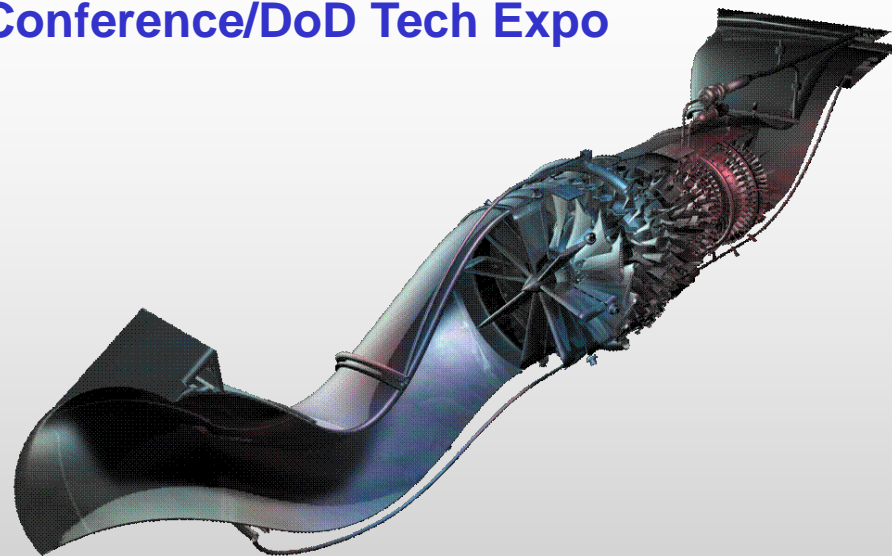


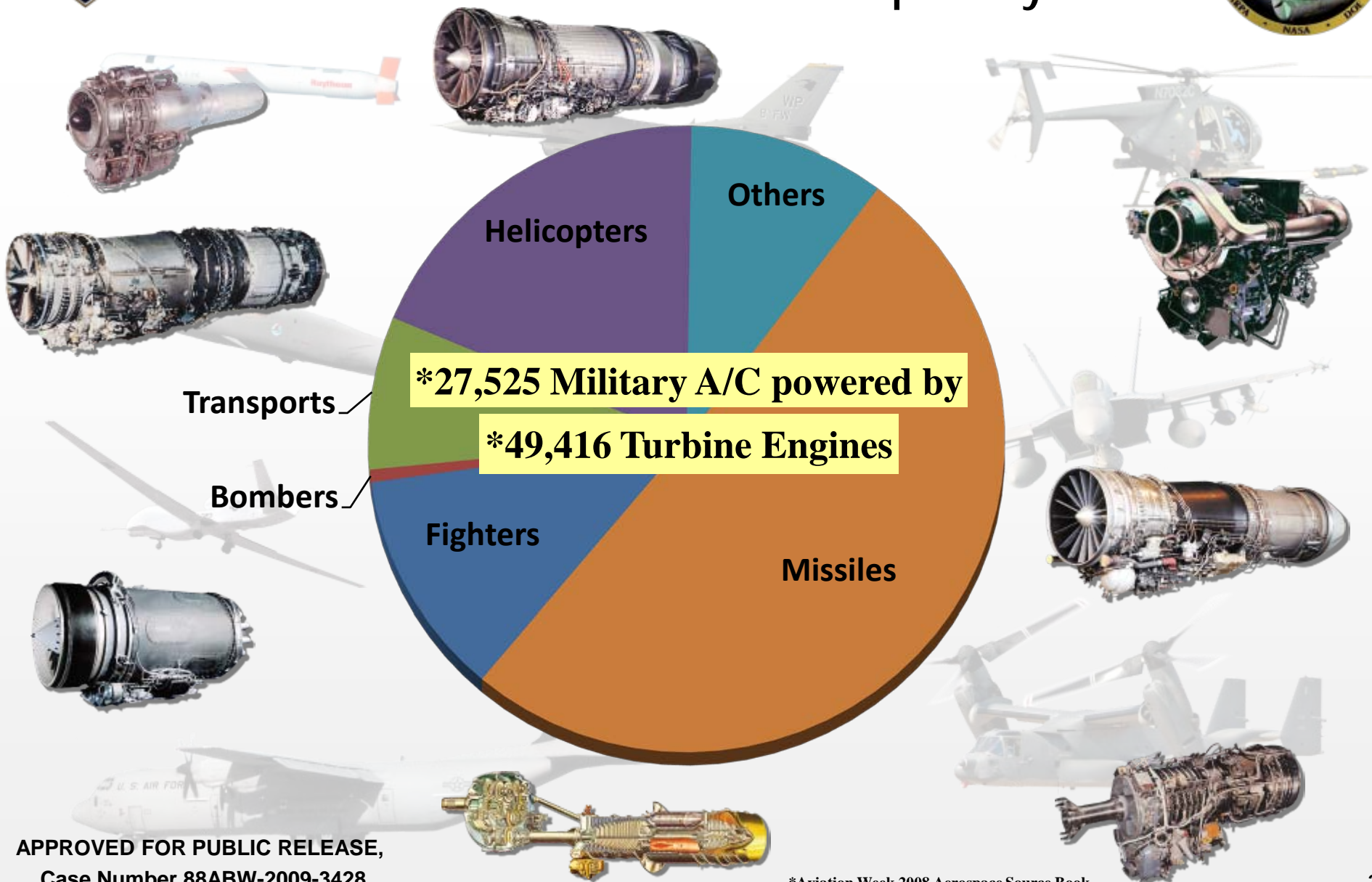
11th Annual Science & Engineering Technology Conference/DoD Tech Expo



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Turbine Engines Power DOD's "Air Presence" and "Air Capability"





US Air Force Energy Program



Vision ... “Make energy a consideration in all we do”

- Reduce Demand
- Increase Supply
- Cultural Change



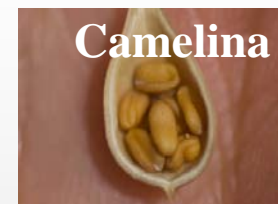
The Air Force's mission to *fly, fight, and win* entails operations that require a tremendous amount of energy



Increase Supply Single Battlespace Fuel (SBF)



- **Completing S&T support for “Hydrotreated Renewable Jet” (HRJ) biomass-derived jet fuel 50/50 blend certification by AFCO per AF Energy Plan**
 - Research Reports
 - Data to support gap analyses
- **Developing next generation alternative fuels to TRL 6**
 - Working with DARPA, CAAFI/FAA, DOE, USDA
 - Advanced processes, fully synthetic fuels
- **Developing improved emissions measurement tech**
 - Collaborating with FAA, EPA
- **Next generation endothermic fuels for hypersonics**
 - Improved fuels, catalysts
- **Nanotechnology for improved fuels, deployable energy**



Camelina



Algae

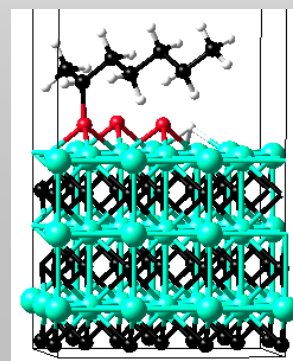


Alt fuel testing



Laboratory
Scale Tests

catalysts



modeling

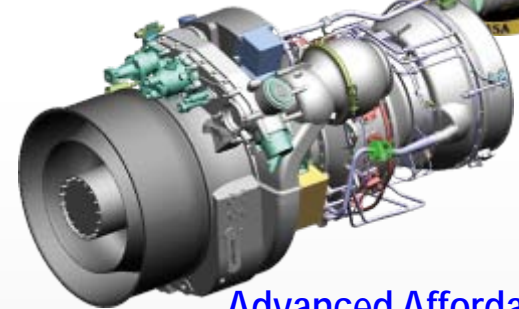




VAATE Provides Game Changing Capability with Superior Fuel Efficiency and Reduced Emissions



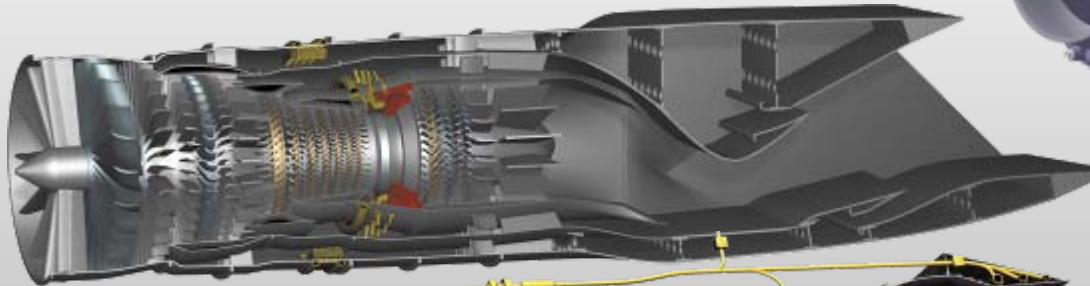
“A primary long-term goal in aircraft propulsion is to **reduce system specific fuel consumption by more than 30 percent** over (current) gas turbine engines. . . Technical challenges being pursued include: efficient, high-overall-pressure-ratio compression systems; variable-cycle engine technologies; advanced high-temperature materials and more effective turbine blade cooling; and techniques to more efficiently recuperate energy while satisfying thermal and power requirements.”



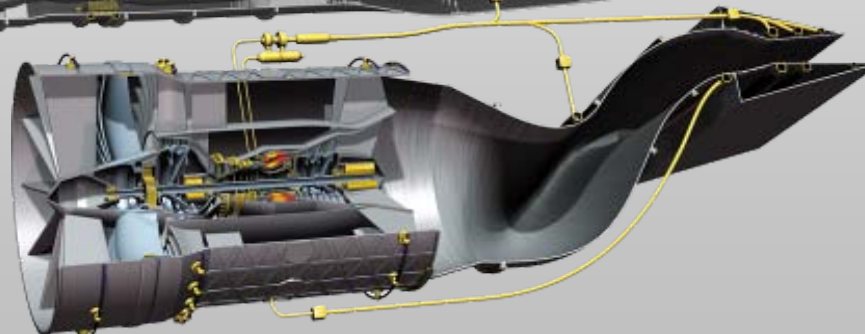
Advanced Affordable
Turbine Engine
(AATE)



Adaptive
Versatile Engine
Technology
(ADVENT)



Adaptive Highly
Efficient Embedded
Turbine Engine
(HEETE)



Efficient
Small Scale Propulsion
(ESSP)



Reduce Demand

ADaptive Versatile Engine Technology

Vision

Multi-design point engines that automatically adjust fan & core airflow and pressures for optimized performance & fuel efficiency at all flight conditions

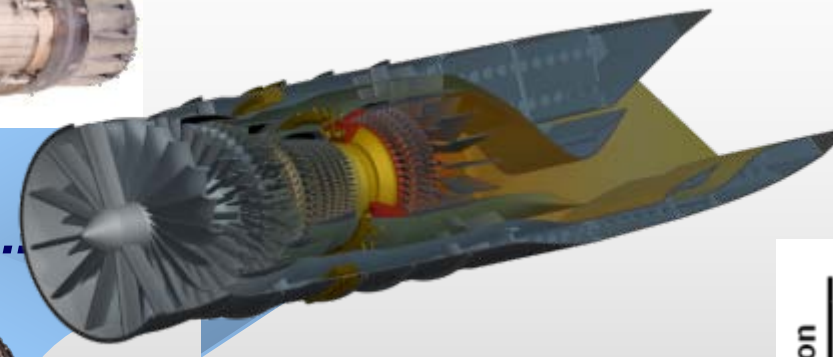
High Performance...

...ADVENT



Supporting multiple capabilities: Strike, mobility, & ISR platforms

Fuel Efficiency...



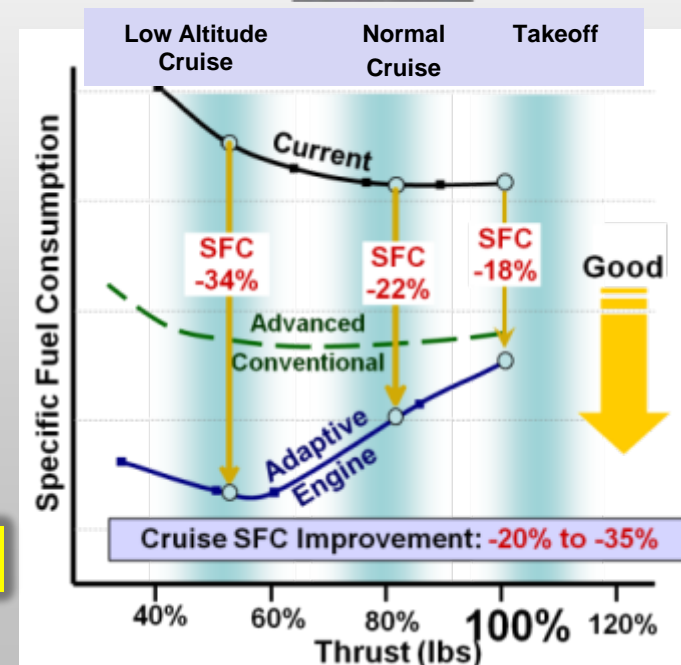
High Efficiency Core

+

Adaptive Engine Technology



Significant Fuel Demand Reduction





Reduce Demand

Highly Efficient Embedded Turbine Engine



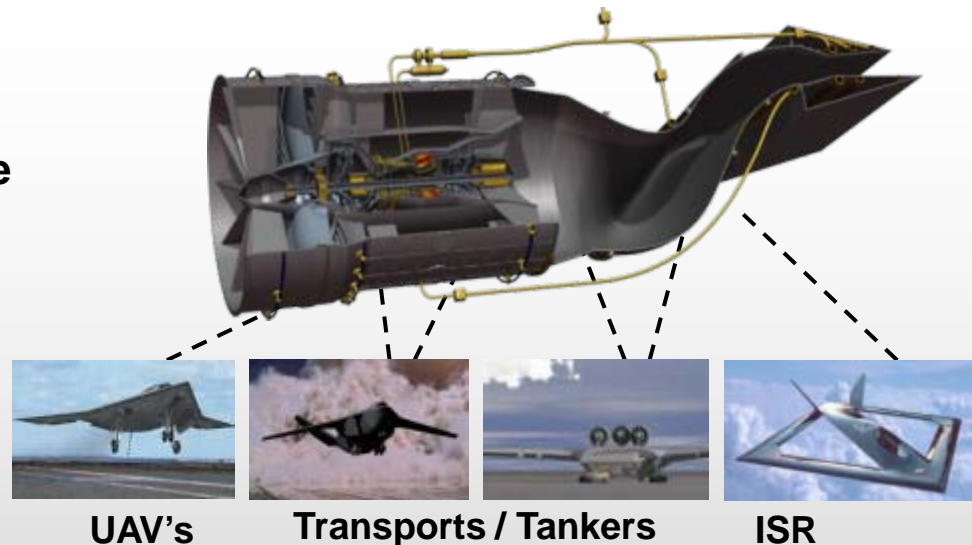
Product Vision:

- Develop fuel efficient, subsonic propulsion that supports future ISR, UAVs, tankers and mobility extreme endurance and range requirements

Approach:

- Combine next-generation, ultra-efficient cores with adaptive features and advanced thermal management

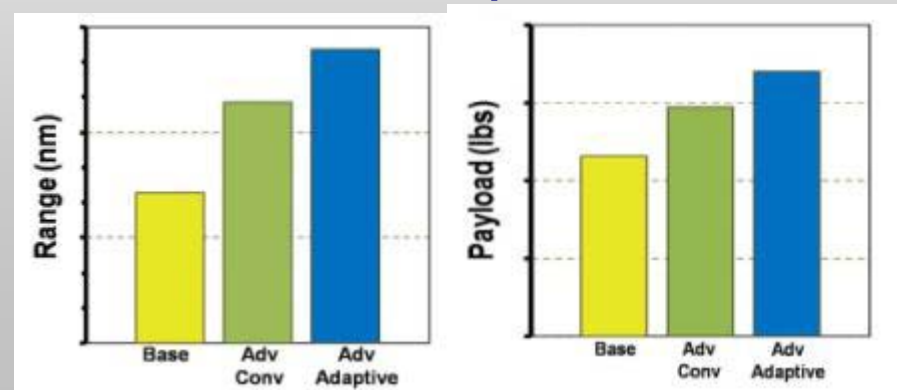
HEETE Supporting Multiple Systems



Benefits:

- 35% improvement in fuel efficiency
- Fuel efficiency at part power
- Reduced emissions & noise
- Increased power extraction

Tactical Transport Benefits





Reduce Demand Advanced Affordable Turbine Engine (AATE) ***3000 HP CLASS***



**CRITICAL TO SUPPORT ARMY AVIATION MODERNIZATION STRATEGY
FOR BLACKHAWK AND APACHE**

GOALS

HIGH PERFORMANCE

-25% Specific Fuel Consumption
+65% Horsepower/Weight

ROBUST

6,000 hours design life
15,000/7,500 cycles LCF cold/hot parts

AFFORDABLE

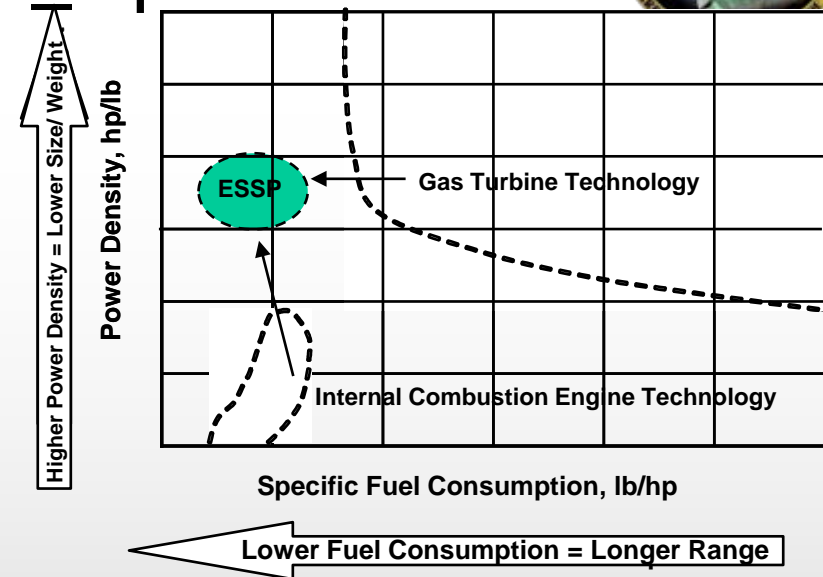
-35% Production Cost
-35% Maintenance Cost

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Reduce Demand

Efficient Small Scale Propulsion



Technologies:

- High Bypass Ducted Fan
- High Pressure Ratio Compression
- Variable Cycle Features
- Direct Fuel Injection Combustion
- Micro Fuel Delivery and Power Generation Components

Benefits:

- 30% Improvement in Fuel Efficiency
- 2X Increase in Loiter Time/Range
- Integrated / Distributed Power
- Conversion to JP8/ Heavy Fuel

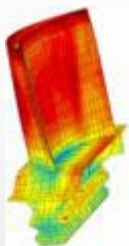
Emerging turbine and Internal Combustion Engine technologies for UAS / missiles



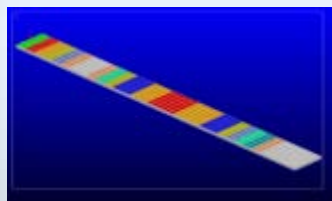
Reduce Demand Component And Engine Structural Assessment Research



*Single engine demonstrator
supports durability validation for multiple technology programs*



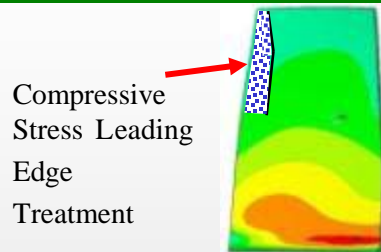
Probabilistic High Cycle
Fatigue (HCF)
Prediction & Time of
Arrival Sensors



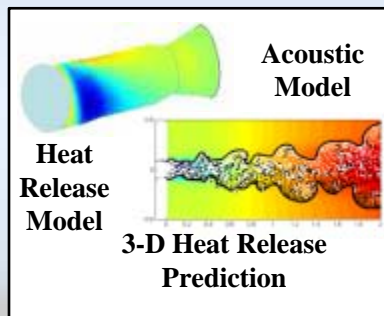
Vibration Damping
Coatings for HCF



Integrally Bladed Rotors



FOD Tolerant
Design System



Fuel Management for Augmentor
Screech Reduction

CAESAR

*Joint Air Force/Navy
Affordable Test Bed*

**Thermal
Management**

**Safety &
Affordable Readiness**

**Life Cycle
Cost**

Thrust Growth

Cruise Efficiency

**Noise
Characterization**



VAATE is our Nation's Planning and Execution Construct for Turbine Engine Technology

THE PARTNERSHIP



THE MISSION

To develop, demonstrate,
and transition

ADVANCED

multi-use, Turbine Engine
technologies that provide a
revolutionary improvement in

AFFORDABLE CAPABILITY

to a broad range of legacy,
emerging, and future military
propulsion and power needs,

with explicit

VERSATILITY

for dual-use application.