NARA
Northwest Advanced Renewables Alliance

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NARA 2014 annual meeting participants at the Museum of Flight in Seattle, WA.

NARA 2014 Annual Conference

NARA just wrapped up its 2014 annual meeting held September 15-17th at the Museum of Flight in Seattle WA.

This annual gathering provides the over 150 NARA members, drawn from 22 organizations, the NARA Advisory Board and USDA-NIFA representatives an opportunity to hear updates from all NARA teams plus coordinate and plan future work.

NARA Co-Project Director Michael Wolcott provides project background

Updates on sustainability assessments

This year, NARA invited over 100 individuals outside of the NARA organization to attend a one-day series of presentations and panel discussions devoted to NARA's work on the economic, social and environmental sustainability of using wood residuals to make biojet fuel and other bio-related co-products. The invited guests provided critical recommendations and perspectives to NARA's work.

Oral presentations from that day were filmed and links are available below for viewing online.

Economic viability

Economic viability is a key component of NARA's sustainability assessment, not only to return a profit to the investing corporation but through increasing the value of the feedstock and maintaining and adding jobs to the community. Listed are the presentations given that relate to economic viability:

Community impact measurements
John Perez-Garcia
Measurement tools are being developed to assess the jobs and economic impact derived from a wood-based biorefinery operation in the Pacific Northwest. Measurement tools are described and significant costs and revenues associated with a wood-based biorefinery are discussed.

Economic aspects of sustainable biomass supply
Darius Adams
Factors that influence delivered biomass volumes and costs over time are discussed in context with a proposed biorefinery sites in Washington state.

Existing assets for plant siting
Natalie Martinkus
Facility sites in the Pacific Northwest are being evaluated for use in a wood to biofuel supply chain. Methods used to evaluate these sites and future work is discussed.

Estimating the available biomass
Kevin Boston
Methods used to determine the amount of residual woody biomass are evaluated, and biomass costs are discussed based on varied harvesting methods.

Social sustainability

NARA evaluates the social sustainability of a wood-based biofuels industry in the Pacific Northwest. Educational tools and assessments were presented that to the social sustainability work.

The informed stakeholder assessment: measuring the social acceptability of biomass and biofuels
Jillian Moroney
Preliminary results from a four-state informed stakeholder survey are discussed.

Creating an energy literacy supply chain: closing the gap from emerging science to education
Karla Bradley Eitel

Scientific research conducted by NARA is being presented to students and teachers with the intent to improve social acceptability and reduce project misconceptions.

Gaging student bioenergy literacy
Jenny Schon
Bioenergy assessment tools for K-12 students are being developed by NARA. Current and future work is described.

Education and tribes in the Pacific Northwest
Laurel James
NARA promotes Tribal partnership projects that explore the potential economic, natural resource, and development impacts of a biojet fuel supply chain on Tribal lands and the surrounding region. A review of Pacific Northwest Tribes and the projects underway is provided along with a summary of how these projects offer educational opportunities for Tribal students.

Environmental sustainability

This working session discussed the many facets of environmental sustainability.

Environmental sustainability overview
Greg Johnson
A review is given to how NARA evaluates the environmental sustainability of a wood to biojet industry.

Air quality impacts of an aviation biofuel industry-preliminary assessments
Vikram Ravi
Key air quality issues for the Pacific Northwest are discussed and an overview of NARA's modeling approach to evaluate how a wood to biojet industry would affect air quality is given.

The effects of biomass removal on microbial communities
Michael Barber
Dr. Barber describes microbial research at NARA's Long-Term Soil Productivity site.

Long-term soil productivity studies
Scott Holub and Jeff Hatten
The NARA long-term soil productivity site contains varied treatments used to measure the impacts of forest residual removal and compaction on vegetative productivity, wildlife and water retention. Site methodology and initial results are provided.


Steven Thomas with the Department of Energy contributes to the discussion at the 2014 NARA annual meeting

NARA nutrition and soil research
Rob Harrison
New research on soil science is discussed as it relates to soil productivity and nutrient levels.

Response of flow and sediment dynamics in mountain streams to biomass removal
John Petrie
The potential biomass removal impacts on flow and sediment dynamics is reviewed, and the methods used to determine these impacts are presented.

Sustainability of biofuel feedstock production: above-ground nutrient pools and removal
Doug Maguire
This presentation explores how much biomass is present on Douglas-fir trees, how much is removed using varied harvesting methods and how much is left after the timber has been harvested. In addition, the amount of nutrients contained in the above-ground biomass is evaluated.

LCA based environmental assessment of NARA bio-jet fuel
Indroneil Ganguly
The framework of the life cycle assessment (LCA) for the wood-to-biojet scenario is presented. In addition, analyses that compare air emissions relating to varied residual hauling and pretreatment methods are given.

Future direction

There are two years remaining for NARA to complete the analyses and tools projected in the original proposal submitted three year ago to the USDA-NIFA. To date, all projects are on track, over 45 peer-reviewed publications have been generated, and efforts to enhance bioenergy literacy among students and educators are beginning to show positive outcomes.

The NARA Advisory Board will submit formal comments and recommendations to the NARA leadership based upon this meeting and from observations made through the year. Board recommendations following last year's meeting in Corvallis centered on establishing a single pretreatment procedure and strengthening team cohesion. These requests were accomplished with the down selection to a mild bisulfite pretreatment process and with the implementation of a Phase-Gate decision-making process and increased cross-team collaboration meetings.

Stem High School, Redmond Washington: First place team in 2014 Imagine Tomorrow biofuels category. From left to right: Oisin Doherty, Pavan Kumar, Mike Town (Coach), Andrew Wang, Ethan Perrin, Isaak Nanneman

Gauging the Impact of the Imagine Tomorrow Alternative Energy Competition

The Imagine Tomorrow competition, partially funded by NARA, encourages high school students to solve challenges related to energy and biofuels. The desired outcome from these activities is to increase the level of energy and bioenergy literacy and encourage students to prepare for careers that will contribute to a more sustainable and inclusive bioenergy economy.

Student and teacher reaction to the Imagine Tomorrow competition has been enthusiastic, and team numbers are increasing dramatically every year since its inception. While these results are encouraging, they do not provide a measure of student learning nor an indication of whether the students are motivated to pursue further education in a STEM (science, technology, engineering, mathematics) related field at the college level.

Recently, two reports were submitted that provide some indication to how the Imagine Tomorrow event impacts high school students. One assessment evaluates the level of energy literacy and biofuels literacy reflected in the students' abstracts and posters and the other measures the students' experience and career intentions.

> View Imagine Tomorrow Literacy Assessments and Surveys here.

Biofuels Literacy Assessment

The study titled "Energy literacy and biofuels literacy assessment of abstracts and posters" measures the energy literacy for all Imagine Tomorrow entries (n=140) and conducted a separate biofuels literacy assessment for the 22 biofuels category teams. The biofuels category is one of four entry challenges in the Imagine Tomorrow completion.

The study expands on a recently published assessment initiated in 2013. For this study, the authors included a rubric used to measure the biofuels literacy as reflected in the abstracts and posters developed by the student teams. Evaluators used the rubric to score the abstracts and posters from the biofuels challenge entries on a scale of 0 to 5 (0 absent, 1 emerging, 2 developing, 3 competent, 4 effective and 5 mastering). To aid the evaluators and increase validity, a matrix was then developed in 2014 that paired rubric categories with elements contained in the Department of Energy guide "Energy Literacy: Essential Principles and Fundamental Concepts for Energy Education Version 2.0".

2014 assessment results show that students do better at describing technical concepts over impacts in their posters. Those teams that develop their projects as part of an extracurricular activity show greater biofuels literacy than those that manage their project in class. Little difference in biofuel literacy is noted between male and female participants or whether their project advisor taught a high school STEM related course. Due to the relatively few teams in the biofuels category (n=22), the trends reflected are not as apparent or as valid as those available from the energy literacy assessment. An interesting trend shown in the energy literacy assessment is that students in their junior year demonstrated the greatest energy literacy over students from senior, sophomore and freshman years. Another interesting result reflected in the biofuel and energy literacy assessments is that males and females perform equally well.

These assessments provide a novel approach to measuring bioenergy and biofuel literacy and will be further developed in the subsequent years. They suggest some interesting trends and will provide a baseline to assess the biofuel and bioenergy literacy impacts from future Imagine Tomorrow competitions.

Imagine Tomorrow Impact and Experience Assessment

For this assessment, 164 students who competed in the 2014 Imagine Tomorrow competition responded to a questionnaire. Event judges and team advisors also supplied information from separate questionnaires. Forty nine percent of the students indicated that their interest in the topic was the main motivator to participate. On a three-point scale (1=low; 2=medium; 3=high), 90 percent of the students indicated a 2 or 3 with 44%

selecting 3 to whether they would want to pursue a STEM related career. Students responded to an additional question regarding their experience and a majority indicted a positive experience.

During the upcoming year, data across the two years will be evaluated to assess outcome trends and distinctions.

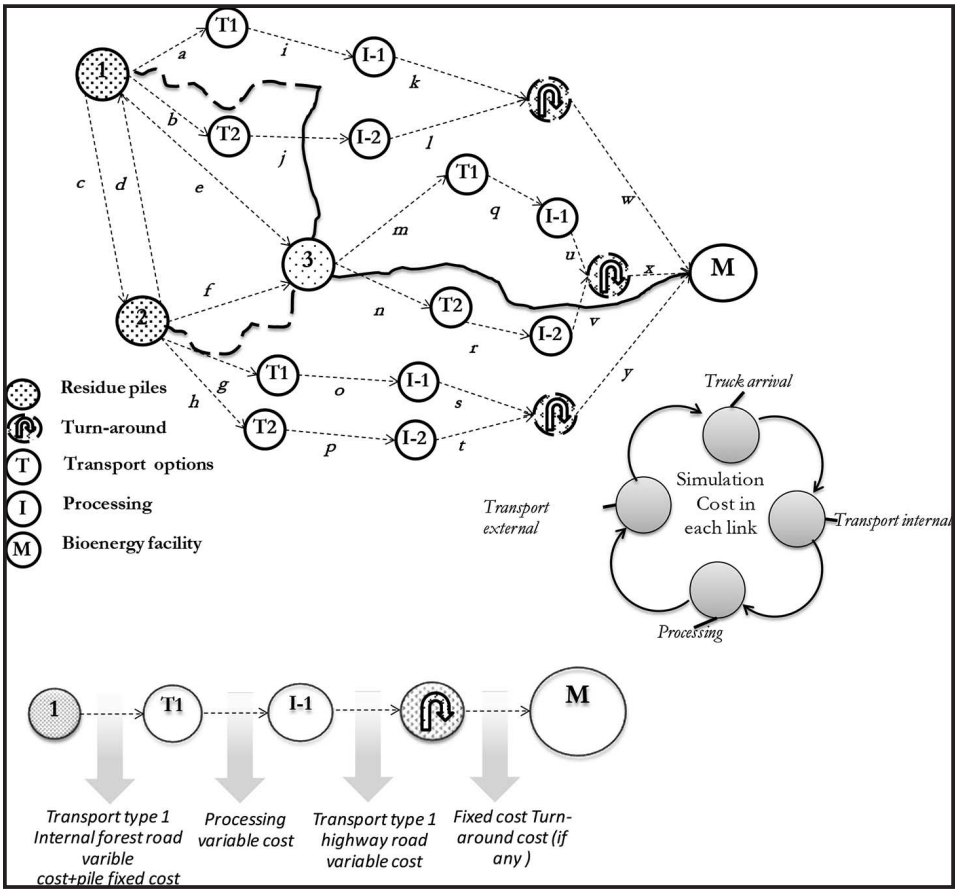

Image from Zamora-Cristales et al. (2014) paper showing potential transport and processing choices.

Collecting, Processing and Transporting Forest Residuals at the Lowest Cost

One of the biggest economic challenges to using forest residuals as a feedstock for biofuel production is the cost of residue collection, processing and transport. Based on NARA's preliminary analysis, nearly 18% of the manufacturing cost for biojet fuel is associated with getting the feedstock to the biorefinery.

To help keep feedstock costs to a minimum, NARA researchers are developing tools and recommendations that will help land managers reduce costs. One such tool is a model developed by NARA researchers at Oregon State University used to evaluate options for forest residual transport and processing.

In a recently published paper partially funded by NARA and titled Economic Optimization of Forest Biomass Processing and Transport in the Pacific Northwest USA, authors Rene Zamora-Cristales, John Sessions, Kevin Boston and Glen Murphy describe the economic estimation model and provide examples of its use.

View E*conomic Optimization of Forest Biomass Processing and Transport in the Pacific Northwest USA*

In the paper, the authors identify previous studies designed to assist forest managers and landowners recover biomass. This work, however, differs from previous studies by considering detailed factors such as multiple slash pile locations, road access and type, terrain, turn around and turnout locations, and equipment selection and interaction. This simulation model should help forest managers and landowners determine the most cost effective locations and operational layouts to process forest residuals and select the most cost-effective machinery to do the job.

Model Validation

The researchers tested their model on a harvest unit located near Sutherlin in Oregon where forest residues were processed in the field and transported to a bioenergy facility. In their analysis, they asked the following questions:

- Which pile locations could be used as a centralized landing?
- Should a centralized yard be established?
- What type of processing option was the most cost-effective under the problem circumstances?
- What type of truck configuration is most cost-effective?
- What is the maximum investment that can be justified in road improvement and turnaround construction to allow for larger trucks?

The program selected the best machinery options (grinders, bundlers and trucks) from the available options based upon the operating and transport costs. The program estimates the processing and transport cost of each slash pile allowing the manager to evaluate piles are profitable and those that should be left in the field. When the optimal approach predicted by the model was compared to the actual harvesting operation, the modeled approach suggested a potential cost savings of 21%. The authors then compared the outcomes of their model to six different operations in western Oregon and Washington. In the six simulations, potential savings ranged from 3 to 34%.

The authors highlighted that one of the model's strengths is the flexibility to changes in productivity and cost. A current model weakness is that it only considers slash piles located at the roadside. Future improvements will allow for cost estimation of slash piles that are distant from the road. The next step is to develop a software application for public use. A collaboration with other Oregon State University faculty members is being considered to develop the application.

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