V(A). Planned Program (Summary)

Program # 6

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
123	Management and Sustainability of Forest Resources	20%		0%	
125	Agroforestry	20%		0%	
131	Alternative Uses of Land	20%		0%	
205	Plant Management Systems	40%		50%	
511	New and Improved Non-Food Products and Processes	0%		50%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	2.0	0.0
Actual Paid Professional	1.1	0.0	1.4	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
43230	0	46957	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
56767	0	198028	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
371016	0	518384	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

AFES researchers concentrated primarily on yield potential of lignocellulosic crops and woody biomass and oilseed crops. If successful, this research will lead to development of "best practices" management regimes and genetics of bioenergy crops. In the future, we intend to conduct research in remote locations in Alaska to determine the feasibility of various crops in small villages where people often have little experience in agriculture. For this purpose, we will concentrate on crops likely to be successful in these situations, especially woody crops, which will require little agricultural knowledge and simple technology.

AFES researchers continued work on utilization of low value biomass for fuels and chemicals, mostly through thermochemical means (gasification, pyrolysis, supercritical fluids). The chemical composition of alder, birch, hemlock, yellow cedar, Sitka spruce, red cedar, white spruce and aspen were evaluated for biofuel production via supercritical liquefaction. CES is working with communities on use of biomass products and with producers to develop value-added forest products.

An AFE/CES researcher is assimilating all existing information on the total forest and crop biomass available in Alaska into one database to determine the gaps in the database and the information needed to fill the gaps. This will determine the biological, physical and economic feasibility of using Alaska biomass as biofuels.

2. Brief description of the target audience

The target audiences will include producers and consumers, communities, agriculture and forestry businesses, industry leaders, entrepreneurs, individuals and groups concerned about the quality of the Alaska environment; as well as public resource agencies, public and private resource managers, other faculty and researchers, and undergraduate and graduate students. Our efforts were directed toward environmentally and economically sustainable development and conservation of our natural resources to benefit all citizens. Advisors and the target audience included: Alaska farmers; rural and urban communities in Alaska; and a graduate student who has been trained and is performing the catalytic upgrading work as part of his Master of Science thesis project.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	386	1500	0	0

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	0	5	5

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Output Measure 1: Workshops, demonstrations, short courses, classes, field days, and conferences organized and conducted.

Year	Actual
2012	12

Output #2

Output Measure

- Output Measure 2: Bioenergy crop varieties tested.

Year	Actual
2012	42

Output #3

Output Measure

- Output Measure 3: Bioenergy research projects conducted.

Year	Actual
2012	12

Output #4

Output Measure

- Output Measure 4: Bioenergy crop and technology publications.

Year	Actual
2012	5

Output #5

Output Measure

- Output Measure 5: Community, organizations, and one-on-one consultation concerning bio-based energy opportunities.

Year	Actual
2012	180

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Outcome Target 1: Identify crops suitable for sustainable production of bio-based energy in Alaska.
2	Outcome Target 2: Identify new value-added by-products from bio-based energy crops and woody species.
3	Outcome Target 3: Compile a forestry biomass database.
4	Outcome Target 4: Adoption of bioenergy technologies.

Outcome #1

1. Outcome Measures

Outcome Target 1: Identify crops suitable for sustainable production of bio-based energy in Alaska.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	42

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Research for alternatives to fossil fuels is urgent. Energy costs in most rural communities in Alaska are prohibitively expensive, sometimes surpassing $9/gal for diesel. This necessitates heart-wrenching choices between food and warmth. We are moving forward with research in biofuels and biomass with the goal to offset some of these high-energy costs.

What has been done
Woody species tested were Salix alaxensis, Populus balsamifera and Salix lasiandra. A trial comparing numerous grass species showed highest yields for smooth bromegrass on well-drained soils. Soil moisture as a yield determinant has been a major consideration. Unfortunately reed canarygrass, which had the highest yield, is considered an invasive species weed in Alaska.

Results
To date our results indicate biomass yields for both woody shrub and grass species are likely to be considerably lower than those reported in more temperate regions, although we expect yields to be higher in the future with improved management practices and through selection of strains for high biomass yield. However, more research will be required to understand the full potential biomass yield production and the economic feasibility of producing these crops in a subarctic environment.

4. Associated Knowledge Areas

KA Code	Knowledge Area
125	Agroforestry
131	Alternative Uses of Land
205	Plant Management Systems

Outcome #2

1. Outcome Measures

Outcome Target 2: Identify new value-added by-products from bio-based energy crops and woody species.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	12

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Using locally sourced feedstocks is of significant importance for rural communities who operate off the power grids. The development of small biorefineries able to use local resources will offset petroleum heating costs, which are often over $8/gal for diesel fuel.

What has been done
Noncommercial sources of biomass species were evaluated for their value-added properties for use in the production of liquid and gas fuels.

Results
The standard used for combustion is white oak and all Alaska species that were tested presented encouraging results. No species underperformed as lignocellulosic species.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
125	Agroforestry
131	Alternative Uses of Land
205	Plant Management Systems
511	New and Improved Non-Food Products and Processes

Outcome #3

1. **Outcome Measures**

Outcome Target 3: Compile a forestry biomass database.

Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

Outcome Target 4: Adoption of bioenergy technologies.

2. **Associated Institution Types**

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
On a yearly basis, Alaska's fishing and processing industries produce over 1 million metric tons of fish wastes. The city of Yakutat is ready to embrace technology developed through a collaboration with the Agricultural Research Service and the Agricultural and Forestry Experiment Station.

What has been done
In order to evaluate the conversion technique and establish a baseline for comparison, raw materials were analyzed for composition, proximate analysis and elemental analysis. As a result, protocols for maximizing the value were developed. A scaled down single reactor catalytic pyrolysis unit was developed so it would fit within a GC/MS instrument interface, resulting in a cost-effective technology that can be deployed from the laboratory to industry.

Results
Fish waste and coastal alder can now be used to create a functional fuel. Fish processing plants that are usually in rural settings use significant amounts of diesel for food processing. This technology has the capability to offset significant and expensive diesel fuel. Technology

Readiness Levels or TRL's have gone past Levels 3 and 4, which is the proof of concept, and are now at TRL 6 level ready for deployment.

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land
511	New and Improved Non-Food Products and Processes

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

Brief Explanation

The Wood Chemistry professor who has been heading this work is in the process of leaving the state. He will maintain a 51% commitment for at least one year. The School of Fisheries and Ocean Sciences who have been collaborating wish to continue the partnership as well as the City of Yakutat.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The only quantitative evaluation results to date are scientific results. No official extension work has begun.

Key Items of Evaluation