

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Sustainable Energy including Biotechnology

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
202	Plant Genetic Resources	15%	0%	15%	20%
205	Plant Management Systems	15%	0%	20%	20%
401	Structures, Facilities, and General Purpose Farm Supplies	5%	0%	5%	0%
402	Engineering Systems and Equipment	20%	0%	20%	20%
403	Waste Disposal, Recycling, and Reuse	20%	0%	15%	20%
404	Instrumentation and Control Systems	10%	0%	10%	0%
511	New and Improved Non-Food Products and Processes	15%	0%	15%	20%
	Total	100%	0%	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	7.0	2.0	10.0	5.0
Actual Paid Professional	9.0	0.0	9.0	4.6
Actual Volunteer	1.0	0.0	0.0	7.7

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

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
147508	0	156323	607851
1862 Matching	1890 Matching	1862 Matching	1890 Matching
147508	0	156323	347881
1862 All Other	1890 All Other	1862 All Other	1890 All Other
572003	0	1141426	2386188

V(D). Planned Program (Activity)

1. Brief description of the Activity

- Developing productive efficient systems to profitably produce a variety of crop and forestry based substrates for biofuels production
- Developing engineering solutions and systems to efficiently convert raw materials into useable fuels
- Exploit bioprocessing systems to produce a variety of compounds that might have utility in processing and manufacturing processes
- Advance or knowledge of energy use and conservation in human, agricultural, animal and processing environments
- Communicate solutions and systems to users through extension education and demonstration activities
- Further study of cattails as a feedstock for biofuels

2. Brief description of the target audience

Scientists, commercial and limited resource farmers, regulatory entities, homeowners, general public, agribusinesses

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1000	5000	0	0

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

Patent Applications Submitted

Year: 2013
 Actual: 2

Patents listed

Process for Conversion of Biomass to Fuel Appl # 13/709,878 US, Malaysia

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	5	48	53

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Studies on producing agricultural and forestry substrates for biofuel production

Year	Actual
2013	10

Output #2

Output Measure

- Studies on engineering conversion processes for biofuels and other components

Year	Actual
2013	16

Output #3

Output Measure

- Educating homeowners, growers and processors through workshops and other group educational approaches on sustainable energy topics

Year	Actual
2013	182

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	New crops or other biofuels substrates identified
2	New bioprocessing technologies developed
3	New bioproducts identified
4	Number of households improving energy conservation measures
5	Installation of energy saving strategies on animal and crop production facilities

Outcome #1

1. Outcome Measures

New crops or other biofuels substrates identified

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Nutrient management for optimal Giant Miscanthus production for uses as a feedstock source for biofuel.

What has been done

A field experiment was conducted by NC A&T researchers with 5 fertilizer treatments (five rates of nitrogen were: 0, 60, 120, 180 and 240 lbs/acre) in 4 replications; data collected and analyzed.

Results

Data analysis showed that the fertilizer treatment T3 with 120 kg N/ha produced significantly better growth results than the other treatment conditions.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
205	Plant Management Systems
511	New and Improved Non-Food Products and Processes

Outcome #2

1. Outcome Measures

New bioprocessing technologies developed

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	2

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Current animal waste management technologies emphasize waste treatment rather than waste utilization.

What has been done

An advanced biological system is being developed by NC A&T scientists to efficiently and economically treat swine wastes and recover materials and energy from the wastes. Researchers have optimized the microalgal process for bioremediation of swine wastewater, established a novel biological process to directly make ethanol and acetic acid from wet microalgae, and developed a novel thermochemical process to make biodiesel from wet microalgae.

Results

(1) A microalgal process for bioremediation of swine wastewater and production of multi-products; (2) a novel fermentation process to produce bioethanol and acetic acid from fresh microalgae; and (3) a novel hydrothermal process to extract lipid and produce biodiesel from wet microalgae.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
511	New and Improved Non-Food Products and Processes

Outcome #3

1. Outcome Measures

New bioproducts identified

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	4

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

There is a need to develop and evaluate low-capital cost, low-maintenance cost and highly scalable cultivation systems for year-round production of algae.

What has been done

A process has been developed by NC A&T for microalgal strain isolation, screening and identification of algae with good biofuel production potential.

Results

(1) A newly identified microalgal strain, *Chlamydomonas debaryana* AT24, with high lipid production and bioremediation; (2) two scaled-up algal photobioreactors were constructed.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse
511	New and Improved Non-Food Products and Processes

Outcome #4

1. Outcome Measures

Number of households improving energy conservation measures

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	577

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Many limited-resource individuals are poorly informed or unaware of the advantages of energy efficient products for their homes.

What has been done

Cooperative Extension in Guilford County partnered with the High Point Housing Authority by providing eight energy conservation programs in 2013 to address this need.

Results

Seventy-seven percent of the participants increased their knowledge, benefited from various energy conservation strategies to help them save energy and money, and used at least one recommended energy technique. Nearly half of the participants reported installing Energy Star appliances/products in their homes. Statewide, 577 program participants reported using energy conserving BMPs to reduce energy consumption in homes and other structures.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment

Outcome #5

1. Outcome Measures

Installation of energy saving strategies on animal and crop production facilities

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	10

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Curing fuel represents one of the largest expenses in flue-cured tobacco production.

What has been done

Cooperative Extension in Wilson County has addressed this issue by promoting energy efficiency in curing tobacco through the use of automatic ventilation controls, additional insulation, replacing seals, and other methods.

Results

Survey results of tobacco growers in 2013 indicated that there are 662 automatic ventilation controllers in use in the county, which represents 76 percent of the tobacco curing barns. There were 96 new automatic ventilation controllers installed in 2013. These new controllers that were installed helped growers save an additional 36,864 gallons of LP gas this curing season. At an average price of \$1.40 per gallon, these efforts saved Wilson County tobacco growers \$51,610 in fuel. On a broader scale, the total energy performance of three different make of new curing barns at the same on-farm location was evaluated during the 2013 season. Instrumentation was implemented to monitor fuel and electrical energy consumption each cure. Based on the results, if a grower can increase energy efficiency with the purchase of a new barn from a season average of 10 lb/gal LP to 14 lb/gal LP or higher, the result is a cost savings of approximately 3¢ or more per pound cured based on 2013 fuel prices.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment

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

Economic and environmental considerations related to energy use, sources and conservation continue to present challenges to both producers and users of energy. North Carolina's bioenergy research efforts have focused on developing biomass sources and processes suitable for capturing biofuels from those materials. That has been a slow process, even though plant breeders and agronomists continue to work toward prolific and productive plants to produce biomass. Energy conservation in homes and business continues to get some emphasis, especially as it relates to solar energy. And some of our research and engineering efforts have targeted energy use in both cooling and heating livestock and poultry buildings, with some success with solar approaches for heat and geothermal processes for cooling. Considerable opportunities may exist for continued impact in these areas.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Our research support base is modest, but nevertheless, our scientists and extension workers in this area have demonstrated the capacity to acquire external grants, publish their work in peer reviewed journals, and generate new processes and products. Plant breeders and agronomists have been successful in developing new cultivars of biomass producing grasses for potential biofuels production. Process engineers have made progress in solving some of the challenges to producing cellulosic ethanol, though commercial applications are not in operation in the state. One recent challenge was defunding by the state of the North Carolina Biofuels Center, which provided significant funding for biofuels research, although a portion of the funding was restored through another agency. Continued opportunities may exist for exploiting this area, particularly in research of producing biomass and discovering processes to make production of cellulosic ethanol efficient..

Key Items of Evaluation

Tools to fully capture accomplishments in this field of science to be revised as we have indicated in other program areas.