

NARA Goal Five

2nd Cumulative Report

April 2013 - March 2014



Bioenergy Literacy

Improve bioenergy literacy to develop a future energy workforce, provide professional development, and enhance citizen understanding.

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SUMMARY

The NARA project is designed to enable a new and technically complex industry in the Pacific Northwest. Elevating general knowledge around energy literacy serves an important role to ensure that a biofuels industry will become and remain sustainable by: 1) educating and providing training to a future energy workforce; 2) providing timely information and resources to stakeholders and professionals in industries connected to the biofuels supply chain; and 3) enhancing citizen understanding to improve public support and participation in political decision making.

To secure an effective and sustainable workforce and generate future leaders who can move the biofuels industry forward, training and educational opportunities related to Science, Technology, Engineering and Mathematics (STEM) topics, and specific to the biofuels supply chain, need to be created and promoted. For this purpose, NARA provides opportunities tailored to engage students along the education pathway from K-12 students and educators, to undergraduate and graduate students, and finally to practicing professionals.

K-12 STUDENTS AND TEACHERS

Programs targeted to K-12 students and teachers provide curriculum development and educational programs. Six new lesson plans have been developed to support energy and climate literacy curriculum. Six more are currently in process.

Completed lessons include:

- The Value of a slash tree
- Plant cell walls to alcohol
- Exploring hydropower
- Hydroelectric power and dams
- Biomass adventure race
- Water resources in a changing climate

In addition to these lessons, a nine-lesson energy cur-

ricula titled Fueling Our Future: Exploring Sustainable Energy Use was published and is available in print, digital and SMART Board formats. This curricula is promoted through the Facing the Future website and through targeted teacher workshops and conferences throughout the US. To date over 200 copies have been distributed to educators. The McCall Outdoor Science School (MOSS) pilot tested the curricula to over 1500 K-12 students. Over 200 K-12 students were assessed after introduced to the curricula and showed significant increases in bioenergy knowledge, a positive attitude towards biofuels, and science processing skills. In addition, summer workshops that focused on bioenergy and climate change were provided to K-12 teachers. Fifteen teachers attended the workshop with 60 teachers following on-line (Task E-2).

A follow-up survey connected with this workshop indicates that:

- 70% of the teachers participating in our summer workshop agree or strongly agree that they understand enough about biofuels in the Pacific Northwest to have an informed opinion.
- 48% of teachers report that they have been able to incorporate biofuels into their curriculum
- 73% agree or strongly agree that they understand key parts of the supply chain.
- 82% of the teachers agree or strongly agree that they are more likely to use problem-based learning after being involved in the workshop.

All of the NARA educational deliverables, plus biofuels literacy content from non-NARA sources, are available through energyliteracyprinciples.org, which has undergone significant development this reporting period (Task O-9).

Again this year, NARA was a major sponsor for the Imagine Tomorrow program. This event engages high school students to develop creative solutions to

society's energy challenges. The 2013 event showed an increase in total student teams (133 student teams in 2013 to 112 in 2012) and in teams that participated in the biofuels challenge category (18 in 2013 to 14 in 2012). An assessment was initiated that measures STEM career choices and bioenergy literacy for the Imagine Tomorrow participants. The results show that 67% of the students were extremely or very interested in pursuing a career in science (Task E-4). In 2012, due to NARA funding, Imagine Tomorrow opened the competition to teams from Montana, Idaho and Oregon. In order to promote team participation from these newly added states, NARA provides high school team training and funding. Twenty-two teachers from Montana, Idaho and Washington have participated in a webinar series to support coaching Imagine Tomorrow teams for the 2014 event (Task E-2, O-9).

UNDERGRADUATES AND GRADUATES

Programs targeted to undergraduate and graduate students provide research opportunities that contribute directly to NARA project outcomes. The Summer Undergraduate Research Experience in Biofuels (BF-SURE) is a summer (10 week) research experiences for undergraduate students that provides laboratory, fieldwork, and research skills in the broad area of biofuels and bioproducts research. In 2013, 38 students applied and nine were selected and teamed with NARA principal investigators, including placements at Weyerhaeuser, to conduct research and showcase their projects at a poster symposium sponsored by Washington State University. Demographics of 2013 applicants were 61% women, 39% men; and 11% Hispanic, 3% Native American, 34% Asian, 8% African American, 5% multicultural and 39% Caucasian. The program's popularity is increasing with over 50 applicants received for the 2014 summer season (Task E-5, E-6).

The IDX course included undergraduate and graduate students representing a variety of disciplines including engineering, environmental studies, chemistry, community planning, architecture, landscape architecture, construction management and law, to develop the western Montana corridor (WMC) and the Mid-Cascade to Pacific (MC2P) supply chain analyses described in the Supply Chain Coalitions segment of this report. (Task E-5). In addition, graduate students affiliated with MOSS, interviewed NARA researchers to develop media used to train Imagine Tomorrow teams and supplement educational materials (Task E-2).

Graduate students associated with the University of Washington and Salish Kootenai College, plus NARA SURE undergraduate students, were involved in the NARA Tribal Team. This team completed a 10-year biomass projection for the reservation of the Confederated Salish and Kootenai Tribes (CSKT) (Task T-E1, T-E6) and will expand their work opportunities with other PNW tribes and on other NARA related projects. This group will employ seven interns in summer 2014.

Lastly, for this reporting period, NARA funds have supported 69 graduate students working on tasks assigned to the NARA project.

PUBLIC BIOENERGY LITERACY

To promote bioenergy literacy opportunities to the public, NARA outreach developed multiple information delivery pieces including over 70 stories posted on NARA's online newsletter and blog plus 10 infographics. This information is distributed through the NARA website (10,866 unique visits, 60,360 page-views, 54.48% new visits in this reporting period), affiliated organization websites, Facebook, Twitter and through targeted mailings to regional policy-makers. In addition, journalists published 31 NARA related news stories. To provide stakeholders with relevant information from NARA and other sources relating to bioenergy literacy, NARA maintains a knowledge base

that is currently being transformed into a dynamic and searchable source at woodtobiofuel.org (Tasks O-1 through O-7).

Significant outputs to date for this team are listed below.

- A report "Biomass supply estimates for the Confederated Salish and Kootenai Tribes on harvest planning and management goals" has been provided to the Confederated Salish and Kootenai Tribes. (Task E-1).
- A lesson plan "The Value of a Tree: Comparing Carbon Sequestration to Forest Products" was published and is targeted to middle school students. http://www.nsta.org/store/product_detail.aspx?id=10.2505/4/ss14_037_07_27
- A nine-lesson energy curriculum titled "Fueling Our Future: Exploring Sustainable Energy Use" was published and is available in print, digital and SMART Board formats. <http://www.facing-thefuture.org/CurriculaFreeUnits/BuyCurricula/tabid/550/ProductID/69/Default.aspx -.U4YVX-pRdXZV>
- 2013 Imagine Tomorrow program was completed along with survey collection and analysis. This deliverable is a NARA milestone and trends suggest expanded interest in newly added states (OR, ID and MT). Imagine Tomorrow Students were surveyed after the competition with 67% of the students responding that they were extremely or very interested in pursuing a career in science (Task E-4). <http://imagine.wsu.edu/past/2013/default.html>

Outcomes are:

- Two undergraduate students who participated in the NARA SURE program applied and were accepted to graduate school at the University of Washington and will work with NARA researcher Dr. Ivan Easton. NARA related internship experi-

ence was an important factor in their acceptance (Task E-6).

- Over 200 K-12 students were assessed after introduced to NARA generated curricula and showed significant increases in bioenergy knowledge, positive attitude towards biofuels, and science processing skills. This deliverable is a NARA milestone and establishes a baseline used to evaluate the success of future summer programs at MOSS (Task E-2).
- Summer workshops that focused on bioenergy and climate change were provided to K-12 teachers. Seventy-five teachers participated in the workshops. A follow up survey connected with this workshop indicates that:
 - 70% of the teachers participating in our summer workshop agree or strongly agree that they understand enough about biofuels in the Pacific Northwest to have an informed opinion.
 - 48% of teachers report that they have been able to incorporate biofuels into their curriculum
 - 73% agree or strongly agree that they understand key parts of the supply chain.
 - 82% of the teachers agree or strongly agree that they are more likely to use problem-based learning after being involved in the workshop (Task E-2). <http://sandbox.clearingmagazine.org/AL@.pdf>

Training

Name	Affiliation	Role	Contribution
Burdette Birdinground	Univ. of Wa, School of Environmental and Forest Sciences	Graduate Student	Fuels reduction and treatment planning on lands adjacent to Tribal Reservations
Breanna Gervais	Portland State University	Undergraduate Intern	Washington Tribal biomass infrastructure & development assessment
Shawn DeFrance	Salish Kootenai College	Undergraduate Intern	CSKT Fuels Treatment planning in conjunction with John Bailey's (NARA-OSU) iFLAMES project
Ikechwuku Nwaneshiudu	UW, ChemE	Ph.D Student	ASPEN simulation, process monitoring research
Blake Hough	UW, ChemE	Ph.D.Student	Forest biomass assessments, pyrolysis chemistry
Quinn Langfitt	WSU Graduate Student	Assessment Team Member	Energy Literacy Assessment Activities
Chad Gotch	Research Associate - WSU	Assessment Team Member	STEM survey research
Jessica Beaver	WSU Graduate Student	Assessment Team Member	STEM survey research
Calvin Silas	New Mexico State	SURE part.	http://nararenewables.org/site/media/035.pdf
Jing Li	WSU	SURE part.	http://nararenewables.org/site/media/021.pdf
Andrea Laguna	Univ. Wisconsin	SURE part.	http://nararenewables.org/site/media/039.pdf
Karissa Garcia	Washington State U.- TC	SURE part.	http://nararenewables.org/site/media/023.pdf
Stephen Cline	Penn. State U.	SURE part.	http://nararenewables.org/site/media/040.pdf
Chanel Casayuran	Cornell U.	SURE part.	http://nararenewables.org/site/media/042.pdf
Yuanlong Li	U. of Minnesota	SURE part.	http://woodsymposium.wsu.edu/documents/041.pdf
Daniel Leong	Olin College of Eng.	SURE part.	http://nararenewables.org/site/media/022.pdf
Ben Seipel	University of Idaho	Graduate student -- assessment	Conducted energy literacy assessment
Hanna Ridgeway	University of Idaho	Graduate student – curriculum	Revised and formatted energy curriculum
Luke Smith	University of Idaho	Graduate student – teacher PD	Facilitation and coordination of webinar series
Michael Wang-Belt	University of Idaho	Graduate student – Energy Literacy Principles Matrix	Is adding material to the “matrix” and aligning materials to energy literacy principles
Jim Casey	University of Idaho	Graduate student – curriculum	Developed energy related lessons
Jyoti Jennewein	University of Idaho	Graduate student – curriculum	Developed energy related lessons
Joy Adams	University of Idaho	Graduate student – curriculum	Developed energy related lessons
Kelly Martin	University of Idaho	Graduate student – curriculum	Developed energy related lessons
Carmen DeLeon	University of Idaho	Graduate student – curriculum	Developed energy related lessons
Dawn Harfman	University of Idaho	Graduate student – curriculum	Developed energy related lessons
Imagine Tomorrow participants in Biofuels category (80)	Regional Highschools	High School student	Completed various reserch projects related to bio-fuels development

Resource Leveraging

Resource Type	Resource Citation	Amount	Relationship or Importance to NARA
Donations			NARA partially supports the cost of the Imagine Tomorrow program, leveraging over \$200,000 in other private donations to run the program.
Assessment Donations		\$15000 yr 1 \$15000 yr 1 \$15000 yr 2 \$5000 yr 2 \$10000 yr 2	Ecoworks Bank of America Ecoworks Bank of America CESTiCC (Center for Environmentally Sustainable Transportation in Cold Climates)
Scholarship	China Scholarship Council		Zhou Zheng, a visiting faculty member working on ASPEN sugar depots.
Staffing for SURE		\$3,000	The program for presenting undergraduate work was sited with the existing summer undergraduate research poster session at WSU-Pullman on Aug. 2. The staffing and support for this event (on the order of \$3000) is covered from WSU internal sources, and not charged to NARA.
Grant	McCall-Donnelly Education Foundation	\$4,032	MOSS Development
Scholarship	The W. K. Kellogg Engagement Scholarship Award	\$7,500	MOSS Development
Grant	Idaho Community Foundation	\$3,000	MOSS Development
Grant	Steven Leuthold Family Foundation	\$10,000	MOSS Development
Grant	Whittenberger Foundation	\$4,000	MOSS Development
Grant	EPSCoR National Science Foundation	\$70,000	MOSS Development
Grant	Doceo Center for Innovation + Learning	\$17,000	MOSS Development
Grant	The DeVlieg Foundation	\$12,500	MOSS Development
Grant	United States Geological Survey	\$23,673	MOSS Development

TASK E-1: BIOENERGY AND BIOPRODUCTS GRADUATE EDUCATION AND RESEARCH IN PARTNERSHIP WITH NORTHWEST TRIBES

Key Personnel
Daniel T. Schwartz

Affiliation
University of Washington

Task Description

The goal of this task is to educate the next-generation of scholars with unique skills for devising integrated resource management and technical designs that deliver bioenergy and bioproduct systems tailored to the resource, ecologic, and economic development needs of a community. To accomplish this, we work with tribes, tribal organizations, and each partner campus to offer up to 3 grad student tribal research projects. Specifically, student teams work collaboratively with Northwest Native American tribes to provide integrative research on technical issues tied to feedstocks, their sustainable production and logistics, and conversion to value-added products. Students benefit from outstanding training in interdisciplinary communications and research. Tribes benefit by collaborating to define, research, and assess a technical problem that is deemed a tribal priority for ecologic or economic development purposes. Each student team makes several trips to the partner tribe's reservation. We seek to complement the IDX team corridor-scale activities by incorporating detailed landscape scale information provided by major forested landholding tribes. To have maximum impact and credibility in Indian Country, this task has significant liaison activities with tribes, tribal organizations, and campus offices that coordinate with tribal student recruiting and retention programs.

Activities and Results

Tribal Partnership Projects (TPP) involve re-search-based education and training in partnership with tribes. This report documents the completion of a 10-year biomass projection for the reservation of the Confederated Salish and Kootenai Tribes (CSKT). The assessment was a partnership with CSKT Forestry and Tribal Council and is based on CSKT-provided continuous forest inventory data, timber harvest planning data for 2014-2024, road layers, and the Inland Empire forest growth models embedded in the USDA Forest Service "Forest Vegetation Simulator". A key finding was that ecologically-prescribed forest treatments that are intended to restore the structure and function of CSKT forests to a pre-fire exclusion regime produced timber and slash volume results comparable to typical commercial harvest practices in western Montana. Results were reported to the Tribal Council, Tribal Forestry, and Energy Keepers, the CSKT energy office. Funding for follow-on work was secured by Energy Keepers, so we transferred data and communicated results to the Beck Group and Harris Engineering. University based follow-on work is being carried out to prepare for publication.

During the reporting period, the Tribal Project's Team facilitated the establishment of a study between CSKT, OSU Forestry (John Bailey) and Salish Kootenai College (Adrian Leighton) to test the fire resiliency of silviculture treatments designed by Prof. Bailey.

The team also provided a simple Process Simulation model that provides mass and energy needs for a dilute acid pretreatment process used to prepare a 30% water sugar syrup from biomass. The work is suitable for basic assessments of the process needs for site evaluation in the IDX team.

We have engaged several new tribal students in our work. Breanna Gervais is an undergraduate at Portland State University who is carrying out a regional assessment of biomass grants and infrastructure among tribes in the NARA region. Burdette Birdinground is an MS student at the University of Washington (UW) learning to use the growth models and harvest prescriptions in the Forest Vegetation Simulator (FVS) to carry out biomass assessment work in the broader Western Montana Corridor and other NARA study areas. Shawn DeFrance is an undergraduate at Salish Kootenai College working with Adrian Leighton and John Bailey to carry out state-of-art silviculture prescriptions for fire and fuels on the CSKT reservation.

CONFERENCE PARTICIPATION & OUTREACH

1. Intertribal Timber Council (ITC) -- Laurel James continues her role and participation in ITC events via her role as their Research Sub Committee, Co-Chair. This ensures NARA TPP continued coordination with ITC member tribes.
 - a. In 2013, NARA TPP had a panel presentation at the National Indian Timber Symposium.
 - b. In 2014, NARA TPP will have 2 speakers on the student panel at the National Indian Timber Symposium.
 - c. ITC has provided some tribal data for Breanna Gervais' work related to biomass infrastructure and development.
2. Outreach and recruitment for the NARA SURE program occurred at
 - a. the American Indian Science & Engineering Society (AISES) national conference, exhibit booth sponsored Shelley Pressley (NARA WSU), included participation by Calvin Silas (Navajo) NARA SURE Summer Intern. Calvin also pre-

- mented his research poster at AISES.
- b. Salish Kootenai College, as part of a NARA reporting trip to the Tribe, within an SKC Forestry & Natural Resources Club meeting
3. Participation and liaison duties amongst NARA projects
 - a. Laurel continues participation within the NARA education teams, assisting in energy literacy and curriculum development issues by coordinated mailing of all energy questionnaires and curriculum to tribal communities.
 - b. Laurel is helping introduce and when possible, introduce tribal students to John Bailey's NARA iFLAMES project work in collaboration with Tribal communities.
 - i. CSKT has agreed to initial planning of the iFLAMES work, as a continued refinement of the NARA TPP Biomass assessment for their lands.

Introduction of the iFLAMES work has also been coordinated with the Yakama and Spokane tribal forestry departments.

Recommendations | Conclusions

Biomass supply estimates for the Confederated Salish and Kootenai Tribes based on harvest planning and management goals

This past year, the NARA TPP project consulted with and completed a forest biomass assessment for the Confederated Salish & Kootenai Tribes. Blake Hough a UW Chemical Engineering PhD student completed this project in combination with Tom Richards, a forest biometrics consultant from Northwest Management, Inc. Benefits for our tribal partner includes an assessment that can guide project planning and implementation via their timber harvest and fire and fuels reduction management planning for the next ten years, see Figure E-1.1. Slash volume estimates were compared to conventional commercial harvest data for western Montana, as provided by NARA faculty Todd Morgan at the University of Montana. Blake's academic and professional development overlap and

include forest engineering and forest biometrics using both Geographic Information Systems (GIS) and the Forest Vegetation Simulator (FVS). In addition, Blake delved into forest habitats and planning in completing his assessment. The Tribe is using our report as the foundation for the \$807,239 DOE grant they have received to fund follow-on research and design work carried out by the Beck Group (Roy Anderson) and the Harris Group (Doug Dudgeon).

2014-2015 Academic Year -- Project Planning

This year, the NARA TPP focused on the entire NARA region (Figure E-1.3) We are developing student projects that will capitalize on previous student training in FVS and GIS as well as other US Forest Service tools and data sets such as Forest Inventory Analysis (FIA) that contain forest species and density information. As we progress, we will also seek out coordination with the WMC and MC2P NARA assessments.

A regional tribal biomass infrastructure and development assessment

Breanna Gervais (Penobscot) is an undergraduate intern from Portland State University. She has been working on an assessment of tribal lands (acres), including tribal Infrastructure development and monetary resources for tribes within the NARA Region. To date, Breanna has completed an overview of Washington Tribes (Figure E-1.2) and will have completed a full overview of all remaining tribes in OR, ID and MT by the end of this academic year (Figure E-1.3). Breanna does not have a forest biomass specific background, thus she is gaining a great amount of academic and professional training in general energy literacy, tribal operations, biomass operations and a broad overview of tribal forestry operations in the Pacific Northwest. Breanna will graduate next fall and is seeking out a potential Master's program at WSU in Vancouver. Ideally, she would like to consider climate change, forest resilience (ecosystem function, disturbance regimes, growth or mortality) that can be related to tribal traditional plant use.

CSKT forest residues from fire and fuels treatment planning

Shawn DeFrance (Confederated Salish & Kootenai Tribes) is an undergraduate intern from Salish Kootenai College. Shawn is a recent addition to NARA TPP, and his project work is outlined for the remainder of the academic year and summer. Shawn will work with our recently completed CSKT biomass assessment and will partner with both CSKT and John Bailey (NARA-OSU) to further refine biomass availability. This work will expand upon Blake Hough's biomass availability report to address potential project implementation in conjunction with CSKT's silvicultural prescriptions and on the ground layout and implementation of fire and fuels related thinning projects. Shawn's academic and professional development will include the enhancement of forest biometrics, silviculture and fire management. Shawn is currently red-carded as a wildland firefighter; consequently, he could gain enhanced, on the ground, field experience and task book credentials with the implementation of any prescribed burns. In addition, Shawn is receiving an introduction to environmental policy and planning to review the NEAP requirements for his specific assignment. John Bailey will provide silvicultural training. Pre and post project monitoring plots will be jointly defined and introduced on the landscape by the tribal forestry and fire staff, John Bailey and Shawn DeFrance. Professional development, via Shawn's Federal Wildland Firefighter task-book, will be tracked by his home agency, the CSKT Fire Management Office. Shawn will graduate this spring and is seeking an MS degree in forestry from either the University of Montana or Oregon State University.

PNW Landscape Fire & Fuels Assessment

Burdette Birdinground (Crow) is a recent addition to the NARA TPP as is Karl Oleson. Burdette has just begun an MS degree in the School of Environmental and Forest Sciences (SEFS) at the University of Washington. A fire and fuels related project has been developed that will target biomass residues that could be available to Tribes within areas attainable

via USFS Stewardship Contracting agreements. This would include those lands adjacent to tribal forests and would provide some measure of protection to tribal reservations. The goal is to have Burdette evaluate the stewardship contracting option that has had limited success for tribal communities. Academic and professional training for Burdette will include forest biometrics (via USFS FIA data), FVS and GIS and environmental regulations (tribal, state & federal) in relation to forest thinning and biomass operations. Burdette has completed FVS training with his SEFS lab and will begin project layout during this current spring quarter. Burdette and Karl will carry the work forward into the 2014-2015 academic year and will pick up the biomass and FVS work from Blake Hough and Tom Richards. Karl will also support ASPEN modeling.

2014 Summer Internship -- project planning

1. Breanna Gervais, will continue as described
2. Shawn DeFrance, will continue as described
3. Burdette Birdinground, will continue as described
4. Cody Sifford (Navajo), a former NARA SKC Summer intern on GIS with Burdette
5. Clarence Smith (Blackfeet) Tribal marketing of wood products
6. Calvin Silas (Navajo) a 2013 NARA SURE summer intern is a sophomore in Mechanical Engineering at New Mexico State University. Calvin's research experience thus far in his academic career include renewable energy of the environment through Biomass (Wood, forest and agricultural wastes, domestic sewage, industrial waste) research experience includes:
 - a. 2013-2014 academic year: fabricating, "Dynamics and Control of Spacecraft with a Generalized Model of Variable Speed Control Moment Gyroscope (VSCMG)"
 - b. 2013 NARA SURE: research to develop a methodology to integrate nanocellulose into phenolic rich fractions.
 - c. 2012 and 2013 via both New Mexico Alliance for Minority Participation (AMP) and AMP-Summer Community College Opportunity for Research

Experience (SCORE). He has also worked on bio fuel research projects on the cultivation and growth of Algae bio mass, developing his research skills in the renewable energy of the environment through Biomass (Wood, forest and agricultural wastes, domestic sewage, industrial waste).

- This year, Calvin is looking to advance his renewable energy research experience as a part of the NARA TPP. He will gain MECH E lab experience while he also begins to explore potential graduate program opportunities. Two different options are available for Calvin to explore at the University of Washington. The first would allow him to participate in the design, fabrication, and emissions testing of cookstoves, and the second option would explore combustion characteristics of several biofuels as replacements for conventional jet fuel.
7. Our seventh summer intern will be Emile DeLuca. Emile will be working on the characterization of biomass char produced by natural and man-made processes. The work will incorporate Raman spectroscopy, scanning electron microscopy, and thermal analysis within the UW Chemical Engineering department.

Physical and Intellectual Outputs

- Report: Biomass supply estimates for the Confederated Salish and Kootenai Tribes based on harvest planning and management goals, provided to the Confederated Salish & Kootenai Tribes, Forestry department and the Energy Keepers, Inc., including all completed data files.
- CSKT-NARA forest vegetation simulator (FVS) output files provided to CSKT and Energy Keepers, for implementation in renewable energy planning for the CSKT Lands.

REFEREED PUBLICATIONS (ACCEPTED OR COMPLETED)

Alex D. Paulsen, Blake R. Hough, C. Luke Williams, Andrew R. Teixeira, Daniel T. Schwartz2, Jim Pfaendt-

ner, Paul J. Dauenhauer, Fast Pyrolysis of Wood for Biofuels: Spatiotemporally Resolved Diffuse Reflectance In situ Spectroscopy of Particles, ChemSusChem 7(3), 765-776 (2014).

CONFERENCE PROCEEDINGS AND ABSTRACTS FROM PROFESSIONAL MEETINGS

Conference Abstract Submissions:

Two abstracts submitted and accepted to the Intertribal Timber Council, National Indian Timber Symposium for presentation during the 2014 national conference.

1. A regional assessment: Tribal biomass operations leveraging sovereignty to meet tribal needs
Tribal interest, infrastructure and operational status of bioenergy projects throughout Washington, Oregon, Idaho and Montana can provide an understanding of how biomass operations can meet an array of tribal community needs. This study aims to assess the interest, bioenergy outreach, education, community values, investments, feasibility and /or planning of bioenergy resources. Infrastructure and operations can provide a thorough understanding of how feasibility assessments, planning and operations incorporate tribal value and needs, across a range of spatial scales and with multiple stakeholders. Unique themes are beginning to surface where bioenergy projects and assessments are being used to meet tribal needs from resource inventory to energy independence. Energy, Forestry and Natural resource policy are often integrated in Indian country. The standards, scientific methods and regulations associated with bioenergy operations in Indian country could be of value and provide tools to assist in leveraging tribal sovereignty and meet tribal needs.

Breanna Gervias (Penobscot) – NARA, Tribal Partnerships Projects/Undergraduate Student - Portland State University, Portland, OR

2. Estimating tribal biomass availability using FVS
We describe the use of the Forest Vegetation Simula-

tor (FVS) to assess slash production from an ecologically-based, tribal forest management plan developed by the Forestry Department of the Confederated Salish and Kootenai Tribes (CSKT). Landscape scale planning requires knowledge of the distribution and composition of forest resources and the prescriptions that achieve ecological and harvest goals. The CSKT provided Continuous Forest Inventory (CFI) data and GIS layers for roads and harvest units planned for the next decade. The CFI data was input into FVS to estimate the spatial distribution of slash that will be generated from management over the next decade. Linking detailed landscape-level forest structure information with actual harvest planning, transportation accessibility, and expert forest manager review supports biomass planning by providing the checks and balances that build confidence in the projected slash volumes.

Burdette Birdinground (Crow) (presenter) MS Student, Blake Hough, NARA Tribal Partnership Project PhD Student, University of Washington, Seattle, WA, and Tom Richards, Tribal Partnership Projects Consultant, Northwest Management

RESEARCH PRESENTATIONS

Nwaneshiudu, I., Z. Zhou and D.T. Schwartz. Process Simulation for Conversion of Woody Biomass to Sugar. Poster presentation at the NARA Annual Meeting, Corvallis, OR, September 10, 2013.

Hough, B.R., D.T. Schwartz, L. James, C. Sifford, J. Durglo and T. Richards. Biomass supply estimates for the Confederated Salish and Kootenai Tribe based on harvest planning and management goals. Poster presentation at the NARA Annual Meeting, Corvallis, OR, September 10, 2013.

Schwartz, D.T., L. James, B. Hough, T. Richards, J. Durglo, S. Pressley and A. Leighton. NARA Tribal Partnership Projects, Biomass supply estimates for the Confederated Salish and Kootenai Tribes based on harvest planning and management goals. Oral

presentation and NARA UW final report presented at the Confederated Salish and Kootenai Tribes, Tribal Council Chambers. Pablo, MT. January 16, 2014.

Schwartz, D.T., L. James, B. Hough, T. Richards, and J. Durglo. NARA Tribal Partnership Projects, Biomass supply estimates for the Confederated Salish and Kootenai Tribes based on harvest planning and management goals. Oral presentations and final report presented to the CSKT Division of Forestry at Ninepipes Lodge, Charlo, MT. January 16, 2014.

Schwartz, D.T., L. James, B. Hough, T. Richards, J. Durglo, and A. Leighton. NARA Tribal Partnership Projects, Biomass supply estimates for the Confederated Salish and Kootenai Tribes based on harvest planning and management goals. Oral presentation and final report presented at the Energy Keepers, Inc., Ronan, MT. January 17, 2014.

Pressley, S., D. Schwartz, L. James, J. Durglo and A. Leighton. NARA Summer Undergraduate Research Experience. Oral presentation at Salish Kootenai College, Forestry & Natural Resources Club meeting, Pablo, MT. January 17, 2014.

VIDEOS AND WEBINARS

Webinar sponsored by Energy Keepers, Inc. with UW NARA, CSKT Forestry, SKC, the Beck Group Consulting and Harris Group, Inc.

Schwartz, D.T., L. James, B. Hough, T. Richards, J. Durglo, and A. Leighton. NARA Tribal Partnership Projects, Biomass supply estimates for the Confederated Salish and Kootenai Tribes based on harvest planning and management goals. Oral presentation and final report, webinar via WebEx at the Energy Keepers, Inc., Ronan, MT. January 17, 2014.

Webinar sponsored by OSU NARA with UW NARA, CSKT Forestry, CSKT Fire and SKC

Bailey, J., L. James, J. Durglo, R. Swaney, S. DeFrance, A. Leighton, D. Clairmont and Rick Everett. Integrated Fireshed-Level Adaptive Management

Evaluation Sites (iFLAMES). Presentation and outline of next steps in planning and plot layout, webinar via Adobe Connect. Corvallis, OR. March 11, 2014

THESIS AND DISSERTATIONS

Ike Nwaneshiudu, Ph.D., Tailoring Polymer Micro-extraction Phases to Enhance the Sensitivity and Selectivity of Raman Spectroscopy, Chemical Engineering, University of Washington, Sept 2013.

Kenneth Faires, Ph.D., Gasification of in-forest residues with supercritical water. Mechanical Engineering, University of Washington, April 2013.

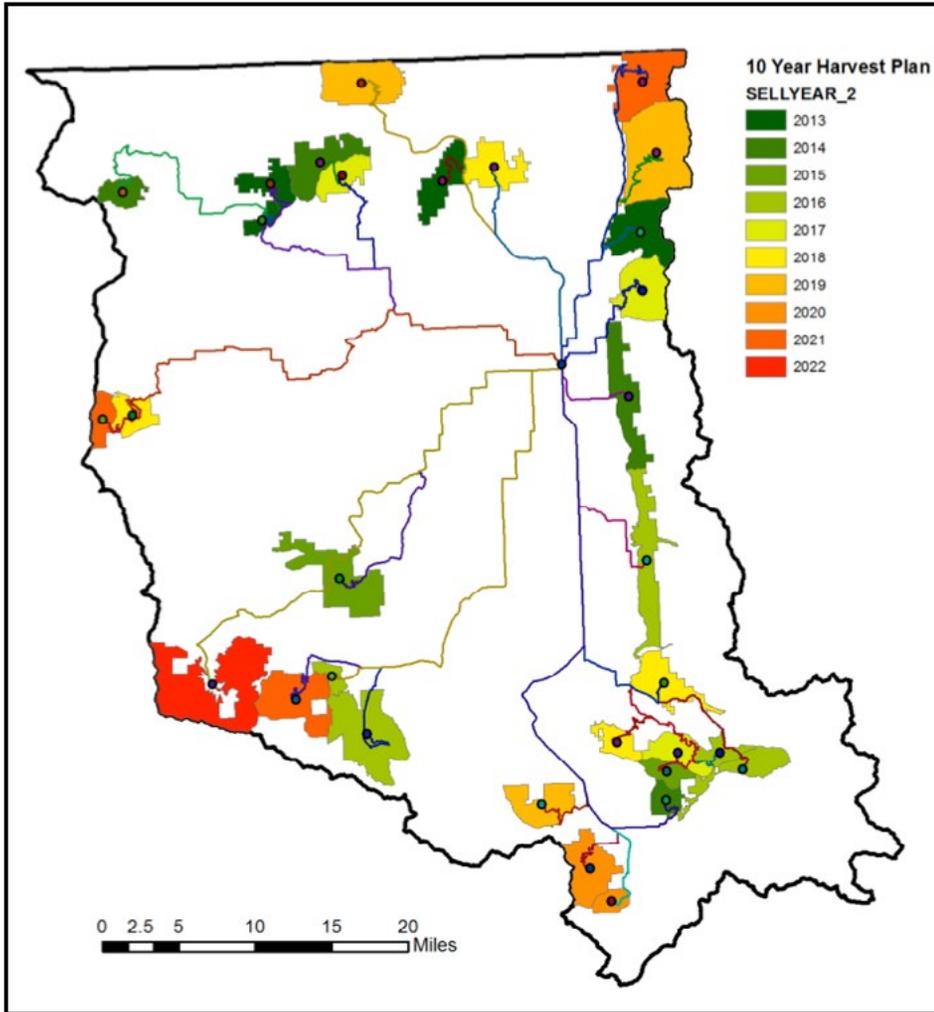


Figure E-1.1. Forest management areas on the CSKT Reservation for the next 10 years. Roads connecting the centroid of each management area to a central facility in Pablo, MT

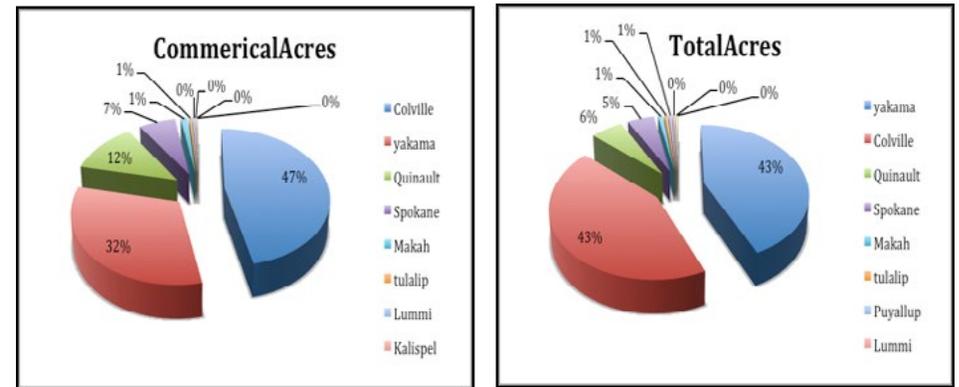


Figure E-1.2. Top 10 Tribes in Washington with Total and Commercial Forest Acres

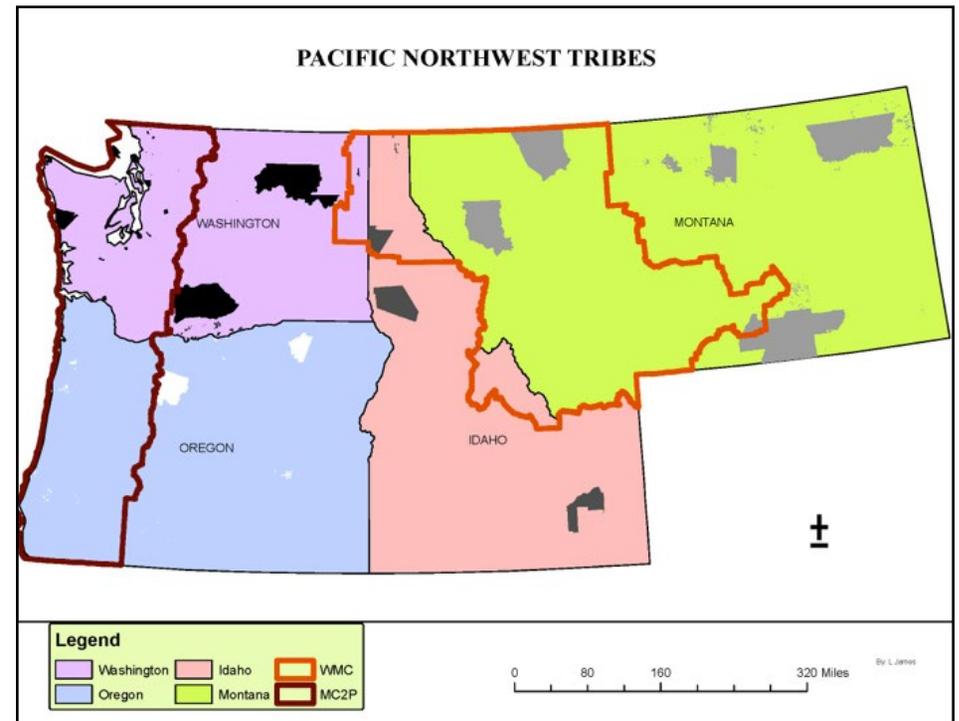


Figure E-1.3. Tribal lands (shaded) for each State and in vicinity to the NARA WMC & MC2P regions

TASK E-2: GREENSTEM K-12 INITIATIVES

Key Personnel

Tammi Laninga
Greg Fizzell
Danica Hendrickson
Karla Eitel

Affiliation

University of Idaho
University of Idaho
Facing the Future
University of Idaho

Task Description

The NARA Education Initiative, or GreenSTEM, includes an imaginative suite of programs that seamlessly link an array of educational and training programs with our university and commercial partners in order to meet the region's most compelling energy development needs. The overarching goal of GreenSTEM is to increase the capacity of the region for a transition to biofuels. This will be accomplished through four interrelated objectives:

1. Meet the workforce needs of the bio-energy/bio-products economy;
2. Develop the next generation of energy leaders for industry, government, and the civic sector;
3. Improve the biofuels literacy of teachers educating our future citizens; and
4. Strengthen overall science literacy of these same young citizens in areas particular to the biofuels debate.

The program develops energy and biofuel curricula, which are field-tested at University of Idaho's award winning McCall Outdoor Science School (MOSS), annually reaching 2,500 K-12 students and 150 teachers. This curricula will then be delivered via the web and social networking approach pioneered by Facing the Future (FtF), a Seattle-based non-profit renown for web-based sustainability curricula. K-12 teacher training will also be achieved through MOSS teacher institutes and FtF webinars and professional development workshops. Teachers and students will be impacted through this work and outcomes- through assessment and evaluation - will show that:

1. K-12 students are more knowledgeable about biofuels, biofuels research, and energy.
2. K12 students apply knowledge in energy literacy to successfully develop an approach to answering a problem-based energy issue.
3. K-12 teachers are more knowledgeable about biofuels, biofuels research, and energy.
4. K12 teachers apply knowledge in energy literacy to help their students successfully develop an approach to answering a problem-based energy issue.
5. Teachers participating in professional development programs will integrate problem-based learning and energy content in their home classrooms with increased confidence.

Task E-2.1. K-12 Students (MOSS)

The McCall Outdoor Science School delivers bio-fuel education programs to 2,500 middle and high school students annually both during the school year and during the summer. New biofuel lesson plans are created and field-tested in partnership with FtF. Select students will participate in conjunction with their teacher and MOSS graduate students as they prepare a problem-based project to compete in the Washington State University (WSU) Imagine Tomorrow (IT) Competition.

Task E-2.2. K-12 Teachers (MOSS)

The McCall Outdoor Science School delivers a summer workshop and an annual biofuel webinar series for 15 - 30 middle school to high school teachers. Teachers participating in the webinar series are supported as coaches for the Imagine Tomorrow (IT) competition while developing their own energy literacy through a series of lectures and discussions with NARA research scientists. An additional 40—50 teachers follow the IT competition preparation process via the web. Fifty teachers that accompany

their 6th grade students to MOSS residential school programs participate by observing their students as they participate in biofuel focused education lessons. Teachers are also supported through a web-based "Energy Literacy Principle Matrix" (ELPM), designed to house and effectively organize educational materials covering a broad spectrum of subjects related to biofuels. Its design is flexible and adapts well to NARA activities while providing a single site where teachers or community members can effectively find information about biofuels.

Task E-2.3: Energy Curriculum Web Delivery (FtF)

Facing the Future creates interdisciplinary K-12 curriculum resources that equip and motivate students to develop critical thinking skills, build global awareness, and engage in positive solutions for a sustainable future. These resources use global sustainability as a framework to present engaging, real-world issues such as energy to K-12 students. Our resources reach 1.5 million students each year and are used in all 50 states and 135 countries through web-based delivery.

Facing the Future provides K-12 educators with high quality free and low-cost curriculum resources through the web that engage students in learning math, science, language arts and social studies through the context of real-world social, environmental, and economic issues such as energy. Our curriculum resources align with standards in all U.S. states. FtF's professional development services equip school districts, schools and educators with sustainability and global education frameworks and content, instructional strategies, and curriculum resources to help students excel academically. Facing the Future works with 12 peer educators from around the country who provide professional development to other educators based on FtF resources.

Activities and Results

MOSS: Task E-2.1. K-12 Students & Task E-2.2. K-12 Teachers

Fifteen teachers participated in a summer workshop that focused on bioenergy and climate change, with sixty teachers following the workshop online.

In a follow-up survey conducted in March 2014:

- 70% of the teachers participating in our summer workshop agree or strongly agree that they understand enough about biofuels in the Pacific Northwest to have an informed opinion;
- 48% of teachers report that they are able to incorporate biofuels into their curriculum;
- 73% agree or strongly agree that they understand key parts of the supply chain;
- 82% of the teachers agree or strongly agree that they are more likely to use problem-based learning after being involved in the workshop.

Twenty-two teachers from Montana, Idaho and Washington have participated in a webinar series to support coaching Imagine Tomorrow teams. Seven webinars will have been delivered during this reporting period and have included six scientists and two curriculum developers from the NARA team plus a professional from the Department of Energy and an educational researcher from the University of Washington (see outputs for list of webinars).

Ten graduate students have developed energy literacy curriculum (see products below), conducted energy literacy assessment, facilitated a webinar series and have contributed material to the Energy Literacy Principles Matrix.

Six new lesson plans have been developed to support energy and climate literacy curriculum. Six more are currently in process. Completed lessons include (see attached copies):

- The value of a slash tree
- Plant cell walls to alcohol

- Exploring hydropower
- Hydroelectric power and dams
- Biomass adventure race
- Water resources in a changing climate

A team of seven students traveled to Seattle from McCall to collect video and learn more about the NARA project so that they could prepare new curriculum based on emerging understandings. These students met with seven scientists and one key stakeholder on the NARA project.

More than 1500 students have participated in MOSS residential programs that deliver the MOSS energy literacy curriculum. A random sample of students (n = 208) participated in an energy literacy assessment before and after participation in the program. A paired-samples was calculated to compare the mean pre-test scores to mean post-test scores. Results are reported in Table E-2.1.

MOSS is an active participant in the NARA Assessment Task Force set up to develop a project-wide set of energy literacy assessment tools that can be used to assess our progress across the education and outreach teams.

Facing the Future(FtF): Task E-2.3: Energy Curriculum Web Delivery

This past year, Facing the Future (FtF) published middle and high school versions of Fueling Our Future: Exploring Sustainable Energy Use in digital (PDF) and print formats (100% post-consumer recycled materials). Additionally, Alicia Keefe has converted the high school curricula into SMART Board (an interactive whiteboard technology) format. Fueling Our Future: Exploring Sustainable Energy Use is the 9-lesson energy curricula developed during years 1 and 2 of the NARA project. This curriculum is aligned to state and national standards as well as the principles outlined in the Energy Literacy Framework. All of the above-mentioned formats as well as one free lesson entitled, Fueling the Future, are currently available on Facing the Future's website. An energy curricula for primary grades is currently being researched and developed.

The middle and high school resources have been promoted to our network through a fall social media marketing campaign, eNewsletters, and via strategic partners such as Joshua Sneideman, the 2013-14 Albert Einstein Fellow working at the Department of Energy. To date, this resource has been distributed to the following number of people:

Middle School Free Lesson: 26
 Middle School PDF: 96
 Middle School Print: 4
 High School Free Lesson: 36
 High School PDF: 72
 High School Print: 1

Table E-2.1.

Index	Mean pre-test score	Mean post-test score	Significance
Bioenergy content (8 points possible)	4.01	4.51	p=.000
Attitudes towards renewable energy (35 possible points)	25.4	26	p=.042
STEM Identity (30 possible points)	19.6	20.8	p=.000
Science Process Skills (55 possible points)	40.6	43.1	p=.000

High School SMART Board: 4
High School Free SMART Board Lesson: 5

Dave Wilton (Professional Development Manager) developed teacher training materials tailored to FtF and energy literacy that have been used for the following webinars/workshops:

- An FtF Webinar in April 2013 (11 attendees)
- The NSTA STEM conference in St. Louis in May 2013 (85 attendees total between two workshops)
- The Webster University Summer Sustainability PK-12 Institute in St. Louis in June 2013 (52 attendees)
- Fueling our Future was shared as a part of a MOSS webinar for prospective teachers interested in participating in the Imagine Tomorrow competition in the fall of 2013.
- Facing the Future hosted its own webinar about the NARA project and FtF in the fall of 2013. The webinar has been archived on FTF's YouTube channel: <https://www.youtube.com/watch?v=N-wHUDdntGCE>
- An in-person workshop conducted at the National Science Teachers Association conference in Portland received overwhelmingly positive feedback from the 78 attendees from primarily the Pacific Northwest (one of whom had even attended a previous MOSS workshop that included NARA education materials).
- Danica Hendrickson facilitated 2 workshops for Oregon State University's Science and Math Investigative Learning Experiences (SMILE) program teachers in January 2014. These workshops emerged from conversations between the NARA and Advanced Hardwood Biofuels Project education teams at the 2013 NARA Annual Meeting (19 middle school teachers, 13 high school teachers).

In addition, Danica Hendrickson presented to the MOSS graduate students on the curriculum development process used for FtF. She has also been working with the NARA Education Team to develop Energy Literacy Assessments to be used to evaluate the Education team's progress on the NARA project.

Recommendations | Conclusions

MOSS

The teacher webinar series has been very successful and has enabled the NARA education team to reach teachers at a greater distance at a lesser cost than in years past. This coupled with the workshop plus blog format has enabled the team to reach a greater number of teachers over a great geographic region than could have otherwise been present. More significantly, it has integrated project scientists into outreach efforts (seven scientists have been involved in the 2013-14 school year), has connected with agencies at the national level, and has connected to other NARA education efforts (Imagine Tomorrow and Facing the Future). This integration of goals and opportunities has led to a more robust educational effort for all parts of the team.

The addition of graduate student projects has greatly increased our capacity to create curriculum products, videos, blogs and webinars. This curriculum is being integrated into various K-12 and teacher education efforts. Continued development of the energy literacy matrix and development of a project-wide set of energy literacy assessment tools will bring the integration of education and science project objectives full circle.

A better tool for assessing energy literacy will help us ensure that we are measuring the construct in a way that represents the projects' concept of energy literacy. The process of developing the tool will help the various elements of the team align to a more common conception of this construct, hopefully leading to greater alignment of educational interventions.

FACING THE FUTURE

Over the last year, we have met many people beyond the NARA project who are also working to encourage energy literacy in the K-12 arena. Conversations with these folks have fostered new relationships and, we believe, a stronger response to the need for quality

and robust energy curricula. Moving forward, we will continue to participate in these conversations as well as continue to work with the NARA Assessment Task Force to develop an energy literacy assessment tool for the NARA Education and Outreach teams.

Physical and Intellectual Outputs

REFEREED PUBLICATIONS (ACCEPTED OR COMPLETED)

Schon, J., Eitel, K.B., Bingaman, D., Miller, B.G., Rittenburg, R. (accepted for publication, 2014). Little leaders in conservation. *Science & Children*.

Schon, J., Hougham, R.J., & Eitel, K.B., Hollenhorst, S. (2014). The value of a tree. *Science Scope*. 37(7), pp. 27 – 35. (https://docs.google.com/a/nararenewables.org/file/d/0B0uYXL_FRYF7S2EzTFZ1cIB3R3M/edit)

RESEARCH PRESENTATIONS

Eitel, Karla, R. Justin Hougham, Jenny Schon, Jyoti Jennewein, Jan Eitel, Gary Thompson, and Steven Hollenhorst. 2013. "Teacher Professional Development: An Energy Literacy Supply Chain" (Poster). NARA Annual Meeting. Corvallis, OR, September 10.

Hougham, R. Justin, Jenny Schon, Karla Eitel, Danica Hendrickson and Steven Hollenhorst. 2013. "Education at the Speed of Research: Communicating the Science of Biofuels" (Poster). NARA Annual Meeting. Corvallis, OR, September 10.

Hougham, R. Justin, Jenny Schon, Brant Schroeder, Karla Eitel and Steven Hollenhorst. 2013. NARA Energy Literacy Matrix: <http://energyliteracyprinciples.org>" (Poster). NARA Annual Meeting. Corvallis, OR, September 10.

Facing the Future

Hendrickson, D., D. Shaw, S. Jacob, A. Keefe, and L. Skelton. 2013. "Fueling Our Future: Exploring Sustainable Energy Use; An Interdisciplinary Curriculum for Middle and High School" (Poster). NARA Annual Meeting. Corvallis, OR, September 10.

VIDEOS AND WEBINARS

MOSS (<http://teachingadventurelearningatmos.wordpress.com/media-archive/>)

- November 13, 2013: Facing the Future's Fueling Our Future curriculum (Dave Wilton)
- December 12, 2013: The Energy Literacy Principles and Matrix (Josh Sneiderman and Justin Hougham)
- January 16, 2014: Coaching an Imagine Tomorrow Team (Andrew Morozov)
- February 13, 2014: Bioenergy supply chain logistics (Tammi Laninga)
- March 13, 2014: Life Cycle Assessment (Tait Bowers and Francesca Pierbon)
- April 17, 2014: Valuable co-products (Carter Fox and Ian Dallemeyer)
- May 15, 2014: Practice for the Imagine Tomorrow Competition
- Facing the Future (<https://www.youtube.com/watch?v=NwHUDntGCE>.)
- November 15, 2013. Fueling our Future: Exploring Sustainable Energy Use

TRAININGS, EDUCATION AND OUTREACH MATERIALS

MOSS

1. Six new lesson plans developed to support energy and climate literacy curriculum. Six more are currently in process. Completed lessons include:

- The Value of a slash tree
- Plant cell walls to alcohol
- Exploring hydropower

- Hydroelectric power and dams
- Biomass adventure race
- Water resources in a changing climate

The above lessons are available for viewing here:

https://drive.google.com/a/nararenewables.org/?tab=mo#folders/OB0uYXL_FRYF7ZDB-org/wa3ZqVS1vQUE

2. "Supply chain" field trip conducted March 3 – 7 with seven graduate students. Students created a blog documenting their trip and collected video of NARA scientists that will be contributed to the Energy Literacy Principles Matrix. Additional students visited atmospheric scientists, remote sensing professionals and classroom teachers to understand the larger context for our work. Field trip included visits with Karl Englund, WSU; WSU Tri-Cities conversion labs; Carol Sim, Alaska Airlines; Carter Fox and Ian Dallemeyer, Weyerhaeuser; Indroneil Ganguly, Tait Bowers, Francesca Pierbon, UW; Danica Hendrickson, Facing the Future.

Facing the Future

Wilton, D. & Hendrickson, D. 2014. Fueling Our Future: Exploring Sustainable Energy Use. (PowerPoint.) OSU SMILE Winter Teacher's Workshop 2014. Corvallis, OR, January 24. <https://dl.dropboxusercontent.com/u/59697507/Fueling%20Our%20Future%20for%20OSU%20SMILE%20workshop.pdf>

INTELLECTUAL PROPERTY

Facing the Future

Hendrickson, D., Shaw, D., Jacob, S., Keefe, A., & Skelton, L. 2013. Fueling our future: Exploring sustainable energy use. (Middle School ed.). Seattle: Facing the Future. DOI: www.facingthefuture.org

Hendrickson, D., Shaw, D., Jacob, S., Keefe, A., & Skelton, L. 2013. Fueling Our Future: Exploring Sustainable Energy Use. (High School ed.). Seattle: Facing the Future. DOI: www.facingthefuture.org

Hendrickson, D., Shaw, D., Jacob, S., Keefe, A., & Skelton, L. 2014. Fueling Our Future: Exploring Sustainable Energy Use. (High School ed.). (SMART Board.) Seattle: Facing the Future. <http://www.facingthefuture.org/CurriculaFreeUnits/BuyCurricula/tabid/550/ProductID/69/Default.aspx>

TASK E-4: IMAGINE TOMORROW WITH BIOFUELS

Key Personnel

Liv Haselbach

Affiliation

Washington State University

Activities and Results

Task Description

The NARA Imagine Tomorrow (IT) program is designed to engage high school students in developing creative solutions to society's energy challenges. This project builds on the Imagine Tomorrow high school science competition at Washington State University. Now in its sixth year, the goal of Imagine Tomorrow is to unite educators, scholars, and industry leaders to teach students of all backgrounds and high school grade levels how to translate ideas into results. This energy-based competition program has been expanded to include a biofuel track, with the following objectives:

1. Engage future energy innovators. Students find ways to shift the public mindset, reshape governance and policy, reengineer technologies, and redesign communities toward a new energy future.
2. Foster collaboration. The competition shows students how collaborative actions make a difference in meeting the challenge of energy production and use in the 21st century.
3. Support educators. High school teachers inspire students to think bigger, gather information from diverse resources, and jointly develop new ideas.
4. Strengthen our community. Imagine Tomorrow creates connections among students, research faculty, and industry leaders. Students build confidence in their ability to make a positive difference in their communities.
5. Raise energy literacy. Imagine Tomorrow builds awareness of energy issues among students, educators, and the general population.

This project continues to support Tasks E-4.1 and E-4.2, engagement of future energy innovators, and fostering collaboration. During this year the competition held in May 2013 reached more students than previous competitions, including more students in Idaho and Montana. An assessment program was initiated. The assessment items focused on in this inaugural program included STEM career and energy literacy assessment development. The initial results from the 2013 competition are very positive for the impact that the competition had on the students' interests in STEM careers. Figures E-4.1 and E-4.2 are taken from the assessment by French et al. in August 2013. More longitudinal instruments are being developed in 2014 at Washington State University, including evaluation into where students might be furthering their education post high school. In support of Task E-4.5, researchers at Washington State University are working on an Energy and Bioenergy Literacy Rubric that measures the competition deliverables (abstract initially and posters at the competition). This is a novel research endeavor in energy literacy, and a paper has just been accepted for publication in the ASCE Journal of Professional Issues in Engineering Education and Practice that describes this rubric covering applicable abstracts from 2009 to 2013 and posters in 2013. Currently, this rubric is being re-evaluated and work is also underway on cross-matricing the energy literacy portions of the rubric with the Seven Principles of Energy Literacy as recently developed by the Department of Energy. There has been support of Task E-4.3, with the continuation of awards to formerly non-participating schools and the MOSS efforts on mentoring teachers. A proposal for a complementary Research Experience for Teachers proposal has also been submitted to the National Science Foundation. The 2013 assessment report also supported the goals of Task E.4.4, community connections, as seen in Figure E-4.3, where the number one best

part of the competition as seen by the students were meeting the judges, which came from industry, government, academia, etc. There has been substantial marketing for the 2014 IT competition to be held late in May 2014, particularly in Montana from the Moss group, and in Oregon by this investigator during the September 2013 annual meeting. This year again is seeing substantial growth in the competition. Registration numbers when registration closed on April 1, 2014 had 187 projects and 670 students registering, which are well above the 2013 count although there is always some attrition. Five of the teams are from Oregon, which exceeds the 2014 goals. The assessment work is also leveraging additional funding. \$30,000 was raised for assessment in this last year, and \$30,000 more is promised for the 2014 competition assessment cycle. These additional monies are from Ecoworks, Bank of America and a USDOT University Transportation Center. Other funds being leveraged for the competition costs include many businesses and individuals and other NGOs such as the Bullitt Foundation.

Recommendations | Conclusions

Support for the Imagine Tomorrow Competition continues to see expansion in the numbers of participants and states involved, and the competition is also impacting energy literacy and STEM interest in positive ways. Addition of the biofuels category has also provided a larger platform for promoting alternative fuel knowledge and growth in the region, and the US Department of Energy has expressed interest in funding the winning Biofuel team for a trip to the National Biomass Conference in July 2014 in Washington DC. The 2014 Princeton Review's Guide to 332 Green Colleges cites the Imagine Tomorrow competition as an important attribute in recognizing WSU as one of the green colleges listed. Additional assessment of these outcomes is growing with the leveraging of additional funds from other sources for the assessment research activities, and will be expanded in future competitions to try to track longitudinally the college and career paths of participants. The energy literacy assessment work is also going to be coordinated with the other energy literacy work NARA-wide and with the recently published Energy Literacy Principles as published by the US Department of Energy. The collaborative work amongst other NARA education team members with the Imagine Tomorrow is making the potential for positive outcomes even more possible, particularly with the investment by the MOSS team in teacher mentoring and education in energy literacy and student team support. The marketing campaign for 2014 also included direct meetings with educators at Oregon State University and Walla Walla community college in order to expand the opportunities within their STEM outreach programs. It is recommended that the level of support for the competition increase with the prediction of higher rates of participation, additional assessment and a more widespread reach. Continued participation by high profile executives such as the Washington State Superintendent Randy Dorn and keynote speaker Bob Peters, Washington State President of the Bank of America in 2013, and the 2014 keynote speaker, Mike Jobes, architect and principal of the renowned [Miller Hull Partnership](#), point

towards even greater success and engagement in collaboration and strengthening our communities for the future. In future years, the competition may expand to other regions in the United States, as a Midwest university has recently approached WSU with interest in hosting a future regional Imagine Tomorrow in Kansas City, a great indicator of its success and widespread impacts.

Physical and Intellectual Outputs

AWARDS

- Although not selected, the Imagine Tomorrow competition was nominated for the Washington State LASER Science Advocate Award by Ralph Rise, a participating mentor from a high school in the Coulee Dam region of Washington.

REFEREED PUBLICATIONS (ACCEPTED OR COMPLETED)

Langfitt, Q., Haselbach, L., and Hougham, R.J., Artifact Based Energy Literacy Assessment Utilizing Rubric Scoring. Accepted for publication, ASCE J of professional issues in engineering education and practice, 2014

RESEARCH PRESENTATIONS

Langfitt, Q., Haselbach, L. and Hougham, R.J., 2014. Graduate Student Research Poster Presentation on Energy Literacy Rubric Development, at the WSU Showcase, Pullman, WA. March 28, 2014.

OTHER PUBLICATIONS

Beaver, J., Gotch, C. and French, B., Impact and Experiences of Imagine Tomorrow 2013, Report submitted to the WSU Imagine Tomorrow Steering Committee, July 2013 by the WSU Learning & Performance Research Center.

Congratulations final piece appearing in The Seattle Times acknowledging winners and major sponsors. Appeared Friday, May 24, 2013.

Article in NARA Newsletter June 2013, Imagine Tomorrow Raising Bioenergy Literacy for High School Students and Teachers, <http://nararenewables.org/feature/newsletter-7>

[Student idea for new middle school places fourth at Imagine Tomorrow](#)
Daily Record, July 9, 2013

[Students 'Imagine Tomorrow' with energy tracker](#)
The Columbian, June 19, 2013

[STEM Students Shine at Imagine Tomorrow Competition](#)
Redmond Reporter, June 14, 2013

[Imagining Tomorrow: Spokane Students Participate in Alternative Energy Solutions Competition](#)
Spokane STEM, June 14, 2013

[CHS Students earn honors in 'Imagine Tomorrow'](#)
Camas-Washougal Post-Record, June 11, 2013

[STEM School students win Imagine Tomorrow awards](#)
Redmond Reporter, June 11, 2013

[KHS team's project a winner at Imagine Tomorrow](#)
Kingston Community News, June 6, 2013

[Imagine Tomorrow: Raising Bioenergy Literacy for High School Students and Teachers](#)
Northwest Advanced Renewables Alliance, NARA Blog, June 5, 2013

[Teams 'Imagine Tomorrow' with solar power](#)
The Bengals' Purr, Lewiston High School, Lewiston, Idaho, May 31, 2013

[Imagine Tomorrow team brings home the bacon](#)
Flight, Capital High School, Boise, Idaho, May 29, 2013

[School Winners](#)

The Herald, May 27, 2013

[Science teams take prizes in big competition](#)

The Star, May 22, 2013

[Imagine Tomorrow: The Big Winner Is....](#)

Washington Clean Technology Alliance, May 21, 2013

[Seattle City Light Sponsors High School Alternative Energy Competition](#)

Seattle City Light, Power Lines, May 8, 2013

[Carbon Footprint Calculator App Group Wins BIG at Imagine Tomorrow Competition](#)

TAF Academy

[Imagine Tomorrow Competition 2013](#)

Yelm High School

TRAININGS, EDUCATION AND OUTREACH MATERIALS

- Imagine Tomorrow Competition, May 2013, Pullman WA. There were 572 students, 57 advisors, and 135 judges who participated in IT 2013.
- Burke, Charles, NARA Exhibition booth at the Imagine Tomorrow Competition in Pullman WA, May 2013.
- Haselbach, L., Imagine Tomorrow. Poster Presentation at the BNARA 2013 Annual Meeting, Corvallis, Oregon, September 2013

TASK E-5: SUMMER UNDERGRADUATE RESEARCH EXPERIENCES (BF-SURE)

Key Personnel
Shelley Pressley

Affiliation
Washington State University

Task Description

BF-SURE is a summer immersion research experience for undergraduates aimed at giving them hands on skills in biofuels and bioproducts research, feeding the pipeline into energy research careers.

SURE participants participate in full time research experiences for a summer (ten week) program that provides laboratory, fieldwork, and research skills in the broad area of biofuels and bioproducts research.

The SURE program goals are:

1. To excite undergraduate students about cutting edge research in the area of biofuels and bioproducts;
2. To develop skills needed for future biofuels and bioproducts research careers;
3. To increase the number of students participating in biofuels and bioproducts research in the northwest, including those from schools that do not have strong research efforts;
4. To integrate mentoring experiences for graduate students and post docs into a formalized training program.

Activities and Results

Recruit and Select SURE Students

In the second year of the program (summer of 2013), there were a total of 38 applicants resulting in nine students that were selected for participation. Primary recruitment efforts included development of a NARA SURE website (<http://www.nararenewables.org/ed>)

and individual faculty members in NARA contacting students at their schools. The number of applications quadrupled between the first and second year, indicating better recruitment efforts. The applicants for the second year were also very diverse. Demographics of 2013 applicants were 61% women, 39% men; and 11% Hispanic, 3% Native American, 34% Asian, 8% African American, 5% multicultural and 39% Caucasian.



Figure E-5.1. 2013 NARA SURE students (l to r) Calvin Silas, Stephen Kline, Kane Norton, Andrea Laguna, Chanel Casayuran, Karissa Garcia, Daniel Leong

SURE Experience

Students were selected based on their applications and skills (relative to the proposed projects). Students were placed at five different NARA locations: WSU Pullman (4), WSU-TC (1), Penn State (1), U. of Wisconsin (1), and Weyerhaeuser (2). This was the first year that SURE students were placed in a corporate research experience. The students were paid a stipend of \$5000 for the 9.5 week experience of conducting research full time, with additional costs for housing or tuition added for students depending on location and on-site needs. The students (Figure

E-5.1) conducted research during this reporting period (May 29 – Aug 2, 2013) and all students participated in the poster session on August 2 in Pullman followed by a NARA SURE meeting for students and faculty to interact independent of the poster session. The list of 2013 students and their associated research topic is provided in Table E-5.1.

Recruit and Select SURE Students

The third group of SURE students is currently being recruited and accepted for the summer 2014 program. The application pool is very strong with over 50 applications to date. Applications are currently being reviewed and students will be notified shortly about acceptance. Additional recruiting efforts were continued during Fall 2013/Spring 2014. An informational flyer advertising NARA SURE was developed and distributed at the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS) and the American Meteorological Society (AMS) Annual Meeting. In addition, a notice was posted on the Institute for Broadening Participation: Pathways to Science website (<http://www.pathwaystoscience.org/>). Two additional recruitment efforts were done this reporting period. One at the American Indian Science and Engineering Society (AISES) Annual Conference which was held in Denver, CO Oct. 31 – Nov. 2. One of the NARA SURE students, Calvin Silas, was invited to attend and present his summer 2013 research. Calvin Silas and Laurel James (UW) also recruited potential students for the 2014 SURE experience at a recruiting booth during the conference. The second was January 16-17, 2014 when Shelley Pressley, Laurel James, Daniel Schwartz, and Blake Hough visited the Confederated Salish Kootenai Tribal Council and the Salish Kootenai College (SKC). A presentation was made to about 15 students (from Adrian Leighton's class) at SKC about undergraduate research opportunities with NARA.

Table E-5.1. 2013 NARA SURE students, their home institution, the title of their research, and their advisor

SURE student	Home Inst.	Research Title	Primary Advisor(s)
Calvin Silas	New Mexico State	Nanocellulose reinforcement for bio based phenolic thermo-responsive resins	Karl Englund
Jing Li	WSU	Batch Studies of Enzymatic Hydrolysis of Cellulose	Nehal Abu-Lail
Andrea Laguna	Univ. Wisconsin	Determining the effect of densification of pretreated harvested forest residue on enzymatic monosaccharide production	Junyong Zhu, Mike Wolcott
Karissa Garcia	WSU –Tri-Cities	Phenotypic variations of biomass recalcitrance in Douglas fir families	Xiao Zhang
Stephen Cline	Penn. State U.	Isolation of High Purity Lignin from Bio-Jet residues	Carter Fox, Dave Fish
Chanel Casayuran	Cornell U.	Preparation and characterization of porous carbon materials from lignocellulosic residuals	Ian Dallmeyer, Dave Fish, Carter Fox
Yuanlong Li	U. of Minnesota	Aviation Fuel Supply Chain Study in NARA region	Paul Smith
Daniel Leong	Olin College of Eng.	Depolymerizing Lignin Using Hydrogenolysis	Jinwen Zhang
Kane Norton	U. of Glamorgan	Effect of ball milling on crystallinity of wood	Mike Wolcott, Jinwu Wang

Recommendations | Conclusions Physical and Intellectual Outputs

Student recruitment increased from 11 to 38 to over 50 for the past three years. Based on this trend, it is recommended that we continue to recruit in the same fashion, including recruitment efforts at AISES. The experience in the corporate setting seems to be positive as well, and we anticipate placing students there again for the summer 2014.

RESEARCH PRESENTATIONS

Silas, C., Sahaf, A., and Englund, K. Nanocellulose reinforcement for bio-based phenolic thermo-responsive resins. Poster presented at the American Indian Science and Engineering Society Annual Conference. Denver, CO. Oct. 31 – Nov. 2, 2013.

Pressley, S., and M. Wolcott. NARA SURE Summer Undergraduate Research Experience. Poster presentation at the NARA Annual Meeting. Corvallis, OR. Sept 10-12, 2013.

OTHER PUBLICATIONS

NARA Newsstory: <http://nararenewables.org/blog/?p=238>

WSU News Story (July 30, 2013): <http://university-college.wsu.edu/units/undergraduateresearch/News-Events/headlines/wsuhostpostersymposium/>

Summer 2013 Undergraduate Research Poster Symposium Abstract Booklet: <http://universitycollege.wsu.edu/units/undergraduateresearch/photos-docs-pdfs/2013-REU-CompleteAbstractBooklet-FINAL3.pdf>

TRAININGS, EDUCATION AND OUTREACH MATERIALS

Summer 2013 Undergraduate Research Poster Symposium. August 2, 2013 in Smith CUE atrium at Washington State University. <http://universitycollege.wsu.edu/units/undergraduateresearch/share/reuposter/>

TASK E-6: SUMMER UNDERGRADUATE RESEARCH EXPERIENCES (SURE-SKC)

Key Personnel
Adrian Leighton

Affiliation
Salish Kootenai College

Task Description

Biofuels and bioproducts offer a high value use for woody biomass. Tribal forestry operations generate substantial quantities of woody biomass during fuels reduction aimed at forest health, timber harvest, and other activities. These forestry operations are keen to realize the environmental, economic, and social benefits of developing high value products from the forest. In order to help accelerate the development of high value-added uses of woody biomass among Northwest tribal communities, NARA is partnering with the forestry program at Salish Kootenai College (SKC), a tribal university, to provide research opportunities tied to biofuels and bioproducts from woody biomass. Annual summer internship awards will be made to SKC Forestry students so they can join a NARA research university for a summer research experience.

Summer Undergraduate Research Experiences (SURE) participants engage in a full time research experiences for a summer (ten week) program that provides laboratory, fieldwork, and research skills in the broad area of biofuels and bioproducts research.

The SURE program goals are:

1. To excite undergraduate students about cutting edge research in the area of biofuels and bioproducts.
2. To develop skills needed for future biofuels and bioproducts research careers.
3. To increase the number of students participating in biofuels and bioproducts research in the northwest, including those from schools that do not have strong research efforts.

4. To integrate mentoring experiences for graduate students and post docs into a formalized training program.

Activities and Results

Three SKC students have interned with NARA related biomass research projects. All three have since leveraged this position in various ways at NARA related institutions. Two interns have been accepted to graduate school at the University of Washington (UW) with NARA researcher Dr. Ivan Eastin. In the case of both students, the NARA internship proved to be a valuable asset in their applications and also their exposure to UW partners increased their interest in UW natural resource grad programs.

The third student successfully completed an internship in New Zealand studying fire ecology through a Montana State University PIRE grant. Again, NARA internship experience in biomass helped her leverage an internship (she had been unsuccessful in her previous application for the PIRE program), and she will be working with MSU researchers this summer in Yellowstone National Park on invasives and fire ecology.

Three internships will be set up this summer, including one that is with the Confederated Salish and Kootenai Tribes' forestry department, building on biomass work that was done for the Tribe last summer.

Recommendations | Conclusions

NARA has provided excellent opportunities for Native American undergraduate students to conduct meaningful research. This has led to all three students to date pursuing other research internships and graduate school opportunities. This is creating a "ripple effect" at SKC that is leading to increased interest in NARA, in research, and in graduate school.

Physical and Intellectual Outputs

PHYSICAL

Two NARA interns have been accepted to Graduate School at the University of Washington. NARA related internship experience was an important factor in their acceptance.

RESEARCH PRESENTATIONS

None to date – though two NARA related student posters accepted for June 2013 Intertribal Timber Council Indian Timber Symposium

OTHER PUBLICATIONS

Tribal forest biomass could become jet fuel. Lake County Leader, March 20, 2013. http://leaderadvertiser.com/news/article_22f2d800-91a1-11e2-98f2-0019bb2963f4.html

TASK 0-9: EDUCATION AT THE SPEED OF RESEARCH: NARA ASSESSMENT AND WEB-BASED RESOURCES

Key Personnel

R. Justin Hougham

Affiliation

University of Wisconsin

Task Description

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 assessments 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 and all education efforts is integral to the success of the NARA project's goal of enhancing energy literacy.

1. Lead 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 refine-

ment of energy literacy tools.

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

Development work for NARA Matrix, which includes the development of Literacy Assessment for Biofuels, can be delivered through energyliteracyprinciples.org. Additionally, the Energy Literacy Matrix and Web products will be developed and NARA project products will be organized into an online infrastructure. MagMag LLC will provide ongoing support of web-based tools, including refinement of energyliteracyprinciples.org

Activities and Results

Integrated approaches to literacies in the sciences, including energy literacy, must be developed to effectively cross disciplines, include all stakeholders and situate environmental sciences into the consciousness of learners of all ages. Meaningful approaches to this challenge address education at all levels—students, teachers, and public. Efforts can be found that communicate the exciting research in the natural world around students, while enriching the greater understanding of our changing world. NARA Education is addressing many entry points into the education system, while supporting the collection of materials suitable for education as EnergyLiteracyPrinciples.org does, supporting learners and providing the infrastructure for education at the speed of research. Students and educators need not wait for research results to trickle down through publication and eventually into textbooks, they can instead engage as meaningful partners along the path that all research takes.

Exciting discoveries and research are occurring everyday at the university and by research partners all over the state and the world. Having teaching and education move at the same relative pace is vital to 21st century skills that prepare students to be responsible citizens, as well members of a global or local community and workforce. STEM education is important to students everywhere to participate in the economies of tomorrow. It is increasingly imperative that they have the skills and literacies in science, technology engineering and math to make good decisions, to make new discoveries and to enrich quality of life for themselves and for those around them.

Efforts in this project to advance the above include developing and maintaining a web-based library of energy resources, teaching workshops and presentations for educators, adapting research concepts to curriculum and disseminating results in peer reviewed venues. Additionally, the NARA Assessment Advisory has made significant progress towards outcome statements and assessment materials that will be implemented in year four of the NARA project.

Recommendations | Conclusions

My observation is that NARA Education and Outreach efforts have built great capacity that is ready to move into new sectors. We really have a great opportunity to take a leadership role in bioenergy literacy.

Physical and Intellectual Outputs

REFEREED PUBLICATIONS (ACCEPTED OR COMPLETED)

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 (In press).

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.

RESEARCH PRESENTATIONS

Hougham, R. Justin (2014). NARA Energy Literacy Principles Matrix. Department of Energy, 2014 Data Jam, Washington DC.

Hougham, R. Justin, Jenny Schon, Karla Eitel, Danica Hendrickson and Steven Hollenhorst. 2013. "Education at the Speed of Research: Communicating the Science of Biofuels" (Poster). NARA Annual Meeting. Corvallis, OR, September 10.

Hougham, R. Justin, Jenny Schon, Brant Schroeder, Karla Eitel and Steven Hollenhorst. 2013. NARA Energy Literacy Matrix: <http://energyliteracyprinciples.org>" (Poster). NARA Annual Meeting. Corvallis, OR, September 10.

Hougham, R. Justin (2013). Education at the Speed of Research: Communicating the Science of Biofuels. Invited lecture, University of Wisconsin-Milwaukee, June 2013.

OTHER PUBLICATIONS

Contributor and Reviewer, Fueling our Future. (Facing the Future publication)

VIDEOS AND WEBINARS

Imagine Tomorrow teacher training series through MOSS, 5 webinars.

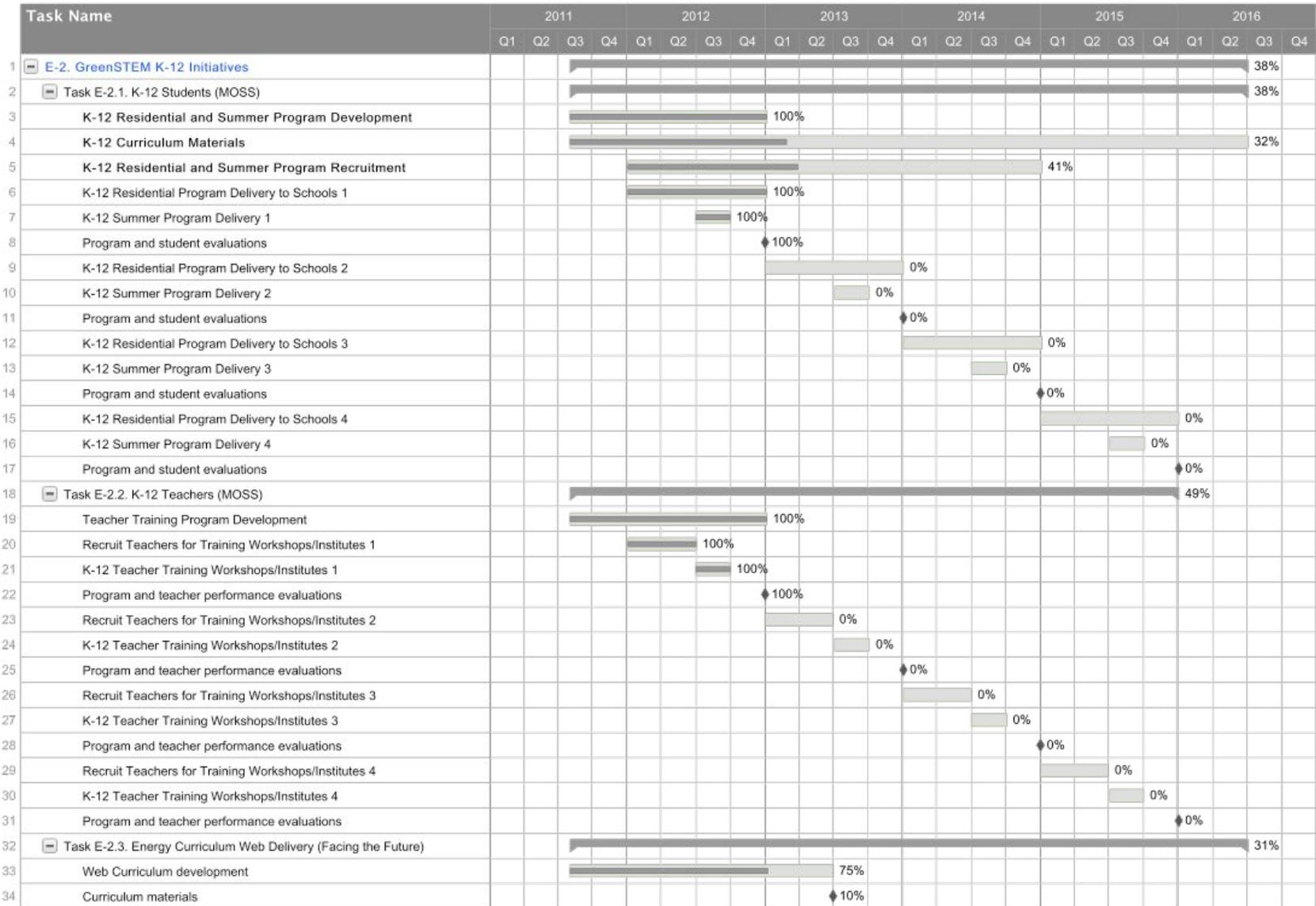
TRAININGS, EDUCATION AND OUTREACH MATERIALS

Adaptation of Value of a Tree for Wisconsin ecosystems

Education_Schwartz



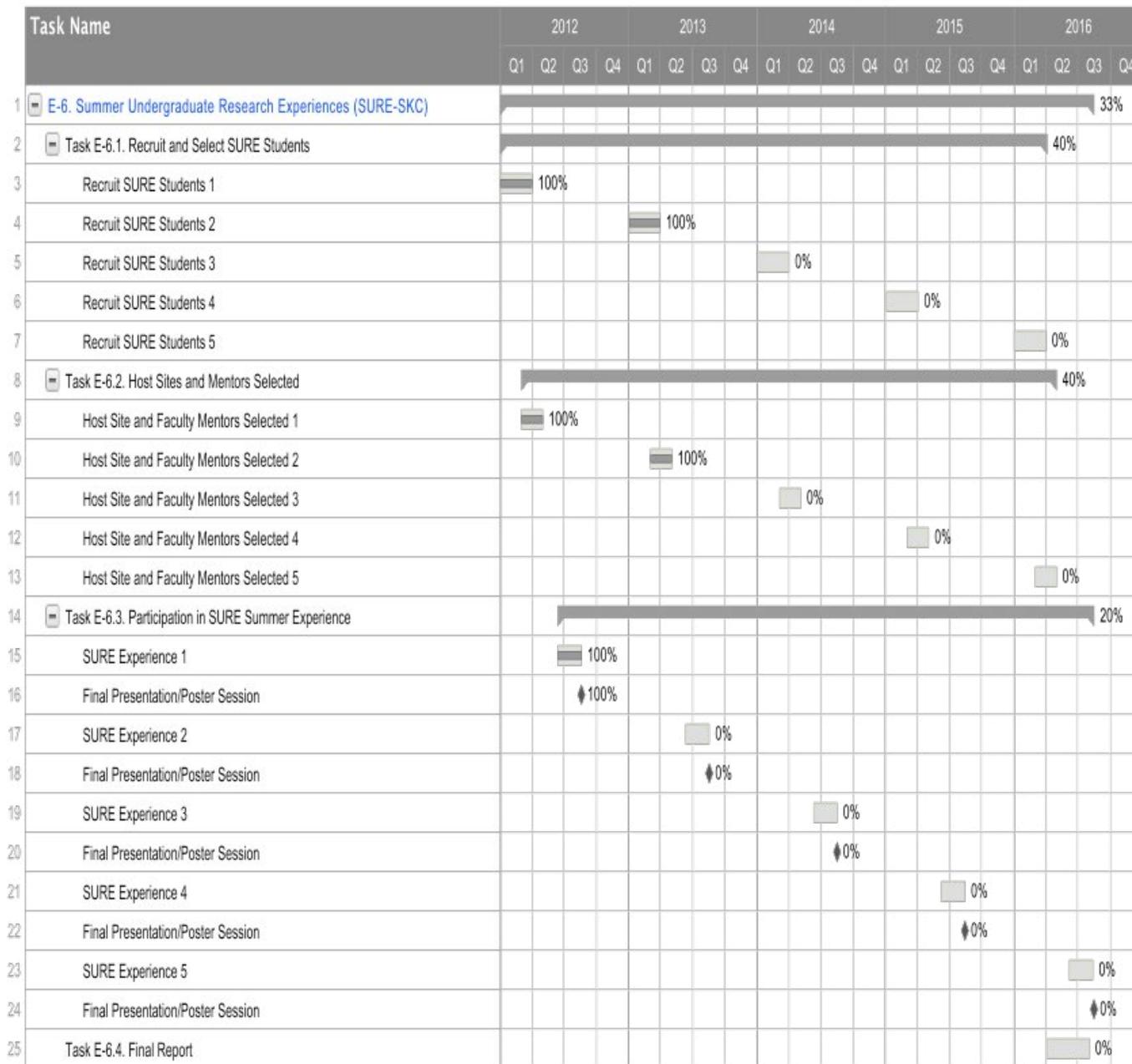
Task Name	2011				2012				2013				2014				2015				2016				
	Q1	Q2	Q3	Q4																					
1 E-1. Bioenergy and Bioproducts Graduate Education and Research in Partnership with Northwest Tribes																								28%	
2 Task E-1.1. Liaison functions with Tribes, Tribal Organizations, Campuses																									35%
3 Annual coordination with research sub-committee of Intertribal Timber Council																									35%
4 Annual coordination with campus Native American liaison officers																									35%
5 Task E-1.2. Tribal energy research project 1																									67%
6 Establish research collaboration agreement and scope with tribal partner 1																									100%
7 Collaboration agreement and scope documents																									100%
8 Student Selection for project 1																									100%
9 Student activities: Field Trip, Statement of work, research, reporting (oral, written)																									60%
10 Student project reports published to web																									0%
11 Publications: tribal review, peer review, edit, publish																									0%
12 Publication of project final report and journal manuscripts																									0%



Task Name	2011				2012				2013				2014				2015				2016								
	Q1	Q2	Q3	Q4																									
35 Web delivery and social marketing																													10%
36 Curriculum websites and marketing materials																													10%
37 Teacher training development																													100%
38 Teacher training program materials																													0%
39 Teacher training delivery																													20%
40 <input type="checkbox"/> Program and teacher evaluations																													
41 Program and teacher evaluations																													0%
42 Program and teacher evaluations																													0%
43 Program and teacher evaluations																													0%
44 Program and teacher evaluations																													0%
45 E-2.4, Final Report																													0%

Task Name	2011				2012				2013				2014				2015				2016				
	Q1	Q2	Q3	Q4																					
1 E-4. Imagine Tomorrow with BioFuels																								27%	
2 Task E-4.1. Program Development																									34%
3 Initial																									100%
4 Assessment																									20%
5 Enhancements																									20%
6 Task E-4.2. School and Student Recruitment																									40%
7 School and Student Recruitment 1																									100%
8 School and Student Recruitment 2																									100%
9 School and Student Recruitment 3																									0%
10 School and Student Recruitment 4																									0%
11 School and Student Recruitment 5																									0%
12 Task E-4.3. Recruit and Select Judges																									34%
13 Recruit and Select Judges 1																									100%
14 Recruit and Select Judges 2																									100%
15 Recruit and Select Judges 3																									0%
16 Recruit and Select Judges 4																									0%
17 Recruit and Select Judges 5																									0%
18 Task E-4.4. Program Delivery - Imagine Tomorrow Competition																									
19 Program Delivery - Imagine Tomorrow Competition 1, survey collection and analysis																									100%
20 Program Delivery - Imagine Tomorrow Competition 2, survey collection and analysis																									20%
21 Program Delivery - Imagine Tomorrow Competition 3, survey collection and analysis																									0%
22 Program Delivery - Imagine Tomorrow Competition 4, survey collection and analysis																									0%
23 Program Delivery - Imagine Tomorrow Competition 5, survey collection and analysis																									0%
24 Task E-4.5. Final Report																									0%

Task Name	2011				2012				2013				2014				2015				2016				
	Q1	Q2	Q3	Q4																					
1 E-5 Summer Undergraduate Research Experiences (BF-SURE)																									27%
2 Task E-5.1. Recruit and Select SURE Students																									34%
3 Recruit SURE Students 1																									
4 Recruit SURE Students 2																									
5 Recruit SURE Students 3																									
6 Recruit SURE Students 4																									
7 Recruit SURE Students 5																									
8 Task E-5.2. Recruitment of Faculty Mentors																									30%
9 Recruitment of Faculty Mentors 1																									
10 Recruitment of Faculty Mentors 2																									
11 Recruitment of Faculty Mentors 3																									
12 Recruitment of Faculty Mentors 4																									
13 Recruitment of Faculty Mentors 5																									
14 Task E-5.3. SURE Experience																									20%
15 Task 3.1. SURE Experience 1																									
16 Poster Session																									
17 Posters Posted on Web																									
18 Task 3.2. SURE Experience 2																									
19 Poster Session																									
20 Posters Posted on Web																									
21 Task 3.3. SURE Experience 3																									
22 Poster Session																									
23 Posters Posted on Web																									
24 Task 3.4. SURE Experience 4																									
25 Poster Session																									
26 Posters Posted on Web																									
27 Task 3.5. SURE Experience 5																									
28 Poster Session																									
29 Posters Posted on Web																									
30 Task E-5.4. Final Report																									



Outreach_Hougham



Task Name	2013				2014				2015				2016			
	Q1	Q2	Q3	Q4												
1 <input type="checkbox"/> O-9. Education at the Speed of Research: NARA Assessment and Web-based Resources																18%
2 <input type="checkbox"/> Task O-9.1. Energy Literacy Assessment																10%
3 Maintain Collection of Energy literacy Assessment Tools																22%
4 Establish and continue Assessment and Advisory Committee																22%
5 Pilot Assessment tool (measures for secondary students, university students, public)																18%
6 Implement Assessment Tool																0%
7 Compile analysis and findings related to energy literacy																0%
8 Stage 2 implementation of refined assessment tool																0%
9 Analysis of datasets from Stage 2																0%
10 Facilitate use of assessment tool via web and professional development efforts																0%
11 <input type="checkbox"/> Task O-9.2. Web-based Energy Literacy Tools																26%
12 Lead MATRIX Phase 2 development																100%
13 Manage Front End, Content Sequencer, Survey tool on energyliteracyprinciples.org																100%
14 Convene steering committee and expert review for energyliteracyprinciples.org																18%
15 Support Knowledge Base development																22%
16 Design and lead Phase 3 development																0%
17 Maintain current online inventory of resources																22%
18 Lead professional development and curricular application of energyliteracyprinciples.org																0%
19 Final Report																◆