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ICAO STOCKTAKING SEMINAR
TOWARD THE 2050 VISION FOR
SUSTAINABLE AVIATION FUELS



Fuel Approval Process & Status

James Hileman

Chief Scientific and Technical Advisor for
Environment and Energy

Federal Aviation Administration

April 30, 2019

Many slides provided by Mark Rumizen, FAA





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FAA Efforts Relating to Jet Fuel

Testing

- Support ASTM Intl Certification/Qualification testing and improve process
- Measure combustion emissions

Analysis

- Environmental sustainability
- Techno-economic analysis
- Future scenarios

Coordination

- Interagency
- Public-Private
- State & Regional
- International





Over a Decade of Progress

May 24, 2006
Commercial Aviation Alternative
Fuels Initiative (CAAFI) Established

A1

June 2009
FT-SPK Annex A1

June 2009
ASTM D7566 Issued

December 2009
ASTM D4054 Issued

A2

July 2011
HEFA-SPK Annex A2

A3

June 2014
SIP Annex A3

A4

November 2015
FT-SPK/A Annex A4

A5

April 2016
ATJ-SPK Annex A5
Isobutanol Feedstock Only

A5

June 2018
ATJ-SPK Annex A5
Ethanol Feedstock Added

How a Fuel Gets Approved for Use

New Fuel Meets Existing Operating Limitations, Therefore Approved to Use on Virtually All Existing Aircraft



1 FAA Approved Operating Limitations Based on ASTM Fuel Specifications

2 D4054 Fuel Evaluation Process



If New Fuel Meets Conventional Jet Fuel Spec & Properties

4 D1655 = D7566



Conventional Jet Fuel Spec



Drop-In Jet Fuel Spec

ASTM Specification = FAA Certification

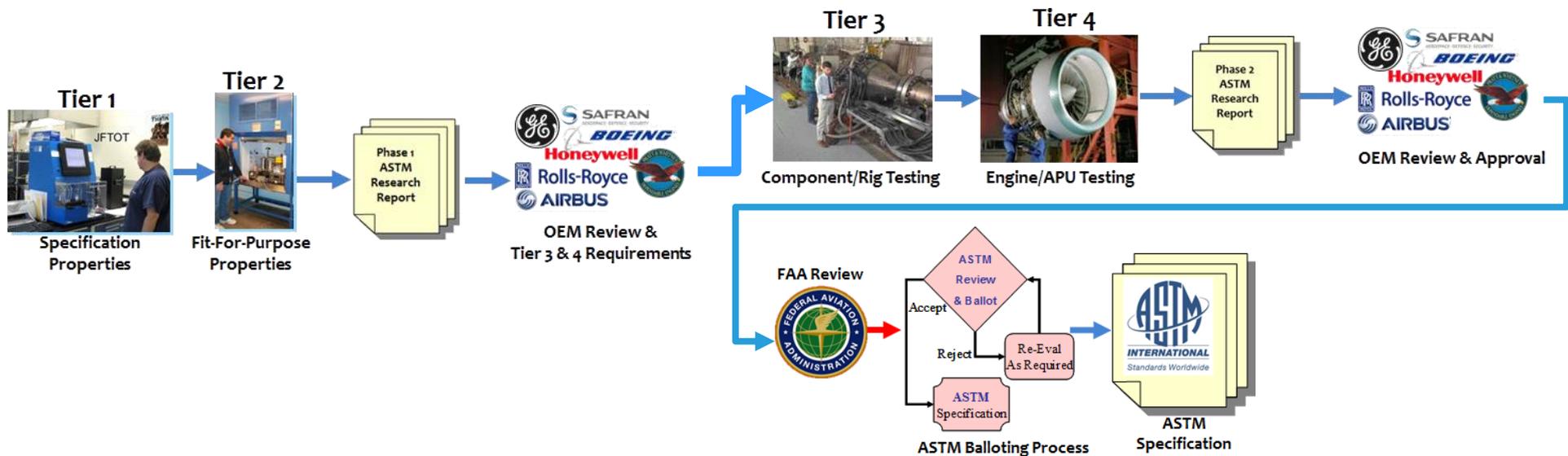
3 D7566 Drop-In Jet Fuel Spec



Then New Fuel Annex Added to Drop-In Fuel Spec



ASTM D4054 Alternative Jet Fuel Evaluation Process



ASTM D4054 Evaluation Status

Exploratory Discussions



Tier 1



Specification Properties

Tier 2



Fit-For-Purpose Properties



Phase 1
ASTM
Research
Report



OEM Review &
Tier 3 & 4 Requirements

**HFP-HEFA
(Green Diesel)**

**Virent SK
(Inactive)**

Virent SAK

Tier 3



Component/Rig Testing

Tier 4



Engine/APU Testing

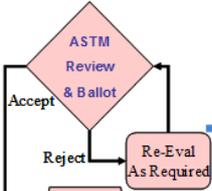


Phase 2
ASTM
Research
Report



OEM Review & Approval

FAA Review



ASTM Balloting Process

ARA CHJ



ASTM
Specification

- Annex A1 FT-SPK
- Annex A2 HEFA
- Annex A3 SiP
- Annex A4 FT-SKA
- Annex A5 ATJ SPK (Isobutanol) & (Ethanol)

FOG Co-processing (D1655)

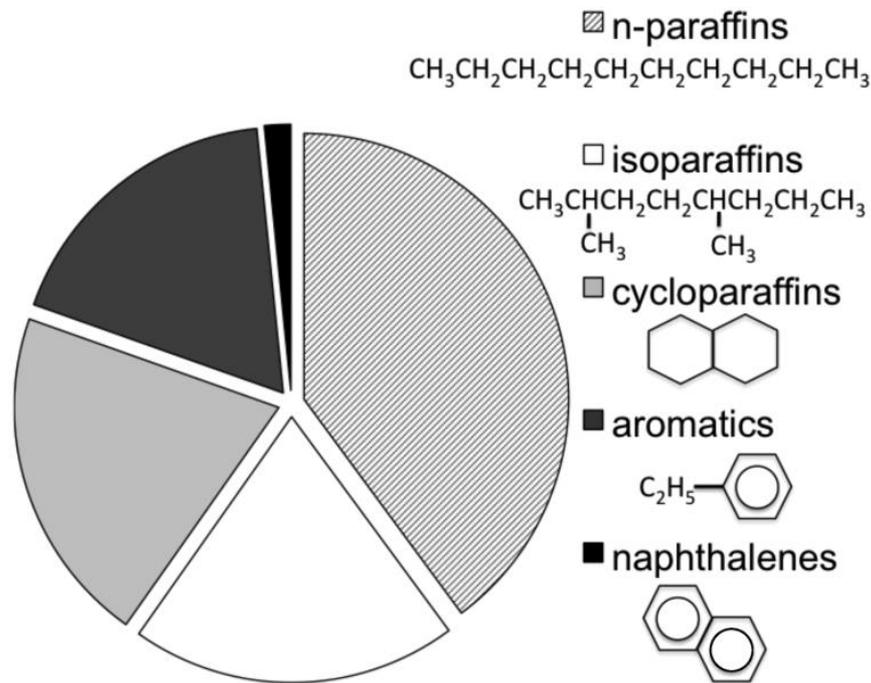
- Shell IH²
- IHI Bb-Oil HEFA
- ATJ-SKA (Byogy, Swed Biofuels)
- HDCJ (KiOR) (Inactive)

FT Co-processing (D1655)



Jet Fuel Composition

- Conventional jet fuel composed of variety of hydrocarbons
- Fuels approved thus far composed mostly of normal and isoparaffins
- Next set of fuel approvals contains larger variety of “jet fuel” hydrocarbons



Estimated Requirements for Fuel Approvals

As a result of the investments made by FAA and others, time and fuel requirements for ASTM Intl approval have fallen over time

Fuel Type	Date ASTM began data review	Date final phase II research report submitted	Date of addition to ASTM Specification (D7566)	Estimated gallons of fuel produced for testing	Estimated time from first review to approval	Composition
FT-SPK	9/2007 est.	09/2008	09/2009	710,000 ¹	3 years	Largely normal/iso-paraffins
HEFA-SPK	6/2008 est.	05/2010	07/2011	626,000 ²	3 years	
SIP	6/2011	04/2013	06/2014	16,000	3 years	
Gevo ATJ-SPK (isobutanol)	12/2010	04/2015	06/2016	93,100 ³	5 1/2 years	
Lanzatech ATJ-SPK (ethanol)	09/2016	07/2017	04/2018	50 ⁴	1 1/3 years (16 months)	
ARA CHJ	6/2012	10/2018	2019 (expected)	79,000	7 years	Wider range of molecules

¹ USAF fuel purchases in 2007 and 2008 for fleetwide qualification

² USAF & Navy fuel purchases in 2009-11 for fleetwide qualification

³ USAF, Navy and CLEEN fuel purchases in 2012-2014

⁴ Only tier 1 & 2 testing needed for Lanzatech due to existing knowledge base and similarity to previously approved fuels.



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Potential Benefits of Additional Fuel Approvals:

- Wider range of biomass could be used
- Reduced cost of fuel production
- Greater environmental benefit
- Greater blend level

Diversity of options results in greater opportunity for success in more places

ASTM D4054 Clearinghouse Concept

Structured as a Cost Share Arrangement

Accepts In-Kind Contributions (testing partners)

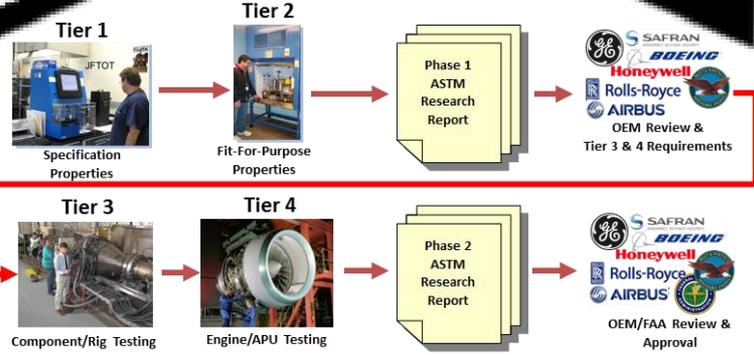
Also Accepts Direct Contributions

Stakeholder Engagement /Support Needed!

FAA Seed Money Under ASCENT Center of Excellence



Candidate Fuel In

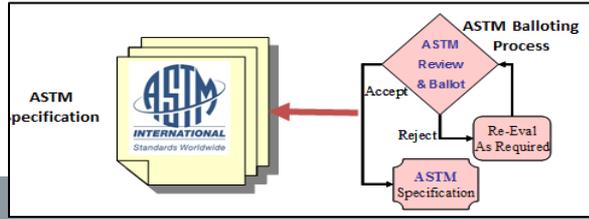


Final Research Report Out



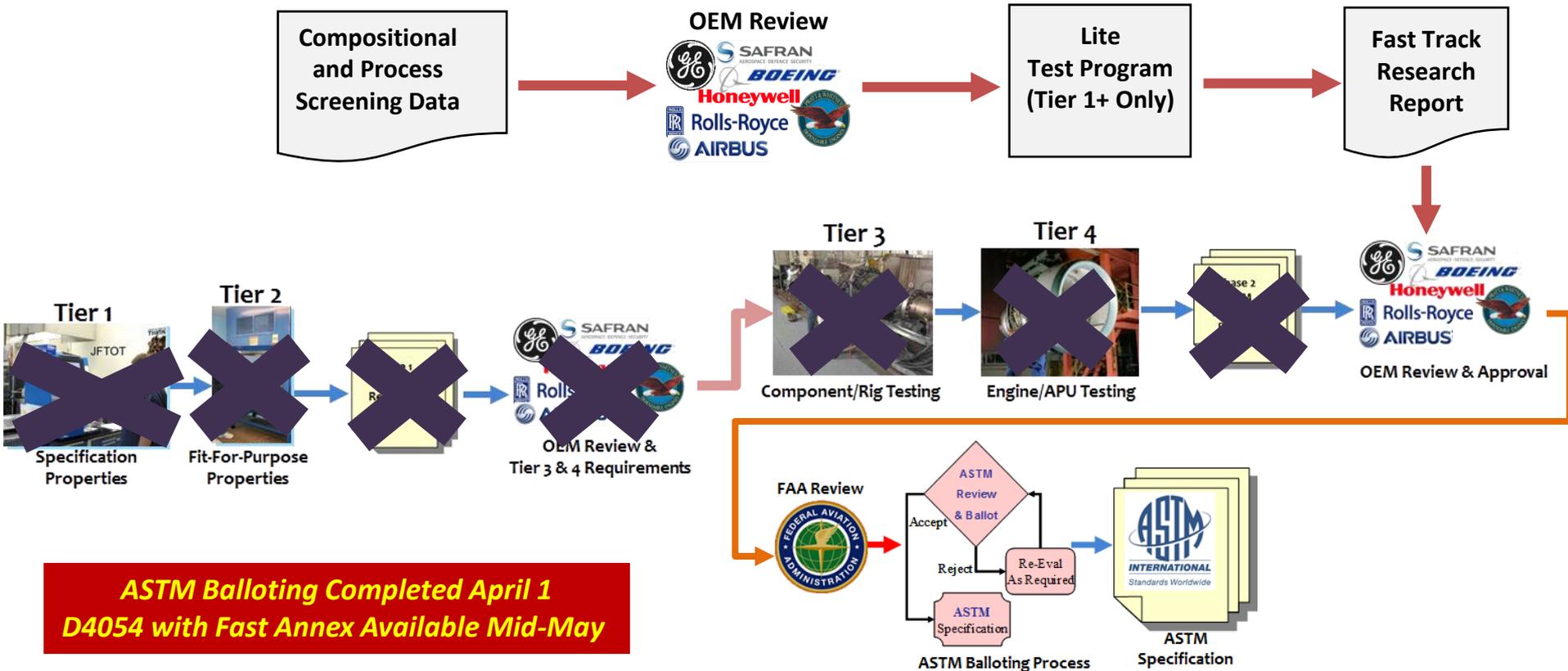
University of Dayton Research Institute (UDRI)

UDRI Contact
 Dr. Steven Zabarnick
Steven.Zabarnick@udri.udayton.edu
 (937) 255-3549



ASTM D4054 Fast Track Annex

For new fuels with conventional hydrocarbon composition





Closing Observations

- Fuel approvals are essential to developing a robust sustainable aviation fuel industry
- We have achieved considerable progress in approving fuels due to robust governmental support and a strong partnership with industry
- Much work remains to be done to approve additional new fuels – we need to work in collaboration across the globe to leverage scarce resources



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THANK YOU