

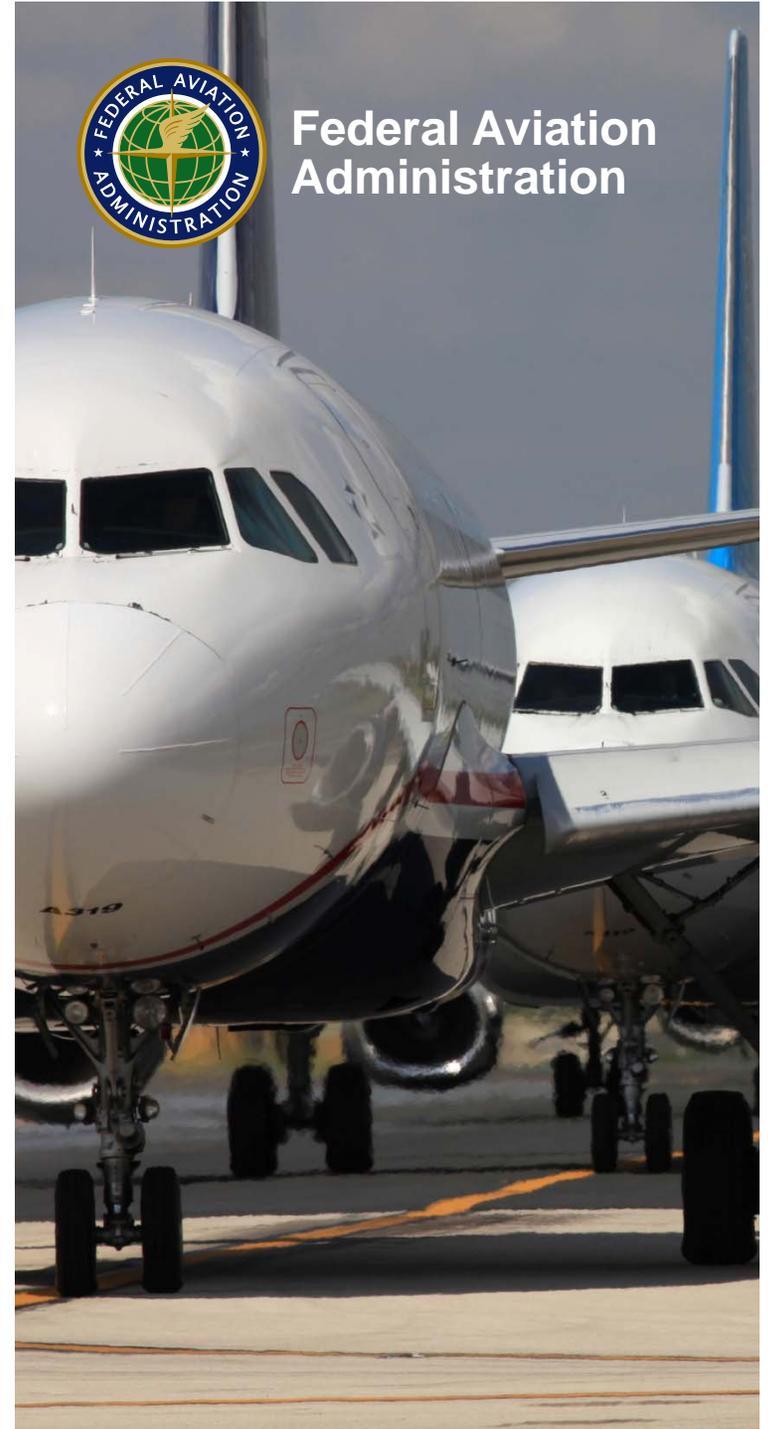
FAA Alternative Jet Fuel Activities

Overview

Presented to: CLEEN Consortium

By: Nate Brown

Date: November 20, 2013

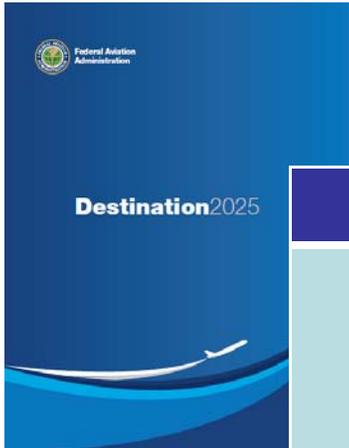


Outline

- **Alt Fuels Relevance to FAA goals**
- **Challenges for Alt Fuels Development**
- **FAA Role & Current FAA Alt Fuels Activities**
- **Near-term Alt Fuels Focus at FAA**
- **Conclusions**



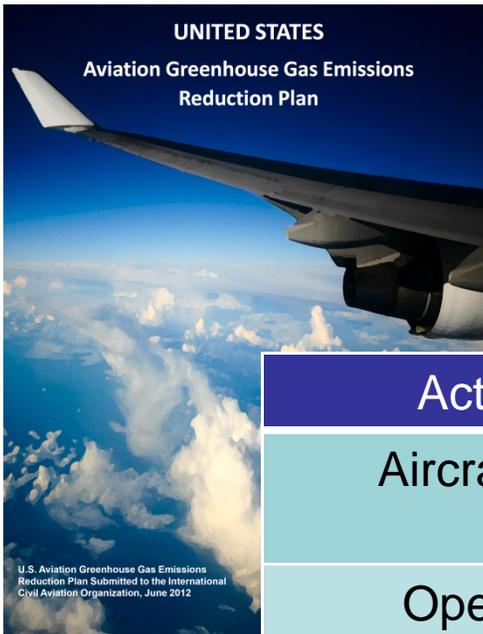
Alt fuels relevance to FAA D2025



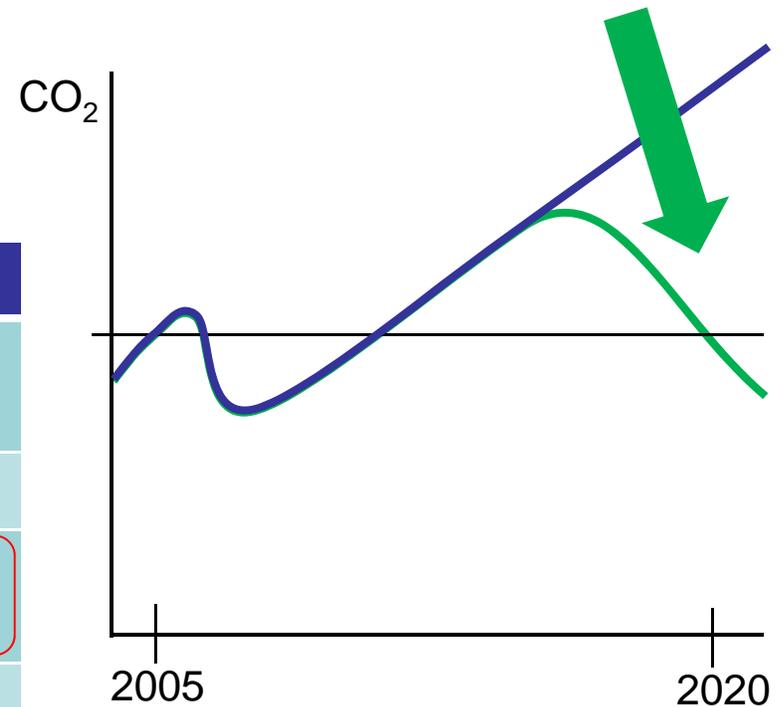
Aspiration	Performance Metrics (2018)
Sustaining our Future	One billion gallons of renewable jet fuel is used by aviation
	Population exposed to significant aircraft noise around airports reduced to less than 300,000.
	Aviation emissions contribute 50% less to significant health impacts and are on a trajectory for carbon neutral growth using a 2005 baseline
	Improve NAS energy efficiency (fuel burned/miles flown) by at least 2% annually



Alt fuels relevance to U.S. Climate Action Plan



- Actions to Reduce GHGs
 - Aircraft & Engine Technology Improvement
 - Operational Improvements
 - Alternative Fuels Development & Deployment
 - Policies, Standards & Measures
 - Scientific Understanding & Modeling/Analysis



Challenges for Sustainable Alternative Fuels

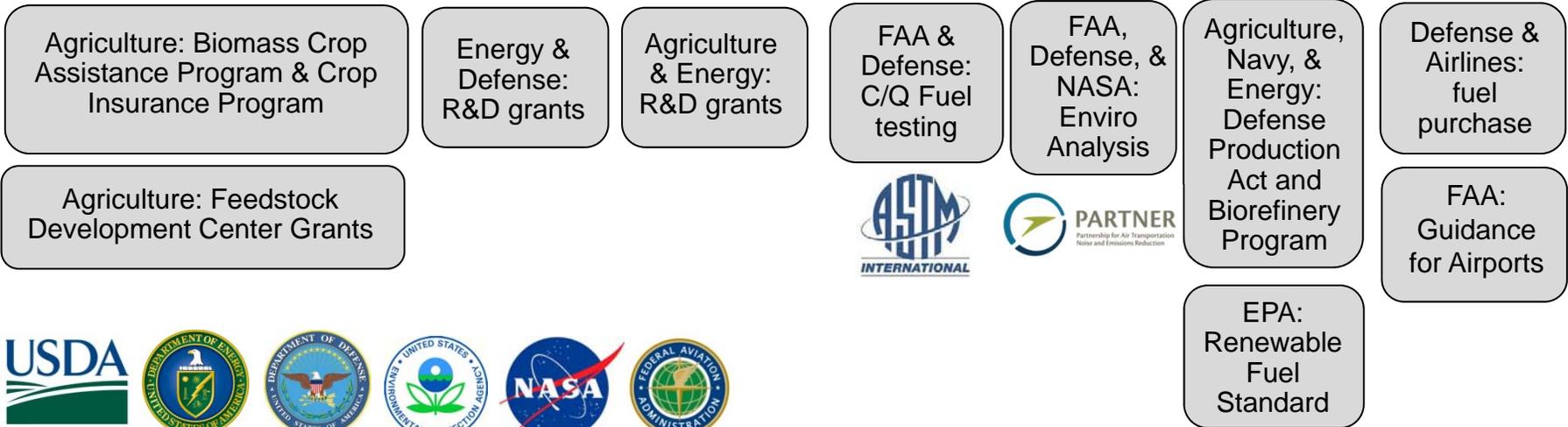
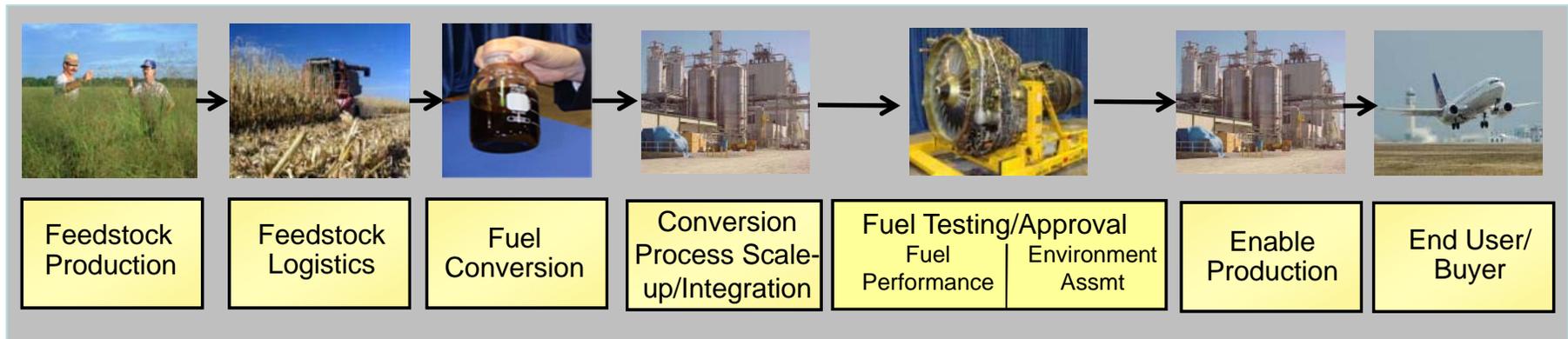
- **Feedstock Availability**
- **Competitive cost for alternative fuel**
- **Approved for performance/safety**
- **Environmentally sustainable**
- **Commercially produced**



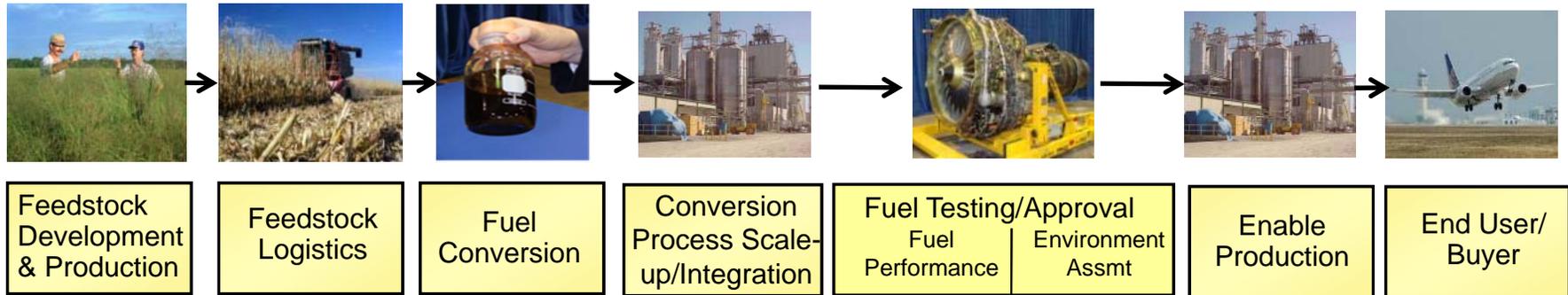
Coordinating USG Efforts across Supply Chain



Facilitating Deployment and Investment



FAA Areas of Focus in Alternative Fuels



Agency		✓		✓	✓	✓		✓	
FAA	Interest	Role				Goal			
	Enabling aviation growth by reducing aviation air quality and GHG impacts and energy security with alternative aviation fuels.	Emissions certification & standards for aircraft, engines; Facilitation of qualification/certification of aviation fuels at ASTM Intl; Environmental impacts assessment & measurement, analysis & analytical tools development; maturation of promising alt. fuel candidates; Info exchange/coordination; key sponsor of CAAFI.				1B gallons by 2018. CO ₂ neutral growth by 2020 using a 2005 emissions baseline. Net reductions of air quality health & welfare impacts despite aviation growth.			

High level description of agency effort:

- Fund fuel testing to inform approval at ASTM
- Environmental & cost analysis
- Enable government & aviation and energy industry coordination
- Additional support and studies

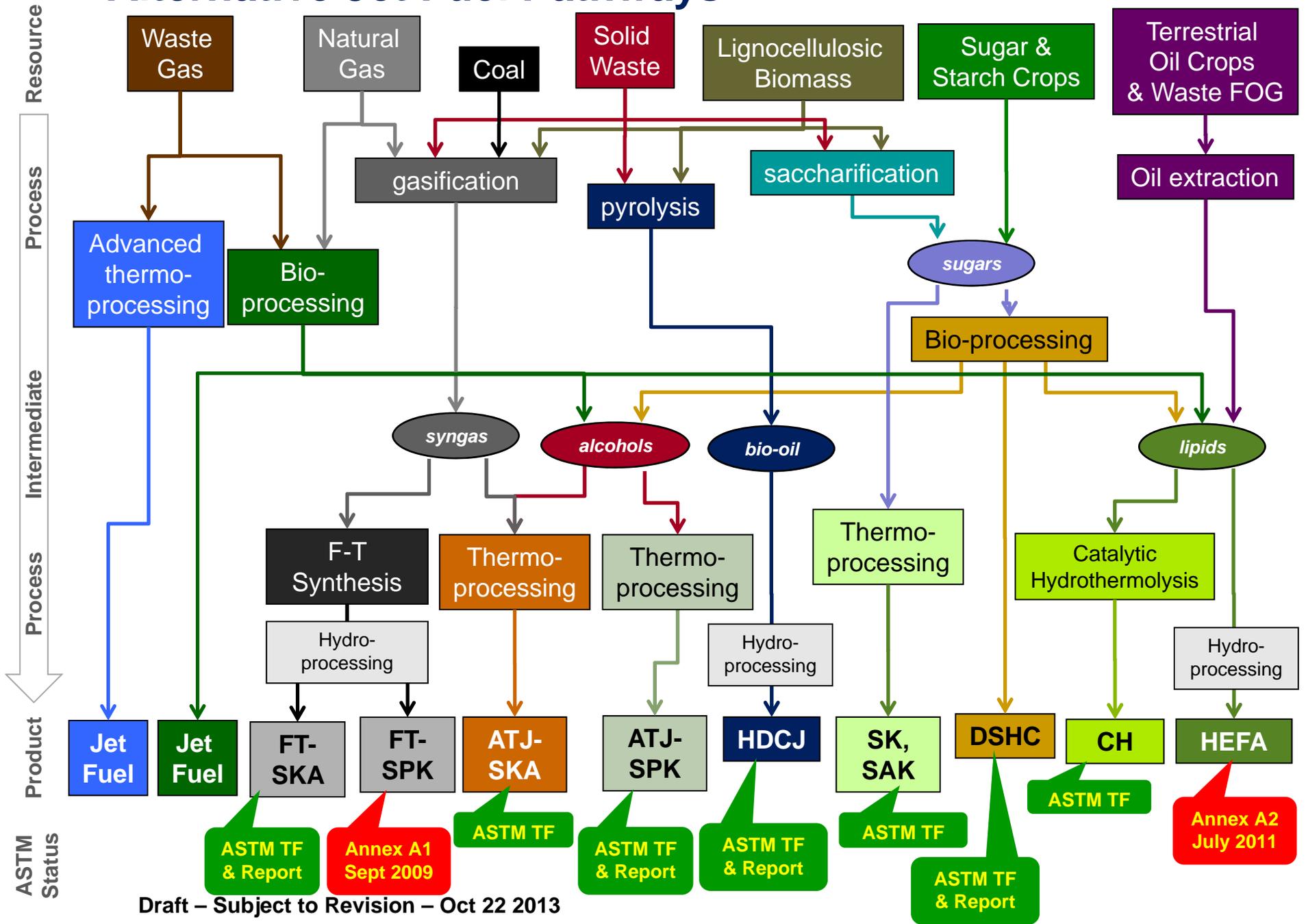


Current FAA Alternative Jet Fuel Activities

- **Testing**
 - Material compatibility
 - Certification / Qualification
 - Emissions measurements
- **Analysis**
 - Environmental sustainability
 - Techno-economic analysis
 - Future scenarios
- **Coordination**
 - Public-Private
 - State & Regional
 - International
- **Tracking Fuel Use**



Alternative Jet Fuel Pathways



Alternative Jet Fuels Test Matrix

		Genre	Synthetic Paraffinic Kerosene				Synthetic Kerosene w/ Aromatics				Alcohol-to-Jet				Cellulose to Hydrocarbon		Direct Sugar to Hydrocarbon	Synthetic Kerosene									
		Acronym	FT-SPK	HEFA			FT-SKA	FT-SAK	HEFA+SKA			CH	ATI-SKA		ATI-SPK		HDCJ	DSHC	SK								
		ASTM Status	Annex A1	Annex A2			Research Report				-	-		Research Report		Research Report	-	Research Report									
		Process	Gasification/FT Hydroprocessing	Deoxygenation/Hydroprocessing			Gasification/FT & Hydroprocessing	FT w/ renewable aromatics	HEFA w/ Renewable Aromatics			Catalytic Hydrothermolysis	Fermentation Olig/hydro/Catal		Fermentation Olig/hydro		Hydrotreated Depolymerized Cellulosic Jet	Fermentation	Catalysis of Sugars								
FRL Level	Total Fuel Quantity Required for Evaluation	Example Producers	Sasol	Synrolabium	Shell	UDP	Dynamis Fuels	Neste	EERC	Sasol	Shell/Virent	Algenol/Swift	UDP	ARA-Radjet	ByoBY	LanzaTech/Swedish Biofuels	Loggas	Gero	UDP	Cobalt/US Navy	LanzaTech/Swedish Biofuels	KOR	UDP	Amynis/Total	Virent		
5	100-gallon	Fuel Production													FAA			FAA							FAA (Virent)		
4 / 6.1	1-gallon	Lab Testing	USAF	USAF	USAF	USAF	USAF	FAA		USAF	USAF	USAF	USAF	USAF	USAF	USAF								USAF	USAF	USAF	
	10-gallons	FPF/Lab Testing	USAF	USAF	USAF	USAF	USAF	FAA		USAF	USAF	USAF	USAF	USAF	USAF	USAF								USAF	USAF	USAF	
6.3	20-gallons	Cold Fuel Atomizer Plugging			FAA	Honeywell				FAA	Honeywell	FAA	Honeywell				FAA	USAF	FAA	Honeywell			FAA	Honeywell	FAA	Honeywell	
	40-gallons	Atomizer Spray & Check Valve	USAF	Honeywell	USAF	Navy	Honeywell			FAA	Honeywell	FAA	Honeywell				FAA	USAF	FAA	Honeywell			FAA	Honeywell	FAA	Honeywell	
6.3 / 6.4	50-gallons	APU Cold and Altitude Starting	USAF	Honeywell	USAF	Navy	Honeywell			FAA		FAA		FAA	FAA	USAF		FAA	USAF	FAA	Honeywell			FAA	Honeywell	FAA	Honeywell
	100-gallons	Combustor Rig								FAA	Honeywell	FAA	Honeywell			FAA	USAF		USAF	FAA	Honeywell			FAA	Honeywell	FAA	Honeywell
	5,500-gallons [31-9[B]	Endurance			USAF	Honeywell				FAA	Honeywell																
6.3 / 6.4	400-gallons e.g. TPE331-10	Engine Perf/Oper/Emiss &/or Dyno	USAF	Honeywell	USAF	Boeing	Honeywell					FAA						USAF	Honeywell					FAA		FAA	
	150-gallons	Combustor Rig	USAF	Honeywell	USAF	Honeywell						FAA						USAF						FAA		FAA	
	5000 gallons e.g. HTF 7000	Engine Perf/Oper/Emiss &/or Dyno								FAA	Honeywell																
6.3 / 6.4	120,000-gallons	Endurance			FAA	Honeywell																					
	T63 engine	Engine Prop &/or Dyno	USAF		USAF																				USAF		
	1000-gallons T55 engine	Combustor Rig	US Army	Honeywell	US Army	Honeywell												US Army	Honeywell								

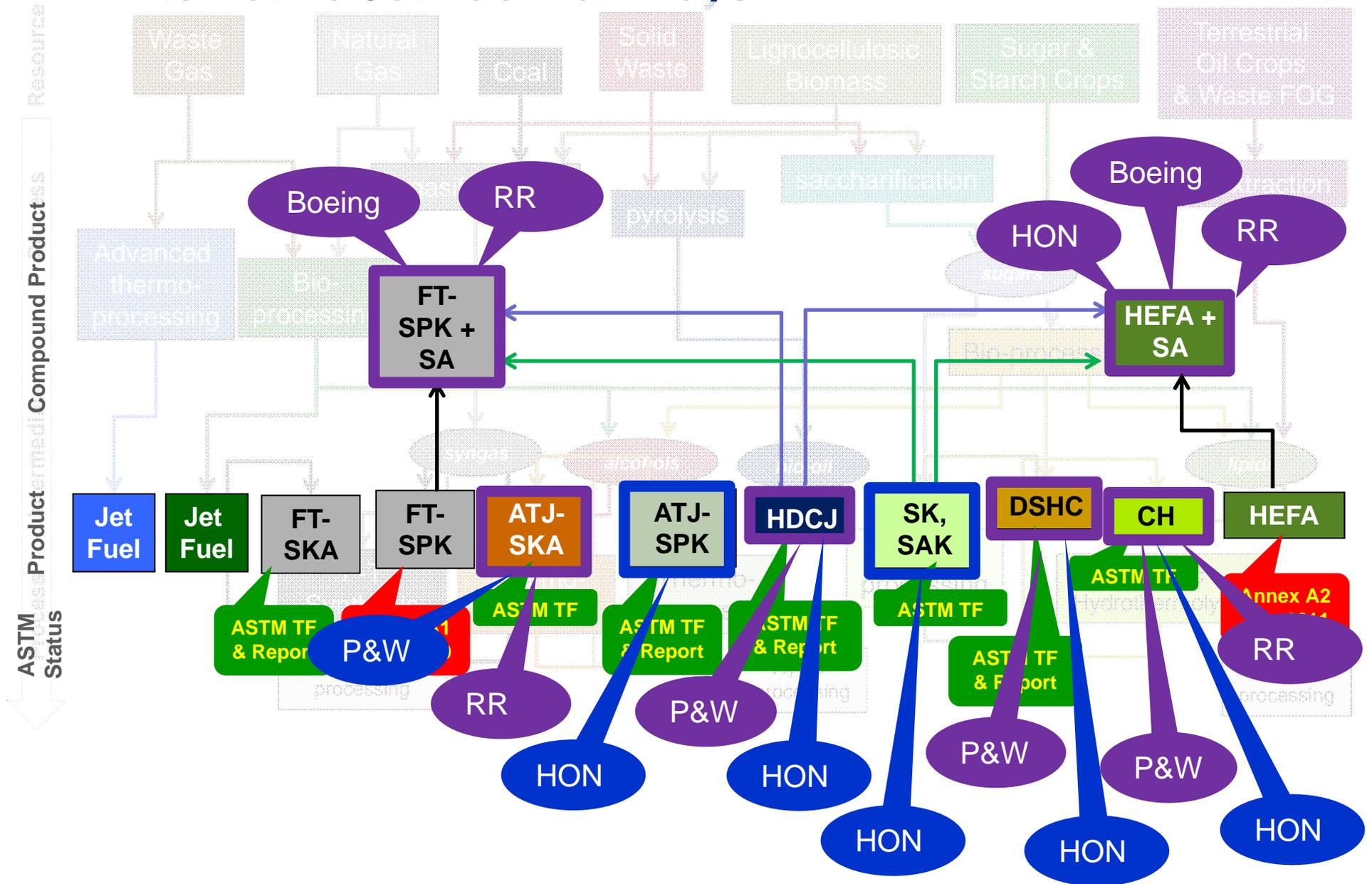
Legend

-  Planned or completed testing by GE
-  Planned or completed testing by PW
-  Planned or completed testing by RR/LW
-  Planned or completed testing by Honeywell
-  Planned or completed testing by AFRL

- Matrix is under development (subject to revision)
- Need to add ongoing US Navy testing
- Focusing on near-term candidates
- Working to streamline process



Alternative Jet Fuel Pathways



FY13 CLEEN Accomplishments

- **Boeing/UDRI testing of cycloparaffins complete**
- **Honeywell demonstration progressing, LCA GHG report delivered**
- **Rolls-Royce lab, rig & APU tests complete, final reports delivered**
- **P&W fuel testing program well underway, two of three fuels tested**

Other FY13 Accomplishments

- **Deliveries of 100 gallon samples by UOP, Virent & Lanzatech**
- **Additional testing capability with BAA: 5 fuels tested by Honeywell**
- **Robust coordination via CAAFI – Farm to Fly 2.0 signed**

FY14 Plans

- **Continuing testing of 6 novel fuels**
- **Analysis, coordination & tracking**
- **Publication of reports and analysis from completed projects**
- **Develop COE and CLEEN II alternative jet fuel testing plans**
- **Facilitating deployment**



Summary

- **Advancing use of alternative jet fuels is key for meeting U.S. environmental goals**
- **Testing & demo efforts (CLEEN & others) accelerate alt fuel technology development / ASTM approval**
- **Analysis efforts improve environmental impacts quantification and decision-making**
- **Coordination among government agencies and across the supply chain is key to deployment**
- **Partnership between government & industry vital to success**
- **Global engagement will support sector goals**
- **Tracking use measures progress towards FAA goals**

