

# INFORMING AND ENGAGING STAKEHOLDERS

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# LIST OF ACRONYMS

AHB	Advanced Hardwood Biofuels
BBER	Bureau of Business and Economic Research
BDT	Bone dry ton
CAAM	Community Asset Assessment Model
DGSS	Division of Governmental Studies and Services
DNRC	Department of Natural Resources and Conservation
EPA	Environmental Protection Agency
EPP	Environmentally Preferred Products Team
FAA	Federal Aviation Administration
FBN	Forest Business Network
FIA	Forest Inventory and Analysis
IDEX	Integrated Design Experience
IDX	Integrated Design Experience
MSU	Montana State University
NARA	Northwest Advanced Renewables Alliance
NC	NARA community
NIPF	Non-industrial private forest
PNW	Pacific Northwest
PSC	pilot supply chain
RA	Funded research assistant
RIN	Renewable identification number
SAFN	Sustainable Aviation Fuels Northwest
TEA	Techno-economic analysis
TPO	Timber product output
USDA	United State Department of Agriculture
USFS	United States Forest Service
UW	University of Washington
VCOT	Value of a Tree
WMC	Western Montana Corridor
WSU	Washington State University

# EXECUTIVE SUMMARY

The main goal of the outreach team was to promote stakeholder bioenergy literacy and build regional supply chain coalitions for development of a framework of biofuel and co-products production from woody biomass. This goal was attained through two main objectives: 1) *Bioenergy Literacy through NARA Extension Engine*, and 2) *Building Supply Chain Coalitions and Regional Alliances*. The outreach activities were carried out by organizing the team by the four states in the region and coordinating the efforts with supporting units that included USDA FS PNW Research Station, The William D. Ruckelshaus Center, the Department of Governmental Studies and Services at WSU, and the NARA Education team.

## Idaho

Idaho NARA outreach efforts focused on stakeholder engagement and education. Stakeholders were divided into five categories: loggers, professional resource managers, private land owners, educators, and youth. Over the 5-year period, 102 presentations were given regarding the NARA project to 3,056 stakeholders. Two surveys were administered asking stakeholders about their attitudes and perceptions regarding feasibility of converting forest residues into biofuels. Project results were given in 5 publications, 1 dissertation, 2 MS theses, 11 poster presentations and 4 popular press articles.

Overwhelmingly, stakeholders were supportive of the NARA efforts. A majority feel that lack of financial support (capital) is the major obstacle to implementation success. Most feel that their communities would benefit through jobs, economic development, healthier forests, and being associated with sustainable practices, while most do not see any drawbacks to utilizing woody biomass for energy production. Program exit evaluations indicated a large increase in knowledge regarding the NARA project and the ability to convert forest residues to biofuels.

## Montana

Bureau of Business and Economic Research (BBER) and MSU Extension employees at the University of Montana participated in the NARA Outreach efforts primarily during the first two years of the NARA project: networking with NARA team members, identifying Montana stakeholders and infrastructure, helping to develop community selection criteria, identifying potential NARA communities, aiding the development of the Western Montana Corridor (WMC) supply chain coalition, helping to identify potential biomass suppliers, and providing data for and reviewing the WMC Atlas. Throughout the NARA project, BBER participated in the Forest Products Retention Roundtable as a NARA liaison; shared logging residue and mill research findings developed as part of the NARA System Metrics-Sustainable Production Team in conjunction with the U.S. Forest Service's Forest Inventory and Analysis (FIA) timber products output (TPO) program; and developed and deployed an online database for the public to access annual county level timber harvest data

for the four-state NARA region. MSU Extension also participated with the Montana Forest Products Retention Roundtable as well as the DNRC Biomass Working Group, Montana Forest Council, Tree Farm, Montana Forest Owners Association, Montana State Wood Energy Team, and Montana Forest Stewardship Steering Committee for the purpose of keeping these groups informed about NARA advancements and gathering feedback from private landowner and logger stakeholders. During the final year of NARA, BBER assisted with the re-evaluation and presentation of Biorefinery Siting in the Western Montana Corridor, which was important for "closing the loop" on NARA's work in Montana.

BBER and MSU Extension efforts focused on reviewing and sharing information between NARA (e.g., the IDEX Team's WMC Atlas, and Natalie Martinkus' Eastside Biorefinery Siting) and stakeholders in Montana, including the Montana Biomass Working Group, Forest Products Retention Roundtable, Montana DNRC, Montana Wood Products Association, Montana Logging Association, Montana Forest Owners Association, Tree Farm, Montana State Wood Energy Team, MSU Extension County Agents and UM's School of Business Administration. Along with Montana State University (MSU) Extension Forestry and the Forest Business Network (FBN), BBER also advocated for Montana stakeholders, ensuring "eastside" issues – e.g., substantially smaller timber harvest volumes, greater reliance on national forests and NIPF landowners for local timber supply, limited forest industry infrastructure, and larger proportions of ponderosa and lodgepole pines and other species besides Douglas-fir – were considered and addressed by the greater NARA team.

The WMC Atlas and Eastside Biorefinery Siting analyses indicated that development of a full-scale (800,000+ BDT/year) biorefinery and a depot-supplied smaller-scale (280,000 BDT/year) facility were less feasible in Montana due to several factors, including limited amounts of available RINs-qualifying biomass in the region, high feedstock costs, and lack of natural gas supply to potential biorefinery sites. This information was somewhat disappointing, but not unexpected, to many stakeholders in Montana. However, due to the efforts of BBER, FBN, and MSU Extension Forestry, WMC stakeholders remained interested in and engaged with NARA and a significant number of logging contractors indicated an interest and ability to harvest and supply woody biomass that currently has limited or no markets in this region. As a result of the NARA Outreach Team's efforts, Montana stakeholders have more information and tools available to analyze and better understand woody biomass utilization and co-products options.

## Oregon

The focus in Oregon for the project was primarily around actively engaging stakeholders from a wide variety of interests such as the research community, public and private land managers, entrepreneurs, the aviation industry, public decision

makers, K-12 educators and students, ENGOs, and the general public. To keep stakeholders informed about all aspects of NARA, public meetings were held and factsheets summarizing the research outputs of Oregon State University faculty were posted on a page devoted to the project on the Oregon Wood Innovation Center's (OWIC) website.

The Oregon Extension & Outreach team worked to ensure interested parties had a means to engage in dialogue with NARA researchers as opposed to the more traditional route of 'technology transfer' which is often one-way communication. The public meetings referenced above as well as electronic forms on the OWIC website helped to provide avenues for conversation.

### Ruckelshaus Center

Over the course of the NARA project, William D. Ruckelshaus Center (Ruckelshaus Center or Center) senior staff members worked with the Leadership Team to assist in the creation of a Stakeholder Advisory Board, and facilitated regular Executive Committee meetings, monthly Leadership Team meetings, periodic Advisory Board meetings, and annual project meetings, which included stakeholder participation. Additionally, the Center assisted in the development of process protocol agreements that directed interaction between and among project leaders, researchers and stakeholders, and engaged policy makers at all levels and geographies of the Northwest through distribution of quarterly web-based briefing papers, which were produced with information provided by the Project Directors and Leadership Team. The Ruckelshaus Center, through partnership with WSU's Division of Governmental Studies and Services (DGSS), also participated in an assessment of public perceptions to "connect social and technical aspects" of the project through quantitative surveys and focus groups. This work also informed the development of a decision-support model (CAAM), based on national data sets, which allows assessment of social, cultural and human components of communities for incorporation into siting decisions.

### Washington

The collaborative activities undertaken by the Outreach team in the state of Washington disseminated research findings to varying groups of stakeholders over multiple platforms, as well as engaged stakeholders for developing strong interest and brand recognition for NARA. Empowering stakeholders through transfer of research-based knowledge and involving them in the research and designing process to shape the supply chain analysis is a crucial part of developing a roadmap for industry to produce biojet and co-products from forest residues. The Outreach team in collaboration with the Education team identified and engaged regional stakeholders to assess regional assets and needs.

Washington Outreach team, in coordination with rest of the Outreach team members, research teams, and the Education team organized and hosted two international conferences, during the five-year project period, that engaged over 380

stakeholders from 24 different states and 6 different countries. Of the participants surveyed, 95% indicated increased knowledge and awareness of biofuels from lignocellulosic materials; over 75% indicated a significant change in their knowledge regarding woody biomass to biofuels logistics, conversion technologies, and environmental impacts. Twelve webinars were organized and hosted during the last year of the project to disseminate research-based findings. Over 360 stakeholders from over 12 different states and Canada attended these webinars, and over 75% of them indicated an increase in knowledge regarding conversion of wood to biofuels and co-products. A dynamically searchable [repository](#) of unbiased scientific knowledge on wood-based biofuels and co-products was developed and is being maintained. Since inception in 2014, users from over 84 countries have accessed the repository. We have archived the production process of 1000-gallons of bio-jet fuel consumed in flying the [demonstration flight](#) from Seattle to Washington DC by Alaska Airlines in an interactive online timeline to inform the stakeholders about the process, acknowledge the contributions of participating companies in the bio-jet production, and communicate the views of the participating stakeholders.

Throughout the project period, we have communicated research findings to stakeholders through quarterly briefings to 900+ policy makers, developed and produced 31 infographics & factsheets, archived 66 videos of NARA presentations on research findings on YouTube (over 5850 views), produced and distributed 34 newsletters to 800 subscribers, written about NARA activities in 135 news stories, carried out over 300 postings on NARA blog, Facebook, and Twitter, published over 25 refereed journal and extension articles, and gave over 135 presentations. In the last two years of the project, we coordinated with research teams and stakeholders to produce professional videos to educate general public about alternative biofuels and NARA ([overview video](#)) and K-12 teachers and students.

These efforts have activated a large group of stakeholders that included the Washington State Department of Commerce, Forest Biomass Coordination Group, stakeholders from regional communities, and numerous corporations around the supply chain. Our efforts to build regional stakeholder capacity resulted in a broad regional stakeholder community investigating aviation biofuel and co-product development and broadened public understanding and awareness of biofuel and co-product potential from forest residues.

# INTRODUCTION

## NARA extension initiative description

For biofuels to effectively displace fossil fuels, it is necessary to develop and establish an efficient biorefinery infrastructure producing an array of value-added products including energy, chemical co-products, biopolymers, bioproducts, and biofuels. Development of such a system requires a thorough understanding and acceptance of all the components starting from feedstock production and processing to conversion options to product specifications to marketing to distribution channels. It also requires acceptance and approval from the public, the effected industries and businesses, and policymakers as well as a marketplace with ready consumers. The NARA team is sensitive to the fact that cutting edge technology leading to new markets, based on concrete evidence, have to be proposed as viable options to convince the stakeholders from private landowners to industry to policymakers to invest in a biofuel/bioproducs based economy and infrastructure. NARA's Outreach Team facilitated to develop a framework for wood to biofuels and co-products infrastructure in the four-state region of the Pacific Northwest region of the United States of America.

## Overarching biofuel extension goals and programs

It is the obligation of the Outreach team to ensure the knowledge generated collaboratively by the NARA functioning unit is disseminated to the stakeholders, while their concerns are mitigated and a framework for biofuel and co-products infrastructure is understood and developed. Our four extension goals to meet this obligation regionally with a long-term goal of replicating nationally:

1. educate and train woody biomass suppliers about alternative technologies and value-added markets based on biofuel/bio-products;
2. engage the industrial stakeholders in PNW region through consensus to develop a framework for a biofuel/bio-products economy;
3. include and inform other stakeholder groups (concerned citizens, public-interest groups) in the process of developing a structure for building a biofuel/bio-products driven economy, and;
4. alert and inform policymakers at the state and federal level about woody biomass-based biorefinery to facilitate the decision-making and policy development process.

These goals are necessary to catalyze development of the next generation technologies and markets and spur the establishment of sustainable biofuel and co-product infrastructure in the Northwest region, and ultimately contribute to increased U.S. energy independence from fossil fuels and meet the goals of the Energy Independence and Security Act (EISA) of 2007.

These goals are driven by four primary needs:

## NEED #1 (Realization of opportunities by biomass suppliers)

Private forestland owners, biomass-based communities, state and federal agency personnel, and material recovery facilities (MRFs) have to be informed with data (such as prices paid for wood delivered to biofuel/bioproducs production vs. other uses) to assist with their biomass management and selling decisions. The forest products industry and logging and forestry communities in the Interior West are struggling with wood availability and lack of markets for low-value woody material such as logging residues, by-products of thinnings, and even pulpwood. Loggers and contractors are increasingly interested in niche markets that can provide profitable outlets for under-valued and under-utilized material. Land owners may understand the biomass requirements for certain applications such as combined heat and power (CHP) plants, but may not understand the types of biomass suitable for a biorefinery producing bio jet fuel and co-products (such as lignin based value-added products). Landowners and land managers need to be provided with specifications regarding species, size, and quality to assess their resource and determine if these new markets hold potential for them. Demonstrating the value of biofuels as users of and markets for waste wood (mill and logging residues) will be beneficial to judge their economic viability. To appreciate what resources to divert and the economics of new markets, they have to be informed and educated regarding the feedstock requirements for pretreatment and conversion facilities and logistics of handling the feedstock. Stakeholders include private and government land managers (forestland owners, Native American tribes, USFS, BLM, state agencies) and biomass processors.

## SOLUTION # 1:

A role of extension is to bring cutting edge technology to producers and land owners and inform them about exactly what is needed for this potential biomass market and what a range of prices may be for the raw material. As the feedstock group determines suitable processing and handling logistics, we informed biomass growers and harvesters of these developments. For example, the raw material requirements (such as particle size, quality of wood) for pretreatment facilities and expectations of the pretreatment facilities from their suppliers regarding woody biomass (such as species mix, expected contaminants, etc.) were the types of information requested from stakeholders.



## NEED #2 (Industry acceptance and support)

Acceptance of biofuel and co-products as a viable and profitable business proposition, without threatening the current operations, is essential for biofuel/bio-products infrastructure to gain traction and grow sustainably. Inclusion of new processes and products into existing forest-based industry business plans will depend on new markets and price structure. Determining the value of diverting woody biomass towards co-products and biofuel within the scheme of existing infrastructure is critical in the decision making process of the industries to evolve their business plans and expand their product portfolios. Industrial stakeholders include forest-based companies, primary and secondary wood products manufacturers, chemical companies, refineries, and biomass processors.

### SOLUTION #2:

Traditional forest-based industries have to be engaged in the discussion on how to implement the production of biofuels as new value-added co-products so as to promote the acceptance of these products as complementing existing markets. Demonstrating the value of biofuels and co-products as users of and markets for residues from primary and secondary wood products industries will be beneficial in their decision making process. They should be informed regarding how much wood is needed on a sustainable basis, available volumes of forest residuals and their distribution, and how to handle wood for biofuel and co-products manufacturing. Communication between pretreatment facilities and refineries regarding the feedstock characteristics for further conversion into marketable products should also be established.

## NEED #3 (Other stakeholder awareness and engagement)

Approval of the local communities whose livelihood is dependent on woody biomass, including concerned citizens, environmental organizations, and other institutions representing the public interest, is needed to ensure smooth sustainable supply of raw material and acceptance of new products in the market. In building consensus, the concerns of the general public and the environmental communities about sustainability of harvesting/using wood for biofuel and the carbon/emissions associated with using wood for biofuel must be addressed. Stakeholders include biomass-dependent communities, NGOs, and the general public.

### SOLUTION #3:

Demonstrating positive impacts of a biorefinery infrastructure on the environment, society, and economy, while addressing concerns are essential elements for gaining the consent of these stakeholders and influencing policy. Through extension and outreach activities that engage general public and NGOs (e.g., site visits to biomass harvesting/removal sites, primary wood products facilities, bio-refineries, poplar plantations, etc.), we can demonstrate not only the sustainability and fate of wood/carbon used in biofuels, but the alternative outcomes of wood if not utilized.

## NEED #4 (Inform policymakers)

This process is vital to ensure that relevant facts regarding biomass supply, biorefinery operations, and bio-based fuels are considered before implementing policy changes that will impact woody biomass supply, availability, utilization, and development of a biofuel economy. Broader understanding will foster support for policy changes that benefit forest management and the use of wood alternatives to fossil fuels will be easier to achieve regionally and nationally. Stakeholders include state and federal legislators and agencies.

### SOLUTION #4:

The Outreach team worked collaboratively with its members representing USDA FS and the Ruckelshaus Center to inform state and federal level policymakers. Materials were designed and distributed with the intent of alerting and informing the policy makers, but not to advocate any particular position or stand.

## Extension program elements

Unlike traditional top-down and highly centralized extension approach, NARA's outreach team believed in participatory planning and technology development to facilitate building of PNW's biofuel/bioproductions economy that is sustainable beyond the period of this project. NARA units, research, outreach and industry members, partnered and facilitated the ultimate goal of empowering the stakeholders to plan and implement the changes needed to build, develop, and sustain biorefinery infrastructure. We facilitated a process of collaborative learning with the key stakeholders to understand their concerns and issues, educate and train the future bioenergy workforce, and provide a conduit to transfer the science and technology of biofuels and co-products. Besides using traditional methods of extension, we also increased the effectiveness of our outreach efforts by linking with interested communities, effected industries, ongoing events, established organizations, and invested policymakers to develop and implement the following two programs:

1. **Bioenergy Literacy through NARA Extension Engine**
2. **Building Supply Chain Coalitions and Regional Alliances**

The NARA Outreach team has been organized and represented by states in the four-state region as well as by entities that played crucial role in reaching out to specific stakeholders. Following is a list of regional extension agents by state and organizations that played an integral role in advancing the NARA Outreach Team's goals of being an Extension Engine and Building Regional Alliances.

### Idaho

- University of Idaho Extension, Randy Brooks

### **Montana**

- Bureau of Business and Economic Research, University of Montana, Todd Morgan
- Montana State University, Extension Forestry, Peter Kolb & Martin Twer
- Montana Community Development Corporation, Craig Rawlings

### **Oregon**

- OSU Extension, Scott Leavengood

### **Washington**

- Washington State University Extension, Vikram Yadama & Karl Englund

### **PNW Region and National**

- USDA FS PNW Research Station, Eini Lowell
- The William D. Ruckelshaus Center, Michael Kern
- Department of Governmental Studies and Services, Michael Gaffney
- Justin Hougham's Team (Upham Woods): Bioenergy Literacy Tools and Stakeholder Assessment

Therefore, reporting on activities and objectives to achieve our two main tasks – Bioenergy Literacy and Building Supply Chain Coalitions – is organized by these regional alliances for each of the tasks.



# TASK 1: BIOENERGY LITERACY (NARA EXTENSION ENGINE)

Bioenergy Literacy in NARA's case required multiple activities: a) disseminate the research-based information (on technology and markets) to our industrial stakeholders and understand the technical challenges regarding implementation at industrial scale (industry-focus); b) relate the feedstock development and logistics information to our resource-based stakeholders (local communities, forest landowners, forest managers) and hear their concerns regarding the type of information that will assist them in keeping their costs low and marketable value high (resource-focus); and, c) engage the organizations and partnerships in connecting with public-interest groups and policymakers (public-focus). These activities were carried out via a variety of communication mechanisms, including social media, newsletters, briefing papers, extension publications, workshops/seminars, conferences, field trips, and stakeholder meetings.

As illustrated earlier in the introduction, accomplishments and milestones will be discussed for Task 1 by region and entity.

## Idaho

### Task Objectives

- Communicate NARA goals to Idaho stakeholders
- Help plan, organize, and coordinate workshops and stakeholder meetings
- Assist in distributing newsletters/articles/briefs to communities in Idaho

### Methodology

Extension workshops, programs and field days were held over the 5-year period to address NARA tasks and goals. Over 3,050 stakeholders attended the programs. Surveys regarding knowledge of biomass and biofuels were handed out and also made available online via SurveyMonkey.

A survey was sent to 868 stakeholders; 345 completed it, resulting in a 40% response rate. Of those who completed it, 70% did so online, 26% completed hard copies, and 4% took the survey over the phone. Participants were asked to rate their level of knowledge about the use of woody biomass to produce liquid biofuels on a scale ranging from 1 (*I know a lot*) to 4 (*I know nothing*). They also were asked to rate their level of agreement with various statements about biofuels-related topics on a scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). In addition, participants were presented with a list of 13 communication methods that could be used to increase community awareness about a biofuels project and asked to select those they would prefer to use to receive such information (all that applied).

### Results

Over 1200 loggers and 600 landowners have been introduced to the NARA Project and introduced to options for biomass utilization. Logger Education post-workshop exit evaluations showed 62% of those surveyed indicated they could identify opportunities and challenges associated with forest biomass and residues, while 21% were not sure, and 17% indicated probably not. Suggestions for training topics included biomass updates, energy & oil, what new products can be found in woody biomass, and expanding the markets.

Over 650 youth have been introduced to the NARA project, woody biomass and the concept of making biofuel from woody biomass. A portion of these youth were given pre-test, post test, and a 2<sup>nd</sup> post-test two months after the workshops (to assess long-term knowledge retention).

### Conclusions/Discussion

Indicators show that relatively few stakeholders in Idaho are using electronic means to receive communications. Therefore, efforts to educate stakeholders in Idaho need to utilize every opportunity to attend face-to-face meeting to inform them about the project.

Logging contractors, who are the first step and critical link in the supply chain, are open to viable alternatives for slash utilization. Once the broadband and digital technology is available in the rural communities, it would be rapidly adopted by the workforce.

Consistent with other studies, findings from the NARA survey indicate that respondents' self-reported levels of knowledge influence their levels of support for the biofuels industry, when compared using regression. Stakeholders who felt they knew more about the use of woody biomass in producing liquid biofuels were more supportive of various aspects of the wood-to-biofuels industry, including sources of woody biomass to be used, options for use of woody biomass, and the benefits versus the risks associated with the industry. Those who answered "I know a lot" were statistically different in their level of support compared to those who answered "I know nothing."

In general, the stakeholders surveyed wanted to be able to obtain information on the topic of wood-based biofuels on their own and at their own convenience, such as by accessing a website. They also showed support for face-to-face forums (e.g., field trips, community meetings, and workshops), where they can interact with people, ask questions, and get information.

## Montana

### Task Objectives

- Introduce NARA to Montana biomass alliances such as Biomass Working Group, MT Forest Council, MT Logging Association, etc.
- NARA web site on MSU Extension web page
- Communicate updates on NARA findings to MT stakeholders
- Help plan, organize, and coordinate workshops and stakeholder meetings
- Assist in distributing newsletters/articles/briefs to communities in MT and organize and conduct meetings and field trips

### Methodology

The outreach work that BBER did to promote bioenergy literacy for the NARA project included: 1) engaging Montana and other stakeholders during the first two years of the NARA project; 2) sharing the timber harvest, logging residue, and mill information BBER developed throughout the NARA project; and 3) maintaining contact with Montana stakeholders to relay information and concerns between Montana stakeholders and NARA. A more thorough chronology of BBER's outreach activities is outlined under *Task 2: Building Supply Chain Coalitions/Regional Alliances*, and a complete list of specific outputs used to disseminate information are listed under Montana in the NARA Outputs segment of this report. Several key activities and outputs are summarized below.

With Todd Morgan, the University of Montana produced a short press release when the NARA project was originally announced at SeaTac. Todd had an interview on October 5, 2011 with local TV news (KPAX) to help introduce the NARA project to western Montana. Todd also gave a presentation "From stump to pump: wood-based biofuel research in the Northwest" at Portland State University on December 15, 2011 that introduced the NARA project and provided details about the measurement of logging residues that BBER researchers would be collecting.

Along with Craig Rawlings, Peter Kolb, and others, BBER members participated in the February 2012 NARA Montana team meeting at DNRC headquarters in Missoula to encourage DNRC interest in the NARA project and solicit their input on biomass research needs. The BBER team and MSU Extension participated in the March 2012 NARA Outreach Team meeting at the Rocky Mountain Elk Foundation in Missoula, meeting with community leaders about the NARA project and selecting Missoula and the Western Montana Corridor as a NARA Community.

BBER members helped organize and actively participated in the June 2012 Missoula Pilot Community meeting. Todd gave a presentation "Woody Biomass from Logging and Mill Residuals" that described some of the work BBER was conducting as part of the NARA team and highlighted major trends and conditions in the Montana forest inventory, forest industry, and timber harvest. Several BBER team members also participated in the break-out sessions.

Erik Berg presented "Western Montana Corridor: Woody biomass from logging and mill residuals" and several other BBER members presented posters and attended the September 2012 NARA annual meeting in Missoula.

In early 2013, BBER personnel invested more than 100 staff hours reviewing the NARA Western Montana Corridor Atlas project. BBER reviewed 3 separate Atlas products: posters at the January 2013 Missoula Open House, the rough draft Atlas document, and the revised Atlas draft. These oral and written reviews uncovered significant content problems, provided remedies for these shortcomings, and helped shape the final Atlas product.

And in May 2013, Todd Morgan participated in the NARA stakeholder meeting in Vancouver, WA, discussing lessons learned from his experience with the WMC community – identifying and clarifying expectations and products as well as the specific geographic area of analysis.

Several pages on the BBER website were developed (and continue to be updated) to help share information from the BBER team's NARA work and from related forest industry research in the four-state NARA region:

- NARA page: [www.bber.umd.edu/FIR/L\\_NARA.asp](http://www.bber.umd.edu/FIR/L_NARA.asp)
- Harvest by County Tool page: [www.bber.umd.edu/FIR/H\\_harvest.asp](http://www.bber.umd.edu/FIR/H_harvest.asp)
- Logging Utilization page: [www.bber.umd.edu/FIR/L\\_Util.asp](http://www.bber.umd.edu/FIR/L_Util.asp)
- Idaho page: [www.bber.umd.edu/FIR/S\\_ID.asp](http://www.bber.umd.edu/FIR/S_ID.asp)
- Montana page: [www.bber.umd.edu/FIR/S\\_MT.asp](http://www.bber.umd.edu/FIR/S_MT.asp)
- Oregon page: [www.bber.umd.edu/FIR/S\\_OR.asp](http://www.bber.umd.edu/FIR/S_OR.asp)
- Washington page: [www.bber.umd.edu/FIR/S\\_WA.asp](http://www.bber.umd.edu/FIR/S_WA.asp)

These pages contain links to numerous BBER posters, presentations, and publications sharing information on our biomass, logging utilization, and forest industry research done with NARA and for other sponsors, including the Forest Service's Forest Inventory and Analysis (FIA) program.

MSU Extension Forestry also produced and hosted several web pages to update and share information with stakeholders regarding biomass opportunities and potentials:

- <http://www.msuextension.org/forestry/NARA.html>
- <http://www.msuextension.org/forestry/WB2E/pellets.htm>
- <http://e3a4u.info/energy-technologies/wood-heat/overview>
- Promotion and linking of NARA hosted webinars on eXtension Learn (<https://learn.extension.org/search/all?utf8=%E2%9C%93&q=nara>)
- [https://montana.qualtrics.com/SE/?SID=SV\\_1Yo4uDkriL8qlpj](https://montana.qualtrics.com/SE/?SID=SV_1Yo4uDkriL8qlpj)

Although BBER's official NARA Outreach Team involvement ended in mid-2013, Todd Morgan and other BBER team members attended the monthly Forest Products Retention Roundtable meetings in Missoula throughout the five-year span, sharing information about the NARA project and keeping abreast of local forest industry and biomass issues to share with NARA investigators. Likewise, BBER employees shared information about the NARA project with various Montana stakeholders

including: the Forest Products Retention Roundtable, Montana Logging Association, Montana Wood Products Association, the Montana Forest Restoration Committee, Montana DNRC staff, various mill operators, and UM College of Forestry and Conservation faculty and students. And BBER members continued to respond to numerous requests from within and outside NARA, providing information related to timber harvest, logging and mill residue, mill infrastructure, and forest conditions in Montana and elsewhere in the NARA region. BBER personnel also took part in all of the NARA annual meetings.

During late 2015 and early 2016, Erik Berg and Todd Morgan of BBER cooperated with Natalie Martinkus, (WSU), Greg Latta (OSU), and several others on the development and presentation of the Eastside Biorefinery Siting Analysis (Martinkus, 2016) to the Forest Products Retention Roundtable on April 8, 2016 in Missoula. That presentation was very important for “closing the loop” on NARA’s work in Montana and helping stakeholders understand the potential for biojet in Montana. Todd Morgan also presented a [webinar](#) in November 2015 and made a [presentation](#) at the Biofuels +Co-products Conference at SeaTac in May 2016.

## Results

With FBN and MSU Extension Forestry, BBER introduced Montana stakeholders to the NARA project, provided new information from NARA research efforts, and relayed Montana stakeholder interests and concerns to NARA. As a result, the Roundtable and other Montana stakeholders have much more information and a better understanding of the woody biomass resource and the potential feasibility of a wood-based biofuels industry developing in the region. There is greater awareness of some biomass policy issues (e.g., logging residue from federal projects not qualifying as renewable fuel/energy) that may impact Montana more than other NARA states because of the state’s relatively high (20-30%) reliance on national forests for timber supply compared to the other NARA states (2-10%).

## Conclusions/Discussion

The availability of information from the NARA project, involvement of Montana organizations (BBER, FBN, MSU Extension Forestry) in the project, and discussions between Montana stakeholders and NARA via the Outreach Team enabled Montana stakeholders to remain interested and engaged with NARA, and helped them to gain a better understanding of woody biomass supply, utilization and co-products options, as well as other information resources to draw upon.

With Missoula/western Montana as one of first NARA Communities, there were some high and perhaps unrealistic expectations of what the NARA project could accomplish in the region, particularly during the first few years of the study. When the WMC Atlas (NARA, 2013) was first presented to the Roundtable in Missoula, relatively few research results were available from key portions of the NARA project (e.g., feedstock logistics, TEA, co-products, etc.), and some stakeholders felt the Montana analysis was incomplete or the NARA project wasn’t producing on-the-ground results (i.e., a new, more profitable market for biomass) that some were hoping for.

Thus, it was very good that NARA leadership pressed for the Eastside Biorefinery Siting Analysis, produced by Natalie Martinkus and others. The presentation of that material to the Roundtable in April 2016 helped to close the loop on the WMC, bringing more of NARA’s five years of research to bear on the question of biojet feasibility in Montana. Although the WMC Atlas and Eastside Biorefinery Siting Analysis indicated such a facility was less feasible in western Montana than other locations (e.g., Spokane), stakeholders were presented with more complete information and now have access to new tools for analyzing other potential biomass endeavors.

## Oregon

### Task Objectives

- Develop NARA page on OSU Forestry Extension website and communicate to Oregon stakeholders NARA activities and findings
- Assist in organizing NARA conferences to disseminate the findings
- Assist with NARA webinars and inform stakeholders
- Assist in developing NARA one-pagers and their distribution to Oregon stakeholders

### Methodology

The objectives listed here rely on fairly traditional Extension methods – websites, conferences, publications, etc. These methods seem appropriate given the technical nature of the topic and the target audience.

### Results

All of the task objectives were achieved to the extent that the NARA web page on the OSU Forestry Extension website was created and maintained, efforts were made to assist in organizing conferences, five research briefs were created and posted on the website, etc. Beyond that, it is difficult to assess the results of these activities in that the overarching goals were to provide Oregon stakeholders a conduit for engaging with the NARA project. To the extent that conferences and webinars were well-attended, we can speculate that the outreach efforts were successful.

### Conclusions/Discussion

The work of Extension professionals (and many others, for that matter) is highly dependent on relationships. I believe it has been successful for the NARA project to have specific individuals in each state rely on their long-standing relationships with key stakeholders to aid in the process of Extension and Outreach. At least for the forest industry stakeholders (landowners, land managers, forest products manufacturers) and for community leaders, I believe this has worked quite well in Oregon. Use of the traditional methods listed here - websites, conferences, webinars, and brief (‘one-pagers’) publications has helped to keep Oregon stakeholders informed of the NARA project as it progressed and ensured interested parties had a mechanism for engaging with NARA’s principal investigators.

## Washington

### Task Objectives

- Develop communication mechanism to dialogue with stakeholders
- Establish social media to communicate with stakeholders and maintain communications
- Develop and distribute media to stakeholders to update on NARA findings; utilize news media
- Build and maintain clearing house for unbiased wood to biofuel information center that includes NARA findings as well as other researchers and companies
- Organize and carryout NARA webinars
- Develop, organize and coordinate National/International Conferences

### Methodology

#### Communication Mechanism

Determining a communication mechanism to reach out to an array of stakeholders is critical to establish a two-way communication for effective dissemination of research-based findings as well as constructive feedback and “ground truthing.” These stakeholders could include internal and external stakeholders playing different roles in advancing the outreach objectives. In this project, using the stakeholder role and interaction mechanisms established (Figure IES-1.1), an ad hoc committee was established to plan and develop two-way communication mechanisms with NARA stakeholders. Committee was charged to develop a comprehensive stakeholder communication plan that included strategies to engage entire stakeholders to engage with NARA, methods to maintain an effective dialogue during the project duration, and to disseminate NARA findings and relevant information to the stakeholders in a timely manner.

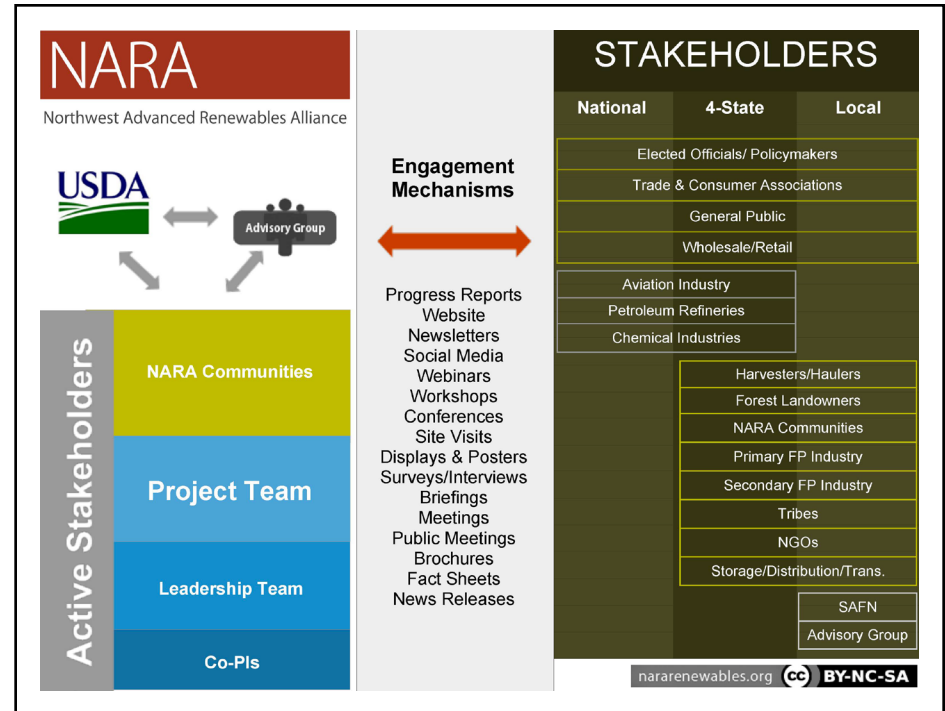


Figure IES-1.1. Schematic of stakeholder levels, roles, and engagement in the NARA project.

#### Social Media

A NARA website (<https://nararenewables.org/>) was developed and maintained to communicate with the stakeholders. Social media, including a project-based blog, Facebook page, Twitter account, and YouTube, was effectively used to inform and engage stakeholders.

#### Media Production

In coordination with the Education Team and other research teams of the NARA project, the Outreach Team produced print, online, and video media to achieve three goals: 1) increase bioenergy literacy among the stakeholders, 2) document the NARA process of producing bio-jet from post-harvest forest residuals, and 3) disseminate NARA research findings to a variety of stakeholders with emphasis on K-12 students.

To achieve these goals, the objectives of media production, especially the videos, were to:

1. Justify USDA funding (validate the process and deliverables)
2. Convey the story of producing biofuels from forest residuals (1K-process incorporated)



- a. 30,000 ft view (approximately 10-15 minutes) - Feedstock, pretreatment, conversion & co-products (sustainability incorporated into each aspect)
  - b. 1K production (video, timeline)
3. Create educational digital assets / tools (short 5-minute videos)
  4. Capture stakeholder perceptions

The Outreach team hired a videographer and a producer to work with the team and with WSU Communications to produce a “Big Picture” video and several educational videos. An interactive online timeline was designed to archive the story and inform the stakeholders about the process and the status. Additionally, a timeline was designed to also acknowledge the contributions of participating companies in the bio-jet production and communicate views of the participating stakeholders.

To disseminate research findings through print media, the NARA team produced brochures, news stories, research-based manuscripts, and other trade journal articles. They were distributed through a variety of local and regional newspapers, trade and association magazines, USFS media group, and peer-reviewed journals. In addition, ad hoc teams were formed within the Outreach team to draft Factsheets and Infographics that were then produced professionally by NARA’s media team. In addition, NARA’s communication manager coordinated with the outreach team and the Ruckelshaus Center to develop and distribute briefings to local, state, and national policymakers. Produced media were distributed through NARA’s stakeholder database as well as already established coalitions in the region (e.g., Gifford Pinchot Task Force, Oregon Department of Forestry, WA Dept. of Commerce, Montana FP Roundtable), nation (e.g., Society of Wood Science and Technology, Forest Products Society), and world-wide (e.g., BC Bioenergy Network, UBC’s Wood Science Listserv).

#### **Repository of Scientific Knowledge on Wood-Based Biofuels and Co-Products**

The Outreach team coordinated and established a dynamic-search enabled knowledge base. It is a repository of unbiased technical and non-technical information (publications, reports, presentations, YouTube videos, etc.) on supply chain for production, distribution, and marketing of lignocellulosic biofuels and co-products. It is a database of information on lignocellulosic biorefinery. As there are common elements and strategies between a biorefinery and a petroleum refinery, information regarding oil-based refinery is also included in this collection of technical knowledge. This repository was established to provide the following primary functions:

1. Storing and organizing unbiased technical and non-technical resources to facilitate development and establishment of regional systems for the sustainable production of bioenergy and bio-based products.

2. Navigating stakeholders through a maze of resources in a logical manner and suggesting additional reading by cross-referencing resources.
3. Tracking user interests and analyzing the traffic at the website to provide insightful data for measuring the usefulness and effectiveness of the site.

#### **NARA Webinar Series**

To disseminate NARA findings to wider group of stakeholders from the four-state region as well as across the nation and Canada, the Outreach Team initiated a Wood-To-Biofuel Webinar series summarizing the research and results of converting slash to biofuel while recognizing and conducting sustainable analysis (triple bottom line). These webinars were designed to inform the industry (primary and secondary manufacturers, chemical, and biofuel), researchers, contractors, land managers, policymakers, state and local agency personnel, NGOs, educators, and students about topics such as biomass logistics, distribution and availability, conversion, supply chain analysis, and sustainability. These stakeholders we believe would be interested and involved in operations converting forest-based biomass to biofuels and co-products.

#### **NARA-Hosted Conferences**

Two *International Wood-Based Biofuels + Co-Products Conferences* were organized, coordinated, and hosted by the NARA Outreach Team in Seattle, WA. One was held in the second year of the NARA project (2104) and the other during the last year of the project (2016). Following sections describe the objectives and format of these two conferences.

##### 1<sup>st</sup> Northwest Wood-Based Biofuels + Co-Products Conference

A biofuels industry based on wood-based feedstock, when economically viable, can be an important component within a country’s green energy portfolio. It could also revitalize the forest products industry in areas rich with woody biomass, such as the Pacific Northwest (PNW). The goal of this conference was to bring together the community of researchers, business leaders, government agencies, and economic development personnel to share and exchange research findings, ideas, and strategies for the common goal of sustainable development of wood-based bio-refineries for production of biofuels and co-products.

This conference was designed to:

1. Communicate key elements of project design for an integrated technical pathway for economically producing biofuels and co-products from woody biomass while simultaneously providing the requisite attention to the social and environmental attributes of an emerging sustainable biofuels industry.
2. Share research-based findings of wood-based AFRI-CAP projects where their objective is to facilitate the establishment of regional systems for the sustainable production of bioenergy and bio-based products.

3. Learn about complementary work being done by national and international researchers and industry leaders. Conference topics will cover all areas across the supply chain for converting woody biomass into biofuels and co-products, including feedstock development and logistics, pretreatment and conversion, and distribution and markets.
4. Showcase the results of the Mid Cascade to Pacific (MC2P) pilot supply chain region study done by the Integrated Design Experience (IDX) students of Washington State University and University of Idaho during the academic year 2013-2014 to the regional stakeholders and national and international stakeholders for their feedback. IDX students will present their work in a technical poster forum at the conference. This experience of mingling and engaging industry, government, and research leaders provides an enriching experience to the students and better prepare them for a career in an emerging industry.

Key outcomes of the conference were envisioned to be:

1. That business, government, and research stakeholders better understand the opportunities, challenges and risks of retooling existing facilities and infrastructure to supply renewable biofuels and co-products derived from wood residuals.
2. Constructive discussion on establishing a sustainable wood-to-biofuels industry with emphasis on potential strategies of collecting, processing, pre treating and converting underutilized biomass, environmental and social impacts, possible co-products, methods of distribution, new markets, and impact on existing forest products industry.
3. Networking opportunities for students, researchers, industry leaders, and personnel from government agencies and economic development communities to explore investment and business opportunities and strategies for their communities.
4. IDX students working on NARA project presenting their work on MC2P pilot supply chain study and an opportunity for regional stakeholders and research community to provide feedback.
5. Archiving of conference proceedings.

### **Conference Format**

Monday, April 28 (Day 1): Plenary Session

Audience: All

Tentative Topics: USDA Program Director, NARA & AHB talks, global & national perspective

1. NARA project overview

2. AHB project overview
3. Other CAP projects working with woody biomass
4. Canadian, European, Asian, and S. American efforts in biofuels from wood

Tuesday, April 29 (Day 2): Three parallel sessions entire day

*Track 1: Acquiring, processing, and transporting of woody biomass for biofuels and co-products*

Audience: Forestland owners and managers, contract loggers, haulers, biomass processors preparing feedstock for different markets, foresters, extension foresters

Topics: Fiber supply, biomass collection, forest operations, transportation, processing for downstream conversion

*Track 2: Economic, social and environmental issues surrounding woody biomass utilization for biofuels and value-added co-products*

Audience: Environmental research community, NGOs, policymakers, sociologists, community-level stakeholders, economic development councils

Topics: LCA/LCI, Community Impact Analysis, social perceptions, supply chain management and analysis, techno-economic analysis, community collaborations, environmental impacts (emissions, water quality)

*Track 3: Pretreatment and conversion for biofuels and value-added co-products*

Audience: researchers, secondary forest products industries, chemical industries, petroleum industry

Topics: pretreatment and conversion methods and technologies and yields

Evening Poster Session + Reception – MC2P findings and other posters

Thursday, April 30 (Day 3): Plenary Session

Audience: All

Tentative Topics: co-products across the supply chain – in the works and ready to be commercialized

### 2<sup>nd</sup> Northwest Wood-Based Biofuels + Co-Products Conference

The overarching goal of this forum is to communicate research findings and promote collaboration to convert wood to biofuels with focus on supply chain development, environmental impacts, co-products development for economic viability, K-12 education, and workforce development. Although the focus will be on regional efforts, a national and global perspective would also be included. The expected outcomes of this conference were:



1. Attendees from various stakeholder groups including researchers, business leaders, government agencies, economic development personnel, students, educators, industry suppliers and technology providers, and community leaders.
2. Advance the discussion of wood to bio-chemicals production from analysis to commercialization.
3. Increase stakeholder awareness of potential environmental impacts, the current status of economic viability, and leveraging existing infrastructure
4. Inform and provide educators with bioenergy literacy tools for use in K-12 curricula
5. Identify knowledge gaps for further research and development
6. News media participation to inform general public and policymakers
7. Archived conference proceedings

This conference was hosted on May 3-4, 2016; Airport Marriott, Seattle, WA.

### **Conference Format**

#### **First Day (May 3):**

Morning Session: Plenary Session - A look at the big picture

Update regarding large-scale national and global projects established to develop wood-based biofuel industries, biofuels outlook, policies, and certification.

Afternoon Session: 4 Parallel Tracks

Four parallel tracks featuring presentations and discussion relating to wood based biofuels and co-products:

1. Track 1: Getting Woody Biomass out of the Woods: Provide the most recent data and perspectives on acquiring, processing, and transporting woody biomass.
2. Track 2: Ensuring Sustainability: Provide the latest research covering the economic, social and environmental issues surrounding woody biomass utilization.
3. Track 3: Converting Lignocellulosic Materials to Biofuels and Co-Products: Highlight the latest pretreatment and conversion technologies.
4. Track 4: Bioenergy Literacy in STEM Education: EPA's Energy Matrix, Biofuel curricula, Educational Tools

A reception with a concurrent poster session was held in the evening.

#### **Second Day (May 4):**

Morning Session: 4 Parallel Tracks Continued

Afternoon Session: Plenary Session – Potential for Commercialization

In the past decade, funding agencies (USDA-NIFA and DOE), stakeholder coalitions (SAFN), state agencies, and industry have invested millions of dollars and time to lay out a roadmap for a Pacific Northwest industry to use wood-based biomass to produce biofuel and other co-products. Multiple assessments are completed, and it is time to build a supply chain. This session's focus was on transitioning from research and development to commercialization.

#### **Results**

At the start of the project, to inform and initiate stakeholder engagement, a brochure highlighting NARA scope and the research teams was developed for distribution to the stakeholders during any of the outreach activities in the four-state region. A web-based mechanism was also established on the NARA site for stakeholder engagement, self-identification, and self-categorization (see appendix A in this report). Roles and engagement of stakeholders in the NARA project, and engagement mechanisms between stakeholders and NARA (Figures IES-1.2 and IES-1.3) were identified and recognized to develop effective strategies for knowledge dissemination and stakeholder engagement. Based on these mechanisms, a stakeholder communication strategy was developed and adhered to inasmuch as possible throughout the project duration via various mechanisms, such as newsletters, social media, stakeholder meetings (including annual meetings), webinars, and conferences.

Extension faculty from each of the four states gathered and compiled a database of stakeholders for each of the states. Through the NARA website ([www.nararenewables.org](http://www.nararenewables.org)), unbiased and vetted NARA-related information and activities were communicated to the self-registered and other stakeholders.

Additionally, the Outreach Team had coordinated with the strategic planner of the William D. Ruckelshaus Center to compile a database of legislators, county commissioners, and tribal directors and liaisons in the Pacific Northwest. This list of policy makers was used by the Ruckelshaus Center to communicate with the policymakers regarding project developments, outcomes, and impacts all through the project period.

Stakeholders	Responsibility	Influence	Proximity	Dependency	Representation	Policy & Strategic Intent
USDA	X	X	X	X		
Advisory Group	X	X	X			
SAFN			X		X	
Elected Officials/Policy makers		X			X	X
NARA Communities		X	X	X	X	
Forest Landowners			X	X		
Harvesters/Haulers/Storage/Transportation/Distribution				X		
Agencies: Local, State, Federal		X				X
Tribes		X				X
Forest Products Industry: Primary, Secondary		X		X		X
Biorefineries				X		
Petroleum Refineries		X			X	
Chemical Industries		X		X	X	
Aviation Industry	X	X	X	X		X
Trade & Consumer Associations					X	X
NGOs					X	X
Wholesale/Retail				X		
General Public		X				X
Criterion	Description					
<b>Responsibility</b>	Stakeholders to whom you have a responsibility					
<b>Influence</b>	Stakeholders with influence or decision-making power					
<b>Proximity</b>	Stakeholders with whom you interact most, including internal stakeholders, those with long-standing relationships and those on whom you depend for day-to-day operations					
<b>Dependency</b>	Stakeholders who are directly or indirectly dependent on your activities					
<b>Representation</b>	Stakeholders who through regulation or custom or culture can legitimately claim to represent a constituency					
<b>Policy &amp; Strategic Intent</b>	Stakeholders whom we directly or indirectly address by policy or practice					

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Figure IES-1.2. Chart illustrating levels of interaction between stakeholders and the NARA project teams.

Internal Stakeholders			Local/4-State Stakeholders					National Stakeholders			
USDA	Advisory Group	SAFN	NARA Communities	Forest Land Owners	Feedstock Logistics	FP Industry	NGOs	Aviation Industry	Trade & Consumer Associations	Elected Officials/ Policymakers	General Public
Progress Reports			Site Visits								
			Displays & Posters								
			Workshops/Conferences								
			Newsletters								
			Surveys/Interviews								
Briefings/Meetings			Focus Group Meetings								
			Public Meetings								
			Extension Brochures & Fact Sheets								
			Press Releases								
			NARA Website								

Figure EIS-1.3. Specifics of engagement mechanisms with stakeholders.

The NARA website ([www.nararenewables.org](http://www.nararenewables.org)) was developed and maintained through which had over 10,000 visit every year from all 50 states and over 114 countries. On the social media front, information regarding NARA related activities were disseminated through over 300 posts and stakeholders were engaged through [NARA blog](#), [Facebook page](#) and [Twitter account](#). NARA generated videos were posted on the [NARA YouTube channel](#). In these videos, NARA researchers presented project updates and described their work and findings on subjects dealing with the five goals of the NARA project.

WSU's outreach team coordinated with other outreach members and NARA teams to produce a variety of print, online, and video media that were distributed through compiled databases and other established infrastructure, such as Forest Business Network, Oregon State University Extension, USFS, Biomass Working Groups, state agencies, and county extension agents. Outputs of these efforts are:

- Quarterly Briefings to 900+ policy makers detailing efforts of NARA and AHB
- Developed & produced 31 Infographics & Factsheets
- 66 videos of NARA presentations on research findings are available for public viewing (over 5850 views)
- 135 news stories have been written about NARA activities
- 34 newsletters distributed to 800 subscribers
- Over 25 refereed journal and extension publications
- Over 135 presentations at stakeholder meetings and conferences

NARA's research activities and findings were also archived in the form of professional videos for informing stakeholders and conveying our final project deliverable efforts of producing 1000 gallons of bio-jet through [1000-gallon bio-jet timeline](#). Forty-four interviews of NARA members and stakeholders were conducted and videotaped. In addition, video b-roll was acquired. These assets are used to construct video products and pertinent b-roll clips are publically available. The Outreach Team, in coordination with other research teams and participating stakeholders, produced professional-quality overview video ([www.youtube.com/watch?v=P-CAXPxYtKc](http://www.youtube.com/watch?v=P-CAXPxYtKc)) to educate general public about alternative biofuels and specifically NARA's approach, and educational videos to assist K-12 teachers communicate bioenergy fundamentals to their students. The educational videos dealt with the process of converting wood to biofuels, co-products in a wood-based biorefinery, and environmental assessment of forest residuals to biofuels conversion process.

A repository of unbiased scientific knowledge related to producing bio-jet fuel and value-added co-products from woody biomass, [www.woodtobiofuel.org](http://www.woodtobiofuel.org), was developed and maintained to have the information readily available to stakeholders interested in developing a wood-based biorefinery. It includes research findings from other sources as well as ones generated by the NARA research teams (Figure EIS-1.4). The repository is constantly updated with recently produced NARA outputs and other relevant and unbiased information published by others. Since its inception, it has been accessed by over 4000 viewers every year from over 80 countries

with majority of them being from the U.S. and Brazil. The four main pathways to the knowledge base have been Google, direct address, NARA site, and Forest Business Network (FBN).

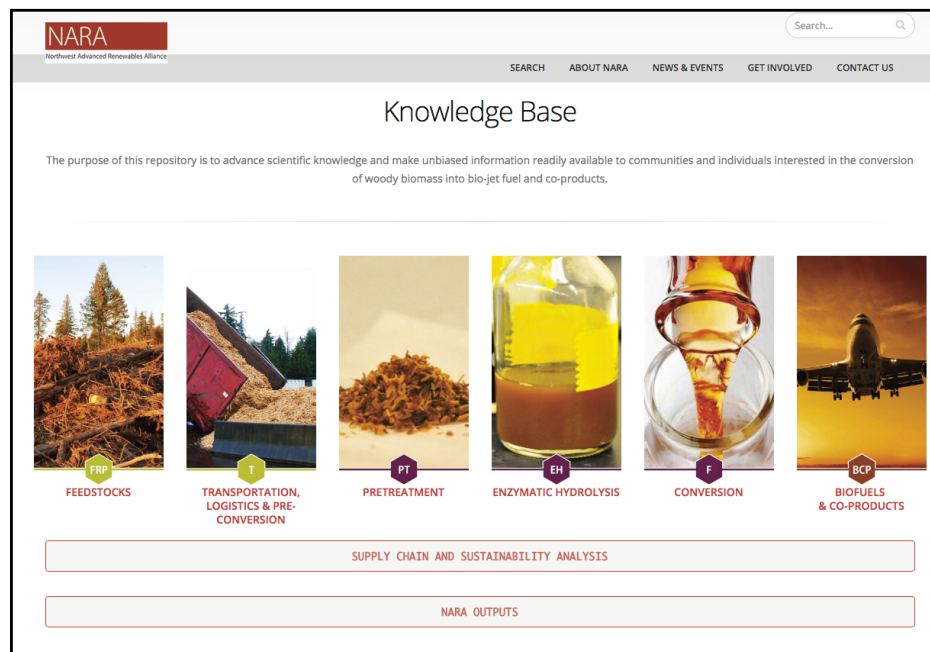


Figure EIS-1.4. A repository of scientific knowledge regarding converting woody biomass to biofuels and co-products ([www.woodtobiofuel.org](http://www.woodtobiofuel.org)).

A total of 12 webinars were offered and hosted in Year 5 of the project. Over 360 attendees from over 12 different states and Canada attended these webinars. Over 75% of the attendees indicated a significant increase in their knowledge as a result of attending these webinars. Number of attendees for each webinar ranged from 28 to 50. Here is a testimonial from one of the attendees: “NARA’s webinars were informative, interesting and definitely worth my time.” All webinars are archived at <https://nararenewables.org/webinar-series/>. These webinars were also posted on [NARA YouTube](#) and on the [WSU Research Exchange](#).

The two international conferences organized and hosted by NARA engaged over 380 stakeholders from 24 different states and six different countries. Participants included over 80 undergraduates and graduate students, 13 K-12 teachers, 11 state agencies, 16 universities, and over 60 companies and NGOs. Attendees represented primary and secondary forest products, chemical, aviation, energy, transportation, biofuels, and petroleum industries. Among the participants surveyed, 95% indicated increased knowledge and awareness of biofuels from lignocellulosic materials and over 75% indicated a significant change in their knowledge regarding woody biomass to biofuels logistics, conversion technologies, and environmental im-

pacts. Proceedings have been archived for both the conferences: the 1<sup>st</sup> Northwest Wood-Based Biofuels + Co-Products Conference and the 2<sup>nd</sup> Northwest Wood-Based Biofuels + Co-Products Conference.

## Conclusions/Discussion

The Outreach Team for the Northwest Advanced Renewables Alliance (NARA) served as a conduit between researchers and community stakeholders. The team helped transfer the science and technology of biofuels and important co-products to communities in the Northwest. The group conducted traditional extension activities that include workshops, webinars, and newsletters, with the aim of helping communities throughout the Pacific Northwest adjust and benefit with the establishment of a biofuels-based economy. Activity outputs have been cataloged at the NARA website, [www.nararenewables.org](http://www.nararenewables.org) and on the WSU Repository, <https://research.libraries.wsu.edu/xmlui/handle/2376/5309>.

The Team provided information and exchange with key governmental and industry leaders and the public by:

- Establishing a communications pipeline to inform policy makers who will be making future policies on bioenergy.
- Communicating and exchanging information with already existing biomass groups such as the WA Biomass Working Group and the Montana Forest Products Roundtable.
- Communicating with economic development groups in rural communities, tribal groups, and the general public

The team also helped to transfer science and technology of biofuels and co-products through organizing and hosting professional conferences and workshops, field trips and facility demonstrations, web-based newsletter, an e-commerce site, and webinars, in addition to the NARA website.

NARA Outreach and Education Team engagement in the 4-state region has resulted in a broad forest stakeholder group investigating aviation biofuels development in the region. Surveys show NARA advanced public knowledge regarding conversion of woody biomass into biofuels and co-products.

## USFS PNW Research Station

### Task Objective

- Assist in organizing and coordinating workshops and focus group meetings
- Produce newsletters and briefing papers for informing USFS officials and other stakeholders involved or concerned with US Forest Service land management activities
- Assist with planning NARA conferences and publishing proceedings
- Communicate NARA project overview to stakeholders through oral presentations, posters and one-to-one conversations.

Methodology

Preparation of materials that inform stakeholders, leadership, and the public about NARA are key to the outreach process. This was accomplished through a variety of media formats including conferences, presentations, posters, webinars, and written and electronic media. A Congressional Briefing Paper was prepared annually for distribution by the PNW Research Station Director to Congressional members and staff and other stakeholders in Washington, DC.

Outreach efforts were broadened by leveraging some existing research projects that complement NARA efforts. Work with the Collaborative Forest Landscape Restoration Program (CFLRP) within the USDA Forest Service provided an opportunity to address both biomass availability issues and rural economic development. These collaborative partnerships have diverse memberships and projects within their boundaries and are possible foundations for, or additions to, pilot supply chain coalitions.

Results

Partnerships throughout the western US are more knowledgeable regarding biofuel from woody biomass and the efforts of NARA. Stakeholders from both Washington and Oregon had identified eastern parts of their states as high priority areas in need of biomass utilization opportunities. Engaging with environmental groups proved challenging.

The breadth of the NARA project allowed for disseminating results in unexpected opportunities. For example, inclusion of the NARA biorefinery concept constituted the major portion of a book chapter that outlines next generation products from wood removed from moist forests (e.g. west side Douglas-fir and hemlock) (Lowell *et al*, 2017).

Topics of interest to the general public as well as those designed to increase awareness among key members of Congress and their staff about the potential of wood-based aviation fuel were prepared in a variety of formats (e-mails, briefing sheet, brochures). Audience includes Congressional delegates and members of the following committees (Table EIS-1.1)

Table EIS-1.1. Congressional audience receiving NARA information

House of Representatives	Senate
<ul style="list-style-type: none"><li>• Energy and Commerce</li></ul>	<ul style="list-style-type: none"><li>• Ag., Nutrition, and Forestry</li></ul>
<ul style="list-style-type: none"><li>• Natural Resources</li></ul>	<ul style="list-style-type: none"><li>• Energy and Natural Resources</li></ul>
<ul style="list-style-type: none"><li>• Science, Space, and Technology</li></ul>	<ul style="list-style-type: none"><li>• Environment and Public Works</li></ul>
	<ul style="list-style-type: none"><li>• Small Business and Entrepreneurship</li></ul>

PNW produced “Science Spotlight” to highlight the use of utilization of restoration byproducts from National Forests in the NARA effort. This information was also submitted to Forest Service and USDA Facebook pages, tweeted, and submitted to FS People, Places, and Things weekly newsletter.

Conclusions/Discussion

Through various means of communication, stakeholders throughout the US have heard of NARA and its goal of producing aviation jet fuel from woody biomass. USDA Forest Service personnel from the local level up to Washington DC are aware of NARA and the potential utilization opportunities from woody biomass it provides.

The Outreach process is continual and adaptive. Efforts to identify and engage stakeholders continue, especially in the environmental community. It will be necessary to continue to connect with Collaborative Forest Landscape Restoration Project (CFLRP) management teams and other partnerships where the US Forest Service has a presence to ensure active participation by the agency. Opportunities to leverage outreach efforts through professional channels will continue. The depot concept developed by IDX provides opportunities for rural communities to participate in this project and is of particular interest to rural communities. There is much synergy in current biomass utilization research and that of NARA. Continuing to foster discussion and opportunities among all parties is beneficial.

Ruckelshaus Center & DGSS

Task Objective

- Help inform and engage policy makers through distribution of quarterly electronic newsletters and briefing papers from information provided by the Project Directors and Leadership Team.

Methodology

- The Center, with the NARA Executive Committee, communications team, and outreach team, worked closely with the Advanced Hardwood Biofuels Northwest (AHB) project to prepare a series of quarterly briefing papers aimed at jointly informing policy-makers in Washington, Oregon, Idaho, Montana and Northern California about the projects’ progress.

Results

From September 2012 through July 2016, 15 briefs were sent to approximately 1,000 policy-makers.

Conclusions/Discussion

Because both WSU and UW were leading five-year, \$40 million AFRI CAP projects related to wood-based biofuels, the potential for confusion among policy makers was very high. This approach of having the two projects communicate jointly was an ideal solution for addressing this potential confusion, as it provided an opportunity to preface their updates with an explanation/reminder about how the two projects fit together and differed. It also demonstrated to the policy makers, funders and other stakeholders how these and other public and private institutions were collaborating and working together effectively on behalf of the overall project goals. The projects also efficiently stewarded public resources by sharing in the creation



and maintenance of one policy maker contact list for these briefings. The team used web analytics to document the receipt, opening and read rates of the briefings. That rate was low (around 10%), but consistent with other mass mailings and probably represented the proportion of NW policy makers with the interest/incentive to pay close attention to these issues.

## University of Wisconsin Extension - Upham Woods Outdoor Learning Center

### Task Objective

#### ***Education at the Speed of Research: NARA Assessment and Web-based Resources (University of Wisconsin-Upham Woods)***

Fundamentally, integrated approaches to energy literacy must be developed to effectively cross disciplines, include all stakeholders, and situate energy literacy into the consciousness of learners of all ages (Hougham *et al.* 2012). Meaningful approaches to this challenge address education at all levels—students, teachers, and public. The approaches found in the NARA project need to meaningfully address—and align—assessment as well as web-based content to communicate the exciting research in biofuels, while enriching the greater public understanding of energy literacy through media-enhanced curriculum. Addressing many entry points into the developing biomaterials economy of tomorrow while supporting an online collection of materials supports learners and provides the infrastructure for education at the speed of research (Hougham *et al.* 2012). Assessing the outcomes of this, and all education efforts, is integral to the success of the NARA project goal of enhancing energy literacy.

#### ***Lead Matrix web development efforts and coordinate population of relevant data into NARA web resources.***

We led development work for NARA Matrix, which includes the development of Literacy Assessment for Biofuels that can be delivered through [energyliteracyprinciples.org](http://energyliteracyprinciples.org). Additionally, we developed and maintain Energy Literacy Matrix and Web products as well as organized project products into online infrastructure. MagMag LLC will provide ongoing support of web-based tools, including refinement of [energyliteracyprinciples.org](http://energyliteracyprinciples.org)

### Methodology

#### ***NARA Energy Literacy Principles: Bioenergy education resources at the speed of research***

Energy Literacy is a foundational component of education for sustainability and for greening the curriculum. Integrated approaches in the sciences, including energy literacy, must be developed to cross disciplines effectively, include all stakeholders, and situate environmental sciences into the consciousness of learners of all ages.

Meaningful approaches to this challenge addresses formal and continuing education settings and engages K through gray alongside educators.

Content relating to an energy literacy infrastructure that reaches educational stakeholders across disciplines and audiences can be found within the [Energy Literacy Principles \(ELP\) website](http://energyliteracyprinciples.org) hosted by NARA.

### NARA Matrix

The NARA Matrix is an online repository of energy education resources. Energy and biofuels literacy can be challenging to teach in the classroom. Energy concepts and applications are complex and holistic, and draw from all the major sciences: biology, ecology, chemistry, physics, math, earth science, and environmental science. Researchers and educators have developed literally thousands of resources for teachers, and it can be difficult to understand how resources can be used to teach different components of science, and how those resources link back to the state and national science standards that all schools follow. The NARA Energy Literacy Principles Matrix is a web-based collection of educational resources related to biofuel solutions that are economically viable, socially acceptable, and meet the high environmental standards of the Pacific Northwest. This poster will discuss how a user can use the Matrix to find teaching materials such as lesson plans, datasets, videos, images, activities, software and modules. It will detail the structure of the Matrix, how to effectively search the Matrix, the different types of resources found within the Matrix, and ways to successfully use the Matrix as a teaching resource. Recommendations to discuss the upkeep and maintenance of the Matrix as well as to determine a data management process to ensure the longevity of the resources within the Matrix upon the completion of this project will be made.

### Results

Progress includes the completion of an energy literacy assessment tool, guest editor of Energy Education issue for Journal of Sustainability Education (featuring a collection of NARA articles), continued enhancement of NARA Matrix (676 assets to date, including 160 added this year), and wide dissemination of NARA efforts in stakeholder venues. Over 21,000 page visits have been recorded on the site from over 4,000 unique visitors. Current number of Matrix assets total over 600.

### Conclusions/Discussion

The collection, hosting and sorting of digital assets emerged as an essential function for Outreach efforts. This served as a multiplier for project team member efforts—digital assets were created and distributed by original authors. Following this, all contact through the Matrix hosting represented a value-added venue totaling over 21,000 contacts.

## TASK 2: BUILDING SUPPLY CHAIN COALITIONS/REGIONAL ALLIANCES

To build supply chain coalitions and regional alliances, the NARA Outreach team provided logistical support and stakeholder development and engagement to the research and education teams. We formed working groups with stakeholders at community and bioregion levels to involve them through collaboration across the supply chain: forestland owners and managers, environmental NGOs, businesses, regulatory facilitators, and community infrastructure working groups to interact with and inform policymakers at regional, state, and federal levels. These stakeholders were internal and external focused around the NARA communities (NCs) selected in the four-state region. This process relied on support from other teams, such as Education and EPP, and considered physical and social assets along with practical aspects in narrowing down the list to a manageable number of communities with the four-state region. A long list was shortened through surveying community-based stakeholders in the PNW and intermountain region to strategically choose several NCs for studying the viability of a biofuel-based infrastructure. Once communities were identified, focus group meetings involving a wide variety of stakeholders were held at each community to discuss feedstock specifications and logistics, technology adoptions within the existing infrastructure, and viable strategies practical and beneficial for the communities. This process involved industrial stakeholders and NARA industry partners as well. Establishing a meaningful dialogue on what local experts perceive to be the barriers and opportunities for facilitating a biorefinery infrastructure in their community is critical.

### Idaho

#### Task Objective

- Network with NARA researchers and initiate stakeholder relationships in Idaho
- Establish working relationships with regional cooperators
- Help identify pilot supply chain regions and assist as needed to engage stakeholders
- Help develop survey with EPP group
- Assist with synthesis of survey results

#### Methodology

Provide extension workshops to address NARA tasks and goals. Extension programs, workshops, field days, etc. were held over the 5-year period. A survey was given to over 300 stakeholders regarding biomass knowledge and perceptions.

#### Results

Over 3,050 stakeholders attended Extension programs and became familiar with

the NARA project. Over 300 surveys were filled out.

A majority of stakeholders were familiar with the concept of using woody biomass as an energy resource (Figure EIS-2.1). Additionally, a majority of stakeholders feel like utilizing woody biomass has sustainability (Figure EIS 2.2). Overwhelmingly, stakeholders feel that lack of financial support (capital) is the major obstacle (Figure EIS-2.3). Most felt that their communities would benefit through jobs, economic development, healthier forests, and being associated with sustainable practices (Figure EIS-2.4), while most did not see any drawbacks to utilizing woody biomass for energy production (Figure EIS-2.5). When asked if there was a cost effective alternative to burning forest residuals for disposal, would you consider using it, almost 75% of the logging contractors surveyed were likely to consider it (Figure EIS-2.6). When asked how communities would benefit if an alternative to burning was available, the majority thought added jobs would be the biggest benefit (Figure EIS-2.7).

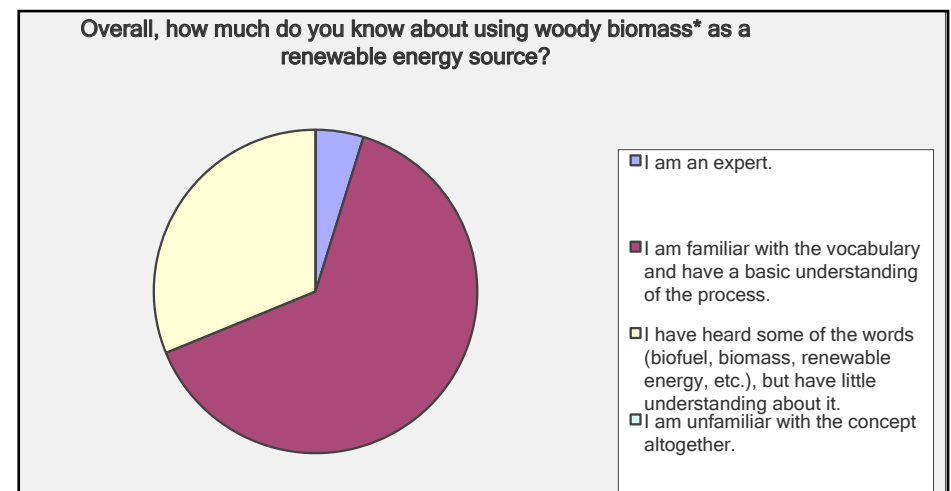


Figure EIS-2.1. How much do stakeholders know about using woody biomass as a renewable energy source?



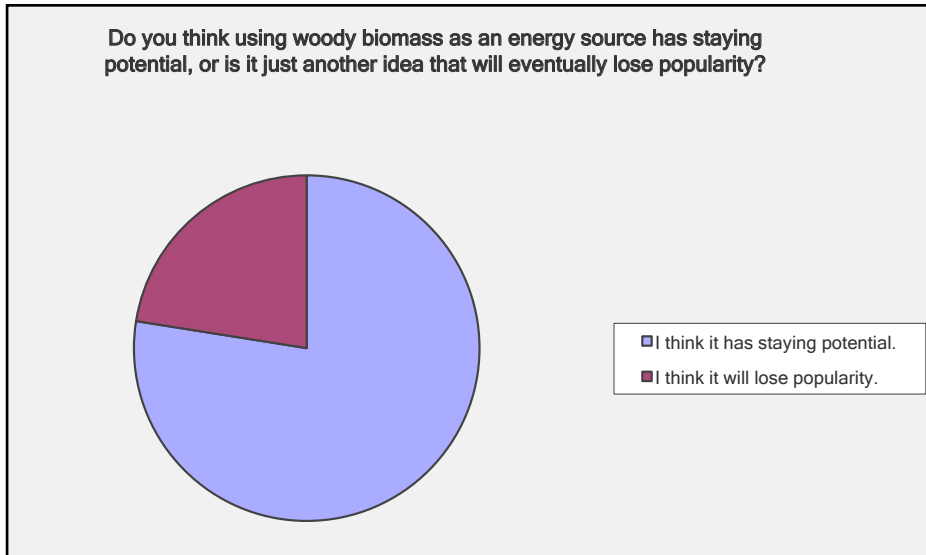


Figure EIS-2.2. Does woody biomass have staying potential or will it lose popularity?

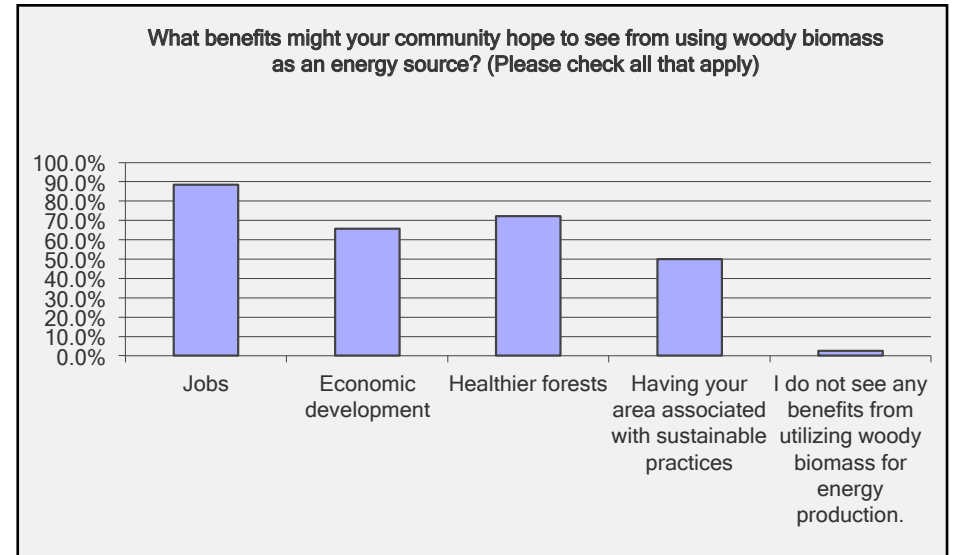


Figure EIS-2.4. How would communities benefit from using woody biomass?

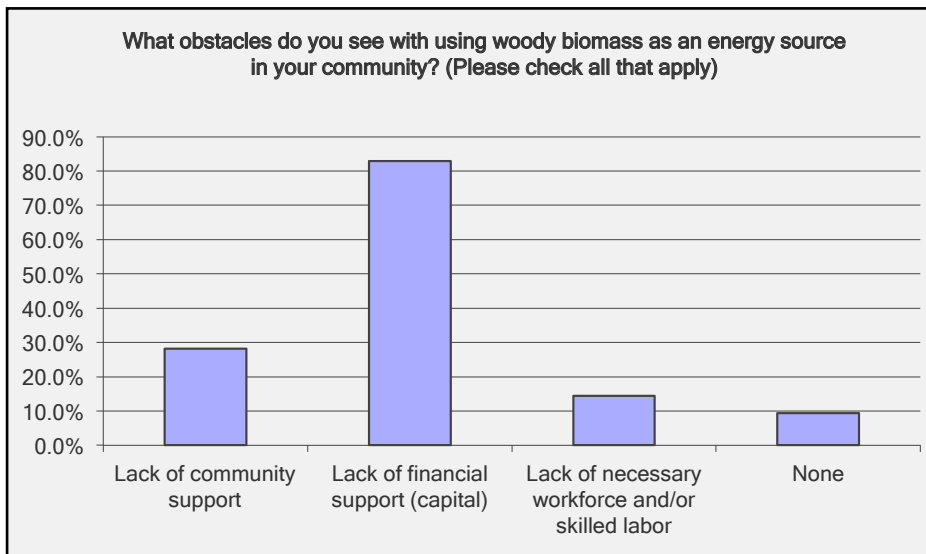


Figure EIS-2.3. What are the obstacles to using woody biomass?

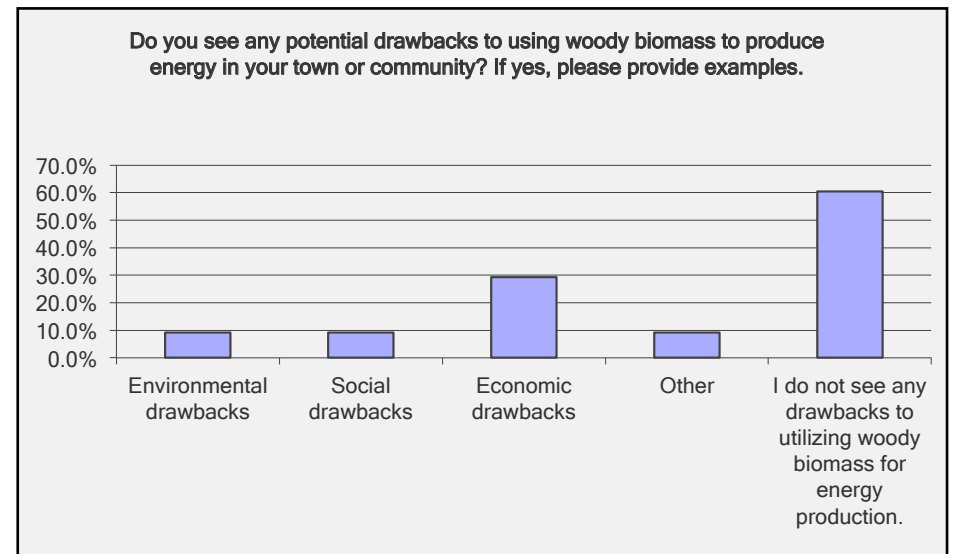


Figure EIS-2.5. What are potential drawbacks to using woody biomass to produce energy?

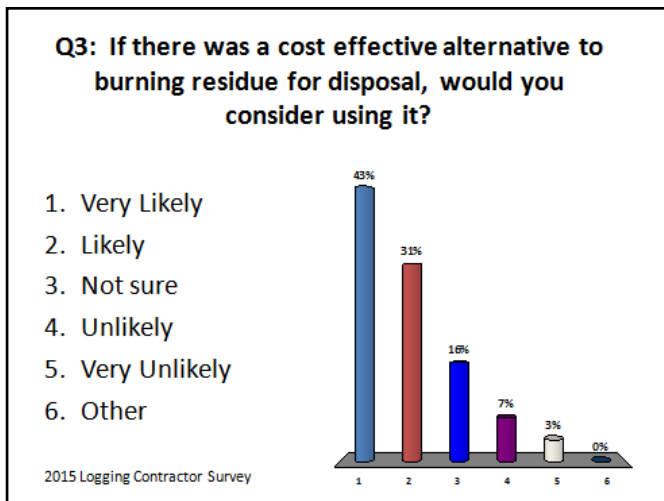


Figure EIS-2.6. If there was a cost effective alternative to burning residue for disposal, would you consider it?

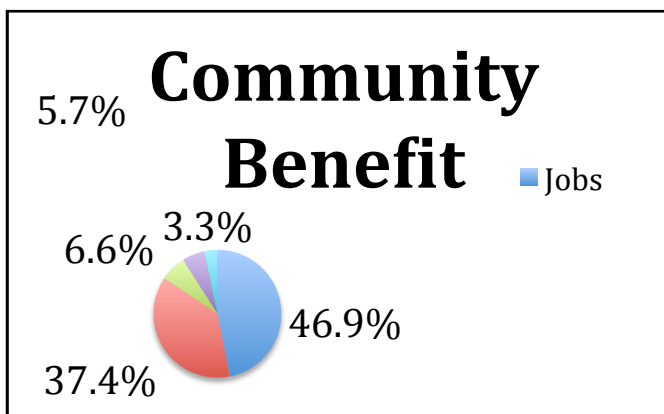


Figure EIS-2.7. Survey participants were asked how they thought communities would benefit if an alternatives to burning were available. The majority thought added jobs would be the biggest benefit.

### Conclusions/Discussion

Survey results show mixed attitudes and feeling towards woody biomass utilizations. Most respondents are familiar with terms and concepts and believe it has staying potential. Job creation and a healthier forest are among some of the perceived benefits. However, lack of financial support is seen as the major barrier to any woody biomass utilization efforts. Fifty-six percent felt they would benefit from an education presentation but felt turnout might be poor.

## Montana

### Task Objectives

- Work with NARA and Montana Forest Products Retention Roundtable to develop pilot supply chain region criteria and rubric
- Identify a Montana NARA community
- Compile Montana assets for supply chain analysis
- Assist with NARA's annual meeting in Montana
- Update Montana coalitions of NARA findings
- Share Montana stakeholder concerns, ideas, and issues with NARA

### Methodology

The Outreach work that BBER did to help build supply chain coalitions for the NARA project included: 1) engaging Montana stakeholders to introduce the NARA project and develop a NARA Community in Montana, 2) sharing our research results from the Feedstock/Supply Chain side of the project, and 3) maintaining contact with Montana stakeholders to relay information and concerns between Montana stakeholders and NARA.

Erik Berg and Todd Morgan participated in the September 2011 NARA Kickoff Meeting in Spokane with Peter Kolb, Craig Rawlings, and others; Todd Morgan attended the USDA announcement ceremony at SeaTac. With Todd, the University of Montana produced a [press release](#) when the NARA project was announced at SeaTac. Todd Morgan had an interview on October 5, 2011 with a local TV news (KPAX) reporter, Russ Thomas, as follow-up to the press release, to help introduce the NARA project to western Montana. Although outside of Montana, Todd gave a presentation From Stump to Pump: wood-based biofuel research in the Northwest at Portland State University December 15, 2011 that was web-cast live. The presentation introduced the NARA project in general, and provided details about the measurement of logging residues that BBER researchers are collecting.

Throughout the community selection process, BBER cooperated with NARA Outreach Team, MSU Extension Forestry, and FBN in developing test bed site criteria, getting Montana stakeholder input, and providing information to the various NARA teams relevant to NARA Community selection. Along with Craig Rawlings (FBN), Peter Kolb (MSU Extension Forestry), and others, BBER members participated in the February 2012 NARA Montana team meeting at DNRC headquarters in Missoula to encourage DNRC interest and participation in the NARA project and solicit their input on biomass research needs. The BBER team and MSU Extension Forestry participated in the March 2012 NARA Outreach Team meeting at the Rocky Mountain Elk Foundation in Missoula, meeting with community, government, and business leaders about the NARA project and selecting Missoula and the Western Montana Corridor as a NARA Community.

Todd Morgan, Steve Hayes, Chelsea McIver, Colin Sorenson and Eric Simmons helped organize and actively participated in the June 2012 Missoula Pilot

Community meeting at the University of Montana's School of Business Administration. This meeting was attended by more than 50 industrial, government, and NGO scientists and managers and showcased Missoula-area biomass processing infrastructure and research capabilities. Chelsea McIver participated in the Human Capital breakout session and added significant content on contractor capacity and the use of collaborative teams. Todd Morgan gave a presentation Woody Biomass from Logging and Mill Residuals on June 13, describing work BBER would be conducting as part of the NARA team and highlighted major trends and conditions in the Montana forest inventory, forest industry, and timber harvest. Steve Hayes, Colin Sorenson, and Eric Simmons also participated in the break-out sessions.

Erik Berg presented "Western Montana Corridor: Woody biomass from logging and mill residuals" at the September 2012 NARA annual meeting in Missoula, highlighting biomass supply in western Montana. Colin Sorenson, Chelsea McIver, Eric Simmons, and Erik Berg presented posters, and with Steve Hayes attended the NARA annual meeting in Missoula, providing information to stakeholders and feedback to NARA on Montana stakeholder concerns and issues.

Along with Gevan Marrs, Mike Wolcott, John Sessions, Todd Morgan and BBER staff drafted an eastside feedstock sampling protocol in the fall of 2012. This document outlined procedures to characterize the differences in sugar yields and conversion issues among readily available eastside feedstock species, such as ponderosa pine, through the NARA feedstock testing process. BBER researchers helped identify biomass suppliers like Kevin Jump, planned logging site and residue pile sampling, chipping logistics, and transportation of chipped residues to Federal Way, Washington for testing. Josh Meek wrote a graduate-level University of Montana term paper (Meek, 2013) detailing potential production-level eastside residue acquisition and chipping in late fall 2012. BBER's feedstock planning helped assure eastside stakeholders that NARA sought feedstock contributions throughout the entire four state project area.

MSU Extension Forestry wrote and published two articles pertaining to the NARA project for their spring landowner and logger newsletter as well as an article in the NW Woodlands magazine. Peter Kolb presented an overview of Montana private landowner assets and management challenges to the NARA annual conference. MSU Extension Forestry had displays and posters of the NARA Supply Chain as well as current outputs from other NARA teams at the annual Forestry MiniCollege for forest landowners and practitioners, as well as the annual MSU Extension Conference for Extension faculty and staff.

Martin Twer lead the effort of gathering, compiling, and editing the document "Why the Western Montana Corridor as a NARA Pilot Community" that provided key decision support for bringing the next NARA Pilot Community to Montana. He did data collection, GIS work and development/implementation of interactive maps for the physical resources in Montana

([http://www.msuextension.org/forestry/NARA/nara\\_resources.html](http://www.msuextension.org/forestry/NARA/nara_resources.html)), including primary wood processing facilities, railroads and potential loading locations, refineries and refined products pipelines, and airfields. These became data layers of the NARA modelling and siting analysis framework.

In early 2013, BBER personnel invested more than 100 staff hours reviewing the NARA IDEX Team's WMC Atlas project. BBER reviewed 3 separate Atlas products: posters at the January 2013 Missoula Open House, the rough draft Atlas document, and the revised Atlas draft. These oral and written reviews uncovered significant content problems, provided remedies for these shortcomings, and helped shape the final Atlas product as well as the later Eastside Biorefinery Siting Analysis.

Todd Morgan also participated in the May 2013 NARA stakeholder meeting in Vancouver, WA, discussing lessons learned from his experience with the WMC community.

Although BBER's official NARA Outreach Team involvement ended in mid-2013, Todd Morgan and other BBER team members attended the monthly Forest Products Retention Roundtable meetings in Missoula throughout the five-year span, sharing information about the NARA project and keeping abreast of local forest industry and biomass issues to share with NARA investigators. Likewise, BBER employees shared information about the NARA project with various Montana stakeholders including: the Forest Products Retention Roundtable, Montana Logging Association, Montana Wood Products Association, the Montana Forest Restoration Committee, Montana DNRC staff, various mill operators, and UM College of Forestry and Conservation faculty and students. And BBER members continued to respond to numerous requests from within and outside NARA, providing information related to timber harvest, logging and mill residue, mill infrastructure, and forest conditions in Montana and elsewhere in the NARA region. BBER personnel also took part in all of the NARA annual meetings, participating not only as NARA researchers but also representing Montana stakeholders.

From 2013 until 2015 MSU Extension engaged Montana forest stakeholders with presentations by Peter Kolb outlining the NARA project to the Montana Tree Farm Board, Montana Forest Council, Montana Forest Owners Association, Montana Logging Association, and Montana Association of County Ag. Agents. In addition, he participated in the western Montana KGVO talk radio show outlining and answering questions about forest biomass utilization projects to an estimated 28,000 listeners. Additional articles and updates on the NARA project were added to the 2014, 2015 and 2016 spring Forest Landowner newsletters and eNewsletter. To support the NARA project and its role in potential forest harvesting Peter Kolb produced a 5 series YouTube production and incorporated woody debris retention guidelines in the Montana Forest Best Management Practices guidebook.

Martin Twer provided quarterly updates on the NARA project to the Montana State Wood Energy Team, distributed and facilitated the NARA-ASCENT survey at the 2015 annual BANR conference in Missoula, participated in the Outreach/Education Team

meeting (1K Biojet Media production; Engaging ENGO's) in February 2015 in Seattle, WA; facilitated contact between Fueling our Future and Montana science teachers; participated in NARA discussion of environmental issues with representatives of environmental NGO's in Colville, WA. In 2015, he was the Montana representative at the Western State Wood Energy Team meeting in The Dalles, OR, and subsequently participated in follow-up conference calls regarding utilizing the NARA analysis framework to assist states in developing their state implementation plans for EPA's Clean Power Plan. In 2016 he provided supplementary information for a possible additional Eastside analysis regarding the potential of co-firing the Colstrip Coal Power Plant in Colstrip, MT, with wood pellets.

During late 2015 and early 2016, Erik Berg and Todd Morgan of BBER cooperated with Natalie Martinkus, (WSU), Greg Latta (OSU), and several others on the development and presentation of the Eastside Biorefinery Siting Analysis to the Forest Products Retention Roundtable on April 8, 2016 in Missoula. That presentation was very important for "closing the loop" on NARA's work in Montana and helping stakeholders understand the potential for biojet in Montana.

## Results

With FBN and MSU Extension Forestry, BBER helped introduce Montana stakeholders to the NARA project, kept stakeholders informed of NARA developments, and relayed Montana stakeholder interests and concerns to NARA. The June 2012 Pilot Community Meeting and September 2012 NARA Annual Meeting in Missoula were considered successful by BBER personnel in attendance. There was strong community interest in the NARA project and any efforts aimed at increasing utilization of, and markets for, woody material removed from Montana forests. As a result, Missoula and the WMC were selected and analyzed as a NARA Community; and the WMC Atlas and Eastside Biorefinery Siting Analysis projects were completed and presented to the Forest Products Retention Roundtable "client". Local constituents had more interest in the supply of woody biomass for use by ANY industry than the jet fuel industry in particular. BBER reported to NARA that efforts in Montana would be well-served by making local wood supply, biomass, and infrastructure information available and useful to existing wood-using industries as well as any potentially new users, like biojet refineries. Consequently, the Roundtable and other Montana stakeholders were successfully engaged, and have a better understanding of the woody biomass resource and the potential feasibility of a wood-based biomass/biofuels industry developing in the region.

## Conclusions/Discussion

Although the WMC Atlas and Eastside Biorefinery Siting Analysis indicated such a facility was less feasible in western Montana than other western locations, WMC stakeholders remained interested and engaged with NARA, seeking to better understand woody biomass utilization and co-products options. The involvement of Montana organizations (i.e., BBER, FBN, MSU Extension Forestry) in the NARA project and discussions between Montana stakeholders and NARA via the Outreach Team enabled the successful development of a regional alliance in Montana. These stakeholders now

have a well-rounded understanding of the realities of processing logging residuals for biomass, and access to new tools and information for analyzing other potential biomass endeavors, as well as a broader network of experts to consult with.

## Oregon

### Task Objective

- Assist in developing briefing paper on NARA community criteria and identify potential OR communities for pilot supply chain studies with IDX and EPA
- Review existing data on OR assets in the supply chain study
- Assist with organizing and coordinating field trip to interact with stakeholders
- Convene focus group meetings when appropriate to inform and engage OR stakeholders
- Stakeholder development in OR and supply chain regions and cultivate regional alliances

### Methodology

The approach to address these objectives emphasized relying on the existing network of Extension professionals in OSU's Forestry & Natural Resources Extension program as well as the network of professionals involved in the Oregon Forest Biomass Working Group. These professionals assisted with identifying key assets in the supply chain in Oregon, existing data such as published reports on the assets, as well as key contacts within the supply chain. Hence the approach taken was to communicate with these individuals (individually and/or via meetings of the Oregon Forest Biomass Working Group) to accomplish the specific objectives listed above.

### Results

A brief summary of specific activities includes:

- Assisting with the organization of two NARA-focused meetings – one very early in the project in Salem to seek the involvement of members of the Oregon Forest Biomass Working Group (10/25/11) and another meeting near the end of the project in Portland organized as a 'community forum' (4/11/16); and in July of 2013, a field trip to visit key assets in the biofuels supply chain in metro Portland was organized
- With the assistance of a graduate student (Janna Loepky), 5 summaries of OSU researchers' activities were developed and posted on the OSU Forestry Extension NARA web page; in addition, two articles on the NARA project were developed for *Western Forester* magazine;
- Presentations related to the project were given to the Oregon Forest Biomass Working Group, a graduate seminar course at OSU, at a conference in Finland, and a lecture by Mike Wolcott for OSU's annual Starker Lecture series was organized
- As a summary of Oregon supply chain assets, graduate student Janna Loepky compiled an updated listing of Pacific Northwest pulp and paper mills

## Conclusions/Discussion

The size and scope of the NARA project resulted in some challenges with addressing a few of the task objectives, at least as they were originally envisioned. The end result, however, was in fact superior to what was originally envisioned. For example, the one OSU Extension faculty member working on the project initially planned to review community assets, convene community forums in locations appearing to have high potential, and then develop a summary report for each location. As the project progressed, it became clear that these tasks were being addressed, and with far more ‘horsepower’, by the faculty and students involved in WSU’s Integrated Design Experience (IDX) program. Therefore, the efforts in Oregon shifted to other areas such as organizing field trips and meetings as well as providing data and connections to key stakeholders in an effort to support the work being conducted by IDX.

## Washington

### Task Objective

- Work with EPP in formulating criteria for pilot supply chain study regions and identify potential regions
- Assist in connecting with key stakeholders and compiling regional assets
- Form regional coalitions and be a conduit between NARA and Biomass working groups

### Methodology

#### *Pilot Supply Chain Regions*

In collaboration with the EPP team and the IDX team, strategies to determine supply chain regions that would serve as pilot study regions, link with stakeholders, and compile assets in these regions were formulated. The EPP and Outreach teams are coordinating with various NARA team experts to identify NARA Communities (NCs) through the following multi-pronged approach:

- The Clearwater Basin was selected by the Education Team as the 1st NARA Pilot Community (NPC) to provide valuable input into the NARA site selection process and to allow their tasks to move forward on schedule. This selection was based on long-standing relationships and experience in the area.
- An expanded team of experts was developed to consider appropriate protocols and relevant criteria for NPC selection. This team determined that a 2nd NPC site in Western Montana (Missoula) represented a logical location based on geographic, political, economic, and social rationale.
- NARA Outreach team members were then asked to complete a web-based survey to identify potential NC sites in the 4-state region and identify potential NC SHs.

## Connect with Stakeholders and Compile regional assets

At the outset, the Outreach Team, with input from other teams and in particular the GIS and the EPP Teams, determined the necessary stakeholder database sets to build. These included the following:

- Forestland owners (private, public, corporate, tribal)
- Forest-based industries (loggers, haulers, primary, secondary, etc.)
- Policy makers at local, state, and national level
- County commissioners
- Recycling centers and MRFs
- NGOs -- environmental and social interest groups
- Biorefineries and relevant chemical/co-products industries
- Transportation

Extension faculty from each state was given the charge of gathering these databases. For WA, we have compiled information regarding all county commissioners and preliminary list of sawmills, secondary manufacturers, and policymakers. Other relevant information, such as railroad lines, airports or airstrips, and roadways, are also being compiled. Compiled databases were distributed to the GIS and EPP teams for supply chain analysis and stakeholder surveys.

### Regional Coalitions

Efforts to identify and strengthen supply chain coalitions included organizing stakeholder meetings and compiling lists of known assets and key stakeholders within the pilot supply chain regions identified. The Outreach Team members assisted the IDX team in coordinating discussions with key stakeholders in these regions throughout the project to identify a client, such as a stakeholder group that represents a wide group of interests, to carry out the supply chain analysis during a given year. As the IDX team conducted their analysis throughout a given year, the Outreach Team facilitated transfer of the supply chain analysis and its results to the stakeholders electronically as well as through regional stakeholder meetings, such as biomass working groups, county economic development meetings, or other workshops/conferences. Periodic progress reports were delivered through presentations to various stakeholder groups, such as Montana Forest Products Roundtable and Washington Forest Biomass Coordination Group, in the four-state region. Quarterly reports were distributed to a compiled list of policymakers at the local, state, and national levels through the Ruckelshaus Center. The efforts made to reach out to the environmental community stakeholders included attending environment related conferences (e.g., PIELC, Eugene, Oregon), distributing NARA newsletters and other publications via email, personal visits, and small regional meetings with targeted individuals.

### Results

An initial NARA community site selection process was developed as summarized in Figure EIS-AppB.1 in Appendix B of this report. This process was modified and refined as the project evolved due to new stakeholder relations that were devel-



oped and information that was gathered regarding assets in different areas in the four-state project region. Simultaneous to assisting to define the pilot supply chain (PSC) study regions, the outreach team collaborated with the EPP and Education teams to develop a scientific method for PSC selection process. As per established methodology, a survey of the NARA Outreach team members was conducted to develop a long list of potential NCs. A total of 24 communities/bioregions have been nominated. Appendix B in this report also includes the NARA Community Survey that was conducted among the NARA Outreach team members, survey results, and selection criteria for a NARA community.

The Outreach team worked with Integrated Design Experience (IDX) in developing a biomass atlas for the Clearwater Basin, Idaho, during the first year. In the second year, NARA's first official pilot supply chain study (PSC) region (Western Montana Corridor) was established where the outreach team assisted IDX and EPP team with engaging stakeholders, gathering assets, and conducting supply chain analysis. In Year 3, the supply chain analysis findings in MC2P region were compiled and summarized working with the Education and Sustainability teams. During this year, the outreach team members actively disseminated WMC and MC2P study findings in Montana, Oregon, and Washington. Assisted the Education Team's IDX group with planning and writing profile document for NARA's Year-4 Supply Chain Study (Pacific Northwest (PNW)), summarizing available assets. Connected the IDX team with key industry stakeholders (GP, Weyerhaeuser, Port Townsend Paper Company, and ZeaChem) and organized fieldtrips to familiarize students with production/conversion facilities relevant to the NARA project.

In the final year, the IDX and the Outreach teams chose the Olympic Peninsula region to conduct a feasibility analysis with PTPC and their biomass supplier, Hermann Brothers, as partners. The three study objectives were:

1. Analyze and design a co-located liquids depot at existing pulp and paper mills, with analysis of biomass requirements and potential markets
2. Analyze and design a lignin recovery facility at existing pulp and paper mills, with analysis of biomass requirements and potential markets
3. Assess community perceptions in Clallam and Jefferson counties related to wood-based biofuels and co-products production

We collaborated with the local WSU County Extension directors of Port Townsend and Clallam counties to connect with community stakeholders to inform them about NARA, the objectives of the regional supply chain analysis, and the importance of engaging them in the process. Input from local stakeholders was critical to conduct a meaningful supply chain analysis.

Students from the IDX course and faculty in the Education and Outreach teams traveled to the Olympic Peninsula and met with Bill Hermann, the owner of Hermann Brothers in Port Angeles, to observe collection and processing of post-harvest forest

residuals or forest slash. We also met with Port Townsend Paper mill and Nippon Paper mill to learn about their operations, and engaged local citizens in an open house forum at Port Townsend to hear their thoughts about a potential industry that could use post-harvest residuals to make bio-jet fuel and other products.

The WSU Jefferson County Extension office hosted a community open house in Port Townsend to engage local citizens. The meeting room was filled with locals. After a brief presentation, the IDX students and the Outreach and Education Team members answered their questions regarding the project and heard their concerns about the use of forest residuals for chemical products. Here are the main issues raised and discussed by this set of stakeholders:

- a. How would the production of bio-fuels and co-products from post-harvest forest residuals affect the local air and water quality, noise, odor and traffic levels?
- b. What are the waste products generated from the conversion process, and will the life cycle assessment (LCA) be unbiased?
- c. How much of the residuals should be left in a working forest to maintain ecological health?
- d. What will be the potential demand for the forest residues once an industry is established.

Throughout the five-year project period, a series of local meetings were organized and hosted to engage with stakeholders in the supply chain regions to solicit information to further augment the Outreach and Education teams' existing asset databases. A communication plan was developed to inform and engage stakeholders (Appendix C of this report).

Represented NARA at WA Biomass Coordination Group and MT Forest Products Industry Roundtable (serve as stakeholder leadership teams providing guidance with regional supply chain analyses). Presented progress on the regional supply chain studies and NARA at seven regional stakeholder meetings. Recognizing the need to actively engage ENGOS, the Outreach Team compiled a list of individuals and environmental organizations for a personal visit for their perceptions and opinions. We engaged stakeholders across the supply chain by networking and presenting at targeted conferences and meetings, such as WA, OR, and MT Logging Associations, Spokane Tribe Council meeting at Wellpinit, WA, Montana Economic Development Association Conference, Lewis County Economic Development Council's General membership meeting, Annual National Indian Timber Symposium in Keshena, WI, Small Log Conference, and the Western Region Forest Resources Association Spring Meeting. Working through these existing coalitions assisted in disseminating NARA research findings quickly to a wide array of stakeholders. Networking during these events resulted in self-registration of many of the stakeholders through NARA's Stakeholder Engagement sign-up link at the NARA project website.



The Outreach and the Education teams capitalized on NARA's effort in Year-5 to produce 1000 gallons of bio-jet fuel by documenting and producing professional-quality media to promote bioenergy literacy by developing educational tools and to archive NARA's research, outreach, and education outcomes. In order to secure a U.S Northwest representative Douglas-fir feedstock supply to produce 1000 gallons of bio-jet fuel made from forest residuals and used for a demonstration flight, forest residuals from Washington, Oregon and Montana were collected. The Outreach Team video recorded the collection of these feedstocks and conducted interviews with the landowners and foresters. The video recordings of the biomass conversion into hydrolyzed sugars, fermented isobutanol, and polymerized bio-jet or IPK were also conducted to produce a professional-quality video describing NARA's effort to help develop an industry that empowers rural economies, increases America's energy security, and reduces aviation's environmental impact by using forest harvest residuals (*Slashing America's Carbon Footprint: An Emerging Biofuel Source*). The involvement of the Outreach Team at the varied feedstock sites (Tribal lands and Weyerhaeuser property) during media production reinforced the engagement between NARA and stakeholders and enhanced stakeholder knowledge regarding NARA activities. An interactive online [timeline of 1K gal Bio-jet production](#) has been created to archive the story and inform the stakeholders about the process and the status, to acknowledge the contributions of participating companies in the bio-jet production, and to update NARA community and the USDA. Video assets were obtained in the Olympic Peninsula (Hermann Bros, Town Meeting in Port Townsend, slash removal and creation), ZeaChem, and ICM.

Environmental communities were not well represented at the stakeholder meetings, conferences, and/or in survey replies. To capture their concerns and opinions regarding utilization of forest residuals for biofuels, the Outreach Team made an effort to engage them through personal visits and communications. We have also reached out to the environmental community through NARA participation at the [Public Interest Environmental Law Conference](#) (Eugene, OR) and discussion with regional environmental communities at the Biofuel Coffee, organized by the Gifford Pinchot Taskforce. This allowed for an open conversation on the utilization of waste wood to biofuel concepts and their implications on the forest ecosystem and the overall environment. Most effective communications with the environmental community was a result of personal visits with representatives from Oregon Wild, Sustainable Obtainable Solutions, Friends of the Little Pend Oreille Wildlife Refuge, Friends of the Clearwater, and GP Taskforce. Based on these discussions, following challenges in converting forest slash to bio-based chemicals were gleaned:

- Rebuilding public trust through open conversation and maintaining transparency. Respect of sense of place and honor commitment to sustainability. Encourage collaborative decision-making. Address economic concerns and jobs.
- Monetizing the process while addressing environmental concerns.
- Potential stiff competition from bioenergy companies.
- Build no new permanent roads to access forest slash.
- Physical, biological, and human dimensions of sustainable management

should be given equal importance in the decision-making process.

- Baseline for sustainability must maintain soil productivity and structure, biodiversity and habitat, water and air quality, visual quality, landscape and community character, sound energy return on energy invested, environmental quality, environmental justice/social equity, and balance flow of output with sustainable flow of inputs.
- Minimize transportation distances and biomass delivery infrastructure.
- Identify and avoid sensitive lands (such as wetlands, threatened & endangered species habitat, steep slopes, and erosive soils).
- Avoid monocultures and maintain biodiversity.
- Encourage citizen involvement (all ages) in implementation and monitoring.
- Engage policymakers and key opinion leaders in ways that meets their needs.
- Work with media to highlight successes and admit what we don't know.
- Establish demonstration sites.
- Recognize that all natural resource decisions are social decisions, and that science informs but does not dictate actions or policies.
- Keep timelines in mind: politicians rarely plan for longer than an election cycle; public land managers rarely plan longer than an adult work life.
- Commit to full life cycle assessments – energy use, carbon footprint, and water use.
- The amount of energy input is more than energy output
- Potentially negative long-term ecological effects from using forest residuals
- Concern that an industry using wood feedstock will demand greater amounts as it develops and those resource demands will expand into the public forests. Concern that if it is successful on private forestlands, will it then spread to federal lands? If successful, how many biofuel plants will be established? It is the fear of industrializing certain aspects.

On the research front within the Outreach Team, Rui Zhu, a PhD candidate, investigated hot water extraction (HWE) as an integrated pretreatment option within the supply chain for production of value added byproducts as woody biomass (Douglas fir) is converted into biofuels and co-products (Figure EIS-2.8). Overall, HWE pretreatment shows great potential for extracting hemicelluloses and altering physicochemical properties of wood in an integrated biorefinery for diversification of product portfolio. Hot water extraction (HWE) was exploited as a pre-process to initially fractionate cell wall structure of softwood Douglas fir, which is considerably more recalcitrant compared to hardwoods and agricultural feedstocks. A response surface model was developed and the highest hemicellulose extraction yield (HEY) was obtained when the temperature is 180 °C and the time is 79 min. HWE process partially removed hemicelluloses, reduced the moisture absorption and improved the thermal stability of wood. To investigate the effects of HWE pre-process on sulfite pretreatment to overcome recalcitrance of lignocellulose (SPORL), a series of SPORL with reduced combined severity factor (CSF) were conducted using HWE treated Douglas fir. Sugar analysis after enzymatic hydrolysis indicated that SPORL

can be conducted at lower temperature (145 °C), shorter time (80 min), and lower acid volume (3 %), while still maintaining considerably high enzymatic digestibility (~55-60%).

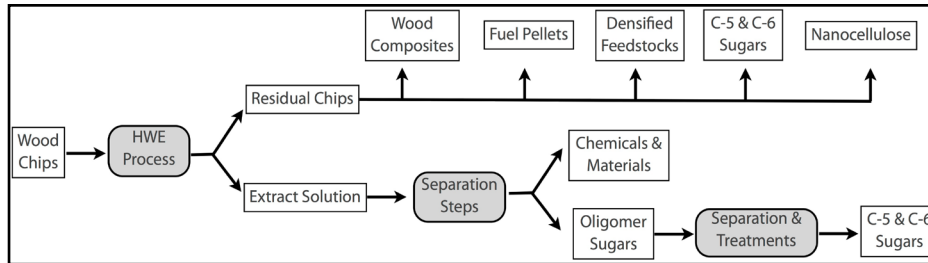


Figure EIS-2.8. HWE as integrated technology to derive value along the supply chain of converting woody biomass into biofuels and co-products.

Deriving valuable co-products would increase the overall revenue and improve the economics of the biofuels supply chain. The feasibility of extracting cellulose nanofibrils (CNFs) from HWE treated Douglas fir by ultrasonication and CNFs' reinforcing potentials in Nylon 6 matrix were evaluated. Morphology analysis indicated that finer fibrils can be obtained by increasing ultrasonication time and/or amplitude. CNFs was found to have higher crystallinity and maintained the thermal stability compared to untreated fiber. A method of fabricating nylon 6/CNFs as-spun nanocomposite filaments using a combination of extrusion, compounding and capillary rheometer to minimize thermal degradation of CNFs was demonstrated. It was found that the nanocomposite filaments have slightly lower thermal stability and crystallinity compared to neat nylon 6 filaments. However, the incorporation of CNFs increased the tenacity and hydrophilicity of the nanocomposite filaments, indicating a potential for their use as precursor materials for textile yarns.

The research project carried out by the PhD student resulted in four publications in refereed journals and multiple presentations at professional conferences.

### Conclusions/Discussion

An important lesson learned through NARA outreach efforts was that it is critical to manage the expectations of generally supportive stakeholders, while continuously engaging potentially opposed stakeholders in the discussions towards the decision-making process. When proposing to utilize forest based biomass, it brings out skepticism and opposition due to concern over who the beneficiaries of biomass programs and subsidies are and their uncertainty, fear of ever-growing industry demand for forest-based feedstock leading to relying on public forests to meet this demand, and over-simplification of the complexities of forest restoration treatments that can lead to unintended consequences such as negative long-term ecological effects from using forest residuals. During this project, working with stakeholders, colleagues in the biomass utilization field, and other team members, we have observed the following:

- Managing stakeholder expectations is critical to mitigate misconceptions of

a physical plant being built by the end of the NARA project.

- In commercially owned forest lands, where shareholders are involved, the bottom line is the value derived from forest slash and not much emphasis is placed upon making biofuels.
- Current forest products industries fear competition of their biomass supply (e.g. mill residues). NARA needs to continue their clear explanation of the feedstock source.
- Stakeholders appreciate information regarding specifications for acceptable feedstocks
- Increasing awareness of the benefits of co-products and green chemistry is becoming more common.
- Stakeholders are often concerned with feedstock collection and transportation logistics

For developing any biomass utilizing infrastructure/economy, it is important to build coalitions across forest- and agriculture-based biomass sectors, chemical industries, state agencies, transportation sector, communities directly affected by establishment of biomass-to-biofuel infrastructure, aviation industry, and environmental community through NARA-type projects or other extension activities. Engaging the environmental community has to be carried out through personal visits and small focused group meetings rather than through large-scale, open forums.

A petroleum refinery had the benefit of developing such framework over many decades; however, limited fossil fuel supply and political uncertainties have resulted in volatility of crude oil prices. This compels us to evaluate the feasibility of adopting a viable pre-process (such as HWE) within a wood-to-biofuel and co-products infrastructure to derive value along the process through production of easily extractable sugars while enabling production of other end products, such as cellulosic nanofibrils, in lieu of biofuels that currently cannot be produced competitively. The findings of the Ph.D research contributed to the knowledge base of HWE's role as a pre-processing step in a wood-based biorefinery. HWE pre-process at a depot offers the flexibility for producing an array of products, including simple sugars for biofuels, less hydrophilic wood chips for wood-based composites and fuel pellets, and easy-to-defibrillated materials for CNFs. The obtained CNFs were demonstrated to be very promising reinforcing nanofillers for Nylon 6 based multifunctional textile material.

### USFS PNW Research Station

#### Task Objectives

- Network with NARA research teams
- Initiate and cultivate relationships with regional stakeholders and partnerships
- Assist in development of decision criteria for pilot supply chain regions
- Meet with clients and stakeholders at pilot supply chain regions

- Assist in organizing and facilitating community meetings
- Communicate with partnerships, collaboratives, and other Forest Service personnel
- Assist with field trips

### Methodology

Many of the methods used to increase bioenergy literacy were also used in building supply chain coalitions/regional alliances. The primary methods were through hosting meetings, making presentations, conducting field trips, and initiating personal contact.

Pilot Supply Chain coalition meetings were held in Montana, Oregon and Washington. Meetings designed to engage the environmental community were arranged. Field trips were organized to meet with local manufacturers whose business might be interested in, or a possible partner in the supply chain.

### Results

Outreach team members met with key individuals from the non-profit and environmental communities. Organizations visited included Oregon Wild (Eugene, OR), Sustainable Obtainable Solutions (Colville, WA), Friends of the Little Pend Oreille Wildlife Refuge (Colville, WA), Gifford Pinchot Task Force; Western Wood Products Association; and Western Forestry Conservation Association. Discussions focused on identification of issues surrounding use of biomass for biorefinery products, expression of barriers or concerns they may have, and seeking common ground among stakeholders to facilitate consensus. Engagement with other public agencies, such as the State of Oregon Biomass Working Group was initiated.

Field trips were arranged to meet with key stakeholders (e.g., Teevin Brothers sort yard in Rainier, OR; Greenway Recycling, Portland, OR; and SeQuential- Pacific Biodiesel in Salem, OR).

### Conclusions/Discussion

It will be necessary to continue engagement with identified and potential pilot supply chain communities and regional contacts to ensure they know of biomass utilization opportunities that might result from NARA research. The depot concept developed by IDEX provides opportunities for rural communities to participate in this project and is of particular interest to rural communities. This is of particular interest to the US Forest Service and the Collaborative Forest Landscape Restoration Program with its numerous partners.

## Ruckelshaus Center & DGSS

### Task Objective

- Develop leadership team and stakeholder advisory board
- Provide project facilitation with project leaders.
- Conducted assessment of potential NARA communities and engage targeted stakeholders in those communities.

### Methodology

- Advisory Board: Ruckelshaus Center and DGSS staff worked extensively with the Outreach Team, Team Leaders, and executive team to develop a structure for categorizing and engaging diverse stakeholders. DGSS staff completed an interview-based assessment of informed observers and senior stakeholders to obtain input on the formation and management of an Advisory Board for the NARA project.
- Facilitation: The Ruckelshaus Center was actively engaged in facilitation and project management support since the start of NARA – specifically supporting the project leadership with team facilitation, agenda development, and establishment of ground rules and meeting protocols. Every year, the Center assisted in the development, planning, and facilitation of the NARA annual meeting and also facilitated the NARA Advisory Board meetings.
- Assessment and Survey: The Ruckelshaus Center/DGSS worked with the NARA Environmental Preferred Products team on the assessment of potential NARA communities and targeted engagement of stakeholders in those communities, using a variety of research and outreach methods including both new primary research and assessment of existing “secondary source” data to assess community and regional perspectives, and to develop the Community Asset Assessment Model (CAAM) (Smith *et al.*, 2016a). This effort focused on the identification and refinement of several social asset tools to better focus on those NARA communities with the highest probability of community support for NARA activities. In the process of NARA community assessment, existing DGSS survey data sets and new survey and interview data were used to validate the use of national-level data sets in the development of the CAAM model to inform the selection process, as informed by new primary data collected by other EPP team members in the region.

### Results

#### Advisory Board

A summary report of that effort (*Northwest Advanced Renewables Alliance Advisory Board Assessment: Report of Interview Findings and Recommendations, Submitted by the Division of Governmental Studies and Services in conjunction with the William D. Ruckelshaus Center, Michael Gaffney, J.D., Christina Sanders, MPA, Season Hoard, Ph.D.*) was presented to the project’s Executive Committee in September 2012. This presentation also included recommendations regarding interests that should be considered when selecting potential board members, as well as a list of individuals who had been suggested as potential members. This report was used to inform the

executive committee's selection of Advisory Board members and in the management of interactions with that board. The inquiry also addressed the more general topic of stakeholder engagement; recommendations on that topic were passed on to the Executive Committee and Outreach Team.

### **Facilitation**

Ruckelshaus senior staff facilitated regular Executive Committee meetings and monthly Leadership Team meetings throughout the course of NARA, from the project kick-off in 2011 through the project conclusion in 2016. These meetings focused on a number of relevant topics, including the Phase & Gate (Beltz, 2016) process and various discussions related to the management of NARA teams and units. The Center also facilitated five annual project meetings, held throughout the region, which brought a total of ~750-1,000 stakeholders and project researchers together to discuss project progress and next steps. All of these meetings involved designing agendas in advance, facilitating the meetings, producing summaries, and strategizing future directions with project leadership.

### **Databases**

DGSS Researchers obtained, aggregated and validated several national databases which provided data on three of the seven "Community Capitals" (Emory and Flora, 2006) – Social, Human and Cultural Capitals. The selection of variables from those data sets was then validated and refined using a number of other data sources, in order to support a model, which could be used to assess community characteristics in support of decision-making for NARA and similar projects. Other data included: existing DGSS data from previous survey work in the NARA region; newly-collected stakeholder interviews and surveys conducted by researchers at the University of Idaho (supported by DGSS; Laninga & Maroney, 2016; Smith *et al.*, 2016b); and case-study comparisons for successful and unsuccessful implementation of similar projects (Martinkus *et al.*, 2014).

### **Conclusions/Discussion**

The facilitation provided by the Ruckelshaus Center was designed to help ensure that the leadership from each overall project objective area communicated and interacted with each other and external audiences in a productive and effective manner. The Center's work to help design the stakeholder involvement process ensured that each project objective area was informed by the insights, priorities and concerns of the external stakeholder communities and policy makers who will influence the degree to which this project's findings affect policy outcomes. The Center – directly or through WSU (DGSS) – provided four services over the life of the NARA project.

1. Stakeholder Advisory Committee: DGSS Director Mike Gaffney conducted informed party interviews and provided a report on stakeholder assessment and perceptions, as well as recommendations that were used to inform the creation of the NARA Advisory Committee.

2. Facilitation: The Center assembled a facilitation team, including practitioners and support staff affiliated with both WSU and UW. UW Evans School of Public Policy and Governance Senior Lecturer Jim Reid provided primary internal and external facilitation. Both Gaffney and Center Director Michael Kern provided back-up facilitation. This facilitation included regular project Executive Committee and Leadership Team meeting facilitation, facilitation of all annual project and stakeholder meetings, facilitation of the Advisory Committee, and related tasks. Facilitating the exchange of information between project leaders and regional policy-makers presented a number of challenges. The first challenge was keeping a complex and ever-changing contact list up to date and ensure that interested policy-makers were included. To address this challenge, unit coordinators updated the contact list in concert with state election cycles. Another challenge was coordinating this effort with the AHB project, which required close communication between projects. Since the Ruckelshaus Center serves as a neutral third-party, an ongoing challenge was clearly communicating that the Center was facilitating the exchange of information, not advocating for the project or its results.
3. Policy Outreach. The Center distributed materials created by NARA and AHB to a multi-state list of elected officials and policy-makers, to help keep them informed of NARA and AHB progress.
4. Assessment and Survey: The work done under NARA on the CAAM has been rolled over into the FAA-funded ASCENT project (years 1 and 2) for enhancement, further validation, and application beyond the NARA region. The FAA funding supplemented NARA funding in years 4 and 5 to allow greater effort, additional data collection, and more robust validation and testing. DGSS became engaged with EPP and assisted with the efforts of that team by providing research and data management services, and by developing CAAM, all of which is more particularly described in the report section pertaining to EPP.

## **University of Wisconsin Extension - Upham Woods Outdoor Learning Center**

### **Task Objective**

#### **Energy Literacy Assessment**

This group led Energy Literacy Assessment coordination efforts with support of Education and Outreach teams as well as stakeholders. NARA Education and Outreach teams seek aligned assessment efforts to 1) internally align energy literacy assessment tools, and 2) create, vet, validate and deliver energy literacy assessments that communicate the impact of NARA energy literacy efforts, as well as contribute to the larger energy literacy landscape. The Learning Performance and Research Center (LPRC) at WSU will support development and refinement of energy literacy tools.



Methodology

Trainings included both Adult Educator Trainings and Upham Woods staff trainings. An Adult Educator Training took place at Upham Woods on February 18<sup>th</sup>, 2015 in which educators from around the state interacted with the VOAT lesson tools and materials to increase interest in lesson facilitation with the respective schools and youth.

Programming took place at Upham Woods throughout the year as well as numerous offsite school and community locations. Each program varied in length from 1 to 3 hours opening with an introduction on key energy literacy principles as outlined by the U.S. Department of Energy. The VOAT lesson materials included lesson kits with all of the required tools and curricula; these kits, housed at Upham Woods, are built to be mail-ready to schools and organizations. The lesson curricula included “Evaluating a Tree,” lasting 30 minutes or more. This portion of the lesson uses common forestry tools such as: clinometers, increment borers, diameter at breast height tapes, and standard measuring tapes. The other lesson components consisted of: creating and discussing tree concept maps, a carbon cycle activity, discussing greenhouse effect, discussing what biomass is, and discovering the process of converting biomass to biofuel. The lessons were presented both indoors and outdoors, depending on the component of the lesson. Each of the lesson components concluded with a group discussion/reflection about the concepts being taught and their importance. A pre- and post-knowledge assessment evaluated student’s gained knowledge with a multiple-choice questionnaire. By analyzing pre- and post-knowledge based assessment, we hoped to determine whether the Value of a Tree program was effective in enhancing the energy literacy of the students.

Product Availability

The pre- and post-knowledge based assessments are stored digitally, through an online Qualtrics survey. These resources are accessible only by qualified Upham Woods staff. These assessments have been made available to Wisconsin Environmental Education Board (WEEB) for reporting. As a result of this lesson a VOAT kit was put together that contains two of each of the following; clinometers, increment borers, diameter at breast height tapes, and standard measuring tapes. Along with the forestry tools there is a VOAT lesson plan, worksheets and additional resources. These are ready to ship kits are available to schools and groups upon request directly from Upham Woods.

Results

The total number of individuals served in the training and teaching of biofuels curriculum was 425. The results from the assessments were aligned based on the student’s initials and birthdate. If there was not both a pre- and post- assessment for a student, that student’s score was removed from the data analysis. There were two different versions of the assessment, based on participating students grade level, one for elementary students (grades 3-6) and the other for middle school students (grades 7-8).

Pre and Post Score Variance and Significance

A paired t-test was performed to test for overall energy literacy level changes between the pre-assessment and post-assessment scores (Table EIS-2.1).

These results indicate that there is no statistically significant difference between the pre-assessment and post-assessment scores at a significance level of  $p < 0.05$ . Although the results were not statistically significant there is a lot that can be learned. Some recommendations might be to make sure the presentation is age appropriate, that the assessment uses familiar words, and that the students are allotted enough time to complete without being rushed.

Table EIS-2.1. A paired t-test used to test for overall energy literacy level changes between the pre-assessment and post-assessment scores

	Mean Difference	Standard Deviation	t-statistic	Degrees of Freedom	p-value
Elementary School	1.102	3.077	0.0156	48	0.988
Middle School	0.0808	3.036	0.791	99	0.43

Item Analysis

An item discrimination test was performed to determine the acceptability of each item of the two versions of the assessments. The highest scoring 27% of students were compared to the lowest scoring 27% of students to determine an individual item’s discrimination index. It is expected that the students with the highest overall scores should have selected the correct response for each item more frequently than the students with the lowest overall scores. And so, discrimination indexes with relatively high values (40-100%) indicate that this is indeed the case. The convention for describing the levels of acceptability range from: Excellent, Good, Usually Unacceptable, and Unacceptable, each corresponding to a specific discrimination index. Through this analysis, it was determined that the average discrimination index for the middle school assessment was acceptable at  $0.46296 \pm 0.13366$ . The average discrimination index for the elementary school assessment was also acceptable at  $0.26948 \pm 0.15261$ . However, 10 out of 22 of the items for the elementary school assessment are usually considered unacceptable by convention, with item 15 having a negative value of -0.07143, putting it outside of the acceptable range. This occurred because the lower 27% answered the question correctly more times than the top 27%. This shows that the question was not adequate for this survey. A recommendation would be to verify the questions are age appropriate, so that there is a fair chance of every student potentially getting the question correct and to allow enough time for each student to fully complete the assessment. Many of the assessments were left incomplete, so the unanswered questions had to be marked wrong. This could be a reason for many of the questions for the elementary school to be considered usually unacceptable.

Item difficulty index was also determined for each assessment to further analyze the reliability of the instrument. The difficulty index is determined by summing the total number of students who responded correctly to a particular item and dividing it by the total number of students who responded to that item. And so, item difficulty indexes can range from 0 to 1, with more difficult items having lower difficulty index values. The average difficulty for the middle school assessment was found to be  $0.52 \pm 0.11$ . While the average difficulty for the elementary school assessment was found to be  $0.45 \pm 0.17$ . The lower difficulty index of the elementary school assessment corresponds to the lower item discrimination index, both indicating possible needs for adjustment in future studies.

### **Conclusions/Discussion**

Continued refinement of the Value of a Tree (VOAT) curriculum provided an accessible and measurable benefit to demonstrate enhanced energy literacy for youth. Over 600 students participated in the assessment effort related to the VOAT, and the assessment itself is hosted on the [energyliteracyprinciples.org](http://energyliteracyprinciples.org) website for future use by educators anywhere.



# NARA OUTPUTS

Significant outputs of NARA's Outreach Team can be summarized as:

- Organized and hosted two international conferences ([2014](#) and [2016](#)) that engaged over 380 stakeholders from 24 different states and 6 different countries. Participants included:
  - Over 80 undergraduates and graduate students
  - 13 K-12 teachers
  - 11 state agencies
  - 16 universities
  - Over 60 companies and NGOs
  - Industries represented: Primary & Secondary Forest Products, Chemical, Aviation, Energy, Transportation, Biofuels, Petroleum
  - 95% of the participants surveyed indicated increased knowledge and awareness of biofuels from lignocellulosic materials
  - Over 75% indicated a significant change in their knowledge regarding woody biomass to biofuels logistics, conversion technologies, and environmental impacts
- Twelve [webinars](#) were hosted in Year-5 disseminating research-based findings regarding biomass logistics, distribution and availability, conversion, supply chain analysis, and sustainability
  - Stakeholders, especially currently operating businesses and entrepreneurs, were informed of ways to find efficiencies across the supply chain of converting post-harvest forest residuals to biofuels and bio-based chemical co-products
  - Catered to industry, contractors, land managers, researchers, policy makers, state and local agency personnel, NGOs, educators, and students
  - Over 360 attendees from over 12 different states and Canada
  - Over 75% indicating an increase in knowledge
- A dynamically searchable [repository](#) of unbiased scientific knowledge on wood-based biofuels and co-products was developed and is being maintained. Since inception in 2014, over 1000 users throughout the world at least one user from 84 countries majority from the U.S. and Brazil
- An interactive online [timeline](#) archiving the story of 1000-gallons of bio-jet fuel production consumed in flying the [demonstration flight](#) from Seattle to Washington DC by Alaska Airlines. The objectives of the timeline are to inform the stakeholders about the process, acknowledge the contributions of participating companies in the bio-jet production, and communicate the views of the participating stakeholders.
- Communicated research findings to stakeholders through:
- Quarterly briefings to 900+ policy makers detailing efforts of NARA and AHB
  - Developed & produced 31 infographics & factsheets

- 66 videos of NARA presentations on research findings are available for public viewing (over 5850 views)
- 135 news stories have been written about NARA activities
- 34 newsletters distributed to 800 subscribers
- 295 blog posts; NARA Facebook and Twitter posts
- Over 25 refereed journal and extension publications
- Over 135 presentations

- Produced professional videos to educate general public about alternative biofuels and NARA ([overview video](#)), and provided material (educational videos geared for K-12 teachers and students) to the education team
- Assisted IDX team with [supply chain studies](#) by:
  - Defining pilot supply chain study regions
  - Identifying key stakeholders
  - Compiling regional assets
  - Engaging stakeholders
  - Disseminating findings

Subsequent sections will identify specific outputs by the Outreach Team units by region/entity.

## Idaho

### Publications:

Brooks, R. and J. Moroney. Forestry Tour Educates Youth in North Central Idaho. 2014. Journal of Extension.Vol. 52, No. 4. August, 2014. Available at: <http://www.joe.org/joe/2014august/iw4.php>

Casey, J., R. Brooks, J. Eitel, and R. Keefe. Using Logging Residues as Biofuel Feedstocks in the Pacific Northwest: Estimating Slash Pile Volumes with Low-cost, Lightweight Terrestrial LiDAR. Submitted to Sensors.

Brooks, Randy. From Wood to Wing: Biofuels and the NARA Opportunity. Idaho Gem State Producer. Vol. 15:8. Pg. 25-27. Dec. 2012.

Saralecos, J., and R. Brooks. 2014. Weighing Your Options. Understanding Weight Scaling. Idaho Farm Bureau Producer. Vol. 18, Issue 5. July 2014. Pg. 18-19.

Casey, J., R. Brooks, J. Eitel, and R. Keefe. 2016. Using Logging Residues as Biofuel Feedstocks in the Pacific Northwest: Estimating Slash Pile Volumes with Low-cost, Lightweight Terrestrial LiDAR. Submitted to Sensors.

## **Presentations:**

Moroney, Jillian, T. Laninga, and R. Brooks. Clearwater Basin Bioenergy Survey. Poster presented at Idaho Chapter of the American Planning Association Annual Conference, Boise, ID. Oct. 10-12, 2012

Brooks, R., J. Moroney, and T. Laninga. 2012. Clearwater Bioenergy Survey. Poster presented to Northwest Bioenergy Research Symposium. Seattle, WA. Nov. 12-14, 2012.

Brooks, Randy, J. Moroney, and T. Laninga. Clearwater Basin Bioenergy Survey. Poster presented at Northwest Bioenergy Research Symposium and Future Energy Conference, Seattle, WA. Nov. 13-14, 2012

Brooks, R. and J. Moroney. 2012. Clearwater Basin Bioenergy Survey: A brief assessment of regional norms and values that could have an impact on community responses to the development of woody biomass as an energy source in the Clearwater Basin. Poster presented at The International Wood Composite Symposium. Seattle, WA, April 11-13, 2012.

Brooks, R. 2012. Forestry Tour Educates Youth and Teachers. Poster presentation at NARA 2012 Annual Meeting, Missoula, MT, Sept 13-14, 2012.

Moroney, J.M., R. Brooks, and T. Laninga. 2012. Clearwater County Forestry Tour: A Knowledge Assessment. Poster presentation at NARA 2012 Annual Meeting, Missoula, MT, Sept 13-14, 2012.

Moroney, J, T. Laninga, and R. Brooks. 2012. Clearwater Basin Bioenergy Survey. Poster presented at Idaho Chapter of the American Planning Association Annual Conference, Boise, ID. Oct. 10-12, 2012

Brooks, R., J. Moroney, and T. Laninga. 2012. Clearwater Basin Bioenergy Survey. Poster presented at Northwest Bioenergy Research Symposium and Future Energy Conference, Seattle, WA. Nov. 13-14, 2012

Brooks, R., J. Moroney, R. Keefe, and T. Laninga. 2013. Biomass Survey Assessment of Idaho Forestry Extension Stakeholders. Poster presented at The International Wood Composite Symposium. Seattle, WA. April 2-4, 2013.

Cochran, A., and R. Brooks. 2015. Biofuels from forest residuals. Poster presented at National Extension Energy Summit. Seattle, WA. 9 April 2015

Cochran, A., and R. Brooks. Small scale pellet production as alternative bioenergy from forest residuals. Poster presentation given at National Extension Energy Symposium. Seattle, WA. April 15, 2015.

A woody biomass overview: presented at LEAP Update sessions in 5 locations across northern Idaho. 300 participants

Keeping the Forest Legacy Alive. Presented to family forest owners Craigmont, ID and Moscow, ID. 40 participants.

Biomass: Options & Opportunities: Presented to the Selkirk Chapter Society of American Forests quarterly meeting. 34 participants

NARA Project Overview: Presented to north central Idaho Pesticide Applicators training meeting, Nezperce, ID. 21 participants

A woody biomass overview: presented at LEAP Update sessions in Council, Idaho, and at LEAP sessions in Moscow and Coeur d'Alene, Idaho. 90 participants

The NARA Project in Idaho: A project overview presented to the Idaho Association of Logging Contractors. 43 participants.

The NARA Project in Idaho: A project overview presented to the Idaho Association of Logging Contractors. 43 participants.

Woody Biomass and the NARA Project Overview: Presented Natural Resources Youth Camp north of Sun Valley, ID at the Central Idaho 4-H Camp. 2 lectures and 5 labs where presented on biomass, biomass utilizations, and biofuels. Over 70 youth and 14 adults were present.

Bioregional Planning and Community Design studio project presentations (2). These projects consisted of looking at the community attitudes towards woody biomass and the feasibility of this industry taking root in North Central Idaho. Approximately 15 stake holder and community participants. (Jillian Moroney)

From Biomass to Biofuels: Clearwater County (ID) 6<sup>th</sup> Grade Forestry Tour. Headquarters, ID. 7/12/12. 78 participants

How biomass and biofuels fits in with a thinning regime. UI Extension Forestry Thinning & Pruning Field Day, Cottonwood, ID. 7/20/12. 28 participants

Biomass opportunities associated with thinning for forest insects and diseases. UI Extension Forestry Insects & Disease Field Day, Moscow, ID. 7/27/12. 21 participants

Utilizing forest biomass to make biofuels. 3 Presentation to UI Ag Resource Policy class. Camp Wittman, ID. 9/19/12. 33 participants

The NARA Project: An Overview. Talk given to UI CNR Dean's Annual Stakeholder Mtg., Moscow, ID. 9/22/12. 23 participants

Moroney, Jillian. Clearwater County Idaho Sixth Grade Forestry Tour Assessment: Tracking the Change in Students' Knowledge and Attitudes. Research presented at the National eXtension Conference, Oklahoma City, OK. Oct. 3, 2012. 68 participants

Brooks, R. 2013. A NARA Project Update and Review. Presented at LEAP Update sessions in 5 locations across north Idaho. 290 participants. Dates: March 3 through March 29, 2013.

Brooks, R. 2013. How Tree Biology can fit in the NARA Project. Presented to Asotin County, Washington, Advanced Master Gardeners. 43 participants. March 12, 2013.

Brooks, R. 2013. Forestry and Biofuels. Presented to UI Extension “Keeping the Legacy Alive”. 15 participants. Lewiston, ID. March 13, 2013.

Brooks, R. 2012. A woody biomass overview: presented at LEAP Update sessions in 5 locations across northern Idaho. 300 participants. March, 2012.

Brooks, R. Woody Biomass and the NARA Project Overview: Presented Natural Resources Youth Camp north of Sun Valley, ID at the Central Idaho 4-H Camp. 2 lectures and 5 labs where presented on biomass, biomass utilizations, and biofuels. Over 70 youth and 14 adults were present. June 24-28, 2013.

Brooks, R. Landowner opportunities for woody biomass utilization. UI Extension Forest Stewardship Field Day. 7/13/13.

Brooks, R. How biomass and biofuels fits in with a thinning regime. UI Extension Forestry Thinning & Pruning Field Day, Moscow, ID. 7/19/13

Brooks, R. Biomass opportunities associated with thinning. UI Extension Field Day, Moscow, ID. 7/20/13

Dec 2013: Brooks, R., J. Moroney, R. Keefe, and T. Laninga. 2013. Biomass Survey of Idaho Loggers. Poster presented at NARA Annual meeting in Corvallis, OR. Sept. 2013.

Loggers aren’t Bloggers – results of 2013 Logger Biomass Survey. Presentation made at 6 Idaho Pro-logger workshops. Hayden, ID (March 4), Kamiah, ID (March 13), Sandpoint, ID (March 18), St. Maries, ID (March 25), Orofino, ID (march 27), Moscow, ID (April 1). 306 participants

Brooks, R. Woody Biomass and the NARA Project Overview: Presented Natural Resources Youth Camp north of Sun Valley, ID at the Central Idaho 4-H Camp. 2 lectures and 5 labs where presented on biomass, biomass utilizations, and biofuels. Over 80 youth and 14 adults were present. June 23-27, 2014.

Brooks, R. How biomass and biofuels fits in with a thinning regime. UI Extension Forestry Thinning & Pruning Field Day, McCall, ID. 5/15/14. 31 participants

Casey, J., and R. Brooks. Examining Alternative Methods of Measuring Logging Residues: A Comparison of Traditional and Laser-Based Slash Pile Estimators. Dec. 8., 2014. Thesis proposal. Moscow, ID. 12 participants.

Brooks, R. 2015. Forest Resources Program at Idaho. Presentation given at American Forest Resource Council Annual Meeting. Portland, OR. 8 April, 2015. 186 participants

Brooks, R., and A. Cochran. 2015. Biofuels from forest residuals. Presentation given at National Extension Energy Summit. Seattle, WA. 9 April 2015. 34 participants

Brooks, R. 2015. Biofuels from forest residuals. Presentation given at Small log conference. Spokane, WA. 25 March 2015. 92 participants

Cochran, A. and R. Brooks. 2015. Biofuel options from forest residuals. 7 Presentations given at 7 Idaho Loggers Education to Advance Professionalism workshop. UI Extension Workshop Series. 4 Mar. 2015 – 31 Mar 2015. 306 participants.

Brooks, R. Woody biomass opportunities and projects. Lecture given to UI Dendrology class. Moscow, ID. April 17, 2015. 36 participants.

Brooks, R. Make your own woody pellets (out of forest residuals?). Oral presentation given at National Extension Energy Symposium. Seattle, WA. April 15, 2015.

Brooks, R. Woody Biomass and the NARA Project Overview: Presented at Natural Resources Youth Camp north of Sun Valley, ID at the Central Idaho 4-H Camp. 2 lectures and 5 labs where presented on biomass, biomass utilizations, and biofuels. Over 70 youth and 14 adults were present. June 22-22, 2015

Brooks, R. Landowner opportunities for woody biomass utilization. UI Extension Forest Stewardship Field Day. New Meadows, ID. 5/13/15. 23 participants.

Brooks, R. 2015. Idaho Forests: Opportunities and Challenges. Presented Leadership Idaho Agriculture. Moscow, ID. 11/5/2015. 32 participants

Brooks, R. 2015. Opportunities in Idaho Forest Operations. Guest lecture to ISEM Climate Change UI Class. Moscow, ID. 11/16/2015. 44 participants.

Brooks, R. Updates on the NARA project. Presentation given to Idaho Pro Loggers Workshop. 5 locations, 283 participants.

NARA and biofuels from logging residues. Presented at UI Extension Natural Resource Camp. June 27- July 2, 2016. Ketchum, ID. 84 participants.

## Oregon

### Publications:

Burke, C.C. and S. Leavengood. 2015. Using Slash Piles to Make Chemical Products: An update on the Northwest Advanced Renewables Alliance (NARA) activities. *Western Forester*. 60(1):7-9.

Lowell, E.C. and S. Leavengood. 2013. From Wood to Wing: NARA Works to Harness Woody Biomass for Aviation Biofuel. *Western Forester* 58(3):12-13.

### Presentations:

Leavengood, S. 2016. The Northwest Advanced Renewables Alliance (NARA) Project: What have we learned, what’s next, and how can you get involved? Stakeholder forum in Portland, OR. April 11.

Leavengood, S. 2014. Northwest Advanced Renewables (NARA) Project Update – Fall 2014. October 22. Corvallis, OR. Seminar for Oregon State University graduate course - WSE 507.

Hansen, E. and S. Leavengood. 2013. The role of the forest sector in a bio-based economy: North American Perspective. Presented 12/13/2013 at “The forest sector in a biobased economy – challenges for industry, policy and research. Rovaniemi, Finland.

Wolcott, M. 2013. Wood to Wing: Envisioning and Aviation Biofuels Industry Based on Forest Residuals in the Pacific Northwest (archived video of presentation). Starker Lecture Series, Oregon State University. April 11.

Leavengood, S. 2013. Meeting of key Oregon agency personnel with interest in NARA Pilot Supply Chains. March 20. Pilot Supply Chain meeting of key personnel in the Oregon Forest Biomass Working Group.

Leavengood, S. 2012. The Northwest Advanced Renewables Alliance (NARA): Recap of outreach team meeting in Missoula, MT. Informal presentation to the Oregon Forest Biomass Working Group. April 2.

Leavengood, S. 2011. The Northwest Advanced Renewables Alliance (NARA): An Introduction. Presentation to the Oregon Forest Biomass Working Group. October 25.

#### **Factsheets:**

Loepky, J., J. Sessions. 2014. Transportation of Residues: Would you bundle?

Loepky, J., K. Boston. 2014. Estimating Biomass Availability

Loepky, J., D. Maguire. 2014. Estimating Nutrient Removals under Varying Intensities of Harvesting Residue Utilization.

Loepky, J., 2014. NARA Graduate Student Research: The 2014 Western Forestry Graduate Research Symposium.

Loepky, J. 2013. IDX Presentation Overview – Site Selection Research

## **Montana**

#### **Meeting participation:**

BBER members participated in the March 2012 NARA Outreach meeting, with approximately 30 participants, at the Rocky Mountain Elk Foundation in Missoula.

BBER members helped to organize and participated in the June 2012 Missoula pilot community meeting, attended by more than 50 participants, at the University of Montana’s Gallagher Business Building in Missoula.

BBER members participated in the September 2012 NARA annual meeting, attended by about 136 participants, at the Missoula Hilton Garden Inn.

BBER members participated in the Forest Products Retention Roundtable monthly meetings, attended by 15 to 30 stakeholders, to share information on NARA progress in the Western Montana Corridor. The Roundtable was identified as the NARA “client” in Montana. Both Todd Morgan (of BBER) and Craig Rawlings (of FBN) regularly attended the Roundtable, reported on NARA progress, and served as liaisons between the Roundtable and NARA.

#### **Databases:**

BBER updated the national TPO (timber products output) database, maintained by the USDA Forest Service, with county level timber harvest, logging residue, and mill residue data for Idaho (2011), Montana (2014), Oregon (2013) and Washington (2012 and 2014) with information developed by BBER for the NARA project. The TPO database is accessible at: [http://srsfia2.fs.fed.us/php/tpo\\_2009/tpo\\_rpa\\_int1.php](http://srsfia2.fs.fed.us/php/tpo_2009/tpo_rpa_int1.php).

BBER developed and maintains a five-state (ID, MT, OR, WA, and CA) annual (starting with 2002) timber harvest by county and ownership database that users can access on line at: [http://www.bber.umn.edu/FIR/H\\_Harvest.asp](http://www.bber.umn.edu/FIR/H_Harvest.asp).

BBER developed and maintains a NARA web page with outputs from our work on logging utilization and biomass supply: [http://www.bber.umn.edu/FIR/L\\_NARA.asp](http://www.bber.umn.edu/FIR/L_NARA.asp)

#### **Presentations:**

Berg, E. 2012. Western Montana Corridor: Woody biomass from logging and mill residuals. Presentation at the NARA Annual Meeting, Missoula, MT. September 12-14, 2012. <http://www.bber.umn.edu/pubs/forest/biomass/NARASep2012.pdf>

Berg, E., E. Simmons, S. Zarnoch, T. Morgan, S. Hayes and C. Gale. October 2012. Estimating logging residues in the State of Idaho: preliminary predictive models. Presentation to the Society of American Foresters 2012 National Convention, Spokane, WA. October 24-28, 2012. <http://www.bber.umn.edu/pubs/forest/util/EstimatingLoggingResidue2012.pdf>

Berg, E., E. Simmons, T. Morgan, S. Hayes, and S. Zarnoch. 2014. Improving Forest Vegetation Simulator (FVS) estimates of logging residues. Presentation to the Society of American Foresters 2014 National Convention, Salt Lake City, UT. October 6, 2014. <http://www.bber.umn.edu/pubs/forest/util/ImprovingForestVegetationSimulatorSAF2014.pdf>

Berg, E., E. Simmons, S. Zarnoch, S. Hayes, T. Morgan, and C. Gale. 2012. Logging Residues: preliminary predictive models. Poster presented at the NARA Annual Meeting, Missoula, MT. September 12-14, 2012. Available online at: <http://www.bber.umn.edu/pubs/forest/util/2012NARAModelingPoster.pdf>



Berg, E., T. Morgan, E. Simmons, and S. Hayes. 2014. Logging Utilization: Decision Support Tools for Land Managers. Poster presented at the Northwest Wood-based Biofuels + Co-products Conference, Seattle, WA. April 28-30, 2014. <http://www.bber.umn.edu/pubs/forest/util/DecisionSupportToolsForLandManagers2014.pdf>

Berg, E., T. Morgan, E. Simmons, and S. Zarnoch. 2015. Logging Utilization Research in the Pacific Northwest: Residue Prediction and Unique Research Challenges. Presentation to the USDA Forest Service Forest Inventory and Analysis Science Symposium, Portland, OR. December 8-10, 2015. Presentation: <http://www.bber.umn.edu/pubs/forest/util/FAISciSymposium2015.pdf>. Proceedings: <http://www.bber.umn.edu/pubs/forest/util/ResiduePredictionNorthwest.pdf>.

Kolb, P. 2012. Montana Private Forest Owners Assets and Challenges. NARA Annual meeting, Missoula MT.

Kolb, Peter. 2013. An overview of the NARA project and expected outcomes. Presented to: Montana Tree Farm Board, Montana Forest Council, Montana Forest Owners Association, Montana Logging Association, Montana Association of County Ag. Agents.

Kolb, Peter. 2014. Biomass to jet fuel and other opportunities for the Montana wood products industry. KGVO morning talk radio. <http://newstalkkgvo.com/montana-forestry-minute/...>

Kolb, Peter. 2014. Updates on advanced for a biomass market for Montana. Spring forest landowner and forester conference, Helena MT, April 23, 2014.

Morgan, T. 2011. From stump to pump: wood-based biofuel research in the Northwest. Presentation at Portland State University, Portland, OR. December 15, 2011. Was web-cast live and available online at: <http://fresc.usgs.gov/spotlight/Presentations.html>.

Morgan, T. 2012. Woody Biomass from Logging and Mill Residuals. Presentation at the NARA community meeting in Missoula, MT. June 13, 2012. [http://www.bber.umn.edu/pubs/forest/util/NARA\\_BBER\\_June2012.pdf](http://www.bber.umn.edu/pubs/forest/util/NARA_BBER_June2012.pdf).

Morgan, T. 2013. UM BBER's Forest Industry Research Program and the Northwest Advanced Renewables Alliance. Presentation to the University of Montana, School of Business Administration's Advisory Board, Missoula, MT. October 4, 2013.

Morgan, T.A. 2014. Condition & Outlook of Montana's Forest Products Industry. Presentation to the Forest Products Retention Roundtable, Missoula, MT. June 12, 2015.

Morgan, T.A. 2014. Idaho Timber Market and Forest Industry Outlook. Presentation at the Idaho Department of Lands Timber Management Meeting, Moscow, ID. December 10, 2014.

Morgan, T. 2015. Developing Timber Product Output (TPO) harvest residue information. NARA webinar presented November 19, 2015. Available online at: <https://www.youtube.com/watch?v=wp2z5YKukLQ&feature=youtu.be>

Morgan, T. 2016. Four years in the field: providing timber harvest and residue information across the Pacific Northwest. Presentation at the Northwest Wood-Based Biofuels + Co-Products Conference. Seattle, WA. May 3, 2016. Available online at: <http://nararenewables.org/conference/wp-content/uploads/2016/04/Morgan-2016NWBCC-1.pdf>

Morgan, T., E. Simmons, E. Berg, C. Gale, S. Hayes. 2012. Forestry IS rocket science: quantifying logging residues as feedstock for bio-jet and other uses. Poster presented at the International Wood Composites Symposium, Seattle, WA. April 11-13, 2012. Available online at: [http://www.bber.umn.edu/pubs/forest/util/NARA\\_poster\\_2012.pdf](http://www.bber.umn.edu/pubs/forest/util/NARA_poster_2012.pdf)

Simmons, E., E. Berg, T. Morgan, C. Gale, and S. Hayes. October 2012. Logging Utilization in the State of Idaho 2008/2011. Presentation at the 2012 Society of American Foresters National Convention. Spokane, WA. October 24-28, 2012.

Simmons, E., E. Berg, T. Morgan, S. Hayes. 2013. Logging residues: comparative efficiency by tree diameter and logging methods in 3 western states. Poster presented at the Council on Forest Engineering (COFE), Missoula, MT. July 8-11, 2013. Available online at: <http://www.bber.umn.edu/pubs/forest/util/COFE%20Residue%20by%20methods%202.1.pdf>

Simmons, E., E. Berg, M. Scudder. 2015. NARA Logging Utilization. Poster presented at NARA annual meeting, Spokane, WA. September 15-17, 2015. Available online at: <http://www.bber.umn.edu/pubs/forest/util/NARALoggingUtilPoster2015.pdf>

Simmons, E., J. Meek, E. Berg, T. Morgan, S. Hayes, and C. Gale. 2012. Idaho Logging Utilization, 2008/2011. Poster presented at the NARA Annual Meeting, Missoula, MT. September 12-14, 2012.

Simmons, E., J. Meek, E. Berg, T. Morgan, S. Hayes, and C. Gale. 2012. Idaho Logging Utilization, 2008/2011. Poster presented at 2012. International Wood Composites Symposium, Seattle, WA. April 11-13, 2012.

Simmons, E., T. Morgan, J. Meek, E. Berg and S. Hayes. 2012. Logging Utilization in the State of Idaho 2008/2011. Poster presented at the USDA Forest Service Forest Inventory and Analysis Science Symposium, Baltimore, MD. December 4-6, 2012. [http://www.bber.umn.edu/pubs/forest/util/Idaho\\_log\\_util\\_poster\\_2011.pdf](http://www.bber.umn.edu/pubs/forest/util/Idaho_log_util_poster_2011.pdf)

Simmons, E., M. Scudder, T. Morgan and E. Berg. 2015. Oregon's Forest Products Industry and Timber Harvest, 2013. Poster presented at the USDA Forest Service Forest Inventory and Analysis Science Symposium, Portland, OR. December 8-10, 2015. <http://www.bber.umn.edu/FIR/..%5Cpubs%5Cforest%5Cfidacs%5COregon-2013Poster.pdf>



Sorenson, C., C. McIver and T. Morgan. Mill Residue Production and Use in Montana, 2009. Poster presented at the NARA Annual Meeting, Missoula, MT. September 12-14, 2012. <http://www.bber.umt.edu/pubs/forest/fidacs/2012NARAMT2009Residue-Poster.pdf>.

Sorenson, C., E. Simmons, T. Morgan, E. Berg, C. Gale, and S. Hayes. 2012. Characterizing logging residues as potential feedstock for the manufacture of biojet. Presentation at the Western Forest Economists Meeting, Newport, OR. June 10-12, 2012.

Twer, Martin. 2016. Moderation of NARA webinar Incorporating Timber Product Output (TPO) harvest residue information and forest market models to evaluate biorefinery siting potential.

Twer, Martin. 2016. Moderation of the Track 2 panel at the 2nd Northwest Wood-based Biofuels + Co-products Conference, May 3-4, 2016, Seattle, WA.

### **Publications:**

Berg, E., T. Morgan, E. Simmons, S. Zarnoch, and M. Scudder. 2016. Predicting Logging Residue Volumes in the Pacific Northwest. For. Sci. 62 (Forthcoming). Accepted for publication May 2016.

Kolb, Peter F. 2012. The future of biomass in Montana, Montana Family Forest Spring Newsletter.

Kolb, P., 2012. The Future of Forest Biomass 2012, Montana Forest Owners Spring Newsletter

Kolb, P., 2012. Is Biomass a Future Market in Montana, Northwest Woodlands Fall 2012, Volume 28. No.4.

Kolb, Peter. 2013. Managing for Forest Soil Productivity, Montana Family Forest News, Issue No. 40.

Kolb, Peter. 2014. Knowing the difference between forest myths and realities. Missoulian Op Ed featured article. [http://missoulian.com/news/opinion/columnists/knowing-the-difference-between-forest-myths-realities/article\\_0712323e-79fe-11e3-a790-0019bb2963f4.html](http://missoulian.com/news/opinion/columnists/knowing-the-difference-between-forest-myths-realities/article_0712323e-79fe-11e3-a790-0019bb2963f4.html)

Kolb, Peter. 2015. Forest woody debris retention guidelines; Pg 59 in: Montana Forestry Best Management Practices. Montana DNRC.

Kolb, Peter. 2015. Montana Ecosystem Processes and Future of Forest Management 5-part You Tube series. <https://www.youtube.com/playlist?list=PL49YIKpvJpX-CAWUqneOiaWxwUSmDqIPkx>

Meek, J. 2012. Chip Sample Study. Forestry 435/436 Term Paper. College of Forestry and Conservation. University of Montana. Missoula, MT.

Simmons, E., T. Morgan, E. Berg, S. Hayes and G. Christensen. 2016. Logging utilization in Oregon and Washington, 2011-2015. USDA Forest Service Pacific Northwest Research Station Gen. Tech. Rep. PNW-GTR-XXX (forthcoming). Submitted for publication May 2016.

Simmons, E., T. Morgan, E. Berg, S. Zarnoch, S. Hayes and M. Thompson. 2014. Logging utilization in Idaho: current and past trends. USDA Forest Service Rocky Mountain Research Station Gen. Tech. Rep. RMRS-GTR-318. Available at: [http://www.bber.umt.edu/pubs/forest/utl/ID\\_logging\\_util\\_2014.pdf](http://www.bber.umt.edu/pubs/forest/utl/ID_logging_util_2014.pdf)

Simmons, E., M. Scudder, T. Morgan, E. Berg and G. Christensen. 2016. Oregon's forest products industry and timber harvest 2013 with trends through 2014. USDA Forest Service Pacific Northwest Research Station Gen. Tech. Rep. PNW-GTR-XXX (forthcoming). Accepted for publication March 2016. Data tables available on line at: <http://www.bber.umt.edu/pubs/forest/fidacs/OR2013.pdf>

Twer, Martin. 2012. Why the Western Montana Corridor as a "Pilot NARA Community". Misc MSU Extension Forestry publication.

Twer, Martin. Promotion and linking of NARA hosted webinars on eXtension Learn (<https://learn.extension.org/search/all?utf8=%E2%9C%93&q=nara>), as well as MSU Extension Forestry eNewsletter.

Twer, Martin. NARA updates on the MSU Extension Forestry website (<http://www.msueextension.org/forestry/NARA.html>) and the MSU Extension Forestry eNewsletter (<http://www.msueextension.org/forestry/News/eNewsletters.html>).

Twer, Martin. 2013. Development and coding of four online calculators related to wood energy

- Estimating Space Heating Demand and Effective Costs, <http://goo.gl/9PU0Q0>.
- A Simple Comparison of Heating Fuels, <http://goo.gl/lhNmQc>.
- How much Energy is in a Slab of Wood? <http://goo.gl/0JDBfW>.
- Firewood as a Heating Fuel Alternative, <http://goo.gl/n1DLjF>.

Twer, Martin. 2014. E3A Curriculum (Exploring Energy Efficiency and Alternatives) Wood Heat Curriculum, <http://www.e3a4u.info/energy-technologies/wood-heat/overview/>.

Twer, Martin. 2014. Submitted/published three articles on eXtension Wood Energy CoP:

- Estimating Space Heating Demand and Effective Costs;
- A Simple Comparison of Heating Fuels;
- How much Energy is in a Slab of Wood?

Twer, Martin. 2015. Online adaptation and implementation of Annual Montana Wood Biomass Energy Facilities Survey; Survey, <http://goo.gl/t7jYGe>; Data compilation and analysis; Facilities online reports/time series, <http://goo.gl/sxma4E>.

Twer, Martin. 2016. White paper to the Montana DEQ regarding consideration of forest biomass in the Montana Energy Blueprint.

Twer, Martin. 2016. Thesis (in progress) for the degree of MA in Economics: Economic feasibility analysis of converting woody biomass into electricity, heat, and char using the Tucker Renewable Natural Gas (RNG) Thermal Conversion System.

## Washington

### Publications:

Zhu, R., V. Yadama. 2016. Effects of Hot Water Extraction (HWE) Pretreatment on Compositional and Physicochemical Changes of Douglas Fir. *Biomass and Bioenergy*, 90:78-89.

Zhu, R., V. Yadama. 2016. Effects of hot water extraction (HWE) of Douglas fir as a pre-process for the sulfite pretreatment to overcome recalcitrance of lignocellulose (SPORL). *Holzforschung*, October 2016 (DOI: [10.1515/hf-2016-0080](https://doi.org/10.1515/hf-2016-0080)).

Zhu, R., V. Yadama, Liu, H., Harper, D.P., & Lin, R. 2017. Fabrication and characterization of Nylon 6/cellulose nanofibrils melt-spun nanocomposite filaments. *Composites. Part A, Applied Science and Manufacturing*, 97(June):111-119.

Zhu, R., V. Yadama. 2017. Isolation and characterization of cellulose micro/nanofibrils from Douglas Fir. *Journal of Polymers and the Environment*. Published Online April 8, 2017 (DOI: [10.1007/s10924-017-1013-6](https://doi.org/10.1007/s10924-017-1013-6)).

### Presentations:

Wolcott, M.P. 2012. *The Northwest Advanced Renewables Alliance: A supply chain to aviation biofuels and environmentally preferred products*. Invited Speaker. Pacific West Biomass Conference & Trade Show, San Francisco, CA, January 17.

Yadama, V. 2012. *Scope of the outreach activities within NARA*. Montana Stakeholder Meeting, Missoula, MT, March 21.

Yadama, V. and Englund, K. 2012. *Conversion of woody biomass to biofuels and co-products*. Oral Presentation, Spokane Tribe, Wellpinit, WA, August 24.

Yadama, V. 2012. *Bioenergy Literacy to Professionals*. 1<sup>st</sup> NARA Annual Meeting, Missoula, MT, September 13.

Gaffney, M., Englund, K., Kern, M., Leavengood, S., Arno, M., Moulton, P., Lowell, E., Kolb, P., Perez-Garcia, and Yadama, V. 2012. *Rural Economic Development & Stake-*

*holder Engagement*. 1<sup>st</sup> NARA Annual Meeting, Missoula, MT, September 14.

Zhu, R., Yadama, V., and Englund, K. 2012. *Hot water extraction (HWE) as a pre-conversion technique for Douglas-fir wood chips*. Poster, National Convention of the Society of American Foresters, Spokane, WA, Oct. 24-28.

NARA Outreach Team. 2012. *Selection process of potential NARA Pilot Supply Chain coalitions in the Pacific Northwest Region*. Poster, NW Bioenergy Research Symposium, Seattle, WA, Nov. 13.

USDA FS PNW. 2013. *Northwest Advanced Renewables Alliance (NARA): A Supply Chain to Aviation Biofuels and Environmentally Preferred Products*. Briefing Paper, March 2013.

Zhu, R. and Yadama, V. 2013. *Impact of hot water extraction (HWE) pretreatment conditions on the physiochemical characteristics of Douglas-fir (DF) wood chips*. Poster, Small Log Conference, Coeur d'Alene, Idaho, March 13-15.

Yadama, V. *NARA – Northwest Advanced Renewable Alliance Biomass to Biofuel*. Montana Economic Development Association (MEDA) 2013 Spring Conference, May 9, Hamilton, MT.

Rawlings, C. *NARA Western Montana Corridor supply chain and the stakeholder involvement*. Annual National Indian Timber Symposium, June 10, 2013, Keshena, Wisconsin.

Zhu, R. and V. Yadama. 2013. *Impact of hot water extraction (HWE) pretreatment conditions on the physiochemical characteristics of Douglas-fir (DF) wood chips*. Technical Poster Forum, 2013 NARA Annual Meeting, September 10-12, Corvallis, OR.

Yadama, V. 2013. *Overview Talk: Community Engagement in the Pacific Northwest to Facilitate Development of Biofuels and Co-Products Supply Chain*. 2013 NARA Annual Meeting, September 10-12, Corvallis, OR.

Yadama, V. 2013. *Pacific to Cascade Supply Chain Coalition – Engagement & Analysis*. Presentation to Washington Forest Biomass Coordination Group on MC2P Supply Chain Study Initiation, October 8.

Yadama, V. 2013. *NARA's Outreach Efforts in Promoting Biofuel Infrastructure in the Pacific Northwest*. AAIC 25<sup>th</sup> Anniversary Meeting on New Crops: Bioenergy, Biomaterials, and Sustainability, October 12-16, Washington DC.

Yadama, V. 2013. *Cascade to Pacific (C2P): Wood-based Biofuels Supply Chain Analysis*. Oregon Forest Biomass Working Group, Salem, OR, November 12.

Yadama, V. 2013. *Cascade to Pacific (C2P): Wood-based Biofuels Supply Chain Analysis*. Lewis Economic Development Council's General Membership Meeting, Chehalis, WA, November 14.

Yadama, V. 2014. *NARA Facility Site Selection: Mid-Cascade to Pacific Region*. Progress

report to Washington Forest Biomass Coordination Group, Feb. 11, 9-12pm.

Yadama, V. 2015. "Siting of Processing Facilities for Wood-To-Biojet Conversion in Oregon," 77<sup>th</sup> Oregon Logging Conference, Eugene, OR, February 19-21, 2015

Yadama, V. 2015. "Web-based portals for dissemination of research-based findings to stakeholders on wood-to-biofuel conversion," Poster Presentation, National Extension Energy Summit: Climbing Toward Energy Sustainability, Seattle, WA, April 7-10.

Gray, Peter. 2014. "Wood-based Aviation Biofuels Supply Chain," the Western Region Forest Resources Association 2014 Spring Meeting, Pasco, WA, April 23.

Rawlings, Craig. 2014. "Tribal Forest Enterprises: 30,000 Feet View with an Economic Development Perspective," at *the Forest Economics & Managing Resources in a Rising Market Workshop*, The Intertribal Timber Council Meeting, Worley, Idaho, June 26.

Zhu, R. and V. Yadama. 2014. "Effects of hot water extraction (HWE) pretreatment on compositional and physicochemical changes of softwood Douglas-fir," 68<sup>th</sup> Forest Products Society International Convention, Quebec City, Quebec, Canada, August 10-14.

Englund, Karl. 2014. "Overview of NARA," the Western Development Committee Forestry Meeting, Richland, WA, August 20.

Englund, Karl. 2014. "Education and Outreach for educating the future employees of the "green" industry workforce," WA Clean Tech Alliance Meeting, Seattle, WA, October 8.

Yadama, V. 2015. Web-based portals for dissemination of research-based findings to stakeholders on wood-to-biofuel conversion. National Extension Energy Summit: Climbing Toward Energy Sustainability, Seattle, WA, April 7-10. (Technical Poster Presentation)

Zhu, R. and V. Yadama. 2015. "Effects of Hot Water Extraction (HWE) Pre-process on the Downstream Sulfite Pretreatment to Overcome Recalcitrance of Lignocellulose (SPORL) and Sugar Yields of Douglas fir," NARA Annual Meeting, Spokane, WA, September 15-17. (Technical Poster Presentation)

Yadama, V., Burke, C., Hougham, J., and Eitel, K. 2015. "Engaging Citizens and Stakeholders Through 1000 Gallons of Biojet Production," NARA Annual Meeting, Spokane, WA, Sept. 15-17. (Oral Presentation)

## **NARA Factsheets:**

[From Wood to Wings](#)

[NARA Flight](#)

[Life Cycle Assessment Based Environmental Impact of NARA Biojet](#)

[Biorefinery Economic Impact](#)

[Education and Outreach Impacts Infographic](#)

[USFS NARA 2015 Briefing](#)

[Micronized Wood Depot Fact Sheet](#)

[Solids Depot Fact Sheet](#)

[Liquids Depot Fact Sheet](#)

[Integrated Biorefinery Fact Sheet](#)

[NARA Resources](#)

[NARA General Overview](#)

[The 2nd Northwest Wood-Based Biofuels + Co-Products Conference](#)

[NARA's Investment in Biofuel Education](#)

[Imagine Tomorrow 2016](#)

[Northwest Forest Residuals to Power a Commercial Flight](#)

[3rd Cumulative Report](#)

[Supply Chain Regions](#)

[NARA's Tribal Partnership Program \(TPP\)](#)

[NARA Supply Chain](#)

[NARA Supply Chain | Metric Version](#)

[NARA SURE](#)

[Supply Chain Flow and Products](#)

[NARA Education](#)

[Environmental Impact Assessments](#)

[Bioenergy Literacy Programs](#)

[Wood Chemical Composition & Products](#)

[NARA Feedstock – Wood Waste](#)

[NARA Key Accomplishments](#)

[Sulfite Pretreatment](#)

[Imagine Tomorrow 2014](#)

[Energy Literacy Matrix](#)

[United States Forest Service/NARA Update](#)

[NARA/AHB Comparison](#)

[NARA Outreach](#)

#### **NARA newsletters:**

(<https://nararenewables.org/newsletters/>)

33 Newsletters were produced and distributed to all stakeholders

#### **Websites:**

[www.nararenewables.org](http://www.nararenewables.org)

[www.woodtobiofuel.org](http://www.woodtobiofuel.org) — A repository of unbiased scientific knowledge on conversion of woody biomass into bio-jet fuel and co-products.

#### **Press releases and news stories:**

A press release has been sent out by Charles Burke regarding the joint symposium “Managing the Woody Biomass Supply Chain,” in Seattle, WA.

Weaver, M. 2012. *Woody biomass alliance holds first meeting*. Capital Press, September 11 (<http://www.capitalpress.com/newsletter/mw-Woody-biomass-meeting-091112>).

Styles, G. 2012. *Jet fuel from trees (or almost anything else)*. The Energy Collective, September 13, (<http://theenergycollective.com/geoffrey-styles/112611/jet-fuel-trees-or-almost-anything-else>).

Baker, D.S. 2012. *What’s happening in the Woody Energy Market?* Pallet Enterprise, August 1 (<http://www.palletenterprise.com/articledatabase/view.asp?articleID=3716>)

Dorminey, B. 2012. *Flying on woody biomass and camelina: consortium seeks biofuel answers*. Renewale Energy World.COM, August 21 (<http://goo.gl/0RQCM>)

Missoula Economic Partnership. 2012. *Biojet Project Takes Off in Missoula* (<http://goo.gl/EpNNe>)

Seale, A. 2012. *Biomass – fueling aviation*. Clean Energy (An independent supplement from MediaPlanet to the Seattle Times, September (<http://goo.gl/RpZQK>)

Burke, C. 2012. *Western Montana Corridor: Putting the Pieces Together*. NARA Newsletter, August (<http://nararenewables.org/news/newsletter>)

FBN Blog maintained by Craig Rawlings: <http://www.forestbusinessnetwork.com/17751/naras-woody-biomass-biofuels-effort-hits-close-to-home-and-how-you-can-help-fuel-the-momentum/>

Chaney, R. 2012. *Group looks to turn forest waste into fuel for jets*. The Missoulian, June 16. ([http://missoulian.com/business/local/group-looks-to-turn-forest-waste-into-fuel-for-jets/article\\_e9560970-b774-11e1-8c83-0019bb2963f4.html#comments](http://missoulian.com/business/local/group-looks-to-turn-forest-waste-into-fuel-for-jets/article_e9560970-b774-11e1-8c83-0019bb2963f4.html#comments)

Burke, C. “NARA member receives national award for STEM education,” WSU News Online, 18 August, 2015.

Burke, C. “NARA member receives national award for STEM education” 1 October 2015.

Burke, C. “Wood-to-biofuel alliance to speak in Port Townsend, WA. Oct. 19<sup>th</sup>,” 6 October 2015.

4/15/13 USDA Press Release  
[Agriculture Secretary Vilsack and Transportation Secretary LaHood Renew Agreement to Promote Renewable Fuels in the Aviation Industry](#)

5/1/13 WSU News  
[Tracking wood in landfills, future energy source](#)

5/8/13 Seattle City Light “Power Lines”  
[Seattle City Light Sponsors High School Alternative Energy Competition](#)

5/22/13 Washington Clean Technology Alliance  
[Imagine Tomorrow: The Big winner is...](#)

5/27/13 The Star  
[Science teams take prizes in big competition](#)

5/30/13 Indian Country  
Sustainability Offers Tribes a Meaningful Way to Diversify Their Holdings

6/6/13 Kingston Community News  
KHS team's project a winner at Imagine Tomorrow

6/11/13 Redmond reporter  
STEM School students win in "Imagine Tomorrow"

6/11/13 Camas-Washougal Post-Record  
CHS Students earn honors in "Imagine Tomorrow"

6/12/13 Oregon Live  
Northwest biofuel researchers will have a booth at Paris Air Show

6/13/13 WSU News  
WSU exhibit to open at Paris Air Show

6/18/13 AviationPros.com  
Washington State's Jet Fuel Research Earns Invite To Paris Air Show.

7/1/13 Western Region Cohesive Wild, and Fire Management Strategy  
Newsletter  
Tribal Partner to reduce fuels and increase biomass utilization

7/9/13 USDA Blog  
Paris Air Show a Hit for USDA Partners

7/23/13 Western Forester  
No Hiding in the Woods: Biomass development requires Engagement, Integration and Innovation

7/23/13 Western Forester  
From Wood to Wing: NARA Works to Harness Woody Biomass for Aviation Biofuel

8/28/13 TAPPI Ahead of the Curve: Wood to Wing  
The Northwest Advanced Renewables Energy Alliance

9/5/13 Engineering Because  
Cornell University Engineer's Research Could be worth \$150 million

11/23/13 The Columbian  
Gifford Pinchot group announces partnership

4/24/14 AgInfoNet  
Wood Based Biofuels Conference

4/24/14 The Eco Report  
Towards a wood based aviation biofuel

4/29/14 KPLU Seattle  
Progress turning woody debris into biofuels

5/6/14 the Eco Report  
Will utilizing Forest Residuals Deplete Soil Nutrients

5/13/14 the Eco Report  
Dr Kevin Boston on the Availability of Biomass

8/29/14 WSU TV Advertisement  
Go-Coogs Ad

11/12/14 WSU News  
WSU honored for strengths in clean technology

11/19/14 WSU News  
Nov.19: Students present potential biorefinery sites

4/23/15 WSU News  
April 29: Students present designs for forest waste facility

4/29/15 Domestic Fuel  
Students Present Wood to Biofuels Design

6/3/15 WSU News  
Alaska Airlines, WSU partner to advance use of aviation biofuels

6/3/15 Juneau Empire  
Alaska Airlines turning to tree power

6/3/15 World Airline News  
Alaska Airlines and WSU to team up on the use of wood residue biofuels

6/3/15 Aviation Pros  
Alaska Airlines, WSU Partner to Advance Use of Aviation Biofuels

6/3/15 Military Technologies  
Alaska Airlines, WSU Partner to Advance Use of Aviation Biofuels



6/3/15 Walla-Walla Union Bullitin  
Alaska Airlines. WSU Partner to Advance Use of Aviation Biofuels

6/3/15 eturbonews  
Alaska Airlines. WSU Partner to Advance Use of Aviation Biofuels

6/3/15 KHQ-Q6  
Alaska Airlines. WSU Partner to Advance Use of Aviation Biofuels

6/3/15 Financial News  
Alaska Airlines. WSU Partner to Advance Use of Aviation Biofuels

6/3/15 Puget Sound Business Journal  
Alaska Airlines. WSU Partner to Advance Use of Aviation Biofuels

6/3/15 Frequent Business Traveler  
Alaska Airlines Partners with NARA on Alternative Jet Fuels

6/4/15 Biofuels Digest  
Alaska Airlines to fly on wood-based aviation biofuels next year

6/4/15 The Spokesman Review  
Alaska Airlines, WSU to test wood-based biofuel

6/4/15 MRO Network  
Alaska Airlines to test new biofuel

6/4/15 SeeNews  
Alaska Airlines plans demo flight on forest residual-derived fuel in 2016

6/4/15 Tri-City Herald  
WSU Tri-Cities research contributes to Alaska Airlines biofuel flight.

6/4/15 EVA International Media  
Alaska Airlines. WSU Partner to Advance Use of Aviation Biofuels

6/4/15 HtSyndication  
Alaska Airlines. WSU Partner to Advance Use of Aviation Biofuels

6/4/15 ETB Travel News  
Alaska Airlines. WSU Partner to Advance Use of Aviation Biofuels

6/4/15 Avionics Today  
Alaska Airlines. WSU Partner to Advance Use of Aviation Biofuels

6/4/15 Teru Talk  
Alaska Airlines and WSU partner to Advance Use of Aviation Biofuels

6/5/15 ATW (Air Transport World)  
Alaska Airlines, NARA team up on biofuel development

6/5/15 Aerospace-technology.com  
Alaska Airlines and NARA to accelerate use of alternative jet fuels

6/5/15 Woodworking Network  
Wood-based fuel gets a trial run in Alaska Airlines Test Flight

6/5/15 The Wenatchee World  
Alaska Airlines, WSU to test wood-based biofuel

6/5/15 Xconomy  
Seattle Roundup: Carena Funding, Avalara Acquisition, Alaska Biofuel

6/6/15 Aeroclix  
Alaska Airlines, NARA team up on biofuel development

6/6/15 Western Forest Protection Association  
Alaska Airlines to complete flight powered by biomass

6/8/15 Your AlaskaLink  
New Fuel for Alaska Air

6/8/15 CAAFI  
Alaska Airlines Teams with Northwest Advanced Renewables Alliance to Advance Aviation Biofuels

6/8/15 YourAlaskaLink  
New Fuel for Alaska Air

6/10/15 National Geographic  
5 technologies that could help curb airplane emissions

6/10/15 Crop Biotech Update  
Alaska Airlines and WSU Partner to Advance Biojet Fuel

6/18/15 GE Reports  
Ralph Cavalieri: Finding an alternative way to fuel the aviation industry

7/4/15 Justmeans  
Airlines Look for Sustainable Jet Fuels

7/8/15 Puget Sound Business Journal  
Jets that burn wood for fuel? It's not as far-fetched as it sounds

7/8/15 Working Forest Action Network  
Alaska Airlines to complete flight powered by biomass

8/24/15 Alaska Beyond  
Alaska and WSU partner to inspire STEM education

9/2/15 Valley Journal  
Flying trees: Tribes part of renewable energy work

10/1/15 WSU News  
Wood to biofuel webinar series offered

10/1/15 WSU News  
First-person exhibit celebrates Open Access Week at WSU

10/23/15 USDA Blog  
Fueling our Future, from wood to wing

11/25/15 USDA Blog  
Tribal partnerships fuel sustainability aviation

11/25/15 USDA Blog  
Alaska Airlines teams with tribes on producing aviation biofuel for 2016 demo

12/3/15 Northwest Mining and Timber  
Bio-Ride: Fuel Solutions for 30,000 feet

12/16/15 The Seattle Times  
Port, Alaska Air and Boeing press ahead on biofuels at Sea-Tac

12/16/15 Boeing News Release  
Port of Seattle Partners with Alaska Airlines and Boeing on Plan to Supply Sustainable Aviation Biofuel at Sea-Tac Airport

12/23/15 USDA-NIFA Blog  
NIFA-funded projects help improve quality of life in Indian Country

4/12/16 WSU News  
NARA Member receives approval for bio-jet fuel

6/7/16 Alaska World  
Alaska Airlines Flies on gevo's renewable Alcohol to Jet Fuel

6/15/16 The Seattle Times  
Plant-based jet fuel: WSU research takes off

6/16/16 National Resources Defense Council  
Cleaner Skies are friendlier Skies: NRDC's 2016 Aviation Biofuel Scorecard

### **Trade Journals:**

Burke, C., S. Leavengood, and V. Yadama. 2015. "Using slash piles to make chemical products: an update on the Northwest Advanced Renewables Alliance (NARA) activities," The Western Forester, Jan/Feb, pp 7-9. (<http://www.forestry.org/northwest/westernforester/2015/>)

### **Videos and Webinars:**

Video news story on NARA's First Annual Meeting (<http://goo.gl/u4NFM>)

23 NARA produced YouTube Videos

Oregon State University 2013 Starker Lecture Series – Mike Wolcott Presents "Aviation Fuels From Wood."

NARA is featured in a WSU video promoting clean technologies.

Video Streaming: MC2P – Site Selection Presentation, October 14, 2013, 2-4pm

Webinar: NARA biofuel supply chain analysis for the Mid Cascade to Pacific (MC2P) Region, December 4, 2013, 2-4pm

Preliminary Site Selection for NARA Supply Chain

Site Selection Webinar

17 other videos produced by NARA's Outreach Team

Slashing America's Carbon Footprint: An Emerging Biofuel Source. 2016. A big picture video that was professionally produced.

Video b-roll and interviews: Forty-four interviews of NARA members and stakeholders were conducted and videotaped. In addition, video b-roll was acquired. These assets are used to construct video products and pertinent b-roll clips are publicly available.

12 webinars posted: NARA and MOSS webinars were posted onto YouTube. Following are the ones that the Outreach team organized and hosted (<http://nararenewables.org/features/webinar-series>):

- Kevin Boston, Associate Professor, Oregon State University. "Estimating forest residue for biomass production," October 13, 2015.

- John Sessions, University Distinguished Professor and Rene Zamora-Cristales, Post Doctorate, Oregon State University. “*Decision support for forest harvest residue collection*,” October 14, 2015.
- Gevan Marrs, Feedstock Sourcing, NARA. “*Characterization of forest residuals for bio-jet fuel production*,” October 19, 2015.
- Indroneil Ganguly, Assistant Professor, Research, University of Washington. “*‘Woods-to-Wake’ life cycle assessment of residual woody biomass based jet-fuel*,” October 21, 2015.
- Jeff Hatten, Assistant Professor, Oregon State University and Scott Holub, Silviculture Research Scientist, Weyerhaeuser NR Company. “*Long-term soil productivity and sustainability of forest harvest residue harvesting*,” October 30, 2015.
- Todd Morgan, Director, Forest Industry Research, Bureau of Business and Economic Research, University of Montana and Greg Latta, Assistant Professor, Senior Research, Forest Engineering, Resources & Management, College of Forestry, Oregon State University. “*Incorporating Timber Product Output (TPO) harvest residue information and forest market models to evaluate biorefinery siting potential*,” November 19, 2015.
- J.Y. Zhu, USDA Forest Service, Forest Products Lab. “*Pretreatment of Woody Biomass for Biofuel Production*,” January 19, 2016.
- Andrew C. Hawkins, Ph.D. and Glenn Johnston | Gevo, Inc., Englewood, CO. “*Production of Lignocellulosic Isobutanol by Fermentation and Conversion to Biojet*,” April 29, 2016.
- The IDX team at Washington State University, *IDX Webinar I: Liquid Depot Facility @ Port Townsend Paper Company*, November 16, 2015
- The IDX team at Washington State University, *IDX Webinar II: Micronized Wood Facility @ Hermann Brothers Site*, November 16, 2015
- The IDX team at Washington State University, *IDX Webinar III: Liquid Depot Facility @ Port Townsend Paper Company*, December 14, 2015
- The IDX team at Washington State University, *IDX Webinar IV: Micronized Wood Facility @ Hermann Brothers Site*, December 14, 2015

### Trainings, Education and Outreach Materials:

Tichy, R., Yadama, V., Englund, K., Lowell, E., Leavengood, S., and Rawlings, C. 2012. *Managing Woody Biomass Supply Chain*. Proceedings of the International Wood Composites and NARA Joint symposium, Seattle, WA, April 11-12 (<http://www.nararenewables.org/2012-iwcs>)

WA Department of Commerce. 2012. *Northwest Bioenergy Research Symposium*. Proceedings of 2012 Northwest Bioenergy Research Symposium, Seattle, WA, November 13 (<http://pacificbiomass.org/BioenergyResearchSymposiums/BioenergyResearchSymposium2012.aspx>)

Forest Business Network. 2013. *Small Log Conference*. Proceedings of the 2013 Small Log Conference, Coeur d’Alene, Idaho, March 13-15 (<http://www.forestbusinessnetwork.com/our-events/slc/proceedings/>; NARA Presentations from the 2013 Small Log Conference)

Yadama, V. 2012. *WSU Biofuels Project*. Forest Owners Field Day, August 18, Maytown, WA.

Yadama, V. and Rawlings, C. 2012. *NARA: A Supply Chain to Aviation Biofuels and Lignin Co-products*. Oral Presentation, Montana Loggers Association, Lubrecht Experimental Forest Station, MT, September 15.

Yadama, V. 2013. *Using Biomass to Create Jet Fuel*. 21<sup>st</sup> Annual Family Foresters Workshop, January 18, Coeur d’Alene, Idaho. (Appendix F)

Yadama, V. 2013. *From Sticks to Jet-Stream: Using logging slash to create Jet Fuel*. Northeast Chapter Annual Winter Meeting, Washington Farm Forestry Association, February 9, Chewelah, WA. (Appendix G)

The NARA project, in connection with WSU, is featured on a display at the Future of Flight Aviation Center and Boeing Tour. The Museum attracts over 225,000 visitors annually. Of these guests, roughly 1/3 are from the immediate region, 1/3 from the balance of the United States, and 1/3 are international. An additional 75,000 people visit the facility to participate in a special event—activities surrounding delivery of Boeing aircraft, receptions, school activities, and so on

The NARA project, in connection with WSU, was featured at the 2012 Smithsonian Folklife Festival at the Washington Mall. This event attracts over one million visitors each year.

Washington-Oregon PSC Study Region -- First Stakeholder Meeting. May 21, 2013, Vancouver, Washington, [Meeting presentations](#)

Preliminary fieldtrips in MC2P region -- Members of the Outreach and Education teams visited several sites in the greater Portland area to learn more about regional resources and develop relationships with stakeholders that will shape our understanding of biomass issues in the region. Fieldtrips included visits with wood recyclers ([Greenway Recycling](#)), biofuel processors ([SeQuential Pacific Biodiesel](#)), log yard ([Teevin Brothers](#)), and environmental organization ([The GP Task Force](#)). A brief report regarding the fieldtrip can be found at [NARA’s Blog](#). This trip set the foundation for further work and research, including the generation of a profile and bioregional atlas focusing on woody biomass and the associated assets in the southwest Washington and northwest Oregon area.

**NARA hosted conferences:**

1<sup>ST</sup> Northwest Wood-Based Biofuels + Co-Products Conference, April 28-30, 2014, Seattle, WA. ([Proceedings](#))

2<sup>nd</sup> Northwest Wood-Based Biofuels + Co-Products Conference, May 3-4, 2016, Seattle, WA. ([Proceedings](#))

Bioenergy Literacy in STEM Education. Education Track during the 2<sup>nd</sup> Northwest Wood-Based Biofuels + Co-Products Conference, May 3-4, 2016, Seattle, WA (Designed for K-12 educators).

**Thesis and dissertations:**

Zhu, R. 2016. Groundwork for integration of hot water extraction as a potential pre-process in a biorefinery for downstream conversion and nano-fibrillation. Ph.D. Dissertation, Materials Science and Engineering Program, Washington State University, Pullman, WA, 177p.

**USFS PNW Research Station****Publications:**

Sands, Yasmeen. 2011. Woody biomass research grant to launch biofuel industry in the Pacific Northwest. Press release issued from Pacific Northwest Research Station/USDA Forest Service September 28, 2011.

**USFS Briefing Papers and Brochures:**

- [Northwest Advanced Renewables Alliance \(NARA\): A Supply Chain to Aviation Biofuels and Environmentally Preferred Products](#) (briefing paper)
- Effects of Residual Biomass Harvesting on Soil Productivity (briefing paper)
- Residual Biomass Harvesting and Carbon (briefing paper)
- Wood to Wing: Environmental Effects of Residual Biomass Harvesting to Produce Wood-based Biofuel (brochure)
- Wood to Wing: The Economics of a Wood-Based Bio-Refinery in Longview, Washington (brochure)

Lowell, E.C. and Leavengood, S. 2013. From Wood to Wing: NARA Works to Harness Woody Biomass for Aviation Biofuel. *Western Forester*. 58(3):12-13,21. Publication available at: [http://www.forestry.org/media/docs/westernforester/2013/WF\\_June\\_July\\_Aug2013.pdf](http://www.forestry.org/media/docs/westernforester/2013/WF_June_July_Aug2013.pdf)

**Book Chapter:**

Lowell, E.C. Yadama, V., Schimleck, L.R. and Skog, K.E. 2017. Chapter 17: Next-generation Products and Greenhouse Gas Implications in VanHorne, B. and Olsen, D. eds. *People, Forests, and Change Lessons from the Pacific Northwest*. Island Press. (ISBN-13: 978-1610917674)

**Presentations:**

Lowell, Eini C. 2012. Video conference presentation to the Chief of the U.S. Forest Service that included describing the overall objectives and providing information on the NARA project as well as my role on the Outreach Team. "Conversation with the Chief" - June 28, 2012

Lowell, Eini C. 2012. "Bioeconomy Opportunity Zones or how do we get there from here?" An oral presentation made to the PNW Research Station Management Team, July 16, 2012.

Lowell, E.C. 2013. "The Northwest Advanced Renewables Alliance A Supply Chain to Aviation Biofuels and Environmentally Preferred Products." An oral presentation to Willamette National Forest Leadership and community leaders. Springfield, OR (1/25/2013)

Lowell, E.C. and Leavengood, S. 2013. Regional Focus: Oregon and Washington Assets and Stakeholder Involvement. Vancouver, WA (May 21, 2013).

Lowell, E.C. and the NARA Outreach Team. 2013. From Wood to Wing: NARA Works to Harness Woody Biomass for Aviation Biofuel. 56th Society of Wood Science and Technology International Convention, Austin, Texas USA (June 9, 2013).

Lowell, E.C. and the NARA Outreach Team. 2013. From Wood to Wing: NARA Works to Harness Woody Biomass for Aviation Biofuel. 67th Forest Products Society International Convention, Austin, Texas USA (June 9-11, 2013).

Lowell, E.C. 2014. "Wood-to-Biofuels Infrastructure: Supply Chain Analysis" was given by Lowell at the Forest Products Society 68<sup>th</sup> International Convention. Quebec City, CAN (8/10-13/2014).

Proceedings of the 2<sup>nd</sup> Northwest Wood-based Biofuels and Co-Products Conference, Seattle, WA May 3-4, 2016 were distributed on flash drives.

Lowell, E.C. 2015. "Community Biomass Handbook Volume 1: Thermal Wood Energy and Financial App - an iBook approach". National Extension Energy Summit. Seattle, WA (April 2015)

Lowell, E.C. 2015. "Community Opportunities: small wood and biomass." North Santiam Economic Vitality Summit, Stayton, OR (4/29/2015)

Lowell, E.C. 2016. "Biofuels from forest residuals – What is on the minds of stakeholders?" International Society of Wood science and Technology Convention (March 6-10, 2016) Curitiba, Brazil

## Ruckelshaus Center & DGSS

Coordinated 5 NARA annual meetings [~750-1,000 total participants]

14 quarterly briefing papers developed and distributed aimed at informing approximately 1,000 policy-makers in Washington, Oregon, Idaho, Montana and Northern California about the progress of AHB and NARA.

The EPP team has developed three conference posters, two conference presentations, and has had one publication accepted for publication, two in revise and resubmit, and another submitted for peer review, in addition to participating in at least one university academic showcase (WSU) with respect to the CAAM and community characteristic assessment projects.

The Center invited SAFN members to attend the presentation on NARA at the 2012 International Wood Composites Symposium followed by an informal lunch discussion with Dr. Wolcott and Ruckelshaus Center.

The Ruckelshaus Center focused its spring 2012 Ruckelshaus Center Advisory Board meeting in Spokane on aviation biofuels and featured the PIs of NARA and the UW-led project on hybrid poplars.

### Research Presentations:

Rijkhoff, Sanne, Season Hoard, Michael Gaffney, Paul Smith, Natalie Martinkus, Nicholas Lovrich, John Pierce and Michael Wolcott. Refining Community Asset and Attribute Modeling: Applying Social Data to Inform Bio-Fuel Project Site Selection in the NARA Region. Poster, 2014 NARA Annual Meeting, Seattle, WA, September 15-17.

Smith, Paul, Season Hoard, Michael Gaffney, Tammi Laninga and Jillian Moroney, 2014. *The NARA Community Assessment Model*. Poster, WSU 2014 Academic Showcase.

Gaffney, Michael, Season Hoard, Paul Smith, Sanne Rijkhoff, 2014. Paper presentation *The NARA Community Assessment Model* at the annual IBBC conference, Seattle, WA.

Kern, M. and M. Gaffney. 2012. *Engaging Policy Makers & Advisory Board Assessment*. Presentation at 2012 NARA Annual Meeting, Missoula, MT, September 13-14.

Wolcott, M. 2012. *Northwest Advanced Renewables Alliance: A New Vista for Green Fuels, Chemicals and Environmentally Preferred Products*. Presentation at the William D. Ruckelshaus Center Advisory Board Meeting, Spokane, WA, April.

Kern, M. 2011. *The William D. Ruckelshaus Center: Fostering Collaborative Public Policy*. Presentation at WSU Extension and CAHNRS all Faculty Conference, Pullman, WA, October.

*USDA Agriculture and Food Research Initiative-Coordinated Agricultural Projects Panel Discussion*. Goldner, W., T. Rials, T. Richard, N. Anderson, M. Wolcott and M.A. Kern (Moderator). Northwest Wood-Based Biofuels and Co-Products Conference, SeaTac, WA, May 2016. Available at: [https://nararenewables.org/conference/?page\\_id=1013](https://nararenewables.org/conference/?page_id=1013)

*Aviation Fuel Supply Chain Stakeholder Perceptions in the PNW (Poster)*. Smith, Gaffney, Shi, Hoard, Ibarrola, Mueller, et al. ASCENT Semi-annual meeting, April 26, 2016.

*Airport Management Perceptions of Aviation biofuels in the Pacific Northwest (Poster)*. Mueller, Hoard, Smith, Sanders, Gaffney, et al. ASCENT Semi-annual meeting, April 26, 2016.

*Aviation Fuel Supply Chain Stakeholder Perceptions in the PNW Region (Poster)*. Shi, Smith, Ibarrola, Gaffney, Hoard, Mueller, et al. Biofuels and Co-Products Conference, Seattle, May 3, 2016.

*Stakeholder Perceptions of Aviation Biofuels in the PNW (Poster)*. Mueller, Hoard, Smith, Sanders, Gaffney, et al. Biofuels and Co-Products Conference, Seattle, May 3, 2016

### Other Publications:

Kern, M. "Creating a 'Flight Path' for Aviation Biofuels. *Ruckelshaus Center eNews Fall 2011*. Nov. 2011 <http://ruckelshauscenter.wsu.edu/eNewsFall2011Edition.html>

Kern, M and E. McCarthy. "Helping Sustainable Jet Fuel Take Flight: The Northwest Advanced Renewables Alliance (NARA)." *Ruckelshaus Center eNews Spring 2016*. May 2016 <http://ruckelshauscenter.wsu.edu/uncategorized/enews-spring-2016/>

### Refereed Publications (submitted, accepted or published):

*Integrating Biogeophysical and Social Assets into Biomass-to-Biofuel Supply Chain Siting Decisions*. Martinkus, Shi, Lovrich, Pierce, Smith, Wolcott. *Biomass & Bioenergy*. 2014; 66: 410-18.

*Communities Ready for Takeoff: Integrating Social Assets for Bio-fuel Site-selection Modeling*. Rijkhoff, Hoard, Gaffney, Smith. Revise and Resubmit from Renewable Energy (RENE-D-15-017240)

*Drivers and Barriers to the Adoption and Diffusion of Sustainable Jet Fuel (SJF) in the U. S. Pacific Northwest*. Smith, Gaffney, Shi, Hoard, Ibarola, Mueller. Revise and Resubmit from Journal of Air Transport Management (JATM\_2016\_133)

*A Stepwise Biogeophysical and Social Analysis to Approach Site Selection of Biorefineries*. Martinkus, Rijkhoff, Hoard, Shi, Smith, Gaffney. Submitted to Biomass & Bioenergy.



## University of Wisconsin Extension – Upham Woods Outdoor Learning Center

### Publications:

Schon, A. Jennifer, Karla B Eitel, **R Justin Hougham**, and Danica Hendrickson. (2015) Creating a research to classroom pipeline: closing the gap between science research and educators. Journal of Sustainability Education (8).

Eitel Karla, **R. Justin Hougham**, Tammi Laninga, Greg Fizzell, Jenny Schon, and Danica Hendrickson. (2015) Teacher Professional Development for Energy Literacy: A Comparison of Two Approaches. Journal of Sustainability Education (8).

Hendrickson, Danica, Kimberly Corrigan, Alicia Keefe, Danielle Shaw, Sheeba Jacob, Laura Skelton, Jennifer Schon, Karla Bradley Eitel and **R. Justin Hougham**. (2015) Global Sustainability: An Authentic Context for Energy Education. Journal of Sustainability Education (8).

DeWaters, Jan, **R. Justin Hougham**, Clare Hintz and Larry Frolich. (2015) Beyond Conservation: Reimagining the Purpose of Energy Education. Journal of Sustainability Education (8).

Langfitt, Q., Haselbach, L., & **Hougham, R.J.** (2014). Artifact Based Energy Literacy Assessment Utilizing Rubric Scoring. Journal of Professional Issues in Engineering Education and Practice.

Schon, J., **Hougham, R.J.**, Eitel, K.B., & Hollenhost, S. (2014). *The Value of a Tree: Comparing Carbon Sequestration to Forest Products*. Science Scope, Vol. 37 No. 7.

Fueling our Future. (2014) Curriculum published by Facing the Future, reviewer and contributor.

### Presentations:

**Hougham, R. J.**, Schon, J.A., Bradley Eitel, K., & Hollenhorst, S.A. (2012). *Education at the Speed of Research: Communicating the Science of Biofuels*. Published Proceedings of the Sun Grant Initiative. New Orleans, LA.

Drozd, M., Schumann, P., Nutter, M., **Hougham, R.J.** (2016). *Biofuel Concept Learning Assessment of Middle School and Elementary School Youth through the Value of a Tree Lesson Plan*. Northwest Advanced Renewables Alliance – Summer Undergraduate Research Symposium. Poster. Pullman, WA. August 2, 2016.

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# NARA OUTCOMES

Following are the accomplishments of the NARA Outreach Team:

1. NARA Outreach and Education Team engagements in four supply chain regions in the four-state region has resulted in a broad forest stakeholder group investigating aviation biofuels development in the region.
  2. Washington Clean Energy stakeholders have regrouped a Biomass Task force and are coordinating with a similar group in Oregon as a result of NARA Outreach Team engagement.
  3. Due to featured display about NARA project at the Future of Flight Aviation Center and Boeing Tour, the Center's educational unit is integrated a biofuel's segment into its educational outreach efforts that reaches over 500 students annually.
  4. Rise in interest among some conversion facilities in exploring viability of integrating technologies to produce co-products and feedstock for down stream conversion into biofuels in the region.
  5. Increase in national awareness of PNW efforts in converting wood to biofuels and co-products as a result of hosting and disseminating research-based findings through two NW Wood-Based Biofuels + Co-Products Conferences, as well as participating in regional association meetings and national-level conferences.
  6. Increased public awareness of the opportunities and challenges of converting wood to biofuels and potential co-products through newsletters, webinars, news articles, social media, and WoodToBiofuel.org web portal.
  7. Several stakeholders, especially business-related stakeholders, at the beginning of the NARA project, questioned the economic feasibility of commercializing biomass for biofuels technology, but now stakeholders in general are more receptive to possibilities of establishing biomass to biofuels infrastructure. One example is that Alaska Airlines, Boeing, and the Port of Seattle recently announced funding to review infrastructure requirements to accommodate bio-jet fuel. In their press release, they mention the NARA as a project that justifies the funding action.
  8. As a result of the Montana NARA Outreach Team's efforts, members of the Forest Products Retention Roundtable and other stakeholders in Montana not only have more knowledge of the feasibility and limitations of a wood-based bio-jet industry developing in Montana, they have better access to a variety of biomass and bioenergy information and tools.
  9. As a result of the Montana NARA Outreach Teams efforts, additional alternative uses of forest biomass are being pursued and have become public knowledge such as home heating, energy pellets, wood gasification and biochar production.
  10. In recent SurveyMonkey surveys conducted in Idaho, we asked foresters and loggers about their use of email and social media. Less than 10% of loggers use email, and less than 1% use social media. Their primary method of gaining knowledge is through face-to-face meetings. This makes getting the word out about the project difficult unless we are invited to the meeting they attend during the "breakup" period (which is when they are not able to log). Many are unwilling to give their mailing addresses out to have project information mailed to them. When presented with an opportunity to speak to these groups, the message needs to be concise and to the point ad must grab their attention immediately. The primary challenge is convincing stakeholders that this process will be commercially and economically feasible and eventually will benefit them. One stakeholder mentioned "this is like telling us we are going to Mars in 20 years, what good does it do us in the here and now".
  11. Awareness of Collaborative Forest Landscape Restoration Program partners to expanded opportunities for biomass utilization
  12. Providing a tool for the assessment of community characteristics indicative of level of possible support for NARA initiatives, and providing strategic insight into management of engagement for those communities.
- These accomplishments resulted in the following impacts or outcomes:
- NARA Outreach and Education Team engagement in the 4-State region has resulted in a broad regional stakeholder community investigating aviation biofuel and co-product development
  - Broadened public understanding and awareness of biofuel and co-product potential
  - NARA has brought conversion of woody biomass to biofuels and chemical co-products into main stream conversation at regional biomass and biofuel coalition groups, such as WA Biomass Working Group
  - Outreach efforts have advanced the conversation from "Is it possible?" to "How do we implement a wood-to-biofuels supply chain?" as evidenced by biofuel infrastructure studies between Boeing, Alaska Airlines, and Port of Seattle

- Surveys show NARA advanced public knowledge regarding conversion of woody biomass into biofuels and co-products
- Increased biofuel and co-product capacity of scientists, engineers, teachers, policymakers, and energy leaders

# FUTURE DEVELOPMENT

- To continue providing benefits and information to stakeholders resulting from the NARA project, BBER will maintain the online, [five-state timber harvest by county database tool](#) developed with NARA and FIA funds. With ongoing support from the FIA program, BBER is enhancing it with more customizable query options, will update the database annually, and will expand the database to provide logging residue quantities as well as harvest volumes.
- NARA Outreach members in Montana (i.e., BBER, FBN, and MSU Extension Forestry) will continue interacting with the Forest Products Retention Roundtable, sharing information, and finding ways to involve Montana stakeholders in future woody biomass related research and business development.
- Future development of bioenergy in Montana is going to need to focus on overcoming the local issues identified as problematic during the NARA project. For example, various factors constrained the available biomass supply in Montana: the high proportion of federal (US Forest Service) lands and associated policies reduced the presumed available supply of woody biomass and the ability of that supply to qualify as renewable energy/fuels (identified with Renewable Identification Numbers (RINs)). Lower harvest and residue volumes than “west side” locations restricted the scale of facilities that could feasibly operate locally. Lack of natural gas supply to potential conversion and depot facility sites was also identified as an issue impacting Montana’s potential for biofuels development. Stakeholders in Montana would like to develop more profitable uses for woody biomass, but supply and availability constraints are concerns for existing, as well as new users of biomass. Many stakeholders in Montana are eager to find solutions to the policy issues impacting biomass supply and the profitability of commercially using biomass.

- Additional research and outreach projects have developed and will continue to use NARA outputs (for example: regional supplies, logistics and efficiency measurements and models) for further development of biomass uses and markets across Montana.
- Continue to examine the possibility of supply chain depots and how it might be a good fit for restoration and wildfire risk reduction activities and byproducts from National Forests.
- The CAAM model is in a final iteration of validation and refinement, and will be made available for use by those who wish to incorporate community social, cultural, human and political (added under FAA funding) characteristics into their site selection and engagement decisions.

Based on our experience within NARA, we recommend that any outreach efforts in the future should plan from the beginning to tackle the following most challenging tasks:

- Putting in place most effective metrics to measure advancement in knowledge and change in behavior as a result of dissemination of research findings and engagement of stakeholders.
- Measuring the effectiveness of informing policymakers, which was accomplished through policymaker handouts distributed through the Ruckelshaus Center. Efforts were made to communicate the findings to policymaker aides through state biomass working groups.
- Gaining the environmental communities trust and having the engage in the process by providing their input regarding concerns and solutions.



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# APPENDICIES

## Appendix A

### Stakeholder Engaging Opportunity

The outreach team for NARA will serve as a conduit between researchers and community stakeholders helping to transfer the science and technology of biofuels and important co-products to communities in the Northwest.

#### Why get involved?

- Have your voice heard
  - We value our stakeholders' perspectives and input
    - Pop-up: *We believe that development of biofuels/co-products from woody biomass is a two-way process between the research teams, industry partners, and the stakeholders such as yourself*
- Keep yourself informed about
  - Science and technology developed by NARA
    - Pop-up: *As NARA teams develop science and technology, keep yourself informed and up to date on latest developments. Find out about upcoming workshops, webinars, seminars, and conferences.*
- Be a delegate
  - conduit between NARA and
    - your community
    - your company
    - your agency
    - your association
    - your peers

### Benefits of a connected stakeholder

- News regarding NARA research and activities
- Announcements and invitations to workshops, seminars, webinars, conferences, etc.
- Facts-based information on woody biomass for biofuels and co-products
- Networking and business opportunities

On this page, a link to the sign-up form was provided.

### Stakeholder Questionnaire

(A Google Form was generated and Linked)

1. \*Name:
2. \*Pick one or more categories that best describes you?
  - a. Private forestland owner
  - b. Corporate forestland owner
  - c. Logging & harvesting
  - d. Chemical industry
  - e. Petroleum/Bio-refinery
  - f. Aviation Industry
  - g. Forest Products Industry
  - h. Solid waste/recycler
  - i. Academic/Research/Extension
  - j. Government – local, state, federal, tribal
  - k. Tribal Organization
  - l. NGO, Interest group, Trade Association
  - m. Retailer/Wholesaler/Distributor
  - n. Elected/appointed official
  - o. Legal
  - p. Entrepreneur
  - q. Consulting
  - r. Educator (K-12, college, other)
  - s. Student (K-12, post high school, college, BS, MS, PhD)
  - t. Media
  - u. Interested Citizen
  - v. Other (describe/explain)
3. \*Company/Affiliation:
4. \*Title/Position:
5. \*City, \*State, \*email (address & phone optional)  
—Disclaimer (disclaimer language?)
6. Other information:
  - a. \*How did you find out about us?
  - b. \*Do you want to receive communications regarding NARA activities?
  - c. Why are you interested in NARA?
  - d. Other comments (i.e., products you produce, acreage you own or manage)

## Appendix B

### Developing NARA Communities

As for **building supply chain coalitions** at the community level, a process has been established in collaboration with the EPP and Education teams to select NARA communities (NCs) across the four-state region (Figure EIS-AppB.1).

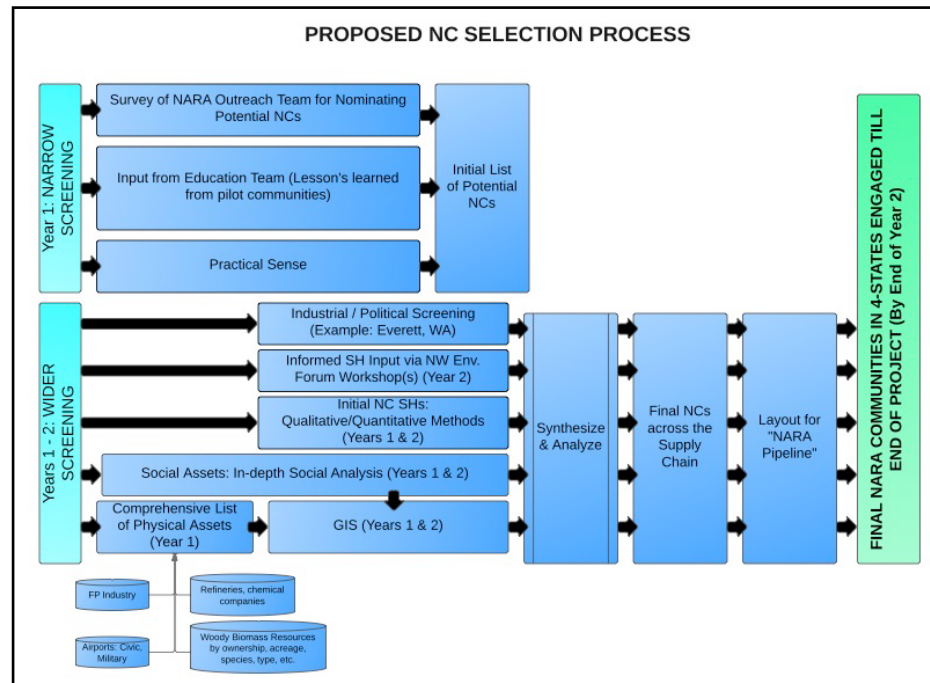


Figure EIS-AppB.1. NARA communities (NCs) selection process initially developed.

As per the established methodology, a survey of the NARA Outreach team members was conducted to develop a long list of potential NCs (see attached survey). A list of criteria to rank the identified NARA communities was developed (see attached Criteria List). A total of 24 communities/bioregions were nominated. During this process, we also compiled information regarding their perceived position in the supply chain, known physical, environmental, and social assets, and recognized stakeholders (see the Summary of NARA Community Selection Survey).

Due to urgency in choosing pilot supply chain study regions (renamed from NARA Communities) in the first two years of the project, results of the survey were conducted were utilized in forming a pilot supply chain study region in Year 2 – Western Montana Corridor (encompassing western Montana counties, northern Idaho counties, and north eastern Washington counties (Figure EIS-AppB.2), see WMC report from the IDX in the Education Team). Subsequently, the Outreach and Education teams have also chosen a pilot supply chain study region in western Washington and Oregon for Year 3 (Figure EIS-AppB.3).

### Western Montana Corridor (WMC) Example

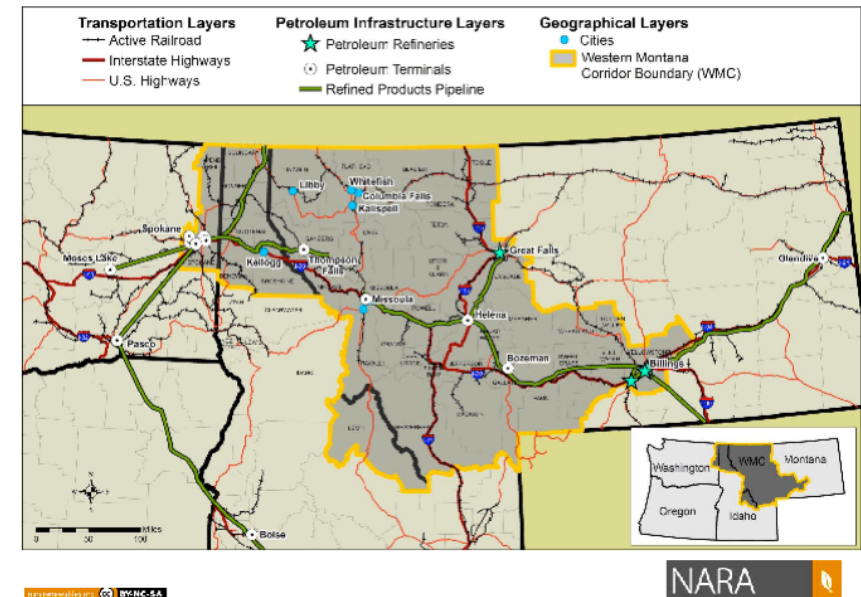


Figure EIS-AppB.2. Western Montana Corridor pilot supply chain study region in Year-2.

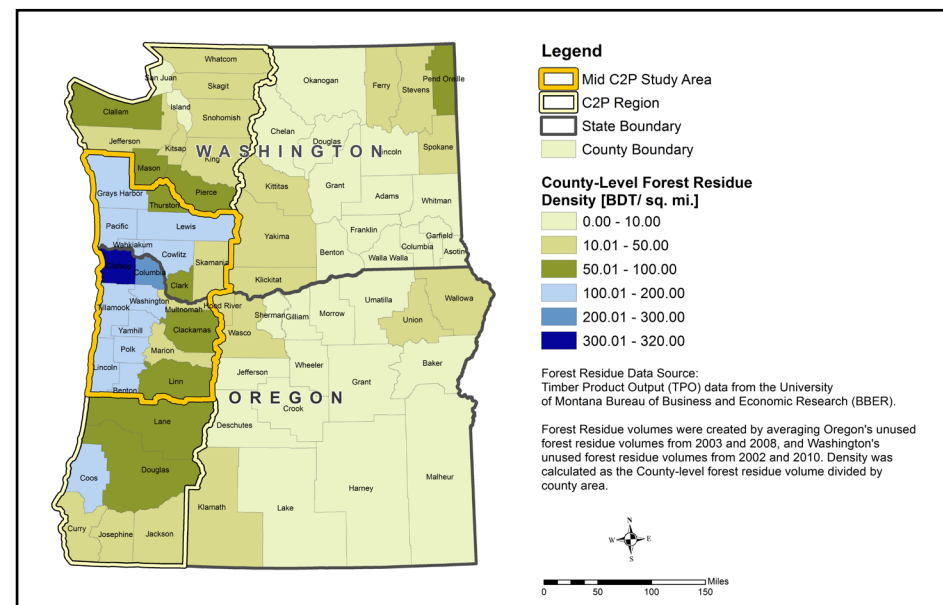


Figure EIS-AppB.3. Tentative Mid Cascades to Pacific (MC2P) pilot supply chain study region in western Washington and Oregon for Year-3. Tentative Mid Cascades to Pacific (MC2P) pilot supply chain study region in western Washington and Oregon for Year-3.

However, follow-up assessments of the pilot supply chain study regions will be carried out based on bio-geo-physical-social metrics for a systematic and unbiased analysis methodology being established by the EPP and Education teams. Applying the model to assess the pilot supply chain study regions chosen in Years 2 and 3 will validate the analytical model.

## NC Selection Survey

# NARA Community Survey 8-26-2011

Please fill in form below to help identify potential NARA Community sites in Idaho, Montana, Oregon, and Washington. Additional details are asked to help categorize the community and identify potential stakeholders in the community. If you have any questions, please email to [vyadama@wsu.edu](mailto:vyadama@wsu.edu) or call 5093356261.

\* Required

## Select the importance of various physical and/or social assets for NARA Community (NC) consideration.

Note: Assets are listed by community's position within the supply chain. Supply chain categories include: forest resource, feedstock production, feedstock transportation, pretreatment, conversion, fuel/coproduct distribution and fuel/coproduct enduser. (Assumptions: this is a proposed ranking criteria for selecting communities across the NW United States that exhibit a high probability of supporting an economically efficient and feasible woody biomass processing facility (either preprocessing, final processing or both) for the industrial production of biojet fuels and byproducts.)

### 1. NC Supply Chain Position: Forest Resource

Mark only one oval per row.

	Very Unimportant		Neutral		Extremely Important
available and sustainable supply (at least 10 years) of woody biomass from private industrial forest owners	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
available and sustainable supply (at least 10 years) of woody biomass from private nonindustrial forest owners	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
available and sustainable supply (at least 10 years) of woody biomass from tribal forestlands	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

available and sustainable supply (at least 10 years) of woody biomass from federal forests	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
available and sustainable supply (at least 10 years) of woody biomass from state forests	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
proximity of woody biomass resource to community sites (less than 100 miles)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
proximity of woody biomass resource to community sites (greater than 100 miles)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
high percentage of larger diameter stems capable of being debarked	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
high percentage of smaller diameter fire hazard reduction and precommercial thinning material with bark and limbs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
presence of certified forests	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
poor markets for existing woody biomass by type and quality of biomass (clean chips, dirty chips, slash, planar shavings, sawdust, trim, bark, mixed species residues)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
existing managed forest plantations designated for primary harvest and wood production	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
available volumes and quality of wood industrial residues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
available volumes and quality of urban wood waste high risk of forest fires	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
potential collaboration efforts (e.g., SW Crown of the Continent, Blackfoot Coop)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
communities acceptance of use of forest wood resources	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
other 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
other 2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**2. If you chose other 1 or 2, please specify what these other assets are.**

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**3. NC Supply Chain Position: Feedstock Production**

*Mark only one oval per row.*

	Very Unimportant		Neutral		Extremely Important
existence of community natural resources advisory board or similar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
proximity to woody biomass resource (less than 100 miles)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
proximity to woody biomass resource (greater than 100 miles)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
existing wood harvesting and feedstock transport infrastructure (logging)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
existing infrastructure (buildings, equipment, power lines, land availability for processing plant.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
favorable community permitting process and favorable environmental regulations (air quality, water, sewer, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
feedstock flexibility (allowing for the conversion of variety of biomass)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
available skilled workforce	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
existing feedstock processing facilities (such as pulp & paper industry)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
potential partnerships with existing integrated forest products industry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
other 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
other 2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**4. If you chose other 1 or 2, please specify what these other assets are.**

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**5. NC Supply Chain Position: Feedstock Transportation**

*Mark only one oval per row.*

	Very Unimportant		Neutral		Extremely Important
availability of transportation infrastructure: Road	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
availability of transportation infrastructure: Rail	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
storage and inventory management (log or chip yards)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
preprocessing equipment availability and efficiency	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
onsite preprocessing capabilities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
other 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
other 2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**6. If you chose other 1 or 2, please specify what these other assets are.**

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**7. NC Supply Chain Position: Pretreatment**

*Mark only one oval per row.*

	Very Unimportant		Neutral		Extremely Important
readiness of communities (public perception of alternate uses for woody biomass such as coproducts and biofuels)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
incentive from communities (tax incentives, cost share, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
proximity to woody biomass resource (less than 100 miles)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
proximity to woody biomass resource (greater than 100 miles)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



favorable environmental regulations and permitting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
existing pretreatment facility	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
distance to highway and/or rail lines	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
energy efficiency	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
strong R&D support from local institutions (university, industry, federal labs, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
available skilled workforce	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
land available for pretreatment facility construction	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
political support	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
other 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
other 2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**8. If you chose other 1 or 2, please specify what these other assets are.**

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**9. NC Supply Chain Position: Conversion**

*Mark only one oval per row.*

	Very Unimportant	Neutral	Extremely Important
existing biorefinery facility	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
existing facility for woody biomass conversion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
land available for conversion facility construction	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
available skilled workforce	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
proximity to woody biomass pretreatment facility (less than 100 miles)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
proximity to woody biomass pretreatment facility (greater than 100 miles)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
distance to highway and/or rail lines	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

readiness of communities (public perception of alternate uses for woody biomass such as coproducts and biofuels)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
incentive from communities (tax incentives, cost share, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
energy efficiency	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
strong R&D support from local institutions (university, industry, federal labs, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
political support	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
favorable environmental regulations and permitting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
other 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
other 2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**10. If you chose other 1 or 2, please specify what these other assets are.**

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**11. NC Supply Chain Position: Fuel/CoProduct Distribution**

*Mark only one oval per row.*

	Very Unimportant	Neutral	Extremely Important
transportation infrastructure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
storage and inventory management	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
terminals/retail sites	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
existing pipelines	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
existing industry supporting biofuel economy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
other 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
other 2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**12. If you chose Other 1 or 2, please specify what these other assets are.**

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### 13. NC Supply Chain Position: Fuel/CoProduct EndUser

Mark only one oval per row.

	Very Unimportant		Neutral		Extremely Important
consumer acceptance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
high demand for biofuels	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
greenhouse gas emission savings	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
existing markets for coproducts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
existing consumer incentives for environmentally preferred products	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
other 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
other 2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### 14. If you chose other 1 or 2, please specify what these other assets are.

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### 15. Could you list any other supply chain categories? \*

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### Select the importance of various stakeholders to the supply chain categories.

#### 16. Stakeholder: General Public \*

Mark only one oval per row.

	Very Unimportant		Neutral		Extremely Important
Forest Resource	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feedstock Production	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feedstock Logistics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pretreatment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conversion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fuel/CoProduct Distribution	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fuel/CoProduct End-user	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

#### 17. Stakeholder: Environmental NGO \*

Mark only one oval per row.

	Very Unimportant		Neutral		Extremely Important
Forest Resource	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feedstock Production	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feedstock Logistics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pretreatment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conversion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fuel/CoProduct Distribution	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fuel/CoProduct End-User	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

#### 18. Stakeholder: Forest Landowners \*

Mark only one oval per row.

	Very Unimportant		Neutral		Extremely Important
Forest Resource	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feedstock Production	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feedstock Logistics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pretreatment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conversion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fuel/CoProduct Distribution	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fuel/CoProduct End-User	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

#### 19. Stakeholder: Local Politicians \*

Mark only one oval per row.

	Very Unimportant		Neutral		Extremely Important
Forest Resource	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feedstock Production	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feedstock Logistics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pretreatment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Conversion	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fuel/CoProduct Distribution	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fuel/CoProduct End-User	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

#### 20. Stakeholder: Forest Industry \*

Mark only one oval per row.

	Very Unimportant		Neutral		Extremely Important
Forest Resource	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feedstock Production	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Feedstock Logistics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Pretreatment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Conversion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fuel/CoProduct Distribution	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fuel/CoProduct End-User	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**21. Could you list any other relevant NARA community stakeholders? \***

It could be an individual, company, group, agency, association, committee, institution, etc.

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**22. Nominate at least one community as a potential NARA community (testbed site). If you know more than one, list and rank them in the order of importance. \***

suggested format: community 1, community 2, community 3.

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**23. Which position(s) in the supply chain will community 1 you identified fit? \***

You may select more than one choice:

*Check all that apply.*

- ☐ Forest Resource
- ☐ Feedstock Production
- ☐ Feedstock Transportation
- ☐ Pretreatment
- ☐ Conversion
- ☐ Fuel/CoProduct
- ☐ Distribution
- ☐ Fuel/CoProduct
- ☐ EndUser
- ☐ Other: \_\_\_\_\_

**24. Which position(s) in the supply chain will community 2 you identified fit? \* (if possible)**

You may select more than one choice:

*Check all that apply.*

- ☐ Forest Resource
- ☐ Feedstock Production
- ☐ Feedstock Transportation
- ☐ Pretreatment
- ☐ Conversion
- ☐ Fuel/CoProduct
- ☐ Distribution
- ☐ Fuel/CoProduct
- ☐ EndUser
- ☐ Other: \_\_\_\_\_

**25. Which position(s) in the supply chain will community 3 you identified fit? \* (if possible)**

You may select more than one choice:

*Check all that apply.*

- ☐ Forest Resource
- ☐ Feedstock Production
- ☐ Feedstock Transportation
- ☐ Pretreatment
- ☐ Conversion
- ☐ Fuel/CoProduct
- ☐ Distribution
- ☐ Fuel/CoProduct
- ☐ EndUser
- ☐ Other: \_\_\_\_\_

## List of Criteria

Assumptions: this is a proposed ranking criteria for selecting communities across the NW United States that exhibit a high probability of supporting an economically efficient and feasible woody biomass processing facility (either preprocessing, final processing or both) for the industrial production of bio-jet fuels and byproducts.

Assets for Forest Resource
Available and sustainable supply (at least 10-years) of woody biomass from:
Private industrial forest owners
Private non-industrial forest owners
Tribal forestlands
Federal forests
State forests
Proximity of woody biomass resource to community sites:
Less than 100 miles
Greater than 100 miles
Estimated percentages of biomass quality:
high percentage of larger diameter stems capable of being debarked.
high percentage of smaller diameter fire hazard reduction and pre-commercial thinning material with bark and limbs.
Presence of certified forests
Poor markets for existing woody biomass by type and quality of biomass (clean chips, dirty chips, slash, planar shavings, sawdust, trim, bark, mixed species residues)
Existing managed forest plantations designated for primary harvest and wood production
Available volumes and quality of wood industrial residues
Available volumes and quality of urban wood waste
High risk of forest fires
Potential collaboration efforts (e.g., SW Crown of the Continent, Blackfoot Coop)
Communities acceptance of use of forest wood resources

Assets for Feedstock Production
Existence of community natural resources advisory board or similar
Proximity to woody biomass resource:
Less than 100 miles
Greater than 100 miles
Existing wood harvesting and feedstock transport infrastructure (logging)
Existing infrastructure (buildings, equipment, power lines, land availability for processing plant.)
Favorable community permitting process and favorable environmental regulations (air quality, water, sewer, etc.)
Feedstock flexibility (allowing for the conversion of variety of biomass)
Available skilled workforce
Existing feedstock processing facilities (such as pulp & paper industry)
Potential partnerships with existing integrated forest products industry

Assets for Feedstock Transportation
Availability of transportation infrastructure:
Road
Rail
Storage and inventory management (log or chip yards)
Preprocessing equipment availability and efficiency
On-site preprocessing capabilities

Assets for Pretreatment
Readiness of communities (public perception of alternate uses for woody biomass such as co-products and biofuels)
Incentive from communities (tax incentives, cost share, etc.)
Proximity to woody biomass resource:
Less than 100 miles
Greater than 100 miles
Favorable environmental regulations and permitting
Existing pretreatment facility
Distance to highway and/or rail lines
Energy efficiency
Strong R&D support from local institutions (university, industry, federal labs, etc.)
Available skilled workforce
Land available for pretreatment facility construction
Political support

Assets for conversion
Existing biorefinery facility
Existing facility for woody biomass conversion
Land available for conversion facility construction
Available skilled workforce
Proximity to woody biomass pretreatment facility:
Less than 100 miles
Greater than 100 miles
Distance to highway and/or rail lines
Readiness of communities (public perception of alternate uses for woody biomass such as co-products and biofuels)
Incentive from communities (tax incentives, cost share, etc.)
Energy efficiency
Strong R&D support from local institutions (university, industry, federal labs, etc.)
Political support
Favorable environmental regulations and permitting

Assets for Fuel/Co-product Distribution
Transportation infrastructure
Storage and inventory management
Terminals/retail sites
Existing pipelines
Existing industry supporting biofuel economy

Assets for Fuel/Co-product End-user
Consumer acceptance
High demand for biofuels
Greenhouse gas emission savings
Existing markets for co-products
Existing consumer incentives for environmentally preferred products

## Summary: NARA Community Selection Survey

### Communities Position in the Supply Chain

Region as a potential NARA community	Which Position(s) in the supply chain will the community fit?
NE WA Corridor (Spokane-Colville)	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Sustainable Production (e.g., plantations, tribal forestlands)</li> <li>Feedstock Logistics</li> <li>Consumer/User</li> </ul>
SE/Olympic Peninsula	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Sustainable Production (e.g., plantations, tribal forestlands)</li> <li>Feedstock Logistics</li> <li>Pretreatment</li> </ul>
Yakima Region	<ul style="list-style-type: none"> <li>Feedstock Sustainable Production (e.g., plantations, tribal forestlands)</li> <li>Pretreatment</li> <li>Conversion</li> </ul>
NW WA I-5 Corridor	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Sustainable Production (e.g., plantations, tribal forestlands)</li> <li>Feedstock Logistics</li> <li>Pretreatment</li> <li>Conversion</li> <li>Consumer/User</li> </ul>
Klamath Falls, Klamath County, OR	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Logistics</li> <li>Pretreatment</li> <li>Consumer/User</li> </ul>

Klamath Falls, Klamath County, OR	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Logistics</li> <li>Pretreatment</li> <li>Consumer/User</li> </ul>
Medford, Jackson County, OR	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Logistics</li> <li>Pretreatment</li> <li>Consumer/User</li> </ul>
La Grande, Union County, OR	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Logistics</li> <li>Pretreatment</li> </ul>
Baker City, Baker County, OR	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Sustainable Production (e.g., plantations, tribal forestlands)</li> <li>Pretreatment</li> <li>Consumer/User</li> </ul>
Astoria, Clatsop County, OR	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Sustainable Production (e.g., plantations, tribal forestlands)</li> <li>Feedstock Logistics</li> <li>Pretreatment</li> <li>Conversion</li> <li>Consumer/User</li> </ul>
Western Montana Corridor	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Sustainable Production (e.g., plantations, tribal forestlands)</li> <li>Feedstock Logistics</li> <li>Pretreatment</li> <li>Conversion</li> <li>Consumer/User</li> </ul>
Coos Bay, Coos County, OR	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Sustainable Production (e.g., plantations, tribal forestlands)</li> <li>Feedstock Logistics</li> <li>Pretreatment</li> <li>Consumer/User</li> </ul>
Gold Beach, Curry County, OR	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Sustainable Production (e.g., plantations, tribal forestlands)</li> <li>Feedstock Logistics</li> <li>Pretreatment</li> <li>Conversion</li> <li>Consumer/User</li> </ul>
Kootenai Valley	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Sustainable Production (e.g., plantations, tribal forestlands)</li> <li>Conversion</li> </ul>
Bend, Deschutes, OR	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Sustainable Production (e.g., plantations, tribal forestlands)</li> <li>Conversion</li> </ul>
Lakeview, Lake County, OR	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Sustainable Production (e.g., plantations, tribal forestlands)</li> <li>Conversion</li> </ul>



Colville, Stevens/Ferry/Pend Oreille, WA	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Sustainable Production (e.g., plantations, tribal forestlands)</li> <li>Conversion</li> </ul>
Wallowa, Wallowa County, OR	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Sustainable Production (e.g., plantations, tribal forestlands)</li> <li>Conversion</li> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Sustainable Production (e.g., plantations, tribal forestlands)</li> <li>Conversion</li> </ul>
Sweet Home, Linn County, OR	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Sustainable Production (e.g., plantations, tribal forestlands)</li> <li>Conversion</li> </ul>
Yakima, Yakima County, WA	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Sustainable Production (e.g., plantations, tribal forestlands)</li> <li>Conversion</li> </ul>
Albany, Linn County, OR	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Logistics</li> <li>Pretreatment</li> <li>Conversion</li> <li>Consumer/User</li> </ul>
Dallas, Polk County, OR	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Logistics</li> <li>Pretreatment</li> <li>Conversion</li> <li>Consumer/User</li> </ul>
Eugene, Lane County, OR	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Logistics</li> <li>Pretreatment</li> <li>Conversion</li> <li>Consumer/User</li> </ul>
Roseburg, Douglas County, OR	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Logistics</li> <li>Pretreatment</li> </ul>
Clackamas County, OR	<ul style="list-style-type: none"> <li>Raw Materials (e.g., forest residues, mill residues)</li> <li>Feedstock Logistics</li> <li>Pretreatment</li> <li>Conversion</li> <li>Consumer/User</li> </ul>

## Physical, Environmental, and Social Assets of the Communities

Regions as a potential NARA community	Physical, environmental, and social assets of the region
NE WA Corridor(Spokane-Colville)	<ol style="list-style-type: none"> <li>1. Forestland - tribal, private, and government</li> <li>2. Good working relationship between forest industry, environmental groups, and forestland managers</li> <li>3. Two rail lines, one major interstate (I-90)</li> <li>4. Kettle Falls, Wood-based bioenergy plant</li> <li>5. Several sawmills</li> <li>6. Plummer Particleboard mill in Post Falls</li> <li>7. Inland Empire Paper, Spokane</li> </ol>
SE/Olympic Peninsula	<ol style="list-style-type: none"> <li>1. Large state forest land in Olympic Peninsula</li> <li>2. Pulp mills -- Gray's Harbor and Longview</li> <li>3. US Oil and Refining Company, Tacoma (capacity - 38,800 bbl/day)</li> <li>4. Imperium Renewables, Grays Harbor, 100 MGal/year biodiesel, multi-feedstock</li> <li>5. Port Townsend Pulp &amp; Paper</li> <li>6. Grays Harbor Paper &amp; Co-gen</li> <li>7. Cascade Grain Idle Bioethanol plant (corn-based) in Clatskanie</li> </ol>
Yakima Region	<ol style="list-style-type: none"> <li>1. Yakama Nation Forestlands -- 647,000 acres of mixed conifers</li> <li>2. Pulp mill</li> <li>3. Hybrid Poplar plantations</li> <li>4. I-90 and I-82 Interstate Hwys</li> <li>5. Closed plant of Jeld-Wen (White Swan), fiberboard plant</li> </ol>
NW WA I-5 Corridor	<ol style="list-style-type: none"> <li>1. Highly populated area/MSW sources</li> <li>2. Extensive infrastructure</li> <li>3. Airports</li> <li>4. Oil refineries</li> <li>5. National, state, and tribal forestlands</li> <li>6. Forest Industry presence</li> <li>7. MRFs - Recovery 1/Waste Management etc.</li> <li>8. EPA Brownfield sites (refineries)</li> </ol>
Klamath Falls, Klamath County, OR	<ol style="list-style-type: none"> <li>1. A large concentrations of wood products manufacturing facilities</li> <li>2. Transportation infrastructure: regional airport, on highway 97, rail, close access to CA</li> <li>3. Large volumes of forest in need of thinning to reduce wildfire hazard and improve forest health</li> <li>4. Lberdrola Renewables has a gas-fired co-gen plant, and is seeking to expand its portfolio of biomass generation projects</li> </ol>
Medford, Jackson County, OR	<ol style="list-style-type: none"> <li>1. The state's largest concentrations of wood products manufacturing facilities</li> <li>2. Has OR's closest access to CA, rail in infrastructure, is on the I-5 corridor, and has a regional airport</li> <li>3. Large volumes of forest in need of thinning to reduce wildfire hazard and improve forest health</li> </ol>
La Grande, Union County, OR	<ol style="list-style-type: none"> <li>1. La Grande is the hub of wood products manufacturing in Northeast Oregon</li> <li>2. Transportation infrastructure is good for both rail and highway (I-84).</li> <li>3. Well-established forestry, logging and manufacturing infrastructure, including workforce</li> <li>4. Large volumes of forest in need of thinning to reduce wildfire hazard and improve forest health</li> </ol>

Baker City, Baker County, OR	<ol style="list-style-type: none"> <li>1. Large Federal and NIPF timber base</li> <li>2. Adjacent to La Grande which is the hub of wood products manufacturing in Northeast Oregon</li> <li>3. Transportation infrastructure is good for both rail and highway (I-84).</li> <li>4. Well-established forestry, logging and manufacturing infrastructure, including workforce</li> </ol>
Astoria, Clatsop County, OR	<ol style="list-style-type: none"> <li>1. Astoria has several wood processing firms, skilled workforce (in forestry, logging, and manufacturing)</li> <li>2. A port city</li> <li>3. Clatsop County has the most actively managed forests in Oregon with 70% Private forest ownership and the 30% that are public</li> <li>4. Home to Oregon's largest pulp mill: Georgia Pacific, Wauna</li> <li>5. Growth rates of forests in the county are among the highest in the Northwest</li> </ol>
Western Montana Corridor, with Missoula as the hub	<ol style="list-style-type: none"> <li>1. Refer to the report submitted to NARA describing the Corridor, specific, towns and communities as well as assets, infrastructure, stakeholders, supply, etc.</li> </ol>
Coos Bay, Coos County, OR	<ol style="list-style-type: none"> <li>1. Long history of forestry and wood products manufacturing, skilled workforce</li> <li>2. The port of Coos Bay is very active in exporting logs and chips</li> <li>3. Recent concerns over Sudden Oak Death Syndrome (SODS)</li> <li>4. A small airport in North Bend (neighboring city) - Southwest Oregon Regional Airport</li> </ol>
Gold Beach, Curry County, OR	<ol style="list-style-type: none"> <li>1. High unemployment rate</li> <li>2. Perfect climate for growing trees</li> <li>3. Abundant forest resources</li> <li>4. Locally depressed economy</li> <li>5. Strong interest in sustainable forest management</li> <li>6. High tech local biomass pyrolysis plant already planned for this area</li> <li>7. Sudden Oak Death Syndrome</li> </ol>
Kootenai Valley	<ol style="list-style-type: none"> <li>1. five sawmills in region</li> <li>2. Strong cultural ties to landscape</li> <li>3. High unemployment</li> <li>4. Pulp chip outlets</li> <li>5. Market development for biomass</li> <li>6. Biomass available for bioenergy</li> </ol>
Bend, Deschutes, OR	<ol style="list-style-type: none"> <li>1. Many projects proposed and underway</li> <li>2. Existing Industrial partners</li> <li>3. Grant leveraging</li> <li>4. Foundation of collaborative efforts in Central Oregon that span a couple of decades - proactive</li> </ol>
Lakeview, Lake County, OR	<ol style="list-style-type: none"> <li>1. Leveraging grants</li> <li>2. Collaborative efforts within the Lakeview Federal Stewardship Unit have been recognized as a national model</li> </ol>
Colville, Stevens/Ferry/Pend Oreille, WA	<ol style="list-style-type: none"> <li>1. Multiple landowners</li> <li>2. Infrastructure within Colville market area includes 10 sawmills, one plywood mill, 2 WTCs, 2 co-gen plants, 2 pellet plants, 1 bark processing plant, 2 newsprint</li> </ol>
Wallowa, Wallowa County, OR	<ol style="list-style-type: none"> <li>1. Proposed Wallowa County Integrated Biomass Energy Center</li> <li>2. Local processing capability</li> <li>3. IBR sells post-and-pole products, truckloads of bundled firewood, and residuals under the name of Community Small Wood Solutions</li> </ol>

Sweet Home, Linn County, OR	<ol style="list-style-type: none"> <li>1. Looking for public/private cooperative</li> <li>2. Local engineered fuel chip manufacturing facility</li> <li>3. Land ownership has a unique public-private checkerboard</li> </ol>
Yakima, Yakima County, WA	<ol style="list-style-type: none"> <li>1. Public, non-profit and tribal land managers organized under a Memorandum of Understanding between five cooperating agencies and NGO's</li> <li>2. Leverage other PNW Research Station projects</li> <li>3. CFLRP (Collaborative Forest Landscape Restoration Program)</li> </ol>
Albany, Linn County, OR	<ol style="list-style-type: none"> <li>1. Centrally located in the Willamette Valley with abundant local timber resources from both the Coast Range and the Cascades</li> <li>2. Well-established forestry, logging, and manufacturing infrastructure, including workforce</li> <li>3. It is the nearest mid-sized community to large private landholdings such as Starker forests</li> <li>4. Albany is on I-5, has good rail access</li> <li>5. Recently idled International Paper kraft pulp mill</li> </ol>
Dallas, Polk County, OR	<ol style="list-style-type: none"> <li>1. The area has abundant local timber resources from the Coast Range</li> <li>2. Well-established forestry, logging, and manufacturing infrastructure, including workforce.</li> <li>3. Good rail access, and available land with potential for bio-refinery infrastructure in that a large sawmill owned by Weyerhaeuser was recently closed.</li> <li>4. The town is near the Salem Municipal Airport, which is also a base for the Oregon National Guard</li> </ol>
Eugene, Lane County, OR	<ol style="list-style-type: none"> <li>1. Home to one of the state's largest concentrations of wood products manufacturing facilities including one of the few remaining pulp mills as well as a charcoal plant</li> <li>2. Well-established forestry, logging, and manufacturing infrastructure, including workforce.</li> <li>3. On the I-5 corridor, has good rail access</li> <li>4. Abundant timber base (much of which is privately-owned)</li> <li>5. A regional airport which currently serves several carriers with daily flights to Seattle and San Francisco</li> <li>6. Seneca Sawmill recently opened a biomass co-gen plant</li> </ol>
Roseburg, Douglas County, OR	<ol style="list-style-type: none"> <li>1. A major hub for the forest industry in Oregon with dozens of wood processing firms, skilled workforce</li> <li>2. Good transportation infrastructure (on I-5 corridor plus rail access)</li> <li>3. Community leaders (e.g., Joe Laurance, County Commissioner) have demonstrated very strong support for development of a biomass-based industry in the county</li> </ol>
Clackamas County, OR	<ol style="list-style-type: none"> <li>1. Heavily forested and has numerous wood products manufacturing facilities including one of Oregon's few remaining paper mills - West Linn Paper Company</li> <li>2. Portland International Airport is nearby</li> <li>3. One city in the county (Estacada) has recent experience with biomass for school heat</li> <li>4. In the "Action Plan for a Sustainable Clackamas County", renewable energy is goal 3 (of 7), with biomass specifically mentioned</li> </ol>

## Stakeholder Groups in the Communities

Regions as a potential NARA community	Related stakeholder groups in this region	Classification of the stakeholder groups
NE WA Corridor(Spokane-Colville)	Northeast WA Forestry Coalition	Association
	Kalispel, Spokane, and Colville Indian Tribes	Individual/Group
	Vaagen Brothers	Company
	Stimson	Company
	Kettle Falls Avista Bioenergy Power Plant	Company
SE/Olympic Peninsula	Quinault Indian Tribe	Individual/Group
	Nippon Paper and Bioenergy Plant	Company
	Sierra Pacific Aberdeen, WA, Wood-based bioenergy plant (sawmill with Co-gen), 18 MW capacity	Company
	Bonneville Power Administration	Company
	Hermann Brothers - Logging and Transportation	Company
Yakima Region	Boise Cascade Pulp mill, Wallula	Company
	Yakama Tribe	Individual/Group
	GWR	Company
	PNNL	Company
	ZeaChem	Company
NW WA I-5 Corridor	Weyerhaeuser	Company
	Boeing	Company
	NW Byproducts Synergy	Association
	Everett Co-gen	Company
	SAFN	Association
Klamath Falls, Klamath County, OR	Active participant in the Southern Oregon Clean Energy Alliance	Committee
	Oregon Tech	Individual/Group
	A member of the South Central Oregon Economic Development District	Committee
	TEAM Klamath (ad hoc committee)	Committee
	Klamath-Lake Forest Health Partnership	Committee
Medford, Jackson County, OR	Southern Oregon Forest Restoration Collaborative, aka Small Diameter Collaborative aka "The Knitting Circle"	Committee
	Southern Oregon Forest Restoration Collaborative, The Applegate Partnership	Committee
	Active participant in the Southern Oregon Clean Energy Alliance	Committee
	Southwest Oregon Interagency Biomass Utilization Strategy	Committee
	A group of forestry contractors is trying to form a "Forest Energy Group."	Individual/Group

La Grande, Union County, OR	Wallowa Resources Organized agricultural groups, including grass seed growers, mint growers and wheat growers associations	Environmental Association
	Oregon Rural Action	Environmental
	Oregon Department of Forestry, has a stewardship forester with FTE	Individual/Group
	Union County Commissioners (contact Steve McClure)	Individual/Group
Baker City, Baker County, OR	The Baker County Private Woodlands Association recently created a forest landowners cooperative	Association
Astoria, Clatsop County, OR	Clatsop Forestry and Economic Development Committee	Committee
	Clatsop Economic Development Resources	Individual/Group
	Clatsop County (North Coast Business Park)	Individual/Group
	The Port of Astoria	Individual/Group
	Tongue Point Investors	Company
Western Montana Corridor, with Missoula as the hub	Refer to the report submitted to NARA describing the stakeholder groups	
Coos Bay, Coos County, OR	Active participant in the Southern Oregon Clean Energy Alliance	Individual/Group
	Start-up bioenergy company in nearby Gold Beach - Three Dimensional Timberlands	Company
	Southwest Oregon RC&D	Association
	Coquille Indian Tribe	Individual/Group
Gold Beach, Curry County, OR	Active participant in the Southern Oregon Clean Energy Alliance	Committee
	Start-up bioenergy company in nearby Gold Beach - Three Dimensional Timberlands	Company
	Southwest Oregon RC&D	Association
	Curry County Natural Resources Committee	Committee
	Curry County Clean Energy Committee	Committee
	Sustainable Land Development Initiative	
	South Coast Watersheds Council	
	Lower Rogue Watershed Council	
Kootenai Valley	Kootenai Valley Resource Initiative	Individual/Group
	The Nature Conservancy	Environmental
	Vital Ground Foundation	Environmental
Bend, Deschutes, OR	For a complete list of the 45+ core participating organizations, please see the Deschutes CFLR Partnership List at <a href="http://www.firelearningnetwork.org">www.firelearningnetwork.org</a>	
Lakeview, Lake County, OR	Lakeview Stewardship Group	Individual/Group
	The Collins Co. (Freemont sawmill)	Company
Colville, Stevens/Ferry/Pend Oreille, WA	Colville National Forest	Environmental
	Northeast Washington Forestry Coalition	Individual/Group
	Washington Department of Natural Resources	Environmental
	Confederated Tribes of the Colville Reservation	Environmental
	American Forest Resource Council	Association

Wallowa, Wallowa County, OR	Wallowa Resources Community Solutions Inc.	Individual/Group
	Wallowa County Board of Commissioners	Individual/Group
	Integrated Biomass Resources	Company
Sweet Home, Linn County, OR	South Santiam Watershed Council	Environmental
	Sweet Home Economic Development Group	Individual/Group
	Sweet Home City Manager	Individual/Group
	Cascade Timber Consulting (CTC)	Company
	Sweet Home Ranger District	Environmental
Yakima, Yakima County, WA	The Nature Conservancy	Environmental
	Washington Department of Natural Resources	Environmental
	Okanogan-Wenatchee National Forest	Environmental
	Yakama Nation	Individual/Group
Albany, Linn County, OR	Starker Forests (Philomath, OR - approx. 15 miles from Albany)	Company
Dallas, Polk County, OR		
Eugene, Lane County, OR	Active participant in the Southern Oregon Clean Energy Alliance	Committee
Roseburg, Douglas County, OR	Part of the Southern Oregon Clean Energy Alliance	Committee
	Douglas Timber Operators Council	Association
Clackamas County, OR	Clackamas County Farm Forestry Association	Association
	Clackamas County Business & Economic Development	Company
	Oregon Woodland Cooperative	Individual/Group

## Appendix c

### Communication Plan: Northwest Advanced Renewables Alliance Outreach Team

**Overall Communications Goal:** To inform all potential stakeholders in the NARA region of NARA's activities and accomplishments; to hear and address stakeholder concerns and desires to contribute to the project; to receive stakeholder input particularly involving asset identification in pilot supply chain regions.

<b>Audience</b>	<b>Specific Communications Objective</b>	<b>Strategy</b>	<b>Message</b>	<b>Trusted Messenger</b>
Environmental Community	<ul style="list-style-type: none"> <li>* To communicate the sustainability studies conducted by NARA.</li> <li>* Get org. to declare how they feel about the project.</li> <li>* Champion those in favor and attempt consensus with those who don't.</li> </ul>	<ul style="list-style-type: none"> <li>* Design collateral materials (fliers, talking points, articles) emphasizing sustainability and environmental benefits;</li> <li>* Contact select groups, inform, and generate dialogue</li> <li>* Present information in targeted media: blogs, journals and newsprint</li> </ul>	<ul style="list-style-type: none"> <li>* LCA shows that biofuels reduce CO<sub>2</sub> emissions over fossil fuel</li> <li>* Forest health tool</li> <li>* Less fire soot in air</li> <li>* Rural jobs</li> <li>* Careful studies being done to predict soil nutrient and carbon, water quality, air and wildlife effects from residual harvest.</li> <li>* Current analysis focuses on private landowners</li> </ul>	<ul style="list-style-type: none"> <li>* USDA</li> <li>* Other environmental groups</li> <li>* Eco friendly legislators</li> <li>* Eco friendly journalists and websites</li> <li>* Eco friendly companies</li> </ul>
Economic Development Offices	<ul style="list-style-type: none"> <li>* To have each office informed and communicate the economic benefits to their stakeholders</li> <li>* Have offices provide information about stakeholders to NARA</li> </ul>	<ul style="list-style-type: none"> <li>* Design collateral materials (fliers, talking points, articles) emphasizing sustainability and environmental benefits</li> <li>* Identify and reach ED principals</li> <li>* Invite to all functions</li> </ul>	<ul style="list-style-type: none"> <li>* Project uses underutilized resource</li> <li>* Many anticipated jobs require existing forestry skills</li> <li>* Raw and finished products produced regionally</li> </ul>	<ul style="list-style-type: none"> <li>* Peer EDO's</li> <li>* Established companies in area</li> <li>* Chamber of Commerce</li> <li>* Business media outlets</li> </ul>
Forest Industry Professionals: Landowners, contractors, mills, transport	<ul style="list-style-type: none"> <li>* To promote the NARA project</li> <li>* To begin implementing harvesting practices that complement residual harvest</li> <li>* To share industry information</li> </ul>	<ul style="list-style-type: none"> <li>* Present information in targeted media: blogs, journals and newsprint</li> <li>* Attend regional conferences</li> <li>* Use extension services to communicate econ development; promote NARA; comm forestry info</li> </ul>	<ul style="list-style-type: none"> <li>* Residual harvest is non-competitive</li> <li>* New industry uses similar skills</li> <li>* Potential expanded business</li> <li>* Potential positive message to general public</li> <li>* The NARA team needs information</li> </ul>	<ul style="list-style-type: none"> <li>* Peer communication outlets</li> <li>* Peer customers and suppliers</li> <li>* Embedded academics</li> </ul>
Educators: middle, high school and undergraduate level	<ul style="list-style-type: none"> <li>* To get students to pursue biofuel related careers</li> <li>* To get teachers to incorporate biofuel topics in their STEM curriculum</li> <li>* To stimulate STEM curiosity generally</li> </ul>	<ul style="list-style-type: none"> <li>* Develop and distribute collateral materials that can be posted at educational institutions, conferences and edu website</li> <li>* Advertise in specific journals</li> <li>* Identify journalists and bloggers who reach teachers</li> </ul>	<ul style="list-style-type: none"> <li>* NARA offers great STEM learning opportunities for your students.</li> <li>* NARA provides resources to teachers for biofuel instruction</li> </ul>	<ul style="list-style-type: none"> <li>* Teacher Associations</li> <li>* Industry Suppliers</li> <li>* Peers</li> </ul>
Policy Makers and Legislature	<ul style="list-style-type: none"> <li>* To be knowledgeable about NARA activities and express the benefits to their constituency</li> </ul>	<ul style="list-style-type: none"> <li>* Send quarterly one-pagers outlining aspects of NARA</li> </ul>	<ul style="list-style-type: none"> <li>* NARA is working to produce an industry that creates economic and environmental benefits</li> </ul>	<ul style="list-style-type: none"> <li>* Quarterly one-page briefing</li> </ul>