CAAFI Readiness Tools

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On behalf of the CAAFI Administrative Leadership Team
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Communication / evaluation tools are a key CAAFI Priority

* **Implement Frameworks & Share Best Practices** – CAAFI will continue to develop tools to evaluate the technical readiness of feedstocks and fuels, and commercial readiness of producers to identify prime targets of opportunity for sustainable near term supply.

  -- CAAFI 2018 Look Ahead, Goals and Priorities (1/12/18)

What are CAAFI's Readiness Tools?

Adaptation of Technology Readiness Level to AJF-specific needs.

* **Fuel Readiness Level** – technical and commercial maturity of AJF production processes.
* **Feedstock Readiness Level** – technical and commercial maturity of feedstocks compatible with AJF production processes.
* **Environmental Progression** – which sustainability evaluations should be performed and when during feedstock/process maturation.
* **Commercial Engagement Readiness** – focus on facilitating interaction of commercially maturing entities with airlines.

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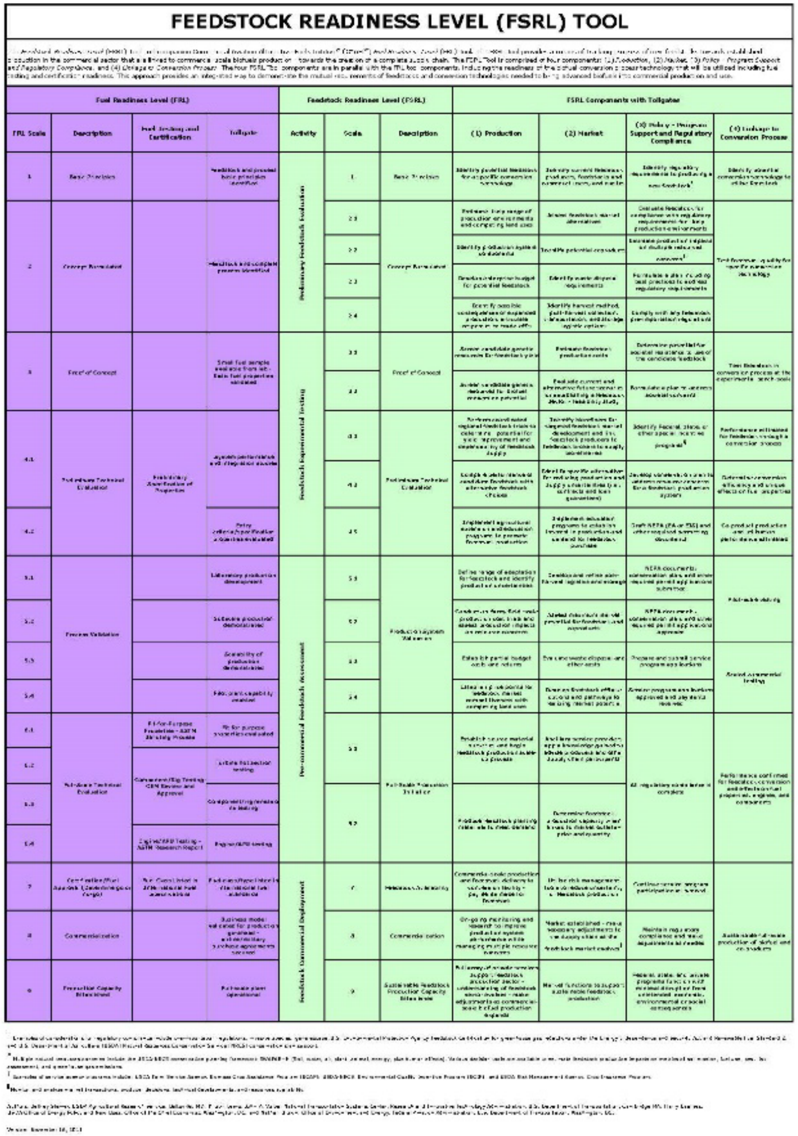
Feedstock Readiness Level (FSRL)

* Response to R&D team need.
* Developed jointly by USDA/CAAFI (FAA/Volpe) at CAAFI's request (2012).
* Revised into checklist format under Farm2Fly 2.0 initiative (2014).



FEEDSTOCK READINESS LEVEL (FSRL) TOOL

Fuel Readiness Level (FRL)				Feedstock Readiness Level (FSRL)			FSRL Components with Tollgates			
FRL Scale	Description	Fuel Testing and Certification	Tollgate	Activity	Scale	Description	(1) Production	(2) Market	(3) Policy – Program Support and Regulatory Compliance	(4) Linkage to Conversion Process
1	Basic Principles				1	Basic Principles				

FSRL Mirrors Development Phases

Level	Description	FSRL Component Tollgate Criteria
1	Basic Principles	Preliminary Evaluation
2	Concept Formulated	
3	Proof of Concept	Experimental Testing
4	Preliminary Technical Evaluation	
5	Production System Validation	Production System Validation
6	Full-Scale Production Initiation	
7	Feedstock Availability	Commercial Deployment
8	Commercial-ization	
9	Production Capability Established	

FSRL Tool Components

		Feedstock Readiness Level (FSRL) Components				Fuel Readiness Level (FRL)
Feedstock Readiness Level #	FSRL Description	(1) PROD	(2) MARK	(3) POLY	(4) LINK	Conversion Process

FSRL uses FSRL desc FSRL is described by four readiness components:
Fuel Reac readiness (1) Production; (2) Market; (3) Policy; and (4) Linkage

FSRL tool modeled after and designed to complement the CAAFI Fuel Readiness Level (FRL) tool.
FSRL developed jointly by USDA/CAAFI (FAA/Volpe) at CAAFI's request

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FSRL Checklist Structure

* Instructions Sheet
* Evaluation Overview
* FSRL Checklist for Dedicated Crops and Woody Species
* FSRL Checklist for Agricultural and Forest Residues
* Summary Table

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FSRL Checklist

* Specific to feedstock, conversion process, region
* Two checklist versions
  * Dedicated crops and woody species
  * Agricultural and forest residues
* Summary table
  * Includes current and anticipated FSRL status
  * Provides opportunity to describe rationale for rating for each component

Fornax, 1988

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FSRL Repository

Goals:

- Benchmark feedstock readiness status.
- Clarify risks and barriers to feedstock development and availability.
- Provide a risk management tool for evaluating individual feedstocks.
- Comparison with FRL to identify R&D gaps.

Potential users:

- Policy makers and R&D funding organizations identifying gaps that require additional R&D funding or incentives;
- Fuel purchasers (e.g., airlines) looking to evaluate proposals for fuel procurement;
- Fuel producers looking to identify feedstock options.

* Resides on USDA National Ag Library Ag Data Commons- https://data.nal.usda.gov/farm-2-fly

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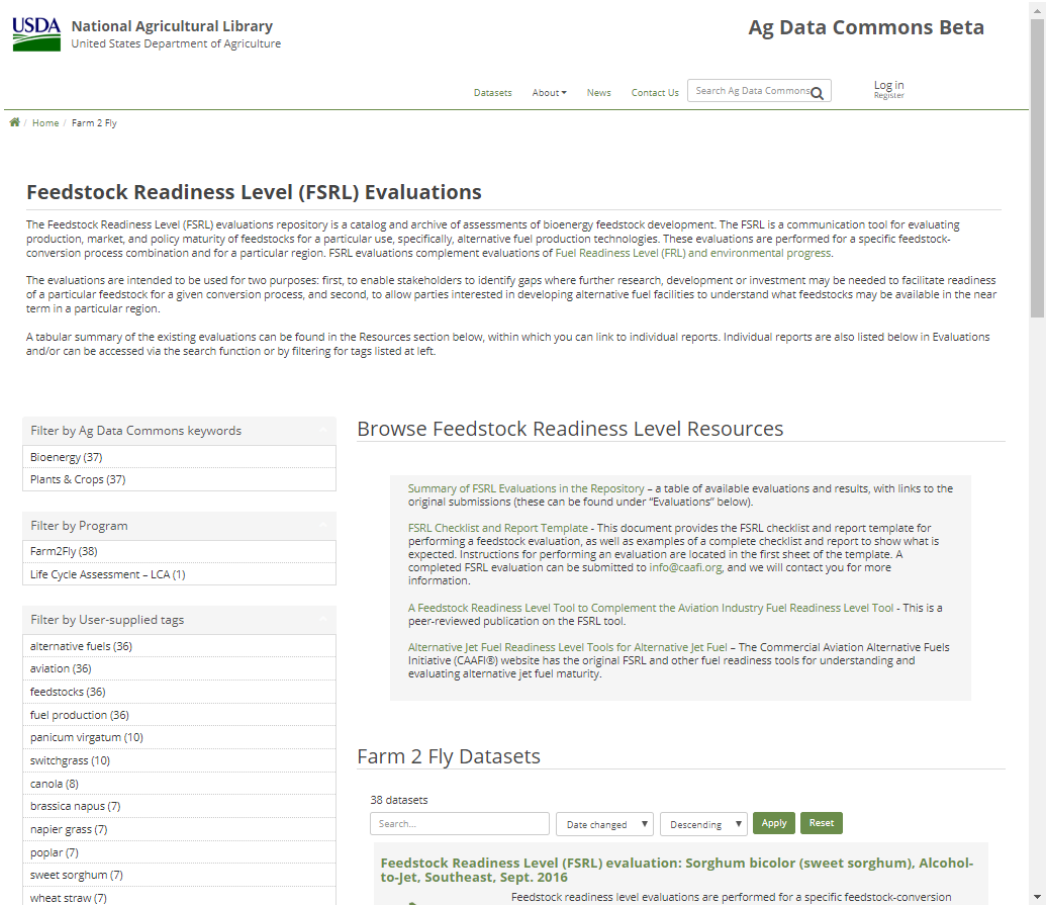
FSRL Repository

* Includes:
  - Checklist and Report Template
  - Summary table of FSRL evaluations in repository.
  - Link to publication.
  - Full FSRL evaluations.
* USDA Biomass Research Center researchers provided initial evaluations.
* Additional evaluations have been submitted by feedstock producers, CAP grant PIs, and others.



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Current evaluations

Oilseeds

Feedstock	Scientific name	Region
Carinata	*Brassica carinata*	Northwest
Canola	*Brassica napus*	Southeast, Northwest
Industrial rapeseed	*Brassica napus*	Northwest
Camelina	*Camelina sativa*	Northwest
Pongamia	*Millettia pinnata*	Southeast

Sugars

Feedstock	Scientific name	Region
Energy cane/ Sugar cane	*Saccharum officinarum*	South, Southeast, Hawaii
Energy beet	*Beta vulgaris*	Southeast
Sweet sorghum	*Sorghum bicolor*	Southeast

Lignocellulosics

Feedstock	Scientific name	Region
Big bluestem	*Andropogon gerardii*	Central East
Eucalyptus	*Eucalyptus grandis*	Hawaii
Juniper	*Juniperus spp.*	Northwest
Giant miscanthus	*Miscanthus x giganteus*	Southeast
Switchgrass	*Panicum virgatum*	Central East, Northwest, Southeast
Herbaceous Perennial Grasses	*P. virgatum, A. gerardii, Sorghastrum nutans*	Central East
Napiergrass	*Pennisetum purpureum*	Southeast
Banagrass	*Pennisetum purpureum x glaucum*	Hawaii
Poplar	*Populus spp.*	Northwest
Sweet sorghum	*Sorghum bicolor*	Central East
Wheatgrass	*Thinopyrum intermedium*	Northwest
Wheat straw	*Triticum aestivum*	Central East, Northwest
Corn stover	*Zea mays*	Central East

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Request for Evaluations

Please contact us if you would like help performing or sharing an evaluation:

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CAAFI Readiness Level Frameworks

* Pathway to SAJF
* Feedstock (FSRL)
* Technology (FRL)
* Guidance for Selling Alternative Fuels to Airlines
* Environmental Progression

Commercial Engagement Readiness Level
New CAAFI Readiness Level Framework

- What:
  - Creation of a mechanism to enable a structured means of assisting, reviewing & measuring progress of potential producers by CAAFI Business Team and cognizant airlines' members via a Commercialization Council (CC)
- Why:
  - The industry has suffered some false starts, and we want to avoid those going forward
    - Industry is interested in clearly communicating expectations, and ensuring producer has a viable commercialization plan
  - As opportunities now expand, this approach lowers workload of producer, buyer, and supporting entities by reducing/eliminating redundancy
- When:
  - 1Q'19 rollout
- How:
  - CAAFI Business Team works with producers – mutually voluntary process
  - Biannual Commercialization Committee meetings – virtual or in-person, where progress would be reviewed/reported using a standard agenda

Risk assessment demands of airlines to enable any serious engagement

"Eight Buckets of Risk" – from Guidance document

1. Construction – what is cost and time to complete?
2. Technology – what if the technology does not work, or fails to yield the promised production?
3. Feedstock – will it be available at any cost, let alone at the presumed cost?
4. Policy – if the project's viability depends on government policy/assistance, will that policy remain constant throughout the facility's economic life?
5. Financial – how will the economic assumptions (e.g., cost of debt and equity, cost of production, selling price of all of the fuel products) been realized?
   * How is the producer thinking about achieving petroleum parity
6. Engineering – is the engineering and design of the plant appropriate?
7. Management – what experience does management have and what happens if it proves inadequate for the task?
8. Scalability – is the project able to scale up and generate meaningful quantities of fuel and co-products?

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Commercial Engagement Readiness Level
New CAAFI Readiness Level Framework

Three phases

Preparatory work for introduction to airlines

* Addressing "bucket of risk" from Airline Guidance document
* Assist in preparation for successful first meetings
* Hold joint Committee meeting for joint airline presentation

Execution of engagement by/with individual airlines

* Producer sufficiently defines business case elements as required by airlines to begin to develop offtake agreements
* Producer and airlines agree to enter into detailed offtake

Commercialization progress tracking

* Monitoring of Commercialization Activity in Progress
* Helping to close gaps
* Identifying when additional/expanded offtakes might be warrranted

Commercial Engagement Readiness Level
New CAAFI Readiness Level Framework

Readiness Levels	Exit Criteria
1. Pre-engagement (R&D, Cert/Qual, ALT, airline) with interests confirmed	1. Producer agrees to CERL Framework
2. Initiation of Framework collaboration	2. Buckets-of-Risk strategy identified
3. Preparation for airline engagement	3. FRL 5, FSRL 3, CC agreement on progress
4. Committee Engagement, presentation, feedback	4. Presentation to CC, feedback provided
5. Individual airline follow-up - progress on buckets	5. Producer and airline agree to progress to formal documentation
6. Transition to direct negotiation & execution of offtake	6. First airline offtake agreement executed
7. Commercialization in progress	7. Financial Close
8. Groundbreaking	8. Construction complete
9. Routine commercial production established	9. Offtake and use communicated

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More detail to follow

CAAFI will:

* Convene Commercialization Council in Q1
  * Define agreed overall approach
  * Agree Entry, Work Elements, and Exit criteria
  * Operating mechanics, ground-rules, operating rhythm
* Publish framework
* Perform initial industry assessment and agree on candidate evaluation order
* Contact selected producers for detailed engagement
* Execute process

CAAFI.org Website Tour

December 6, 2018

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COMMERCIAL AVIATION
ALTERNATIVE FUELS INITIATIVE

Peter Herzig
CAAFI / Volpe / U.S. DOT

What's available?

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FUELING SOLUTIONS FOR SECURE & SUSTAINABLE AVIATION

COMMERCIAL AVIATION ALTERNATIVE FUELS INITIATIVE

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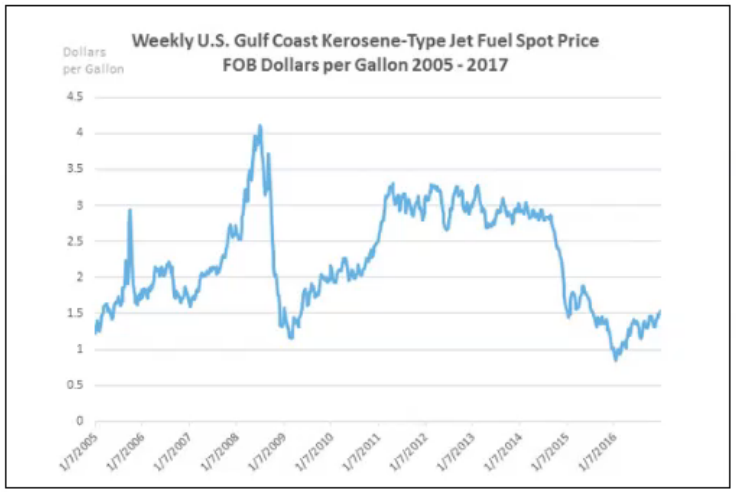

Enabling significant SAJF supply should help address the extreme price fluctuations of crude and jet fuel that have proven detrimental to the industry.

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Quick Links

- CRC Aviation Fuel Properties Handbook
- IATA Aviation Fuel Supply Model Agreement
- CAAFI D4054 User's Guide
- CAAFI Environmental Readiness
- FAA's Alternative Jet Fuel R&D page
- Guidance for Selling Alternative Fuels to Airlines
- Fuel Readiness Tool

Recent News

- Mass production of alternative jet fuel and biodiesel from algae and waste oil to begin in Japan
- Business Aviation Organizations Reaffirm Commitment to Sustainable Alternative Jet Fuel
- Phillips 66 and Renewable Energy Group Announce Plans for West Coast Renewable Diesel Facility
- SAS and 10 other Nordic-based companies commit to AJF use as part of aligning their business strategies with the UN Sustainable Development Goals
- World Energy Paramount announces decision to invest in expanding renewable fuel production capacity more than six times current production levels

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Thank you!

We welcome your input as we are continually updating the website

Contact: **Peter.Herzig@dot.gov**

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