

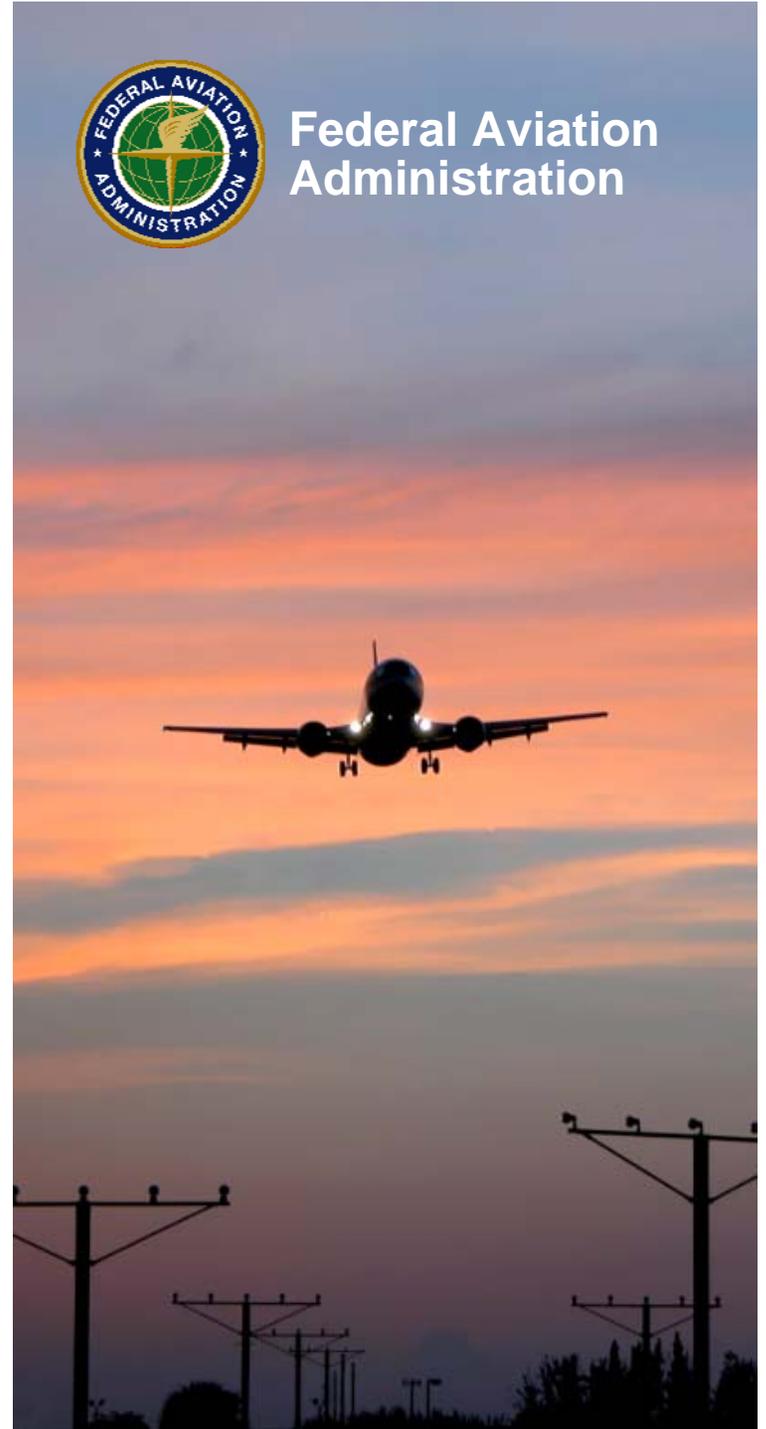
# Propulsion and Structures

## Center of Excellence - General Aviation

Presented to: COE-GA Public Meeting  
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Sub-Team  
Date: November 17, 2011



Federal Aviation  
Administration



## ***Aviation Fuel and Engine Test Facilities***

Laboratory and Rig Test Facility (building 292)

Engine Test Facilities (buildings 211 and 245)



## ***Aviation Research Key Stakeholders***

### **NEW Unleaded Fuels ARC – March 2011**

FAA Engine and Propeller Directorate

FAA Small Airplane Directorate

FAA Office of Environment and Energy

EPA Office of Transportation and Air Quality

General Aviation Stakeholder Coalition

AOPA, EAA, API, NPRM, NBAA, GAMA,  
NTAA

Coordinating Research Council

ASTM International

Society of Automotive Engineers



# Aviation Fuel and Engine Test Facilities



- 3 Identically equipped test cells
- Automated engine, environmental and fuel and oil controls
- Automated data acquisition, and analyses
- Emissions measurement: CO, CO<sub>2</sub>, THC, NO<sub>x</sub>, O<sub>2</sub>
- ASTM and IP compliant laboratory testing
- Turbine and gasoline testing



# Mission Statement

**Provide “world class”, independent, cost efficient fuel and engine research data to support FAA certification and policy officials and industry research and standards bodies in the pursuit of safe, alternative aviation fuels for the aviation industry**



# Regulatory Drivers for Current Avgas Research

- 1990 Clean Air Act Amendments
  - Banned sale of on-road leaded fuels by Jan 1, 1995
- October 2006 'Friends of the Earth' Petition to the EPA
  - Called for lead emission regulations of general aviation aircraft or the commissioning of a study on the health effects of the use of leaded aviation gasoline

- October 2008, EPA reduced Pb National Ambient Air Quality Standard by 90%
  - State compliance by Jan, 2017
  - 2010 EPA chose 15 A/Ps for monitoring
- April 2010, EPA releases Advanced Notice Of Proposed Rulemaking



## Sources Contributing to Lead Pollution

- Sources of lead emissions include:
  - Gasoline for piston-engine aircraft (not used in commercial passenger aircraft)
  - Metal industries
    - Lead smelting
    - Iron and steel foundries
    - Copper smelting
    - Metal mining
  - Manufacturing industries
    - Glass manufacturing
    - Cement manufacturing
  - Waste incinerators
  - Industrial/commercial/utility boilers
- Based on current information, more than 600 tons per year of lead are emitted due to use of aviation gasoline.
  - EPA received and is currently considering a petition to address lead in aviation gasoline.
  - For more information, see [www.epa.gov/otaq/aviation.htm](http://www.epa.gov/otaq/aviation.htm)

Source Sectors of Lead Emissions in the U.S.

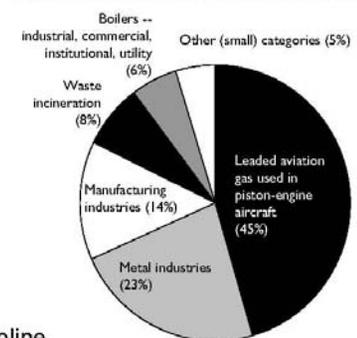


Chart based on EPA's 2002 National Emission Inventory (NEI) with modifications documented in Tam Pass's 05/01/03 memorandum and Mason Hoyer's 05/12/08 and 05/14/08 memoranda to the docket.



# General Aviation Impact on US Economy

- Safety of flying public
- 167,000 general aviation (GA) piston aircraft
- 30% of flying hours in US is done by the GA piston fleet
- 1.3 million jobs (\$53 billion in salaries)
- \$150 billion in annual economic activity
- 60% of all landings are from piston GA aircraft
- 70% of GA flight hours for business purposes
- 30% of the fleet requires high-octane and uses 70% of the 100LL
- 166 million passengers annually
- 5,200 public use airports; 13,000 private landing facilities
- **Only ONE Manufacturer of Lead additive in World (Innospec of UK)**

Source: AOPA letter to EPA in response to Bluewater Network Petition, March 17, 2008





# New Avgas Addition (FY10) – AJP-7870 Acquisition of Piper Navajo Chieftain for Unleaded Fuels Work

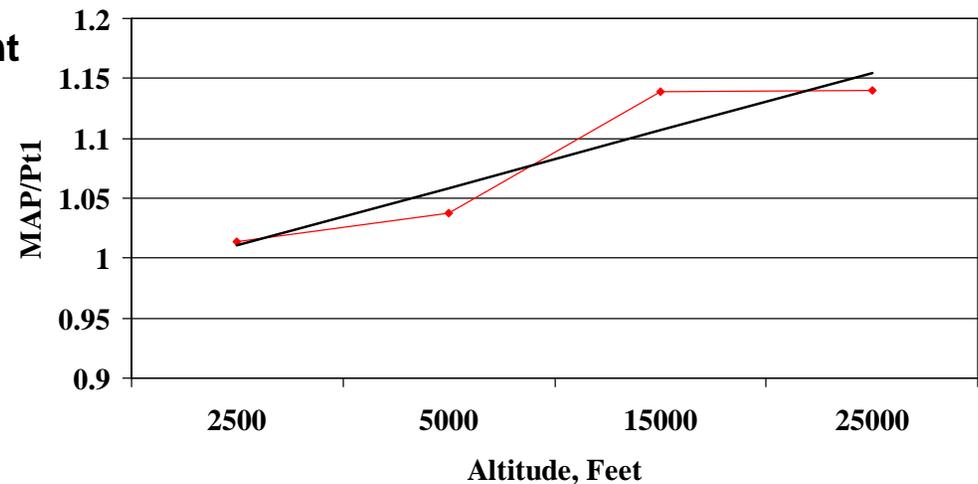


- ✓ Twin Lycoming TIO540-J2BD engines
- ✓ Extensive test-cell based data
- ✓ Support of Unleaded Fuels ARC

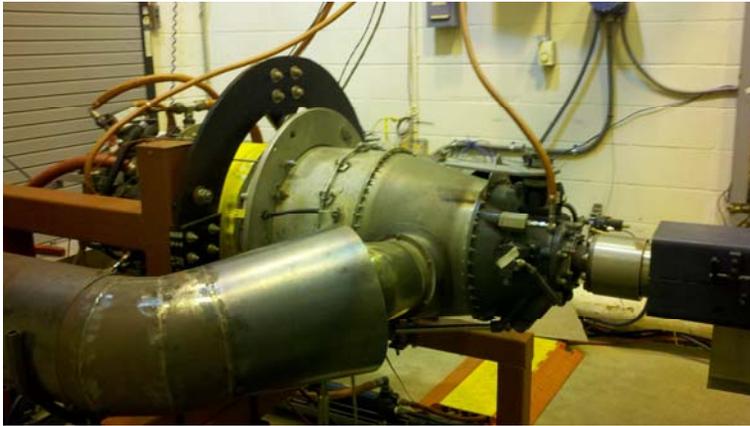


## Current detonation testing of turbocharged engines may overstate octane requirement

- ✓ Engine pressure and temperature ratios difficult to simulate at sea level
  - ✓ Large effect on octane requirement
- ✓ Drives use of more exotic specialty chemicals – “Rubik Cube”
  - ✓ Increases deviations from fuel specification in other key properties
  - ✓ Increases complexity, cost, testing requirements, unknowns
  - ✓ Engine and airframe modifications, materials compatibility issues



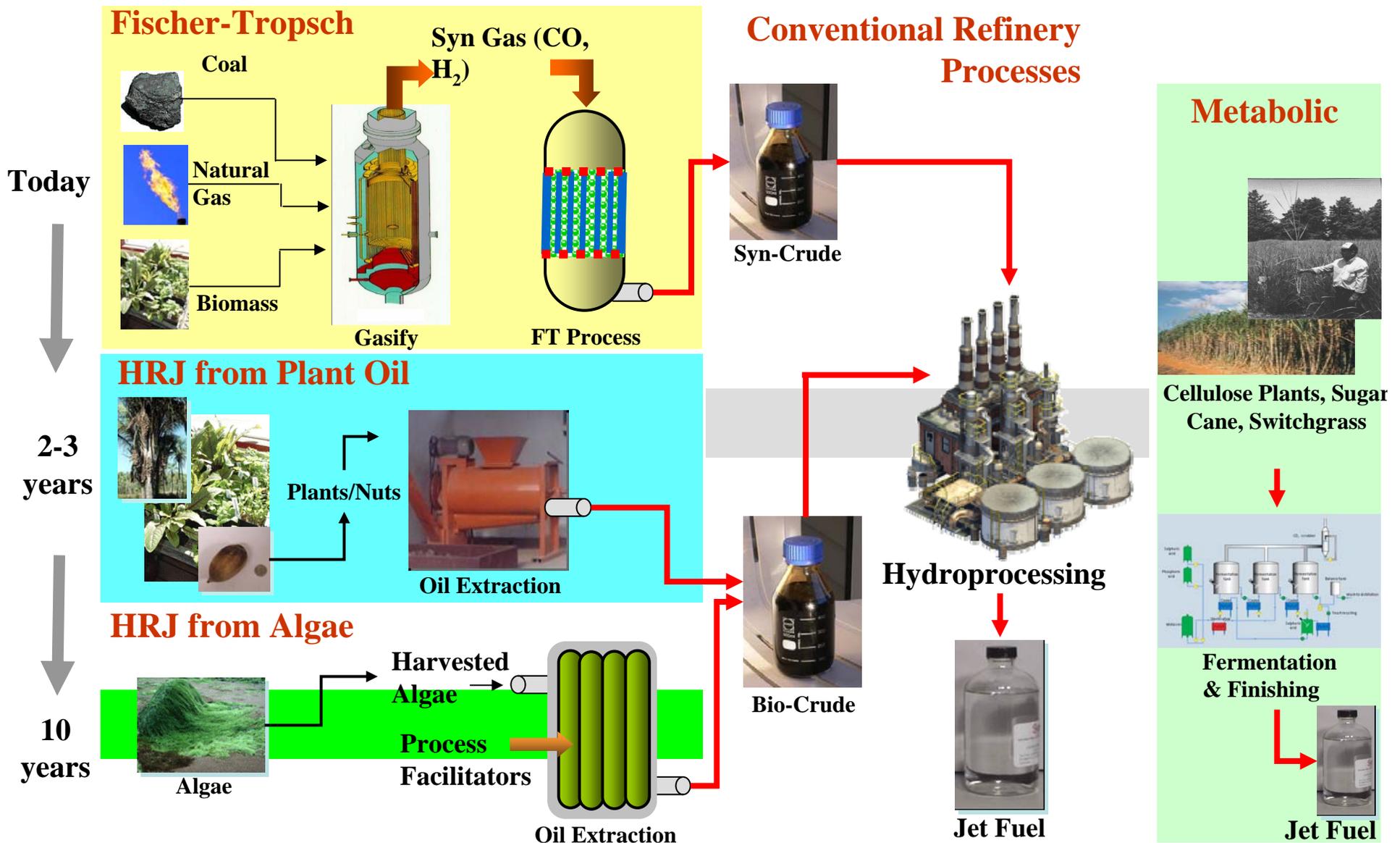
## New Additions (FY10) – Turbine



- PT-6 turboprop engine operational
  - ✓Fuel approval testing unlikely
  - ✓Initial “look-see” testing
  - ✓Turbine Emissions
  - ✓Given 2 JT8D PW engines from B727
  - ✓Alternative turbine fuels are “drop-in”



# Potential Alternative Aviation Fuel Sources (excerpted from CAAFI May 4, 2009 Presentation, Rumizen, Mark)



# Turbine Engine Particulate Emissions

- Society Of Automotive Engineers E-31 Emissions Measurement Committee
  - ✓ Performed in Cooperation with Emissions Division of FAA Office of Environment and Energy
- Use PT-6 to develop rig test methodology
- Develop SAE Aerospace Recommended Practice (ARP) for turbine engine particulate emissions measurements
  - ✓ Standard test practice to be used under AEE Continuous Low Energy, Emissions and Noise (CLEEN) program
- Potential follow-on work with larger turbine engine (JT8D)



# Fuels and Propulsion

