

**V(A). Planned Program (Summary)**

**Program # 3**

**1. Name of the Planned Program**

Sustainable Energy

**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%		5%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%		15%	
204	Plant Product Quality and Utility (Preharvest)	0%		15%	
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%	
	<b>Total</b>	100%		100%	

**V(C). Planned Program (Inputs)**

1. Actual amount of FTE/SYs expended this Program

Year: 2011	Extension		Research	
	1862	1890	1862	1890

Plan	15.0	0.0	50.0	0.0
Actual Paid Professional	78.5	0.0	45.0	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
104570	0	281094	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
104570	0	281094	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
18162277	0	6964320	0

**V(D). Planned Program (Activity)**

**1. Brief description of the Activity**

Research is being conducted on the use of agricultural and woody biomass, and on algal and oil seed lipid production and processing. A major focus of the basic research is in developing feedstocks and processes suitable for higher molecular weight transportation fuels. Camelina shows some promise as a crop that might fit a production niche in Eastern Washington and switchgrass and Arundo donax have some potential in irrigated regions of the state because of the high production levels we have been able to obtain. Aided by a major USDA CAP grant, an effort is underway to develop improved methods for softwood conversion into transportation fuels. Economic analyses are being conducted on various energy systems to assess thresholds for application of these technologies. Extension programs have been very active in teaching and demonstrating energy efficiency practices in homes and businesses, as well as alternative energy systems such as anaerobic digestion, biomass production, oil seed production, and the utilization of wind and solar energy systems.

**2. Brief description of the target audience**

The target audiences will include 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**

2011	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	309046	23581	220	380214

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

**Patent Applications Submitted**

Year: 2011  
 Actual: 2

**Patents listed**

Craig Frear and Shulin Chen COMBINED NUTRIENT RECOVERY AND BIOGAS SCRUBBING SYSTEM INTEGRATED IN SERIES WITH ANIMAL MANURE ANAEROBIC DIGESTER  
 Craig Frear and Shulin Chen HETEROTROPHIC ALGAL HIGH CELL DENSITY PRODUCTION METHOD AND SYSTEM

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

2011	Extension	Research	Total
Actual	0	0	21

**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.

<b>Year</b>	<b>Actual</b>
2011	3778

**Output #2**

**Output Measure**

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

<b>Year</b>	<b>Actual</b>
2011	2

**Output #3**

**Output Measure**

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

<b>Year</b>	<b>Actual</b>
2011	77

**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**

<b>Year</b>	<b>Actual</b>
2011	80

### **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 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, corporate, and public entities was very robust during the year.

#### **Results**

Knowledge was increased among 80% of program participants related to improved energy efficiency in homes and buildings, as well as alternative energy generation such as solar and wind systems. This knowledge enhancement also lead to enhanced collaboration among groups and organizations is realizing a sustainable energy future.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

<b>Year</b>	<b>Actual</b>
2011	70

### **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 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 2011 addressing energy efficiency questions and issues. The program has also provided information assisting in the installation of 568 new solar systems, and 16 small wind systems in 2011. This program also implemented an urban energy efficiency weatherization program with support for the state legislature. Biofuels research and development continued investigation in biomass conversion and biofuel crops and cropping systems.

#### **Results**

Program participants demonstrated 70% 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 solar and wind systems both large and small.

#### 4. Associated Knowledge Areas

<b>KA Code</b>	<b>Knowledge Area</b>
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

<b>Year</b>	<b>Actual</b>
2011	9500

##### 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 has about \$10 million per year from a variety of state, regional, national and international funding sources.

###### **What has been done**

In 2009, 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 18 on-site resource conservation management visits and trainings.

#### **Results**

This program outcome significantly exceeded our goal of 2,000 with over 9,500 homes reducing energy consumption. 2,200 of these were certified by the Energy Star Program.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

<b>Year</b>	<b>Actual</b>
2011	4

##### **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 appear to be viable in the region including solar, wind, and biomass conversion.

###### **What has been done**

The WSU Sustainable Energy Program provided support to the state's renewable energy program, resulting in the installation in the State of Washington of 568 new solar systems, 16 small wind systems, and one anaerobic digester.

#### **Results**

Although we did not meet our goal of stimulating new sustainable energy generation of 11 MW/year in 2011, we did stimulate an increase of 4 MW in 2011 and this is growing.

#### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
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**

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

##### **Brief Explanation**

Ongoing concerns and limitations of the state budget and university budget responses continue to impact our hiring and deployment of human and financial resources,; however, our energy program has continued to flourish in this environment as a direct result of large grants and contracts awarded for energy related work. These grants and contracts are essentially the foundation of all work reported on for this planned program. Many were funded by economic stimulus funds. The level of support subsidy offered in Fall, 2011 to encourage cultivation Camelina was insufficient to stimulate growers to take on new contracts for this potential new crop. Either the support price needs to go up or more background experience will be needed to be successful with this.

#### **V(I). Planned Program (Evaluation Studies)**

##### **Evaluation Results**

Sought to evaluated 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 (9,500 households in 2011) and the amount of new sustainable energy (MW/YR) produced as a result of WSU programs (4 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. Results were collected through a variety of methods including training evaluations, feedback from stakeholders, calculations for funders, and program participants.

### **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 (70%). The success of the program was largely based on the number of households and businesses that reduced energy consumption; with 9,500 far exceeding our goal of 2,000. Our efforts also contributed directly to increasing the amount of new sustainable energy generation (wind and solar) by 4 MW in 2011.

Basic energy research related to plant biomass generation and conversion is quite active, with research programs investigating wood and energy crop growth under various local conditions, oilseed growth in the region and basic plant productivity related to oil composition, algal sources of biomass, pyrolytic and anaerobic digestion and conversion processes and lignocellulosic conversion. Most of these programs are funded through external grants, which involves significant external review.