R&D Breakout Session

January 28, 2014

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COMMERCIAL AVIATION
ALTERNATIVE FUELS INITIATIVE

CAAFI R&D Leadership Team…

Kristin Lewis – Environmental Biologist , Volpe, DOT

Kirsten Van Fossen - Environmental Analyst, Volpe, DOT

Stephen Kramer – Manager, Combustor Technology, Pratt and Whitney

Michael Lakeman - Associate Technical Fellow, Biofuels Strategy, Boeing

Mike Epstein – Systems Engineer, GE Aviation

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R&D Breakout Agenda

R&D Team Breakout Session, Tuesday, January 28, 2014	
Time	Session Title/Description
2:00 – 2:10 p.m.	**Introductions,** *A brief overview of the participants and their relevant R&D activities*
2:10 – 2:50 p.m.	**Identified Challenges and Gaps** *Moderators- Kristin Lewis, Stephen Kramer, Michael Lakeman, Mike Epstein:* *The moderators will briefly present the previously identified challenges and gaps and give updates on their progress; Additional R&D team input on updates encouraged, if applicable*
2:50 – 3:00 p.m.	**Ongoing Communication Efforts** *An overview of the up-to-date efforts within CAAFI and R&D team*
3:00 – 3:10 p.m.	**Summary of General Meeting Messages** *An opportunity to refresh on the views voiced by the expert panel and general membership*
3:10 – 3:30 p.m.	Break
3:30 – 4:15 p.m.	**Future Directions Discussion: Challenges and Gaps** *What is missing, what should be prioritized, and how these relate to General Meeting discussion*
4:15 – 5:00 p.m.	**Future Directions Discussion: Communication Efforts** *R&D team needs, potential improvement, and how these relate to General Meeting discussion*
5:00 – 5:20 p.m.	**Future Directions Discussion: Feedstock Readiness Level (FSRL)** *Discussion seeking R&D team input for improving FSRL uptake*
5:20 – 5:30 p.m.	**Next Steps and Closing Remarks**

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Critical R&D Challenges

Priority	White Paper Title	Date	Download
Immediate	Flexible economic and engineering models to evaluate proposed alternative fuel facilities and supply chains	TBD	
Immediate	Alternative fuels specification and testing	March 2013	PDF
Near-term	HEFA Feedstock Cost Reduction	March 2013	PDF
Near-term	Relative Economics of Sustainable Aviation Fuels, versus competing Biocommodities and uses	March 2013	PDF
Near-term	Development and streamlining of crosscutting technologies	TBD	
Near-term	Diversity in biofuel feedstock production	March 2013	PDF
Near-term	Developing efficient and cost-effective use of wastes as feedstocks	March 2013	PDF
Mid- to long-term	Alternate methods of atmospheric CO2 capture	March 2013	PDF
Mid- to long-term	Approaches that Convert CO2 to Drop-In Jet Fuel	March 2013	PDF

Find chart at http://www.caafi.org/information/rdchallenges.html

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Feedstock Readiness Level

January 28, 2014

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Dr. Kristin C. Lewis
Research and Technical Advisor
Volpe/DOT

Motivation

* Fuel Readiness Level (FRL) did not address feedstock supply.

* What do we need to address with respect to feedstock supply?

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FRL, FSRL & EP

Fuel Readiness Level	Feedstock Readiness Level	Env. Progression
Basic Principles	Basic Principles	Basic Principles
Concept Formulated	Concept Formulated	Concept Formulated
Proof of Concept	Proof of Concept	Proof of Concept
Preliminary Technical Evaluation	Preliminary Technical Evaluation	Preliminary Technical Evaluation
Process Validation	Production System Validation	Scale up Validation of Initial Assessments
Full-scale Technical Evaluation	Full-scale Production Initiation	Full-scale Feedstock Impact Evaluation
Certification/Fuel Approval	Feedstock Availability	Full-scale Fuel Producer Impact Evaluation
Commercialization	Commercialization	Commercialization
Production Capacity Established	Sustainable Feedstock Production Capacity Established	Sustainable Feedstock and Fuel Supply Established

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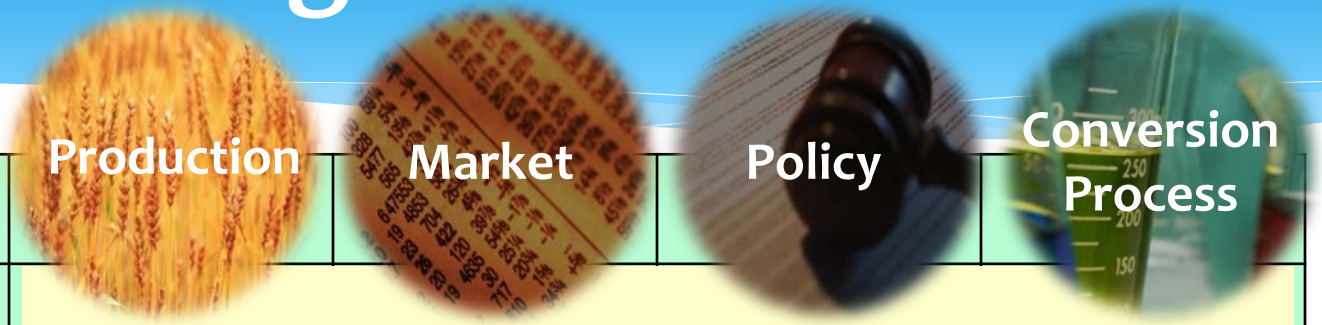
High Level



Feedstock Readiness Level	
Basic Principles	Preliminary Feedstock Evaluation
Concept Formulated	
Proof of Concept	Feedstock Experimental Testing
Preliminary Technical Evaluation	
Production System Validation	Pre-commercial Feedstock Assessment
Full-scale Production Initiation	
Feedstock Availability	Feedstock Commercial Deployment
Commercialization	
Sustainable Feedstock Production Capacity Established	

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Production

Feedstock Readiness Level	Production
Basic Principles	Identify feedstock production potential and evaluate performance
Concept Formulated	
Proof of Concept	
Preliminary Technical Evaluation	
Production System Validation	Run field trials and establish competitiveness
Full-scale Production Initiation	
Feedstock Availability	Scale up production to full scale commercialization
Commercialization	
Sustainable Feedstock Production Capacity Established	Ongoing performance improvement and environmental management

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Market

Feedstock Readiness Level	Market
Basic Principles	Identify market for feedstock and coproducts
Concept Formulated	
Proof of Concept	
Preliminary Technical Evaluation	Estimate production costs and feasibility, reduce risks Develop off take options
Production System Validation	
Full-scale Production Initiation	
Feedstock Availability	Reduce risk and uncertainty of feedstock production
Commercialization	
Sustainable Feedstock Production Capacity Established	Market supports sustainable feedstock production

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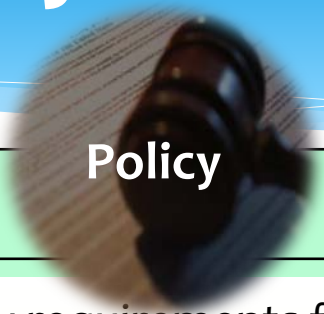
Policy



Feedstock Readiness Level	Policy
Basic Principles	Identify regulatory requirements for a new feedstock, formulate plans for compliance
Concept Formulated	
Proof of Concept	
Preliminary Technical Evaluation	NEPA and other permitting drafts
Production System Validation	
Full-scale Production Initiation	Regulatory compliance complete (permits approved)
Feedstock Availability	
Commercialization	
Sustainable Feedstock Production Capacity Established	Federal, state, private programs support sustainable feedstock production with minimal unintended consequences

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Linkage to Conversion Process

Feedstock Readiness Level	Conversion Process
Basic Principles	Identify potential conversion technology linkage
Concept Formulated	Test feedstock in conversion process
Proof of Concept	
Preliminary Technical Evaluation	Scale up testing
Production System Validation	
Full-scale Production Initiation	Performance confirmed
Feedstock Availability	
Commercialization	
Sustainable Feedstock Production Capacity Established	Sustainable full scale production of biofuel and co-products from feedstock

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Discussion

* Improve utility?
* Additions?
* Specific issues/concerns?

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Links

Find FSRL chart at
http://www.caafi.org/information/pdf/FeedstockReadinessLevel_posted_2011_12.pdf

Find FSRL paper at
http://link.springer.com/article/10.1007%2Fs12155-012-9187-1#

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