HONEYWELL CLEEN PHASE III

Consortium Meeting

November 16, 2022

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

HONEYWELL OVERVIEW

NYSE: **HON** | **~919** sites | **~110,000** employees | **Charlotte, N.C.** headquarters | **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.

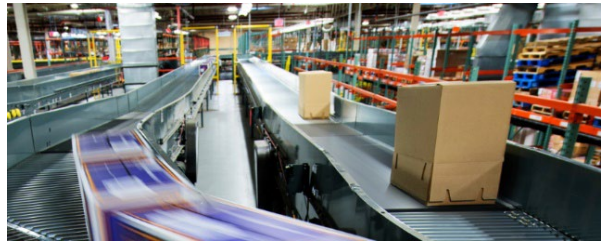
Building Technologies

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

A Global Diversified Technology Company

PORTFOLIO BREADTH: AEROSPACE

ELECTRONIC SOLUTIONS

- Integrated Avionics Offerings
- Navigation, Safety and Surveillance Solutions
- Flight Management Systems, Flight Controls and Synthetic Vision Display Technologies
- Manned/Unmanned and Satellite Applications, Space
- Air Travel Hygiene & Cleaning

ENGINES & POWER SYSTEMS

- Propulsion Engines
- Auxiliary Power Units
- Electric Power Systems
- Hybrid Electric Systems

SERVICES & CONNECTIVITY

- Connected Aircraft Services
- Connectivity Systems/SATCOM
- Data Analytics
- Maintenance, Repair & Overhaul
- Aerospace Trading

MECHANICAL SYSTEMS & COMPONENTS

- Air Pressure & Control Systems
- Components, Heat Exchangers, Valves, Fuel Controls, Actuators, Coatings
- Federal Solutions: Manage & Operate US Government Facilities – Kansas City National Security Campus, Nevada National Security Site, Sandia Labs
- Life Support Systems & Air Travel Hygiene & Cleaning
- Wheels & Braking Systems

ENGINES PRODUCT LINES

PLATFORMS:

Turbofan Engines

3,000 to 10,000 lb thrust

Commercial business jets
Military trainers

Turboprop Engines

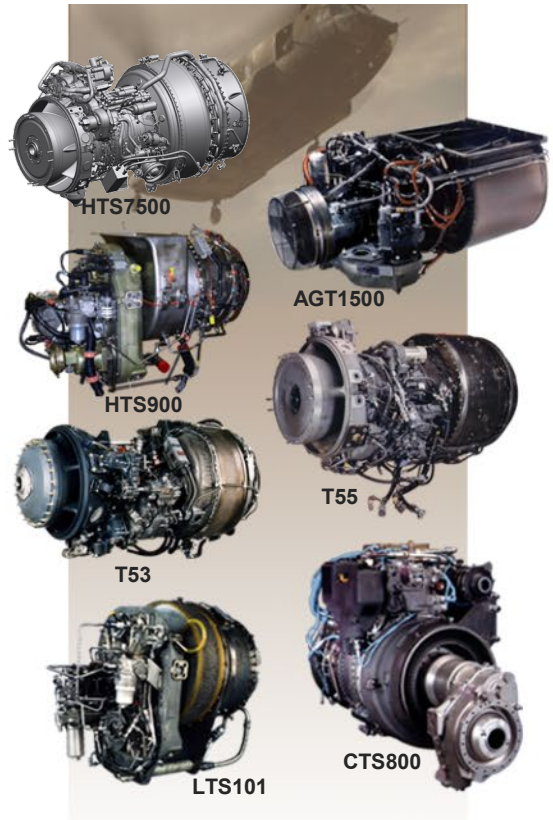
575 to 1,600 shp

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 80,000 Turbine Engines Delivered

NEXT GENERATION TURBOFAN WILL BENEFIT FROM CLEEN III TECHNOLOGIES TO REDUCE FUEL BURN, EMISSIONS AND NOISE

- State-of-the-art (SOA) performance
- Industry leading dispatch reliability
- Quantum leap in value: cost and durability
- Versatile technology for the Business Aviation Market
- Seven aircraft applications to date
  - > 2700 engines in service
  - > 8 million cumulative flight hours
  - > 5 million cumulative flight cycles

Bombardier CL300	Gulfstream G280	Bombardier CL350	Embraer Legacy 450/500	Cessna Longitude	Embraer Praetor 500/600
					
2004	2012	2014	2014 - 2015	2018	2019

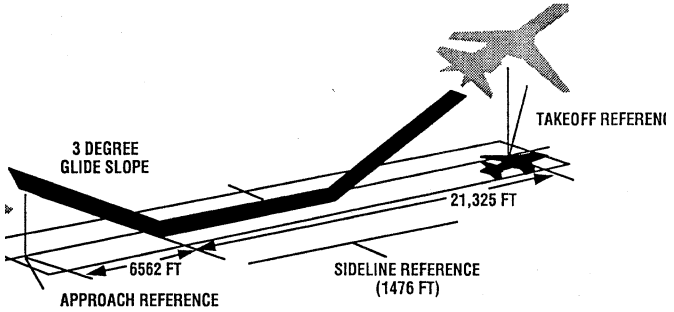
CLEEN III Technologies Enhance Future Product Capabilities

MISSION/FLEET BENEFIT ASSESSED FOR TSFC, EMISSIONS, & NOISE

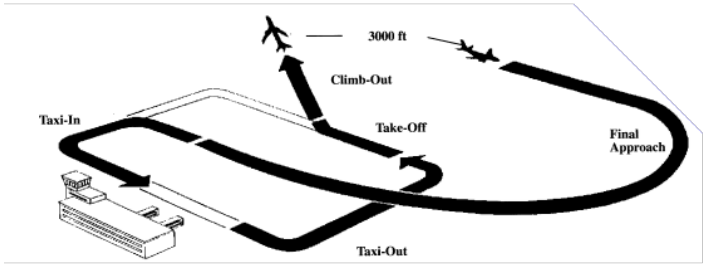
- **Generate cycle-based benefit predictions for CLEEN engine**
  - System PDR to completed by EOY 2022
- **Kicking off Work with Aircraft Manufacturer to quantify benefit for aircraft mission**
- **Provide input to Georgia Tech for fleet wide technology benefit assessment**

Engine TSFC/Emissions/Noise Prediction + Measured Technology Benefits

Fleet Benefits Assessments



ICAO
Landing/Takeoff (LTO) Emissions Cycle

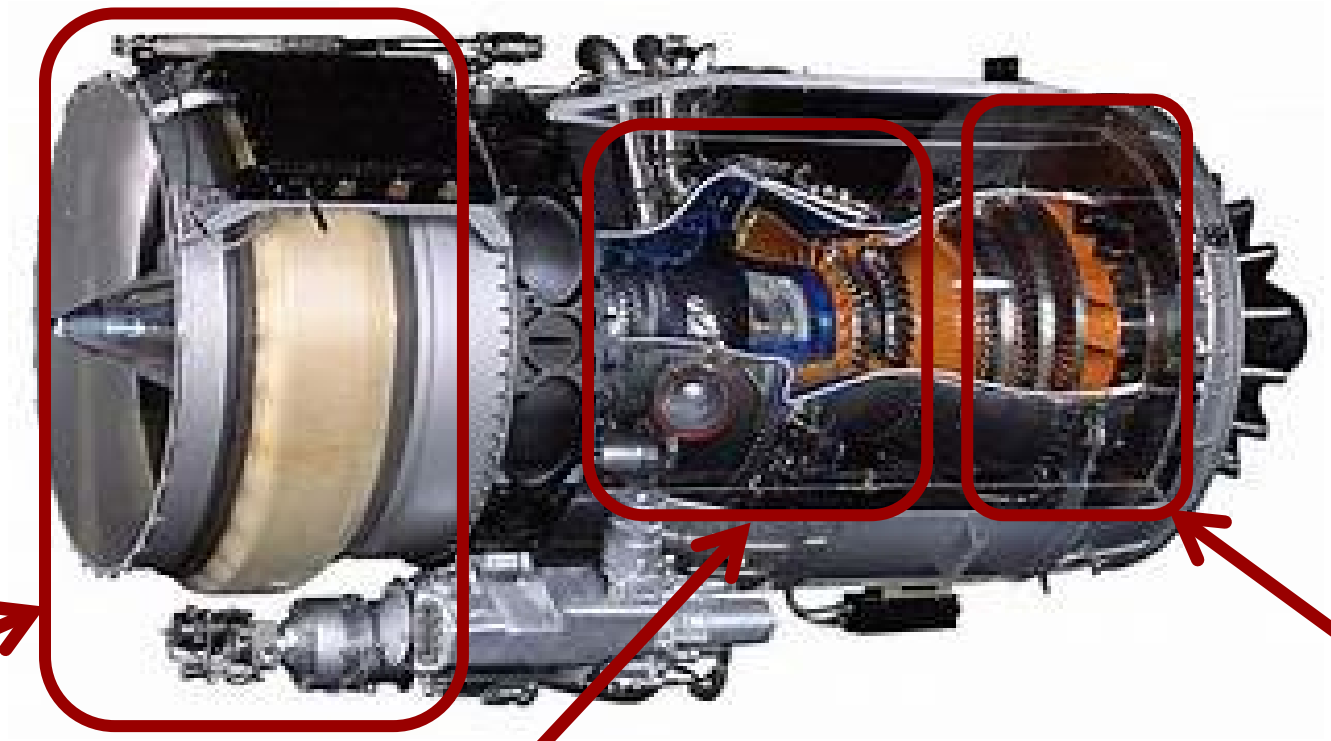


Aircraft Mission Benefit Assessment

Global Benefit of CLEEN III Technology will be Quantified

HONEYWELL CLEEN III TECHNOLOGIES

<u>Elevator Speech:</u> Honeywell's CLEEN III program is maturing advanced propulsion engine technologies for improved fuel burn, reduced emissions and noise.



Highly Efficient Fan Module

Efficient High-Pressure Green Core

High Work / High Lift Low Pressure Turbine

CLEEN III Technologies lead to lower fuel burn, reduced noise and emissions

HIGHLY EFFICIENT FAN MODULE

Technology Description

High Efficiency Fan and Booster Rotors

Over-the-rotor (OTR) acoustic treatment

Optimized Fan Exit Guide Vanes

Optimized Booster Stators

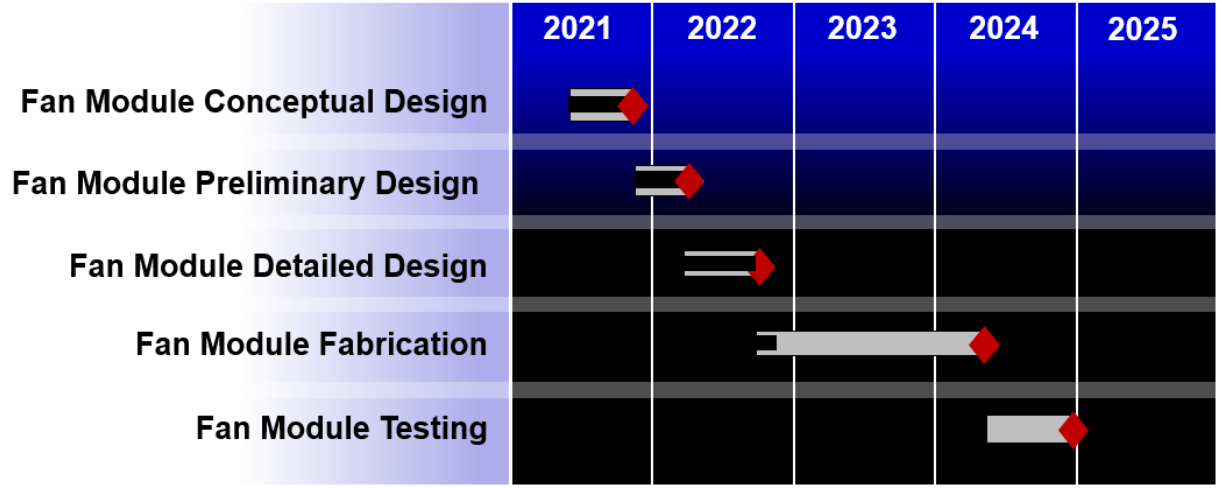
Benefits and Application

- **Noise:** 1.5 EPNdB
- **Fuel:** 1.5% fuel burn reduction
- **Application:** Super mid-sized business jet
- **Entry into service (EIS):** 2031

Accomplishments/Milestones

- Fan Module Detailed Design complete. Fan Rig design underway.
- Fan module has been designed for increased overall pressure ratio and reduced weight
- Acoustic Over-The-Rotor treatment concept design has been designed to reduce fan module noise and efficiency penalty

Program Schedule



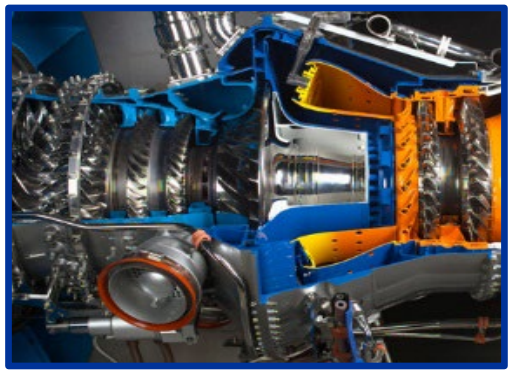
Preliminary Fan Module Design Underway and Progressing Well

EFFICIENT GREEN HIGH-PRESSURE CORE

Technology Description

Advanced High-Pressure Compressor (HiPR)

Low NOx, nvPM Emissions Combustor



Efficient High-Pressure Turbine (HPT)

High Temperature HPT Materials

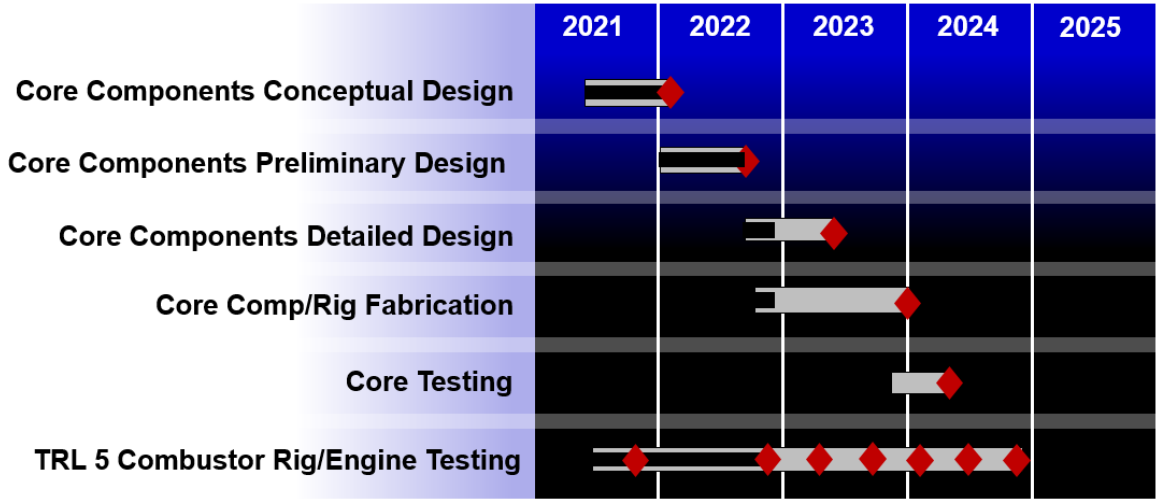
Benefits and Application

- **Noise:** 3 EPNdB reduction
- **Fuel:** 8.3% fuel burn reduction
- **Emissions:** 70% margin to CAEP/8 NOx; reduction in nvPM
- **Application:** Super mid-sized business jet
- **Entry into service (EIS):** 2031

Accomplishment/Milestones

- All Core Component Concept Design Reviews and Preliminary Designs complete
- HPC DDR complete. Go-forward configuration shows improvement in HPC pressure recovery, noise reduction and fuel burn improvement
- Initial Combustor Design Rig Test complete showing good progress toward lower NOx and nvPM. Second test underway
- HPT Materials and Coating Testing continue to show promising results for thermal capability and thermal protection

Program Schedule



Core Technology Development showing good progress

EFFICIENT GREEN LOW-PRESSURE TURBINE

Technology Description

Advanced Low-Pressure Turbine (LPT)

Optimized for Reduced Weight

Advanced Aerodynamics for efficiency

Optimized for Reduced Noise

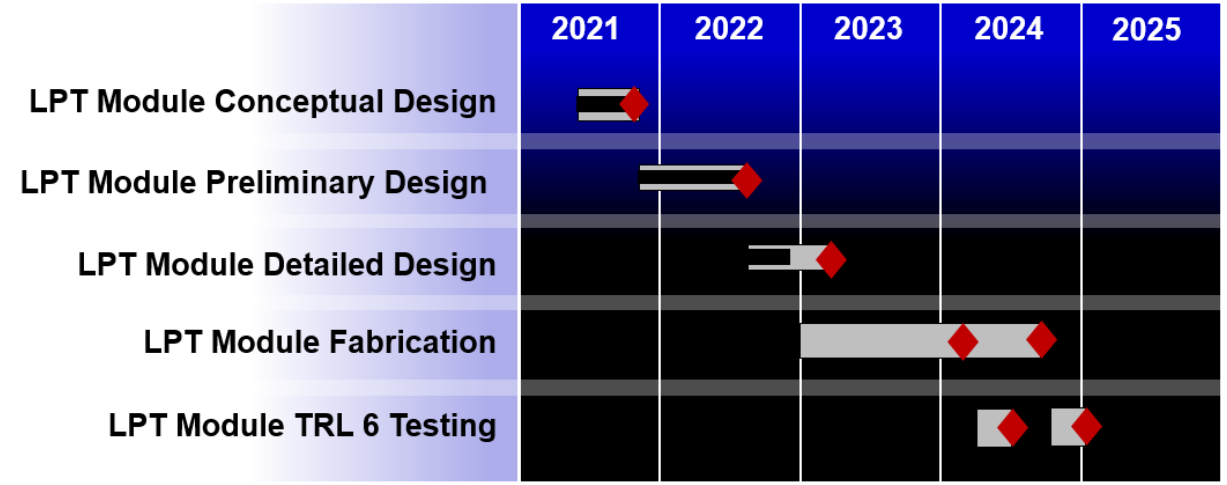
Benefits and Application

- **Noise:** 0.5 EPNdB
- **Fuel:** 2.5% fuel burn reduction
- **Application:** Super mid-sized business jet
- **Entry into service (EIS):** 2031

Accomplishments/Milestones

- LPT Stage airfoil design well positioned from completed Preliminary Design Review (PDR) to incorporate advanced aerodynamic concepts leading to Detailed Design Review in Q1 2023
- Latest LPT Design looks to reduce noise through aerodynamic loading/configuration optimization and application of advanced acoustic treatment

Program Schedule

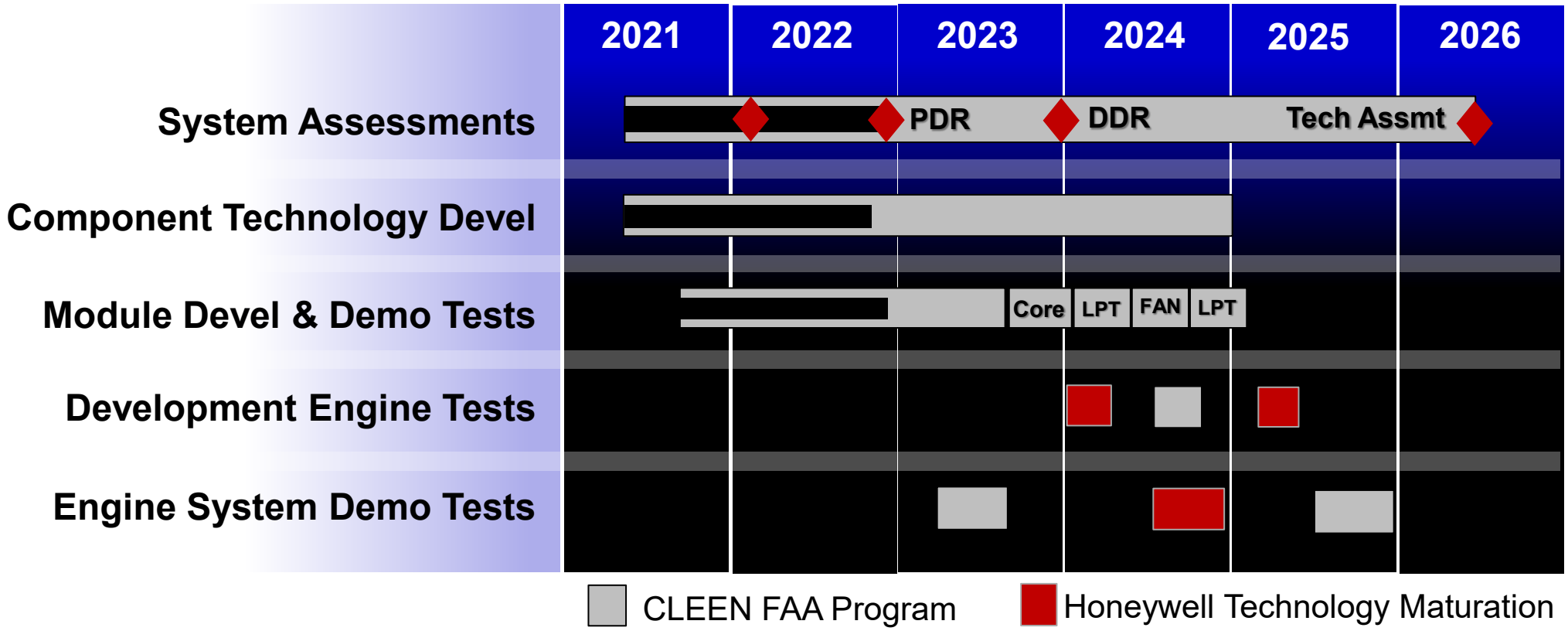


Preliminary LPT Module Concept Designs Complete Leading to PDR

CLEEN III OVERALL SYSTEM SCHEDULE

Analysis and Technology Demonstration Testing | **Component Technology and System Development Testing** | **Engine Demonstration and Validation Testing**

TRL 3 *TRL 4* *TRL 5* *TRL 6*



Acoustic/Dev Engine Testing

Dev/Demo Engine Testing

CLEEN III TRL Maturation Progressing Well to Demonstrate FAA Goals

PROGRAM SUMMARY

- **CLEEN III Technologies designed to lower fuel burn, reduced noise and emissions**
- **Significant benefit comes from a system optimization and balanced approach**
- **Technology Status:**
  - Fan Module Detailed Design complete. Fan Rig design underway
  - Core Component Technology preliminary designs complete. Detailed designs to be completed by EOY 2022
  - Preliminary LPT Module Concept Design complete leading to DDR in Q1 2023
- **The benefits of CLEEN III Technology will be quantified thru TRL 4-6 testing and demonstrate technology maturation toward FAA Goals**

THANK YOU!