



ACOUSTIC EXHAUST TECHNOLOGY DEMO

CLEEN III Consortium Public Industry Day

May 3, 2023

Raytheon Technologies

 **Collins Aerospace**

NET SALES \$19 BILLION



 **Pratt & Whitney**

NET SALES \$17.2 BILLION



 **Raytheon Intelligence & Space**

NET SALES \$15 BILLION



 **Raytheon Missiles & Defense**

NET SALES \$15.3 BILLION



STRATEGIC BUSINESS UNITS

ADVANCED STRUCTURES

Based in Charlotte, North Carolina



- Actuation
- Landing systems
- Nacelle systems
- Flight controls
- Pilot controls
- Propellers
- Naval composites

AVIONICS

Based in Cedar Rapids, Iowa



- Aircraft sensors
- Avionics systems
- Cabin management systems
- Fire protection
- Hoist & winch systems

CONNECTED AVIATION SOLUTIONS

Based in Annapolis, Maryland



- Airport systems
- Applications, analytics & data products
- Business aviation flight support services
- Connectivity & network services
- Passenger & freight rail control systems

INTERIORS

Based in Winston-Salem, North Carolina



- Aircraft seating
- De-icing products
- Evacuation systems
- Galleys & galley inserts
- Interior systems
- Life rafts
- Lighting
- Potable water systems
- Veneers
- Lavatories
- Cargo systems

MISSION SYSTEMS

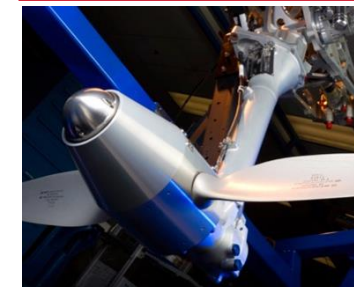
Based in Cedar Rapids, Iowa



- Communication, navigation & guidance
- Electronic warfare
- Ejection seats
- Intelligence, surveillance & reconnaissance
- Simulation & training
- Space solutions
- Strategic command and control
- Unmanned aircraft systems

POWER & CONTROLS

Based in Windsor Locks, Connecticut



- Air management
- Airframe controls
- Electric systems
- Engine controls

SUSTAINABILITY AT COLLINS AEROSPACE



CONNECTED ECOSYSTEM

Providing end-to-end digital solutions to enable more predictable and fuel-efficient airline, airport and air traffic operations.



ADVANCED STRUCTURES

Ensuring our components and systems are designed to be the lightest, most energy-efficient and safest products made, reducing aircraft fuel consumption and contributing to overall aircraft energy efficiency.



ALTERNATIVE POWER SOURCES

Supporting 100% SAF-ready fuel propulsion system components, hybrid-electric propulsion and hydrogen propulsion concepts.



INTEGRATED SOLUTIONS

Creating new opportunities to design for sustainability with a holistic view of the aircraft and its systems.

↓ **15%**



REDUCED GREENHOUSE GAS (GHG) EMISSIONS
BY 2025 FROM 2019

10%



RENEWABLE ELECTRICITY USAGE
BY 2025

↓ **2.5%**



REDUCED ENERGY CONSUMPTION
BY 2025 FROM 2019

↓ **10%**



REDUCTION IN WATER CONSUMPTION
BY 2025 FROM 2019

↓ **10%**



REDUCTION IN WASTE SENT TO LANDFILL & INCINERATION
BY 2025 FROM 2019

100%



IMPLEMENT WATER, WASTE, GHG & ENERGY BEST PRACTICES
BY 2025

By 2030: 46% reduction in our operational GHGs (from 2019) in line with the Paris Agreement

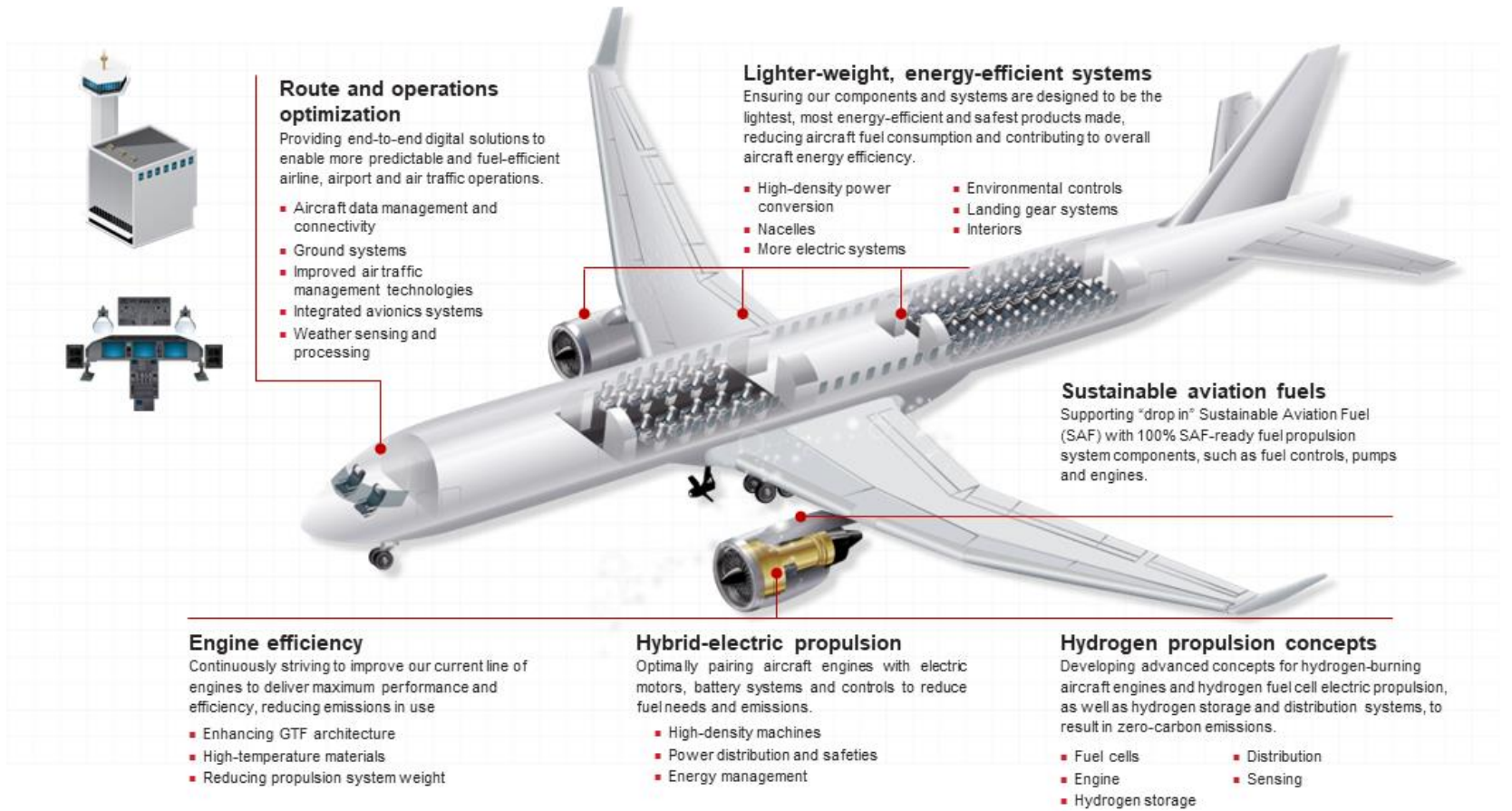


New and expanded technologies & solutions

- Improvements in engine efficiency
- Aircraft system improvements
- Alternative Aviation Fuels
- Trajectory and ground operations improvements

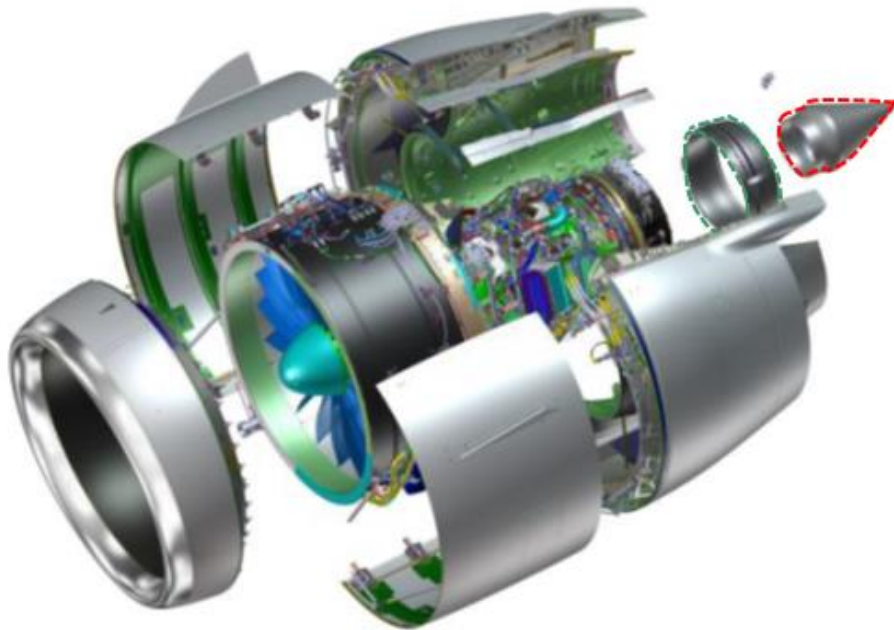
Sustainable aviation

Solutions to help civil aviation achieve net zero CO₂ emissions by 2050.

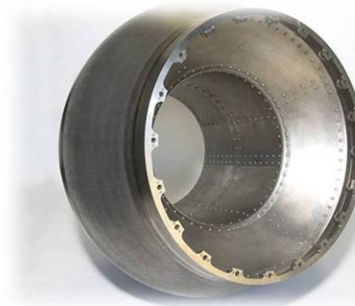


ACOUSTIC EXHAUST TECHNOLOGIES

Technology	Goal Impact	Benefits and Application
Advanced Acoustic Exhaust	Noise Reduction	0.9 – 1.5 EPNdB



Acoustic Chamber....

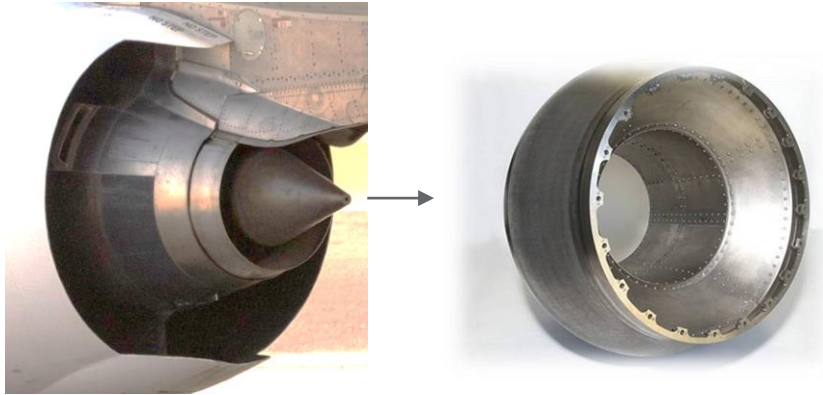


....combined with novel liners

**Large Acoustic Cell
Liners
In Work
IP Sensitive**

INNOVATIVE
PRODUCIBLE  **COST EFFECTIVE**

Advanced Acoustic Exhaust



Benefits:

- **Noise Reduction: 0.9-1.5 EPNdB**
- Fuel Burn Improvement: Neutral

Risks/Mitigations:

- Novel core producibility with exhaust relevant materials is unknown / Perform fabrication trials
- Close tolerances of bonding skins / Assess build repeatability

Objectives:

- Develop and demonstrate an advanced acoustic exhaust
- Advance manufacturing maturity/producibility of novel cores

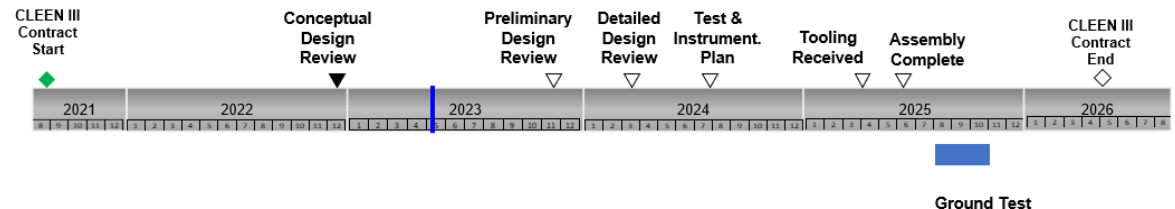
Work Statement:

- Novel core geometries tuned to exhaust tones
- Manufacturing feasibility studies with relevant alloys
- Flat panel mechanical and acoustic property tests
- Demonstrator design, fabrication, and acoustic testing

Progress Update:

- Conceptual Design Review completed
- Producibility trials (1st material assessed, 2nd material ongoing)
- MRL 3 on schedule
- Acoustic tests and model validations in progress

Schedule:





THANK YOU!