progress.
- Honeywell CLEEN III Technologies are being demonstrated to validate Technical Readiness Level (TRL) 4 → 6 maturation to meet FAA Goals and quantified through a Fleet Assessment to show global benefits.

***THANK YOU!***