

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Sustainable Energy

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	0%		5%	
123	Management and Sustainability of Forest Resources	10%		5%	
131	Alternative Uses of Land	5%		4%	
133	Pollution Prevention and Mitigation	10%		2%	
141	Air Resource Protection and Management	5%		3%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		15%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%		15%	
204	Plant Product Quality and Utility (Preharvest)	0%		6%	
205	Plant Management Systems	0%		5%	
206	Basic Plant Biology	0%		5%	
211	Insects, Mites, and Other Arthropods Affecting Plants	0%		5%	
402	Engineering Systems and Equipment	30%		5%	
403	Waste Disposal, Recycling, and Reuse	15%		10%	
511	New and Improved Non-Food Products and Processes	0%		5%	
601	Economics of Agricultural Production and Farm Management	10%		5%	
603	Market Economics	10%		2%	
605	Natural Resource and Environmental Economics	5%		3%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Extension	Research
-----------	----------

Year: 2013	1862	1890	1862	1890
	Plan	80.0	0.0	45.0
Actual Paid Professional	59.0	0.0	50.2	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Institution Name: Washington State University

Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
133210	0	153399	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
133210	0	153399	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
20300854	0	5727707	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research efforts have been especially strong in sustainable energy. The conditions that contribute to our crop diversity make it unlikely that we will be able to specialize with a highly uniform biomass feedstock, except possibly for plantation poplars. Washington's most likely biomass supply will be mixed softwoods and hardwoods, food processing and urban wastes and mixed crop residues. We have a strong basic science foundation for developing processes related to yeast, bacterial and algal fermentation and production, to pyrolysis and other types of biomass conversion, and to modifying crops to make them more amenable for fuel and bioproducts generation. Camelina shows some promise as a crop that might fit a production niche in wheat-fallow cropping Eastern Washington and switchgrass and *Arundo donax* have some potential in irrigated regions of the state because of their high production levels.

Feedstock production, especially of aromatic and aliphatic carbon compounds is a major focus of research, where the targets are generally of higher value than ethanol or biodiesel. Research with *Arabidopsis* and other model oilseeds suggests that there are active mechanisms that resist substantial changes to oil content and quality and that overcoming these will be an important part of increasing biological oil production. Pathways more separated from primary metabolism may be more mutable, as the work with mint oils referred to above suggests.

Supported by a major USDA CAP grant, NARA (Northwest Advanced Renewables Alliance, nararenewables.org) is developing methods for softwood conversion into jet fuels. Supply chain coalitions have or are being developed in Montana, Oregon, and Washington. These coalitions consist of private, tribal, and non-federal public lands forest owners, and include conversion, distribution, and procurement agencies along with state and federal agency representatives. It is estimated that there are sufficient forest

residues in the Pacific Northwest to provide the biomass needed to satisfy the civilian and military aircraft fuel needs in the region with a 50% blend.

The portfolio of projects is broad and includes developing of hardwood species (poplar and alder) that grow well in the region; screening heterotrophic algae and oleaginous yeasts that may take advantage of various feedstocks and carbon dioxide waste streams to generate production streams with relatively high value; and developing oilseed and vegetation crops with a high lipid content that can generate higher levels of lipids that have relatively little conversion cost. WSU has considerable expertise in catalysis that has been augmented by the appointment of several Chemical Engineers to the ARC and the expansion of a program in pyrolysis that is adding the ability to deoxygenate pyrolysis oils in order to evaluate the entire conversion cycle of lignocellulose via heat and pressure treatment. Transportation and LCA related economic considerations are being evaluated through the efforts of research and Extension programs agricultural economics. In work related to the original NARA goals, it has been shown that poplar can be modified to produce phenylethylalcohol (PEA) glycoside at a level of about 1% of total mass. Future work is targeting an increase in PEA-glycoside levels and developing efficient technology for converting PEA-glycoside to PEA, a specialty chemical.

2. Brief description of the target audience

The target audiences included farmers, business owners, homeowners, industry technology providers, project developers, and public agencies and utilities. Two significant targets for some of these applications are the US Department of Defense, through its Green Navy Initiative, and Boeing and other aerospace related companies.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	4500	3600	25	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2013

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	5	32	37

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of workshops, demonstrations, and symposia conducted related to alternative energy and energy efficiency.

Year	Actual
2013	72

Output #2

Output Measure

- Number of peer reviewed (official) WSU Extension publications published annually.

Year	Actual
2013	4

Output #3

Output Measure

- Number of graduate students with a significant professional orientation in the area of Sustainable Energy.

Year	Actual
2013	59

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Percentage of evaluated participants who demonstrated increased knowledge and skills relative to key learning objectives.
2	Percentage of participants who demonstrate application of new knowledge resulting from WSU energy workshops, demonstrations, or symposia.
3	Number of households and enterprises reporting reduced energy consumption as a result of WSU programs.
4	Amount of new sustainable energy (MW/YR) produced as a result of WSU programs.

Outcome #1

1. Outcome Measures

Percentage of evaluated participants who demonstrated increased knowledge and skills relative to key learning objectives.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	96

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Regional systems for renewable, biomass-based, liquid transportation fuels are needed to support energy independence, reduce net carbon emissions, stabilize fuel prices for consumers, provide new economic opportunities for landowners, and create jobs and economic development to rural communities. Hybrid poplar is one species that may suit this need. In order for this system to be successful, stakeholders need to be well informed and understand the opportunities and constraints, and receive technical assistance based on up-to-date research results.

What has been done

Over 200 people have attended field tours and over 900 attended symposia or presentations. The hardwood biofuel webinar series launched had over 100 participants, and 332 others viewed the subsequent recordings. The project videos have been viewed more than 300 times on YouTube, and the newsletter reached over 300 people. The Facebook page reached over 1,900, and the new website launched in August had over 1,200 visitors and 600 of these have been first time visitors.

Results

At this stage of the project, short-term impacts include increased awareness of the biofuels project and increased energy literacy around biomass and biofuels. Extension personnel in the target four-state region are more aware of the potential of hybrid poplar as a feedstock for biofuels and have been specifically targeted in outreach efforts. In post-event evaluations, an average of 96% of surveyed field tour participants reported a better understanding of hardwood biofuels. In addition, 98% of survey participants reported that they were moderately- or highly-likely to communicate to others what they learned. Similarly, 94% of symposia participants reported being moderately- or highly-likely to share with others knowledge from the event.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
131	Alternative Uses of Land
133	Pollution Prevention and Mitigation
141	Air Resource Protection and Management
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse
603	Market Economics
605	Natural Resource and Environmental Economics

Outcome #2

1. Outcome Measures

Percentage of participants who demonstrate application of new knowledge resulting from WSU energy workshops, demonstrations, or symposia.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Number of households and enterprises reporting reduced energy consumption as a result of WSU programs.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	8500

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Many homes, business, and public buildings were built at a time when wood heat was utilized and inadequate insulation was used along with lax weatherization, as fresh air needed to enter the building. Many families, businesses, and public entities cannot afford to upgrade insulation and

weatherization in the whole structure, so the work goes undone and electrical and other energy continues to be wasted.

What has been done

Outputs include energy assessment requests; kilowatt meter checkouts; radon tests conducted to alleviate fears of weatherization; carbon monoxide tests; and compact fluorescent bulbs distributed.

Results

Energy assessments and educational consultations were completed pinpointing energy losses in residential, commercial and government buildings. Compact fluorescent lights were installed with an estimated energy savings of \$15,000. Clientele conducted self- assessments of appliance kilowatt usage over extended periods to identify unnecessary energy usage.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
141	Air Resource Protection and Management
402	Engineering Systems and Equipment

Outcome #4

1. Outcome Measures

Amount of new sustainable energy (MW/YR) produced as a result of WSU programs.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

The steady decrease in fuel prices during 2013 and the high cost of manufacturing of hardwood biofuels has currently made hardwood biofuels not economical to produce. At the current rate, farmers would have to give their poplar production away for free. Plans for a partial capacity biofuels refinery in Northeast Oregon has been put on hold until biofuels can compete on the market and additional investors can be found. Competing priorities have also reduced the time that Extension personnel can dedicate to energy audits and improving the energy efficiency of homes and commercial buildings.

While we have several programs doing research into biomass energy conversion, the decrease of price pressure on fuel usage as the result of changes in production practices in

the oil and gas industries are moving the bar in a way that is familiar to those who remember the 1980's.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Overall, program participants have a greater awareness, increased knowledge, and application of knowledge in their homes and businesses. Overall, energy is being used more efficiently. Farmers have a greater understanding of biofuel crop production but realize that it is not economical at this time

Key Items of Evaluation

Post-event evaluations of Extension personnel, farmers, agency personnel and private business were used to determine knowledge gain. End of meeting forms are used for workshops, conferences and field day events. Major, regional field days are evaluated through personal interview or follow-up online survey.