V(A). Planned Program (Summary)

Program # 7

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: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	0.6	0.0	2.1	0.0
Actual Paid Professional	0.5	0.0	1.8	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**
29936	0	69994	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
20731	0	74970	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
133582	0	164962	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. This research could lead to development of "best practices" management regimes and genetics of bioenergy crops. We concentrated on crops likely to be successful for remote villages, especially woody crops that will require little agricultural knowledge and simple technology.

AFES research continued to work on the 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 have been evaluated for biofuel production via supercritical liquefaction.

Two graduate student research projects are addressing the gaps in the current databases to determine the biological, physical, and economic feasibility of Alaska biomass for biofuels.

CES provided outreach to communities about biomass heating opportunities and forest management relating to biomass and provide assistance to entrepreneurs involved with sustainable energy production.

2. Brief description of the target audience

The target audiences include producers and consumers, communities, agriculture and forestry businesses, industry leaders, entrepreneurs, individuals and groups concerned about the quality of the Alaska environment, public resource agencies, public and private resource managers, other faculty and researchers, and undergraduate and graduate students. Our efforts will be directed toward environmentally and economically sustainable development and conservation of our natural resources that will benefit all citizens and help them adapt and become resilient as the climate changes. Advisors and the target audience include: Statewide Board of Advisors, State Board of Forestry, Society of American Foresters, Alaska Farm Bureau, and the Alaska Northern Forest Cooperative, CES Forest Advisory Group and the Alaska Energy Authority, USDA Natural Resource Conservation Service, the USDA Forest Service, the Alaska Department of Natural Resources, borough governments, and Alaska Native Corporations. Information on impact of fires on soil organic matter will assist the Department of Natural Resources Division of Forestry and private land owners and managers. Outreach efforts will address public education on the sustainability of biomass harvesting, new technologies and community planning.

3. How was eXtension used?

CES/AFES forester developed content for the Climate, Forests and Woodlands Community of Practice.

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	944	13300	0	700

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	0	2	2

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

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

Year	Actual
2013	13

Output #2

Output Measure

- Output 2: Bioenergy crop varieties tested.

Year	Actual
2013	17

Output #3

Output Measure

- Output 3: Bioenergy research projects conducted.

Year	Actual
2013	2

Output #4

Output Measure

- Output 4: Bioenergy crop and technology publications submitted.

Year	Actual
2013	1

Output #5

Output Measure

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

Year	Actual
2013	12

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Outcome 1: Identify crops suitable for sustainable production of bio-based energy in Alaska.
2	Outcome 2: Identify new value-added by-products from bio-based energy crops and woody species.
3	Outcome 3: Compile a forestry biomass database.
4	Outcome 4: Monitor adoption of bioenergy technologies.
5	Outcome 5: Increase community awareness about the use of biomass.

Outcome #1

1. Outcome Measures

Outcome 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
2013	2

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
Seventeen various grasses and wood species were grown and tested for application as biomass. Methods of collection, handling and planting were studied. Soil moisture was a limiting factor at this time. Weed control also was a major problem. Research found that grasses grow well in Interior Alaska and produce reasonably high biomass, however high nitrogen rates were required for high yields making it cost prohibitive. Spring harvests produced low biomass due to warm spring temperatures.

Results
Longer studies in various locations and under varying management regimes will be required for assessment of the economic feasibility of growing biomass as crops for use as an energy source in Alaska.

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

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Outcome 3: Compile a forestry biomass database.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
State legislators and foresters are seeing the benefit of the BAKLAP project, which is providing data on biomass capabilities in Interior Alaska.

What has been done
Two graduate students are researching the effects of harvesting and regeneration. One sampled 27 harvest units to study regeneration after harvest over the long term while the other counted and measured the height of 16,000 trees on 4 1/2 acres after fire disturbance. Six different treatments for regenerating white spruce were used, from leaving everything alone to planting seedlings.

Results
The data for a sustained yield program after harvest and for regeneration of white spruce after fire disturbance is now accessible. Best management practices provide guidance and clarify tradeoffs. This information will be used by state foresters to establish best management practices for sustainable harvests for biomass energy needs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

Outcome #4

1. Outcome Measures

Outcome 4: Monitor adoption of bioenergy technologies.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Biomass research for energy is needed in Alaska. Carrying out this fundamental and applied research at a microscale and cost allows Alaska specific feedstocks and catalysts to be evaluated, laying the foundation for future scale up, applications and design that is cost efficient.

What has been done
A microscale pyrolysis and catalytic upgrading reactor system for the production of pyrolysis products (bio-oil, syngas, bio-char) was created. The evaluation of bio-oils using transition metal and products from microscale pyrolysis unit have been compared with gasoline and diesel fuels based on gas chromatography analysis successfully.

Results
A review paper written by a graduate student and researcher in collaboration dealt with catalytic upgrading of pyrolysis bio-oil. This paper was directed toward research scientists and engineers working in the development of biofuels from lignocellulosic biomass within academia and in private companies worldwide. The work was also shared with representatives of the Alaska Energy Authority and used in course delivery at UAF.

4. Associated Knowledge Areas

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes

Outcome #5

1. Outcome Measures

Outcome 5: Increase community awareness about the use of biomass.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Energy costs remain high, particularly in rural communities. Biomass can offer lower-cost sources of heat in areas where the forest supply is plentiful.

What has been done
CES coordinated and hosted the 2012 Alaska Wood Energy Conference, which focused on community biomass usage. The Ketchikan conference highlighted success stories of Alaska communities that have implemented biomass projects. Other topics included the sustainability and environmental impacts of biomass harvest, new biomass technologies, biobrick fabrication and micro pellet mills. Project financing was also discussed. Some participants toured a pellet mill and a successful biomass project at the Ketchikan library.

Results
The conference was attended by 133 technical providers, facility managers, foresters and community leaders. The conference was essentially a professional development training but public awareness and interest increased as a result of media coverage. Participants who filled out evaluations cited the session content (46 percent) and networking (25 percent) as their top reasons for attending and the "most useful" sessions were on biomass use in Southeast, biomass burners and local experience with chunks, chips and pellets. The conference evaluations also provided suggested topics at the next conference, in FY14.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources

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

Due to university downsizing, the wood chemistry researcher who conducted the biofuel work has moved and the agronomy researcher who addressed biomass crops will retire soon will not be replaced in the near future. Until replacements are in place this work will be on hold.

The production of oil has decreased and the calcuation of oil revenues to the state has changed, creating funding stream losses that are negatively affecting higher education. Until revenues are replaced, research support through the state will be less than previously enjoyed.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The biomass and bio-oil research is in its infancy. Evaluation is limited to research findings held in databases and in published articles.

About one-quarter (29) of the 133 participants in the October 2012 Alaska Wood Energy Conference filled out evaluations. Of those, 29.6 percent said the content was good and 70.4 percent rated it as excellent. The conference highlighted community use of biomass. The top reasons given for attending the conference were content (46 percent) and networking (25 percent). The sessions found most "useful" were on biomass use in Southeast, providing a supply of biomass, biomass impacts, biomass burners and local experiences with chunks, chips and pellets. Participants provided suggestions for topics for upcoming wood energy conferences. Responses showed a diverse audience, which included researchers, educators, manufacturers, agency representatives and consumers of firewood. The responses, including suggested topics for presentations, were used to plan the next conference, in April 2014.

Key Items of Evaluation