CAAFI Readiness Tools

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On behalf of the CAAFI Administrative Leadership Team
CAAFI Biennial General Meeting 2018
December 6, 2018
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.
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).
## FSRL Mirrors Development Phases

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>FSRL Component Tollgate Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Basic Principles</td>
<td>Preliminary Evaluation</td>
</tr>
<tr>
<td>2</td>
<td>Concept Formulated</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Proof of Concept</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Preliminary Technical Evaluation</td>
<td>Experimental Testing</td>
</tr>
<tr>
<td>5</td>
<td>Production System Validation</td>
<td>Production System Validation</td>
</tr>
<tr>
<td>6</td>
<td>Full-Scale Production Initiation</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Feedstock Availability</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Commercialization</td>
<td>Commercial Deployment</td>
</tr>
<tr>
<td>9</td>
<td>Production Capability Established</td>
<td></td>
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</table>
FSRL Tool Components

<table>
<thead>
<tr>
<th>Feedstock Readiness Level #</th>
<th>FSRL Description</th>
<th>Feedstock Readiness Level (FSRL) Components</th>
<th>Fuel Readiness Level (FRL)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(1) PROD</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2) MARK</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3) POLY</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4) LINK</td>
<td>Conversion Process</td>
</tr>
</tbody>
</table>

FSRL is described by four readiness components: (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.
FSRL Checklist Structure

- Instructions Sheet
- Evaluation Overview
- FSRL Checklist for Dedicated Crops and Woody Species
- FSRL Checklist for Agricultural and Forest Residues
- Summary Table
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
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
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.
### Current evaluations

**Oilseeds**

<table>
<thead>
<tr>
<th>Feedstock</th>
<th>Scientific name</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carinata</td>
<td>Brassica carinata</td>
<td>Northwest</td>
</tr>
<tr>
<td>Canola</td>
<td>Brassica napus</td>
<td>Southeast, Northwest</td>
</tr>
<tr>
<td>Industrial rapeseed</td>
<td>Brassica napus</td>
<td>Northwest</td>
</tr>
<tr>
<td>Camelina</td>
<td>Camelina sativa</td>
<td>Northwest</td>
</tr>
<tr>
<td>Pongamia</td>
<td>Millettia pinnata</td>
<td>Southeast</td>
</tr>
</tbody>
</table>

**Lignocellulosics**

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

**Sugars**

<table>
<thead>
<tr>
<th>Feedstock</th>
<th>Scientific name</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy cane/Sugar cane</td>
<td>Saccharum officinarum</td>
<td>South, Southeast, Hawaii</td>
</tr>
<tr>
<td>Energy beet</td>
<td>Beta vulgaris</td>
<td>Southeast</td>
</tr>
<tr>
<td>Sweet sorghum</td>
<td>Sorghum bicolor</td>
<td>Southeast</td>
</tr>
</tbody>
</table>
Request for Evaluations

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

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Volpe National Transportation Systems Center
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617-494-2130
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?
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 warranted
## Commercial Engagement Readiness Level

### New CAAFI Readiness Level Framework

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

13 December 2018
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

Peter Herzig
CAAFI / Volpe / U.S. DOT
What’s available?

COMMERCIAL AVIATION
ALTERNATIVE FUELS INITIATIVE

Featured Program: Farm 2 Fly 2.0 Feedstock Readiness Level Repository

This joint initiative between USDA, US Department of Transportation, Department of Energy, and the aviation industry focuses on assessing and maturing feedstocks and developing supply chains for alternative jet fuel production.

The Farm to Fly 2.0 (F2F2) Feedstock Readiness page is live on the National Agricultural Library page. We would welcome evaluations from CAAFI members.

Quick Links
- CRC Aviation Fuel Properties Handbook
- IATA Aviation Fuel Supply Model Agreement
- CAAFI Biofuels 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 AIP use as part of aligning their business strategies with the UN Sustainable Development Goals
Enabling significant SAJF supply should help address the extreme price fluctuations of crude and jet fuel that have proven detrimental to the industry.
Thank you!
We welcome your input as we are continually updating the website.

Contact: Peter.Herzig@dot.gov
Contact Us

For general inquiries, please email info@caafi.org.

To reach the Executive Director, please email Steve.Csonka@caafi.org.