V(A). Planned Program (Summary)

Program # 5

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			5%	5%
125	Agroforestry			5%	10%
201	Plant Genome, Genetics, and Genetic Mechanisms			0%	5%
202	Plant Genetic Resources			5%	10%
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants			5%	5%
205	Plant Management Systems			10%	15%
211	Insects, Mites, and Other Arthropods Affecting Plants			5%	5%
212	Pathogens and Nematodes Affecting Plants			0%	5%
216	Integrated Pest Management Systems			10%	10%
402	Engineering Systems and Equipment			15%	0%
405	Drainage and Irrigation Systems and Facilities			10%	0%
601	Economics of Agricultural Production and Farm Management			5%	10%
603	Market Economics			10%	5%
605	Natural Resource and Environmental Economics			10%	10%
607	Consumer Economics			5%	5%
	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	8.0	9.0

Actual Paid Professional	0.0	0.0	10.0	9.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Institution Name: Auburn University

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	730380	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	730380	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

2. Institution Name: Alabama A&M University

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	0	92345
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	0	167698
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

2. Institution Name: Tuskegee University

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	0	302105
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	0	289124
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research was conducted to address issues related to renewable energy using bio-based feedstocks that ultimately contribute to the relief of energy dependence on foreign sources.The goal of this program is to increase our knowledge of bioconversion of feedstocks to bioenergy and bioproducts, bioprocessing systems, biomass production, and conversion of byproducts into value-added products and to enhance understanding of the long-term sustainability of feedstock production and bioconversion systems including economics, social issues, land use policies, and energy security and the environment. Specific areas of research include, but are not limited to: alternative crops for efficient production of bioenery feedstocks, biotechnology of bioenergy crops to enhance production or to enhance its utilization as an energy source, development of agricultural practices for newly identified bioenergy crops, and technology development for bioenergy conversion. This priority is aligned with new initiatives on Bioenergy and Bioproducts Research in DOE, USDA, and several other federal agencies, and with the huge energy demands in the state and the nation.

2. Brief description of the target audience

Researchers, educators, extension personnel, community leaders, educators, 4H, youth centers, energy consumers, general public.

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	0	0	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	25	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Publications

Year	Actual
2012	25

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Development of efficient bioenergy crops
2	Increased acreage of bioenergy crops such as corn, switchgrasses, sweetpotatoes, and canola.
3	Increased percentage of bioenergy in the overall consumption of energy

Outcome #1

1. Outcome Measures

Development of efficient bioenergy crops

2. Associated Institution Types

- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Efficiency of bioenergy crops have to be evaluated

What has been done
Several white flesh sweetpotato germplasm high in dry matter have been evaluated
Studies on bamboos and Miscanthus as potential energy crops have been initiated

Results
Several high dry matter and yielding and sweetpotato germplasm has bee selected for their ethanol production potential

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
125	Agroforestry
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202	Plant Genetic Resources
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205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants

216	Integrated Pest Management Systems
402	Engineering Systems and Equipment
405	Drainage and Irrigation Systems and Facilities
601	Economics of Agricultural Production and Farm Management
603	Market Economics
605	Natural Resource and Environmental Economics
607	Consumer Economics

Outcome #2

1. **Outcome Measures**

Increased acreage of bioenergy crops such as corn, switchgrasses, sweetpotatoes, and canola.

Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

Increased percentage of bioenergy in the overall consumption of energy

Not Reporting on this Outcome Measure

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

Gas prices, national and global determination, and availability of many other types of energy sources can seriously affect the outcomes.

Continued funding is required to produce meaningful results.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Auburn University is one of the collaborating institutions on a USDA Bioenergy CAP grants. Working through this CAP project consortium, various public-public, and public-

private partnerships have been developed including:
The IBSS Partnership - The Southeastern Partnership for Integrated Biomass Supply Systems (IBSS) will reduce the risks surrounding the sustainable, reliable, and predictable supply of lignocellulosic feedstock needed for commercial biofuels production. The IBSS Partnership, which includes ArborGen, Auburn University, Ceres, North Carolina State University, the University of Georgia, and The University of Tennessee, has three overarching goals are:
• Demonstrate implementable 'real-world' solutions to the economic and environmental barriers that limit sustainable and reliable biofuels production.
• Introduce new tools and metrics for effective decision-making in site selection and regional deployment of biofuels production from lignocellulosic biomass.
• Provide credible, impactful, and integrated education, extension and outreach (E2O) programs that train the workforce needed, and inform stakeholders and policy makers with the knowledge necessary to fully enable the Southeast's biofuels industry.

At the time the IBSS partnership made their initial application to USDA-NIFA, ClearFuels provided a letter of support and became a key technology provider in the program. With the acquisition of ClearFuels by Rentech, and based on additional detailed discussions, The IBSS Partnership and Rentech are moving to strengthen the relationship, tightly integrating the IBSS sustainable biomass production and supply processes with Rentech's biomass gasification and drop-in fuels production processes.
Rentech Inc. - Rentech is a publicly traded company with a market cap in excess of $400 million. Its core business is focused on providing clean energy solutions. They own and develop technologies that enable the production of liquid fuels and renewable power from biomass. Their clean energy portfolio includes biomass gasification technology that can produce synthesis gas for production of renewable power and fuels. They own the patented Rentech Process that is based on Fischer-Tropsch chemistry capable of producing hydrocarbon mixtures. Standard refining practices are used to upgrade the hydrocarbon to diesel or jet fuels, or industrial chemicals. They are nearing the end of a DOE-funded project to design and build a 20 ton/day biomass gasifier to provide synthesis gas for the process described above.
To demonstrate the synergies created by the combination of these two alternative energy organizations, IBSS has supplied Rentech with almost 120 tons of biomass from 5 well-defined sources. This IBSS-supplied biomass includes: 1) woody biomass harvested with very efficient, low cost operations; 2) woody biomass with known genetic characteristics (pine and hybrid poplar); and, 3) switchgrass produced and harvested with advanced low-cost approaches. Rentech will process the biomass in its gasification and fuel synthesis demonstration plant in Commerce City, CO. The pilot plant processing will allow the IBSS Rentech partnership to determine the impact of different biomass sources on the operation and performance of the Rentech gasifier. Also, preliminary information on syngas composition effects on the Fischer-Tropsch reactor will be generated for these regional feedstocks. More importantly, the work will enable preliminary assessment of economic, environmental, and social sustainability aspects of large-scale biomass production for a commercially viable thermochemical conversion process.
Anticipating a successful demonstration project, the IBSS-Rentech partnership plans to conduct extended campaigns necessary to fully evaluate the sustainable environmental and social impacts of large-scale biomass production in the SE US.
Specific outcomes of the program include:
• Demonstrated performance of IBSS feedstock in the Rentech pilot plant for production of diesel and jet fuels. This could include four 60-day demonstrations on four separate IBSS feedstocks producing approximately 9000 gallons of fuel from each feedstock. (1,200 tons of IBSS feedstocks would be required for each 60-day run).
• The availability of Rentech's drop-in diesel to IBSS feedstock partners for use in their

planting, harvesting and chipping operations, as well as jet fuel for certification and demonstration by a major airline and/or a jet engine manufacturer.
• Information for a detailed assessment of the economic, environmental, and social sustainability challenges of large-scale biomass production for specific sites in TN, AL, and NC. These sites will include at least two sites where there is some infrastructure in place, e.g., under capacity wood products or pulp and paper mills; low value, degraded lands that may be suited for low cost biomass production, or other unique attributes.
• The IBSS-Rentech partnership will advance additional education, Extension and outreach efforts in these local communities to assess their viability as a biomass to liquid fuels host site. The first group of SEED Fellows from Auburn and Tuskegee Universities recently spent 10 days at Rentech's BioEnergy Center of Excellence learning about the Rentech processes and experiencing technology development environment, providing a foundation for further work.
• Upon conducting preliminary site evaluations, Rentech will complete scoping studies for 1 to 3 sites including initial economics for a commercial process. This phase will also offer an opportunity for one-to-three graduate students from the IBSS institutions to participate in a Rentech internship.

1. Institutional Uniqueness (Include a description of the unique or novel features of the project, the expertise of the PI(s), and the facilities/equipment available to support the project, all of which should demonstrate that UT is the logical location for this work):
This multi-institutional project involves researchers and outreach specialists from academic, government, and industry organizations across the southeastern United States. It leverages significant prior investment and extensive expertise in the area of alternative liquid fuels from cellulosic biomass. The IBSS Partnership is uniquely qualified to accelerate the deployment of a drop-in fuels industry in the region.

Key Items of Evaluation

The IBSS Partnership is currently operating under a grant funded by USDA's National Institute of Food and Agriculture. The grant was independently peer-review and awarded a total of $15 million in funding over 5 years; however, the total funding was $30 million less than requested for the complete project.
Apparently, bioenergy research depends on continued funding. Its long term impact will depend on many factors, in particular the gas prices, and availability and economics of many different types of energy sources such as wind, solar, natural gas, etc.