REFINERY-TO-WING STAKEHOLDER ASSESSMENT

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COMPLETED 2016

TABLE OF CONTENTS

NARA is led by Washington State University and supported by the Agriculture and Food Research Initiative Competitive Grant no. 2011-68005-30416 from the USDA National Institute of Food and Agriculture.

Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

EPP	Environmentally Preferred Products
NARA	Northwest Advanced Renewables Alliance
RtW	Refinery-to-Wing
PNW	Pacific Northwest
SJF	sustainable jet fuel
GHG	greenhouse as
CAAFI	Commercial Aviation Alternative Fuels Initiative
ASTM	American Society of the International Association for Testing and Materials
FT-SPK	Fischer-Tropsch Synthetic Paraffinic Kerosene
HEFA-SPK	Hydroprocessed Esters and Fatty Acids Synthetic Paraffinic Kerosene
HFS-SIP	Hydroprocessed Fermented Sugar-Synthetic Isoparaffins
FT-SPK/A	Fischer-Tropsch Synthetic Paraffinic Kerosene plus Aromatics
ATJ-SPK	Alcohol to Jet Synthetic Paraffinic Kerosene
FAA	Federal Aviation Administration
SEA	Seattle-Tacoma International Airport
PDX	Portland (Oregon) International Airport
FBOs	fixed base operators

EXECUTIVE SUMMARY

This NARA report consists of two subtask reports previously identified as SM-EPP-1.3 in NARA reporting:

- Subtask 3.1: RtW Aviation Fuel Supply Chain Stakeholder Interviews
- Subtask 3.2: RtW Stakeholder eSurvey of Airport Managers.

Sustainable Jet Fuel (SJF) represents an important component of the airline industry's strategy to simultaneously reduce GHG emissions while meeting a growing demand for international air travel. SJFs also have the potential to provide fuel supply diversification and security, enhance fuel price stability, and provide regional/rural economic development benefits.

As part of its comprehensive approach, NARA has identified the assessment of the social and economic viability of the supply chain as a means to guide the project going forward. Incorporating stakeholder input into discussions about adding blended SJF into the U.S. aviation fuel supply provides needed insight for the biofuels industry, policymakers, and researchers. This report measures and ranks perceived drivers and barriers to an economically viable SJF industry in the PNW region through personal interviews with key aviation fuel supply chain stakeholders and eSurveys of airport managers conducted from June to September 2015.

Nineteen stakeholder interviewees acknowledge that, in order for regional SJF adoption-diffusion to occur, airline jet fuel buyers must drive the process, particularly as they deal with greenhouse gas (GHG) emission issues and related policy considerations. Important perceived barriers to SJF industry scale-up in the U.S. PNW include the high production costs of SJFs and related issues, such as fuel logistics and quality control in the transport, storage, and blending of SJFs. Perceptions around chain-of-custody issues, such as blending, tracking, and crediting of SJFs and future SJF market share projections for the year 2030 were also examined.

A total of 31 airport managers completed the online survey (38.7% response rate) (Appendix 1). The respondents included airport managers in Large Hub, Small Hub, Non Hub and Non Primary airports in the region, and represented over 98% of total enplanement in the Pacific Northwest Region. Results indicate that a majority of respondents view government intervention as important or very important for establishing an economically viable biojet fuel production industry in the PNW. These results were consistent despite airport size. A majority of airport managers agreed or strongly agreed that policy certainty to attract capital, large volumes of dedicated energy crops, higher oil prices, and financial incentives to biojet users will be required for a viable biojet industry.

INTRODUCTION

Many key players in the aviation industry have adopted goals of moving to SJFs to assist in meeting the goal of achieving carbon neutral growth from 2020 (FAA, 2015). In addition, several agencies have adopted renewable fuel targets, such as the Federal Aviation Administration (FAA), the US Air Force, the US Navy and US commercial aviation industry (GAO 2014; FAA 2015b). In support of these goals, over 1,700 SJF-blend commercial passenger demonstration flights have been conducted between June 2011 and October 2014 (IATA 2015). Additionally, several airlines have sought SJF supply chain agreements with fuel producers, including United Airlines, FedEx Express, and Southwest Airlines (Fahey and Mayerowitz, 2015).

Despite clear leadership by the aviation industry to reduce carbon emissions and adopt SJFs, several limitations remain to the full scale-up of SJFs. Due to a lack of commercial production, current SJF is typically produced and delivered in specified batches; however, future scale-up of commercial volumes of "drop-in" SJFs will be fully integrated into conventional jet fuel storage and distribution systems.

Uncertainty regarding SJF fuel production and purchases and integration into the current supply chain is a major challenge for airlines, verifiers and regulators. Technical considerations include, but are not limited to, potentially developing an agreed-upon system to track fuel for technical, regulatory, and commercial reasons. While the technical and logistical needs are numerous, meeting these needs does not ensure SJF scale-up will be successful. Numerous barriers to SJF blends into the jet fuel supply chain at commercial airports still exist. Jet A fuel supply chain stakeholders may not be aware of the various approaches being pursued to diffuse SJF blends into the aviation fuel system, and many questions will no doubt remain. Aviation stakeholders are important to the future adoption and implementation of SJFs; therefore, their perceptions regarding barriers and drivers to SJF scale-up are particularly important. This study seeks to examine potential uncertainty in SFJ scale-up, and primary barriers and drivers of an SJF industry in the Pacific Northwest of the United States through interviews and an online survey of key aviation stakeholders in the region.

TASK 1: RTW AVIATION FUEL SUPPLY CHAIN, PERSONAL STAKEHOLDER INTERVIEWS

Task Objective

The objective of this task was to examine perceived drivers, barriers and other key issues impacting adoption and diffusion of blended SJF into the aviation fuel supply chain the U.S. Pacific Northwest (PNW). Personal interviews with key stakeholders were utilized to get a more in-depth understanding of key issues impacting SFJ adoption and diffusion in the region. Interviews allowed for a more nuanced conversation regarding key fuel logistics that are not available through other methods, such as an online survey (Appendix 1).

Methodology-Research Design

Study population development

A 2016 FAA database, which contains airport data from 2015, includes 39578 U.S. FAA Certified Primary Airports. In 2015, 378 primary airports enplaned 99.8 percent of all U.S. passengers, of which 30 were categorized as Large-Hub, 30 Medium-Hub, 72 Small-Hub, and 246 Primary Non-hub airports (FAA, 2016) (Table RWSA-1.1). That year, the 4-state U.S. PNW region contained 27 primary airports, of which 2 were large hub, 6 small hub and 19 primary non-hub airports (FAA, 2016) (Table RWSA-1.1).

Interviews

This study's participants included 6 from the two large hubs, 5 from the six small hubs and 5 from the nineteen non-hub airports in the U.S. PNW Region – plus three fuel purchasing/handling participants who operate at multiple airport sites (Table RWSA-1.1). Overall, the eight airports included in this study's interviews represented approximately 91 percent of the four-state PNW regional enplanements in 2015 (FAA, 2016).

Table RWSA-1.1. National Plan of Integrated Airport Systems (NPIAS) Certified Primary Airports in the U.S. and PNW Region (source: FAA, 2016).

Airport Category	Total # of U.S. Certified Airports	Certified Airports in the PNW Region	Enplanement (2015) and % of PNW total	PNW Airports (& Participants)
Primary Large Hub	30	2	28,489,214 (79%)	2 (n=6)
Primary Medium Hub	30	0	---	0
Primary Small Hub	72	6	3,423,535 (10%)	3 (n=5)
Primary Non-hub	246	19	750,033 (2%)	3 (n=5)
All FAA Certified Primary Airports	**378**	**27**		**8 (n=16*)**

*In addition, three "Fuel Purchasing/Handling" participants conducted business at a variety of hub and non-hub airports, resulting in 19 total participants.

Nineteen semi-structured interviews were conducted between June and September 2015 (Table RWSA-1.2). Participants included airport management, airlines, fixed-based operators (FBOs), pipeline and terminal operators, and aviation fuel resellers. To maintain participant anonymity, participants are categorized as either "Group A - Airport Management" (n=8); or "Group B - Fuel Purchasing/Handling" (n=11) (Table RWSA-1.2).

Table RWSA-1.2. Interview participants by airport type and group affiliation (n=19).

Respondent Type	Group	Total
1. Large Hub	A - Airport Mgmt.	3
2. Small Hub	A - Airport Mgmt.	3
3. Non-hub	A - Airport Mgmt.	2
4. Small Hub	B – Fuel Purchasing/Handling	2
5. Non-Hub	B – Fuel Purchasing/Handling	3
6. Large Hub	B – Fuel Purchasing/Handling	1
7. Hub & Non-hub	B – Fuel Purchasing/Handling	1
8. Large Hub	B – Fuel Purchasing/Handling	2
9. Hub & Non-hub	B – Fuel Purchasing/Handling	2

RESULTS

Drivers

While respondents provided 31 responses regarding potential drivers, the findings indicate that three drivers are the most important for the adoption and diffusion of SJF's in the Pacific Northwest Region: airlines, emissions, and government policy (Figure RWSA-1.1). Other drivers identified included public relations, energy security and economic development. In particular, more respondents indicated that airlines were a major driver of SJF than any other factor. Numerous drivers have been identified in the literature; however, "airline driven" has received less focus among scholars.

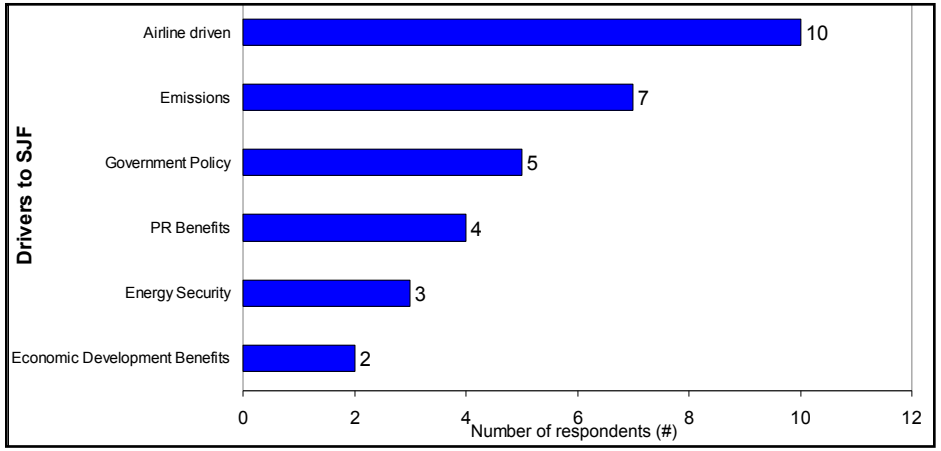

Figure RWSA-1.1. Participants' (n=19) views regarding the drivers to SJF development in the U.S. PNW region

Barriers

The most prominent barriers identified by participants included: cost of biofuels, logistics/quality control, safety, and policy stability (Figure RWSA-1.2).

SJF Chain-of-custody issues: blending, tracking and crediting

Blending

Participants were also asked to provide their opinion on the best location to blend SFJ. "Terminals" (n=6) and "Petro-Refinery" (n=6) were the two most-mentioned SJF blending locations by participants, followed by "Airport Upstream" (n=3), "Airport Fuel Farm" (n-2) and "No Opinion" (n=2).

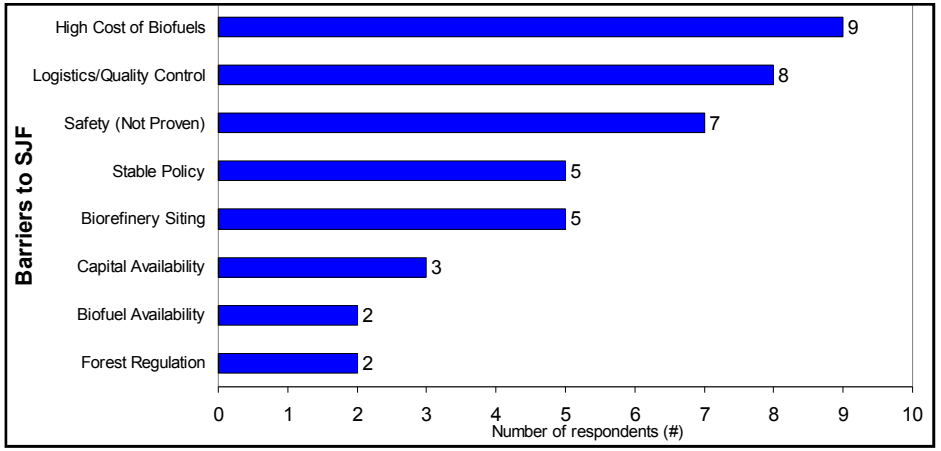

Figure RWSA-1.2. Participants' (n=19) views regarding the barriers to SJF development in the U.S. PNW region

Tracking and Crediting

When asked whether tracking would be necessary for SJFs, 63% of participants stated that it is important to track the SJF molecules. Reasons for tracking varied, including that tracking is important for efficiency, credits, and public perception and recognition. Interestingly, participants who agreed tracking was necessary also supported SJF, while those who did not feel it was necessary were less supporting of SJF.

Most participants (63%) indicated that SJF purchases should have a mechanism for crediting. Reasons for crediting varied, but some participants stated that this would be particularly important for airlines, which also supports airlines as a major driver of SJF in the region. Preference for crediting also depended on whether participants favored or opposed SJFs.

CONCLUSIONS

Overall, participants generally agreed that airlines are the key driver for PNW SJF demand, followed by GHG emissions, policy, public perceptions, and economic considerations. The most mentioned barrier to SJF production and diffusion was the high cost (price) of SJF vs. petro-jet, especially in terms of aviation fuel logistics and quality control issues. Policy, capital availability, and SJF availability are additional barriers related to the high cost of SJF, which may be re-cast as drivers or at least offsets to cost, if developed appropriately.

TASK 2: RTW STAKEHOLDER ESURVEY OF AIRPORT MANAGERS

Task Objective

The objective of this task was to examine airport management perception of key drivers and barriers to adoption and diffusion of blended SJF in the U.S. Pacific Northwest. Airport management has daily interaction with several key stakeholders; therefore, their perceptions regarding SJF issues are particularly apt. An online survey of airport management in the region was conducted in the summer and fall of 2015 (Appendix 2).

Methodology

Airport management of commercial airports in the PNW region received an invitation to participate in the survey. Of 80 survey requests, 31 airport managers completed the survey (38.7% response rate). The survey included questions on barriers and drivers to SJF development, policy, protocol, and logistics requirements for SJF scale up, as well as projections of blended biojet in aviation fuel. Table RWSA-2.1 displays the frequency data for the total survey respondents based on hub size and geographic location. The total enplanement numbers for 2015 are also included (FAA, 2016).

Table RWSA-2.1: Category Frequency Data

Primary Category	Subcategory	Total Surveyed	Regional Total	Response Rate (%)	Enplanement 2015	Enplanement % Total
NPIAS Airport Category	Large Hub	2	2	100	28,489,214	90
	Small Hub	3	6	50	2,475,181	8
	Non-hub	8	19	42	706,139	2
	Nonprimary	18	N/A*	N/A*	5,761**	.001
Geographic[1] Location	West	9	N/A*	N/A*	28,942,768	91
	East	22	N/A*	N/A*	2,733,527	9

*Nonprimary airports make up the bulk of all airports in any given region. Due to these airports' small size and infrequent use, a comprehensive, reliable list that includes all nonprimary airports is not available, making regional totals difficult to calculate.
**Nine of the 18 airports in this category had no data available or had enplanement values of 0.

[1] East vs. West is delineated by the Cascade Mountain range in Western Oregon and Washington.

RESULTS

Government Intervention

Respondents were asked to rate the importance of government intervention for establishing an economically viable biojet fuel production industry in the Pacific Northwest. The results of this question are broken down by airport hub category (Figure RWSA-2.1) and geographic location (Figure RWSA-2.2). Regardless of airport size or geographic location, a majority of respondents indicated that government intervention would be important or very important. This is especially true of the large and small hub airports in the region, which unanimously agreed that intervention was important.

General Drivers and Barriers

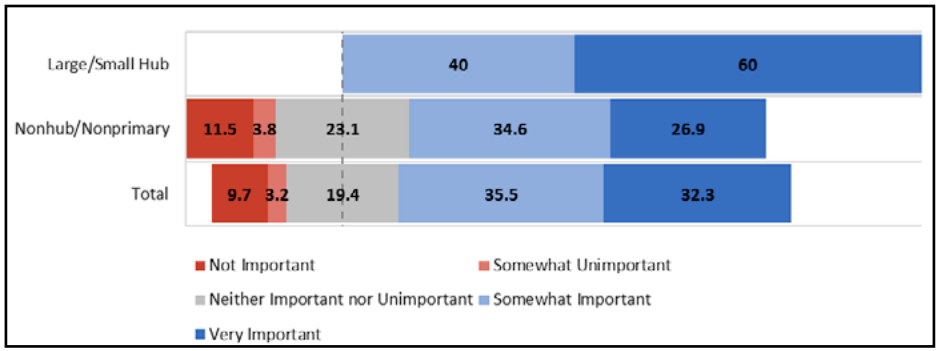

Figure RWSA-2.1. Airport category and opinion on importance of government intervention.

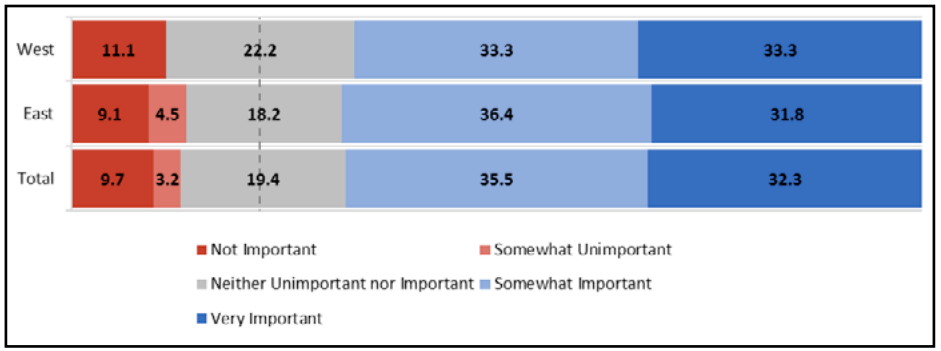

Figure RWSA-2.2. Geographic location and opinion on importance of government intervention.

Respondents were also asked to indicate their level of agreement regarding various potential barriers and drivers that may influence the success of an economically viable biojet fuel production industry in the region. These results are also broken down by airport hub size (Figure RWSA-2.3) where both groups agree that most of the factors presented here will be necessary for a viable aviation biofuel network. Slightly more disagreement is present on the last three factors, which are related

to specific policies or mechanisms. Despite this disagreement, majorities in both groups agreed these factors would be necessary. Generally, there is a strong rate of agreement on these factors among the larger airports, while smaller airports show slightly higher rates of disagreement.

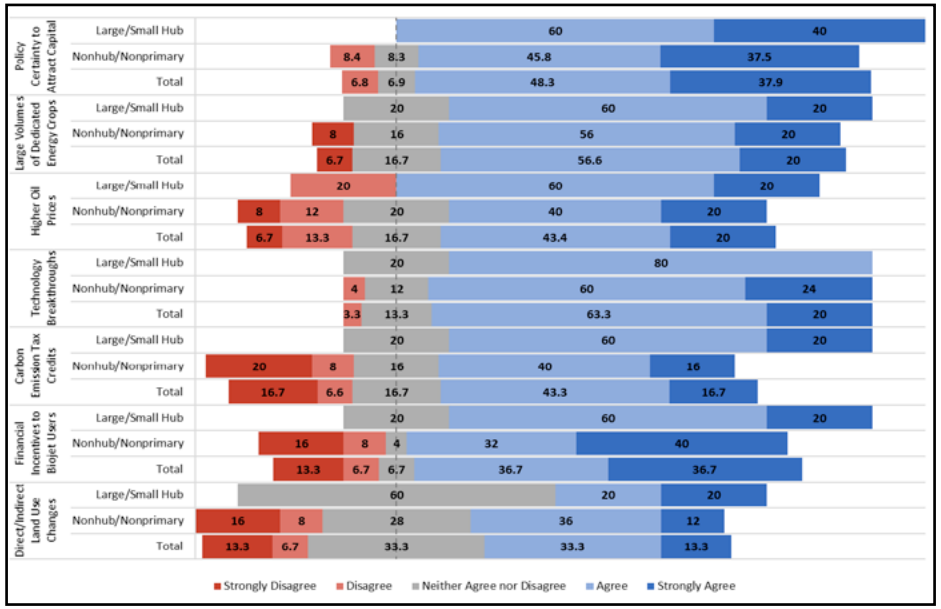

Figure RWSA-2.3. Airport category and level of agreement on requirements for viable biojet industry (%).

CONCLUSIONS

Regardless of some small differences between various groups on select factors, agreement over the necessity for government intervention and general drivers and barriers are largely similar. Most respondents agree that government intervention is important and that certain factors will also be required, including policy certainty to attract capital, higher oil prices, and financial incentives to biojet users, for a viable aviation biofuel network in the Pacific Northwest by 2020. Large and small hub airports have the greatest rate of agreement on the necessity of these factors. This is especially important given the fact that this group sees the greatest fuel use and enplanement numbers in the region.

NARA OUTPUTS

PUBLICATIONS

Smith, P.M., M.J. Gaffney, W. Shi, S. Hoard, I. Ibarrola Armendariz and D.W. Mueller. 2016. Drivers and barriers to the adoption and diffusion of sustainable jet fuel (SJF) in the U.S. Pacific Northwest. Submitted to *J. of Air Transport Mgmt. In review.*

Hoard, S., D. Mueller, P. Smith, M. Gaffney, C. Sanders, W. Shi and I. Ibarrola. 2016. Airport Management Perspectives on the Adoption and Diffusion of Aviation Biofuels: Policy Requirements, Drivers and Barriers in the U.S. Pacific Northwest. To be submitted to *Renewable Energy. In preparation.*

Ibarrola Armendariz, Ibon. 2015. Biojet logistics: research study applied to the pacific northwest of the USA. Masters Thesis, Polytechnic University of Madrid, Spain. 73 pp.

PRESENTATIONS

Smith, P.M., W. Shi, M. Gaffney, S. Hoard, I. Ibarrola, B. Miller and G. Johnston. 2015. Aviation fuel supply chain stakeholder perceptions of sustainable alternative jet fuel. Oral Presentation at the Year 4, NARA Annual Meeting, Spokane, WA. Sept. 15-17.

Smith, P.M., P. Adeniran, A. Chatterjee, C. Grassi, A. Kulkarni, J. Quezada, A. Hawkins, and J. Scheib. 2012. Strategic Marketing Plan for Biofuels in the NARA Region. Presented at the Western Montana Corridor NARA Community Roadmap Development Meeting. University of Montana, Missoula, MT. 13 June.

POSTERS

Shi, W., P. Smith, I. Ibarrola, M. Gaffney and S. Hoard. 2015. Regional Stakeholder Perceptions of Biofuels: Preliminary Results. Poster presentation at the Year 4, NARA Annual Meeting, Spokane, WA. Sept. 15-17.

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Venugopal. P., P. Smith, and Chen, M. 2014. Potential Technology Pathways for the Production of Alternative Jet Fuel. Poster presentation at NARA-SURE, Washington State University, Pullman, WSU. July 31.

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Wertz, S.M., P.M. Smith, and M.P. Wolcott. 2013. Biojet Market Prospects and US Regulatory Considerations. Poster presentation at the Year 2, NARA Annual Meeting, Corvallis, OR. Sept. 10.

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NARA OUTCOMES AND FUTURE DEVELOPMENT

Including consideration of key stakeholder perspectives in the regional development, scale-up, and insertion of blended drop-in sustainable jet fuels (SJFs) into existing petro-based aviation fuel supply chains provides many practical benefits related to investment, policy, and SJF logistics. In particular, these insights allow more informed investor and policy decisions to facilitate SJF facility site selection and scale-up and insertion of blended SJF into the commercial airport fuel system. Academic, governmental, and industrial scientists may consider these regional findings as potential issues for consideration at a national scale to guide efforts to build and support economically viable regional biomass-to-wing supply chains.

The U.S. PNW region is unique due to the strong influence of aviation on the economy, the seminal work of Sustainable Aviation Fuels Northwest (SAFN, 2011), and the relatively limited number of major fuel demand hubs, thus simplifying stakeholder participant selection and interview administration. Findings suggest the multifaceted nature of potential barriers to the adoption and diffusion of SJF and may provide useful avenues for future research. Additional interviews in other U.S. regions will provide needed insights into differences and similarities concerning the drivers and barriers to SJF adoption and diffusion into the aviation fuel supply chain. And, further research regarding the logistical issues of inserting blended SJF into the aviation fuel transportation and storage infrastructure is needed. Third, biorefinery siting decisions can benefit from the inclusion of social asset factors combined with biogeophysical assets. And, finally, findings support the need for practical, stable, and favorable SJF policy for the PNW region.

TASK 1

In general, the region's Large Hub airports appear to be more attuned to all aspects of SJF production, policy, and logistics. We expect this is due to their size and/or their proximity to a more progressive west-coast population. Large Hub airports typically have more management resources allocated to special topic issues, and the volume of fuel use allows for more options in fuel logistics. Finally, the region's large hub airports utilize aviation fuel purchasing consortiums which may offer the most seamless pathway for SJF insertion into the existing delivery framework through consolidated purchasing, handling and distribution logistics.

TASK 2

Whereas prior research identified the general barriers and drivers of adopting aviation biofuel – information that can be used by policymakers to craft policy to target these drivers and barriers – our Task 2 research explores these through the perspectives of aviation management. This research showed that aviation management in the Pacific Northwest is generally interested in aviation biofuels with 52 percent of respondents claiming their airports were interested or very interested and 68 percent claiming they were personally interested or very interested. However, only 38.7 percent responding airport managers believed a viable biojet production industry in the Pacific Northwest by 2020 was likely. This research provides a clearer picture of the drivers and barriers to the adoption of aviation biofuel from the airport manager perspective, which previous research had largely omitted.

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APPENDIX 1

NARA Northwest Advanced Renewables Alliance | Washington State University | PennState | ASCENT

"Opportunities and Barriers to an Economically Viable Sustainable Alternative Jet Fuel (SAJF) Industry in the Pacific Northwest Region"

A. Background - First, a little background on you and your airport.

1. What is your title and what primary functions does your job involve?

2. How long have you held your current position?

3. How long have you been engaged in airport management activities?

4. Please describe your role (if any) in jet fuel management.

B. Opportunities and Barriers: Sustainable Alternative Jet Fuels (SAJFs) are gaining traction in the U.S. with the approval of four ASTM certified jet fuel pathways and thousands of test flights. Alaska Air recently announced a strategic alliance with Gevo, Inc. to fly the first-ever commercial flight on alcohol-to-jet fuel later this year. However, opportunities and barriers remain to scaling a sustainable supply of competitively priced drop-in SAJF.

In YOUR OPINION:

5. What are the **key drivers** for the development of an economically viable SAJF production industry in the Pacific Northwest region?

6. Does a regional SAJF industry provide any **opportunities** for your airport? Please explain.

6.1: For SEA & PDX - Does this fit into your Carbon "Reduction" Accreditation commitment?

7: Which **key stakeholders** would support or oppose a regional SAJF industry? Please explain.

7.1: Can you articulate the general position of the environmental community in the PNW region regarding biofuels, including SAJF?

8. Total U.S. jet fuel consumption is estimated to be 27 billion gallons in 2030. What is your best guess for the 2030 U.S. market share for SAJF? Would you estimate the 2030 SAJF market share **in the PNW** to be the same, higher, or lower? Why?

9. What are the **key barriers** to developing an economically viable SAJF fuel production industry in the Pacific Northwest region?

9.1: Can these barriers be overcome? How so or why not?

C. SAJFs (molecule) Tracking [from "(Bio)refinery-to-Wing"]

In YOUR OPINION:

10. Assuming a maximum SAJF blend rate of 50%, where do you think certified ASTM D7566 SAJF should be blended with ASTM D1655 Jet A1?

10.1: Do you think ASTM D7566 SAJF molecules should be tracked prior to or after blending?

10.2: If so, where (in the jet fuel delivery system)?

11. Do you think SAJF purchases should be “credited”? Please elaborate.

11.1: Do you think “SAJF Credits” should be tradable?

11.2: Who do you think should oversee & manage a “SAJF Credit/Trading System”?

11.3: How do you think key stakeholders will react to a SAJF Credit/Trading System”?

12. What role do you think Airports can play in SAJF tracking, crediting and/or trading?

Do you have any additional comments regarding the potential for SAJFs in the PNW region?

Thank you for your valuable time. We will email this interview content to you, when transcribed, for your review and approval. And, we will forward a summary report, when available.

APPENDIX 2

"Opportunities and Impediments for a Biojet Fuel Production Industry in the Pacific Northwest by the Year 2020"

Airport Manager's Survey

Thank you for taking the time to complete this survey. The purpose of this survey is to assess your opinions regarding the potential impacts and key success factors for an economically viable biojet fuel production industry in the Pacific Northwest (Idaho, Oregon, Washington and Montana) by the year 2020. We are surveying all airports in the Pacific Northwest. Due to this relatively small population, your participation is very important to our understanding of how a biojet fuel production industry would impact the region's aviation industry.

Please take the time to complete this brief survey which should take approximately 15 to 20 minutes of your valuable time. Your participation in this survey is voluntary. All survey responses will remain confidential. Your candid responses will provide valuable information to researchers at the Northwest Advanced Renewables Alliance (NARA), Washington State University, and Pennsylvania State University, who hope to use the information in order to more fully understand the impact of a biojet fuel production industry in the Pacific Northwest.

This study has been reviewed and deemed exempt from further review by the WSU Institutional Review Board (IRB). This survey meets all the university's requirements for the protection of respondent privacy and confidentiality. If you have any questions regarding the survey, you can contact the survey coordinators: Dr. Paul Smith at pms6@psu.edu or Dr. Season Hoard at season.hoard@email.wsu.edu .

If you have any questions or comments about this survey, please contact the survey coordinators: Dr. Paul Smith (pms6@psu.edu) or Dr. Season Hoard (season.hoard@email.wsu.edu.)

To begin, we would like to know more about you.

1. How long have you held your current position (in years)?

2. Please list all airlines that fly out of your airport.

3. Please indicate your airport's level of interest in biojet fuels for the Pacific Northwest (Washington, Oregon, Idaho and Montana).

- ❍ Very Interested
- ❍ Somewhat Interested
- ❍ Neither Interested nor Uninterested
- ❍ Somewhat Uninterested
- ❍ Very Uninterested
- ❍ Don't Know

4. Please indicate your personal level of interest in biojet fuels for the Pacific Northwest.

- ❍ Very Interested
- ❍ Somewhat Interested
- ❍ Neither Interested nor Uninterested
- ❍ Somewhat Uninterested
- ❍ Very Uninterested
- ❍ Prefer not to say

5. How would you assess the likelihood of an economically viable biojet fuel production industry in the Pacific Northwest by the year 2020?

- ❍ Very Likely
- ❍ Somewhat Likely
- ❍ Neither Likely nor Unlikely
- ❍ Somewhat Unlikely
- ❍ Very Unlikely

6. What are the most important factors necessary for an economically viable biojet fuel production industry in the Pacific Northwest by the year 2020?

7. What are the most important barriers to an economically viable biojet fuel production industry in the Pacific Northwest by the year 2020?

8. What is the importance of government intervention (via policies, incentives, mandates, etc.) for the establishment an economically viable biojet fuel production industry in the Pacific Northwest by the year 2020?

- ❍ Very Important
- ❍ Somewhat Important
- ❍ Neither Important or Unimportant
- ❍ Somewhat Unimportant
- ❍ Not Important

9. What type(s) of government intervention do you think are the most important for an economically viable biojet fuel production industry in the Pacific Northwest by the year 2020? Please list all that apply.

We would like to understand your opinions regarding the development of an economically viable biojet fuel industry in the Pacific Northwest.

10. Please indicate your level of agreement that an economically viable biojet fuel production industry in the Pacific Northwest by the year 2020 will...

Require:	Strongly disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Strongly agree
New ASTM-Certified fuels	○	○	○	○	○	○	○
Segregated tanks to store blended biojet fuels	○	○	○	○	○	○	○
New blending facilities for biojet fuels	○	○	○	○	○	○	○
Policy certainty to attract capital	○	○	○	○	○	○	○
Large volumes of dedicated energy crops	○	○	○	○	○	○	○
Higher oil prices	○	○	○	○	○	○	○
Biorefinery technology breakthroughs	○	○	○	○	○	○	○
Carbon emission tax credits	○	○	○	○	○	○	○
Financial incentives to biojet purchasers	○	○	○	○	○	○	○
Insurance considerations for biojet fuel ***blending/ certification***	○	○	○	○	○	○	○
Insurance considerations for biojet fuel ***handling***	○	○	○	○	○	○	○
Direct/indirect land use changes	○	○	○	○	○	○	○

11. An economically viable biojet fuel production industry in the Pacific Northwest by the year 2020 will...

Require policies and/or protocols to address:	Strongly disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Strongly agree
Mandatory volumes of blended biojet fuel							
Clear rules for airlines to claim emissions credits							
Biojet fuel tax credits							
In-flight safety for biojet-fueled flights							
Direct/indirect land use change							
Chain-of-custody tracking of biojet fuel molecules							
Location(s) for blending biojet fuel (ASTM D7566) with conventional Jet A1 fuel (ASTM D1655)							
Biojet fuel sustainability certification criteria							
A system to issue and trade sustainable biojet fuel certificates							

12. Please list any other policy and/or protocol issues that an economically viable biojet fuel production industry in the Pacific Northwest by the year 2020 will require.

13. In your opinion, to what extent will an economically viable biojet fuel production industry in the Pacific Northwest by the year 2020 result in an increase or decrease in each of the items below:

	Greatly decrease	Decrease	Slightly decrease	Stay the same	Slightly increase	Increase	Greatly increase
Aviation fuel prices.							
Fuel shortages in airport fuel tanks							
Fuel tankering by airlines							
Food prices							
US energy security							
CO2 emissions							
Overall greenhouse gas (GHG) emissions							
US oil imports							
Water quality							
Soil quality							
Regional rural jobs							
Regional rural economic development							
Sustainable management of private forests							
Aviation fuel options							
Aviation fuel price stability							
Direct/indirect land use changes							
Sustainable management of public forests							
In-flight safety							

We would like to know more about how you foresee the use of biojet fuel over the next 2, 5, 10, and 20 years.

14. We would like to know your prediction for the most realistic percentage of biojet fuel blended into aviation fuel in the Pacific Northwest. We would also like to know what you believe is the ideal percentage of biojet fuel blended into aviation fuel in the Pacific Northwest.

	The % of neat biojet content out of total jet fuel is *likely* to be _____%:	The % of neat biojet content out of total jet fuel should *ideally* be _____%:
In the next 2 years:		
In the next 5 years:		
In the next 10 years:		
In the next 20 years:		

Thank you for taking the time to complete our survey!

We would appreciate any comments or suggestions you would like to provide. Your comments will receive our very careful attention.

On behalf of the Northwest Advanced Renewables Alliance (NARA), Washington State University, and Pennsylvania State University, thank you for completing this survey. Your participation and thoughtful answers are sincerely appreciated. To stay up to date on the NARA project, please visit the website at: www.nararenewables.org.

If you would like to receive a complimentary summary of the results, please send a brief request note to Season Hoard at season.hoard@email.wsu.edu.

Thank you!