Aviation Fuel Supply Chain Stakeholder Perceptions of Sustainable Alternative Jet Fuel

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I. Aviation Fuel Demand in the NARA Region
II. Why SAJF?
III. Objectives & Research design
IV. Primary Data Collection – Methods & Preliminary Findings
V. Future work
I. Aviation Fuel Demand in the NARA Region

Perspective: U.S. Petroleum and Jet Fuel Consumption

![Pie chart showing U.S. Petroleum Consumption 2013 (291 Billion Gallons)]

- Gasoline, 136BG, 46%
- Diesel, 59BG, 20%
- Other, 74BG, 26%
- Jet fuel, 22BG, 8%
- NARA Region, 1BG, 4%

Figure 1. U.S. Petroleum Consumption and NARA’s share of U.S. Jet Fuel in 2013 (EIA 2015a)
NARA Region Jet Fuel Uptake; Total ~950MG

- NARA total and military fuel consumption data is est. from FAA and SAFN; data for SEA & PDX is A4A based
NARA Region Demand by State (2013)

Data source: Military share is derived from SAFN 2011 Report; the state fuel consumption is from FAA
II. Why SAJF?
Aviation is Different from Transportation Sector

- Global aviation growth (airline passenger travel is projected to double from 2014 – 2034) (IATA 2015)

- No viable alternatives:
  - High-performance, liquid, and high-density
  - SAJF must be “drop-in”
  - SAFE: Rigorous ASTM certification (D7566 – SAFJ; D1655 – Jet A1)

- Access to distribution – few “filling stations” (SAFN)
  - US: 376 primary airports vs. 160,000 gas stations
  - Global: 75 airports = 80% of traffic; Top 21 = 50%

- Customer pull
  - Strong military support
  - Airlines/airports - driven to reduce their CO₂ emissions
Drivers for SAJF

- Petro-jet fuel price volatility
- Growing global demand for air travel
- Public/political pressure re: carbon emissions
- Energy security
- Rural economic development
III. Research Objectives

1. ID key aviation fuel supply chain SHs in the NARA region;

2. Assess SH perceptions regarding the drivers/barriers to economically viable SAJF production in the NARA region;

3. Examine key issues to adding blended SAJF (ASTM D7566) into the ASTM D1655 Jet A fuel supply chain, including molecule tracking and crediting.
Research Design

**Phase I:**
Secondary Data & Exploratory interviews – Population & issues

**Phase II:**
Construct development and verification

**Phase III:**
Primary Data Collection – Interviews & e-Surveys

- Identify key aviation fuel supply chain stakeholders
  - Airports with jet fuel service
  - Airlines
  - FBOs
  - Fuel Resellers, Pipelines & Terminals

- Examine key issues
- Develop interview questions
- Interview (Pre-test) with key industrial experts
- Verify the content, format & interpretation of measures

- Refine constructs; develop questionnaire and interview scripts
- Primary data collection
- Data synthesis and analysis
- Reports and publications

2015 Annual Meeting
Spokane, WA
IV. Primary Data Collection: Methods & Preliminary Findings:

• **e-Surveys — Airport Mgrs.**
  – Pretest, then Round #1 (Spring 2015):
    • 26.5% Response Rate (n=26); mostly small and micro airports
    • Selected 8 for this analysis (size/geog. balance)
    • Sought endorsements to increase RRs
    • Currently being re-administered (Round #2)

• **In-Depth Interviews — 12 Supply Chain SHs**
  – On-Site by Appt; June-Aug.; recorded & transcribed
    • Airports (large & medium)
    • FBOs (fuel facility operators)
    • Airlines
Distribution of Respondents (n=20)

Tier 1: n=4
Tier 2: n=4
Tier 3: n=5
Tier 4: n=7

2015 Annual Meeting
Spokane, WA
Q. What are the key barriers to developing an economically viable SAJF production industry in the Pacific Northwest region?

- High Cost of Biofuels: 8
- Lack of Stable Policy: 5
- Environmental Issues - Prod'n. & Siting: 5
- Not Proven (safety): 4
- Not Proven (Technical): 4
- Lack of Capital (Investment): 3
- Petro Industry Opposition: 2
- Forest Regulation: 1
“Cost is the #1 barrier.” “The cost of production and logistics is limiting market entry and scale up.”

“There is not policy stability or harmony for (S)AJF. In contrast, on-road fuels have better incentives for renewable fuel than jet fuel.”

“Siting refineries is a contentious issue with environmentalists, particularly new greenfield sites. Brownfield siting or co-siting with existing mfg. may be the answer.”

“Safety is a paramount concern in this industry.”

“Lack of long-term (fuel) purchasing agreements to provide a secure return on capital.”

“The forest is over-regulated. We can’t sit and watch thousands of acres of natural resources burn. It (SAJF) is a great use of the biomass.”
Q. What is **driving** the development of an economically viable SAJF production industry in the Pacific Northwest region?

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<tr>
<th>Drivers to SAJF</th>
<th>Number of respondents (#)</th>
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<tr>
<td>Airline driven</td>
<td>8</td>
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<tr>
<td>Environmental Benefits</td>
<td>5</td>
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<tr>
<td>Government Policy</td>
<td>5</td>
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<td>Energy Security</td>
<td>4</td>
</tr>
<tr>
<td>PR Benefits</td>
<td>3</td>
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<tr>
<td>Economic Development Benefits</td>
<td>2</td>
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“In terms of biofuel into the aircraft, we really look at it as an airline prerogative…. the airlines are interested in it (SAJF). As we work with them on a regular basis, of course we will be interested in it.”

“Sustainability is one of the big buzz word we hear all the time… the other thing is environmental (benefit).”

“Policy stability is absolutely critical to economic sustainability and to attract long-term investors.”

“NIMBY-ism is a key factor. Most like the idea of biofuel, but are not interested in a refinery or large industrial facility in their back yard due to transportation impacts and feedstock attractiveness (food vs fuel).”

“We need to plan ahead because, if we don’t, we will get behind the power curve… but at what scale & at what level?”
Some support; some oppose:

– (ENGOs) love the product, but are resistant to the regional industrial development necessary for prod’n (siting issues);

– ...distrust the claimed sustainability certification; opposed to environmental impacts; do not think there is real LCA carbon reduction;

– (ENGO) support/opposition depends on the conversion process and other externalities;

– Local ENGOs could influence local airports;

– (ENGOs) are seeking a credible system, such as ASTM, ISO 4001, etc.
Q. Where would be the logical SAJF blending location for your airport? (n=12)

<table>
<thead>
<tr>
<th>SAJF Blending Point</th>
<th>Number of respondents (#)</th>
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<tr>
<td>Petro-refinery</td>
<td>4</td>
</tr>
<tr>
<td>Airport Fuel Farm</td>
<td>2</td>
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<tr>
<td>Terminal(s)</td>
<td>3</td>
</tr>
<tr>
<td>No opinion</td>
<td>3</td>
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Q. Do you think the SAJF molecules should be tracked? Why? (n=20)

• Yes (n=13, 65%):
  – “I think whoever buys the molecule will drive the tracking mechanism to derive value, both the monetary credits and the public perception.”
  – “Tracking is valuable just from the efficiency standpoint to understand what you make actually works.”

• No (n=3, 15%):
  – “It’s probably not important to track biojet since we really deliver the product separately, but the customers are distinct; we deliver one product per customer type.”
  – “I don’t think there should be any different tracking for biojet vs. our current handling of petro-jet. I don’t see a need to track it.”

• No Comment (n=4, 20%)
Should SAJF purchases have a mechanism for crediting? (n=20)

- **Yes (n=13, 65%):**
  - [SAJF] “… should be credited at point of purchase using the same RSF2 credit pattern.”
  - [Crediting] “… should be for purchases and not (for) use, unless a formula is created to determine who burns the biojet fuel.”
  - “For airlines, it (crediting) is especially important. Saving money on fuel is one of the top initiatives for any airlines because that’s their major cost.”

- **No (n=3, 15%):**
  - [Crediting] “I don’t think so. I don’t believe it is approved (for) every engine.”

- **No Comment (n=4, 20%):**
  - “No opinion, as we are in our infancy on all of this right now.”
How do you think SHs will react to a SAJF crediting system? (n=20)

• Positively:
  – “Local ENGOs would love a credible system.”
  – “…fuel (purchasers) are okay with crediting the fuel.”

• Negatively:
  – “Many stakeholders would have heartburn. Business will generally view it as a tax.”
  – “If it (crediting system) is required, the petroleum industry will object.”

• Unsure:
  – “There must be incentives to gain support from stakeholders. There will be opposition, but a system like this will be popular for most.”
V. Future Work

- Round #2 – eSurveys
- Additional analysis (in-progress) & write-up
- Expand to other U.S. regions and EU nations
Thank You

Northwest Advanced Renewables Alliance (NARA)

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References


5. FAA 2015. 'Passenger boarding (enplanement) and all-cargo data for U.S. airports', (last accessed Jul. 10, 2015).


Growing Global Demand for Air Travel

- Airline passengers up 5% from 2013-2014 (FAA 2015a)
- 2014 – 2034: Airline passenger travel will double (IATA 2015)
- Military jet fuel consumption is projected to be flat

![US Jet Fuel Consumption and Projection](image)

NARA Region in 2013: 927 MGY (~4%)

Figure 3. U.S. Jet Fuel Consumption and Projections (EIA 2015a and EIA 2015b)
Figure 2. Monthly Airline fuel cost per gallons (US DOT 2015)
Public/Political Pressure on CO2 Emissions

- Global Aviation ~12% of all transp. CO2 emissions; ~2% of human CO2 emissions; proj. ~3% by 2050

- Intensified despite 18% reductions (1990-2009)

- Therefore, airlines goals (ATAG 2015):
  - 1.5%/yr. CO2 improvements 2009 – 2020
  - Cap 2020 emissions (carbon-neutral growth)
  - Continue to improve fuel efficiency
    - Deploy more fuel efficient airplanes, engines, parts (e.g., winglets)
    - Reduce distances/flying times, optimize trajectories, improve taxiing

Move toward SAJF…
US Military Biofuel Demand

• 2014 Reauthorization - *Defense Production Act of 1950* (DPA)
  – Provides an explicit "mission to create assured, affordable, and commercially viable production capabilities and capacities for items essential for national defense," including biofuels

  • **Navy** - goal of deploying blended AFJ for its “Great Green Fleet” of ships and aircraft by 2016, and to meet *50% of its total energy consumption using AJF by 2020*

  • **Air Force** is working to acquire *50% of its domestic aviation fuel from nonpetroleum-based sources by 2016*

  • **Army** has a *broad aim of increasing renewable energy*, but has not specified alternative fuel goals