

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%		5%	
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%		5%	
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
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Year: 2012	1862	1890	1862	1890
	Plan	15.0	0.0	50.0
Actual Paid Professional	67.3	0.0	47.4	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
77963	0	276613	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
77963	0	276613	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
14930309	0	7131350	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.

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 development of hardwood species (poplar and alder) that grow well in the region; screen 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; oilseed crops and vegetation crops with a high lipid content that can generate higher levels of lipids

that have relatively little conversion cost. We have considerable expertise in catalysis that has been augmented by the recent 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.

Research/outreach activities are extensive. We sponsored the International Wood Supply Chain symposium (woodsymposium.wsu.edu) and Imagine Tomorrow (imagine.wsu.edu) conferences. We held recruitment meetings for Native American communities with the objective of enrolling students into a summer undergraduate research experience for biofuels research, and held teacher training workshops for K-12 teachers to make them more aware of biofuels and how they could develop lesson plans around biofuel and sustainable energy activities.

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?

Biofuels information was developed for eXtension.

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	319025	28548	211	361255

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

Patent Applications Submitted

Year: 2012
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	3	48	51

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
2012	387

Output #2

Output Measure

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

Year	Actual
2012	3

Output #3

Output Measure

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

Year	Actual
2012	46

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
2012	86

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Continued competitiveness, economic growth and quality of life is dependent in large measure on our ability to find clean, cost effective, and renewable sources of energy. Washington's economy has long relied upon relatively cheap energy from hydropower, but this source is virtually impossible to expand given societal resistance to the creation of new hydroelectric dams. Other sources of energy appear to be viable in the region, including solar, wind, and biomass conversion.

What has been done

Research and Extension efforts have focused on energy efficiency measures, agricultural and woody biomass conversion, and algal and oil seed as biofuel sources. The projects in biomass, microbial, and oilseeds for biofuels are in early stages of work, but energy efficiency work with private individuals, corporations, and public entities was very robust during the year.

Results

Knowledge was increased among 86% of program participants related to improved energy efficiency in homes and buildings, as well as alternative energy generation such as solar, wind systems, and biomass conversion. This knowledge enhancement also led to enhanced collaboration among groups and organizations in understanding and realizing a sustainable energy future

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.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	79

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Continued competitiveness, economic growth and quality of life is dependent in large measure on our ability to find clean, cost effective, and renewable sources of energy. Washington's economy has long relied upon relatively cheap energy from hydropower, but this source is virtually impossible to expand given societal resistance to the creation of new hydroelectric dams. Other sources of energy appear to be viable in the region, including solar, wind, and biomass conversion.

What has been done

The WSU Extension Energy Program logged over 48,000 inquiries in 2012 that addressed energy efficiency questions and issues. The program also provided information assisting in the installation of 601 new solar systems and 16 small wind systems. This program also implemented an urban energy efficiency weatherization program with support from the state legislature. Biofuels research and development continued to investigate biomass conversion and biofuel crops and cropping systems.

Citizen changes in knowledge regarding biofuels and the NARA project were accomplished through the NARA website (over 18,000 first-year visits), NARA's participation at the Smithsonian Folklife Festival in Washington DC (over 1 million participants), and 22 electronic and print articles featuring NARA.

Results

Program participants demonstrated 79% application of knowledge gained in the sustainable energy program, with application to improved energy efficiency practices for homes and buildings, better decision making to address future energy needs, and plans for current and future development of both large and small solar and wind systems. Wind systems are especially well suited to the region.

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 #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
2012	10560

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Energy prices and consumption levels are rising in the U.S. and worldwide. More than ever before, the solution is the enhancement of energy efficiency and development/deployment of renewable energy solutions. The WSU Energy Program receives over \$10 million per year from a variety of state, regional, national and international funding sources.

What has been done

The Washington State Legislature charged the WSU Energy Program with developing and piloting a community approach to urban energy efficiency weatherization using \$14.5 million of ARRA funding. The resulting Community Energy Efficiency Pilot Program included nearly 200 small businesses that employ over 600 people. The program also addressed building efficiency and indoor air quality in schools, along with on-site resource conservation management visits and trainings.

Results

This program produced significant results related to efficient energy use with over 10,000 homes reducing energy consumption.

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.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	9

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Continued competitiveness, economic growth and quality of life is dependent in large measure on our ability to find clean, cost effective, and renewable sources of energy. Washington's economy has long relied upon relatively cheap energy from hydropower, but this source is virtually impossible to expand given societal resistance to the creation of new dams. Other sources of energy that appear to be viable in the region include solar, wind, and biomass conversion.

What has been done

The WSU Energy Program provided support to the state's renewable energy program, resulting in the installation in the State of Washington of over 500 new solar systems and small wind systems, as well as one anaerobic digester for electricity generation.

Results

Although we did not meet our goal of stimulating new sustainable energy generation of 11 MW/year, we reached 9 MW/year in 2012 and this number is growing with the introduction of new programs.

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

Ongoing concerns and limitations of the state budget and university budget continue to impact our hiring and deployment of human and financial resources, however, our energy programs have continued to do well in this environment as a direct result of large grants and contracts awarded for energy-related work. These grants and contracts are the major support of all work reported for this planned program. Many grants were funded by economic stimulus funds at the state and federal level.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

A concerted effort was made to evaluate program impact in terms of the percentage of evaluated participants who demonstrated increased knowledge and skills relative to key learning objectives (80 percent); the percentage of participants who demonstrated application of new knowledge resulting from WSU energy workshops, demonstrations, or symposia (70 percent); the number of households and enterprises reporting reduced energy consumption as a result of WSU programs (over 10,000 households in 2012); and the amount of new sustainable energy (MW/YR) produced as a result of WSU programs (9 MW as a result of the state renewable energy cost recovery program). The number of energy-related inquiries fielded by the national information centers managed and operated by the WSU Energy Program, and the number of energy trainings conducted was also monitored. Stakeholders are more aware of the Northwest Advanced Renewables Alliance (NARA) and the goals of the project. Key contacts have been made throughout the Pacific Northwest. Results were collected through a variety of methods, including training evaluations, feedback from stakeholders, calculations for funders, and program participants. The Advanced Hardwoods Northwest Biofuels project has made key contacts throughout the Northwest through workshops, tours and displays raising the visibility of the project among agencies, farmers, and other stakeholders.

Key Items of Evaluation

The key items of the evaluation focused on learning and knowledge change of program participants (80%) and application of that knowledge (79%). Over 10,000 households and businesses reduced energy consumption by utilizing extended information and assistance. Our efforts also contributed directly to increasing the amount of new sustainable energy generation (wind and solar) by 9 MW in 2012.

Basic energy research related to plant biomass generation and conversion is quite active, with research programs investigating wood and energy crop growth and utilization strategies under various cropping conditions. The NARA program will be reviewed in 2013 but other federal level awards, such as an NSF grant to study superoxide deconstruction of lignocellulose that was based on termite microorganism strategies, indicates that the research in our portfolio is competitive.