V(A). Planned Program (Summary)

Program # 9

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
605	Natural Resource and Environmental Economics	100%		100%	
	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	4.0	0.0	2.0	0.0
Actual Paid Professional	4.3	0.0	1.5	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**
36016	0	69659	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
528212	0	325543	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1077	0	6673	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

- Perform experiments to investigate renewable energy production.

- Develop methodologies and scientifically sound alternatives to fossil fuels
- Educate homeowners, business owners, farmers and agri-related businesses, youth and families about conservation and efficiency practices related to energy use.
- Provide education and training to enhance bio energy related job development and careers.

2. Brief description of the target audience

- University faculty, staff and students
- School aged youth
- Families
- Homeowners
- Farmers
- Agri-businesses
- State agencies and organizations
- Industry partners
- Small businesses
- Entrepernuers
- Policy and decision makers

3. How was eXtension used?

Farn Energy CoP was used as a resource for faculty staff and clientele.

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1826	1172	0	0

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	7	7

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- -Scientific publications and patents produced -Participants reach through direct and indeirect education -New methodologies and technologies developed

Year	Actual
2013	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Short Term - Increase knowledge, energy efficiency technologies and conservation practices related to energy use. Explore research strategies to replace fossil fuel consumption.
2	Medium Term - Participants in direct and indirect educational methods will adopt practices to conserve energy use and reliance on fossil fuels. Business owners will create and maintain green jobs/careers as a result of bioenergy development. Newly developed plants and technologies will be adopted to enhance energy independence.
3	Long Term - Fossil fuel consumption will be replaced with biofuels. Economic development will be enhanced through an increase of jobs and careers as a result of bioenergy development. Environment quality enhanced as a result of sustainable biofuel production and utilization.
4	Medium Term - Microbial Processes in Bioenvironmental Engineering: Bioremediation, Bioaerosols and Bioenergy -Participants in direct and indirect educational methods will adopt practices to conserve energy use and reliance on fossil fuels. Business owners will create and maintain green jobs/careers as a result of bioenergy development. Newly developed plants and technologies will be adopted to enhance energy independence.
5	Medium Term - The Science and Engineering for a Biobased Industry and Economy - Participants in direct and indirect educational methods will adopt practices to conserve energy use and reliance on fossil fuels. Business owners will create and maintain green jobs/careers as a result of bioenergy development. Newly developed plants and technologies will be adopted to enhance energy independence.

Outcome #1

1. **Outcome Measures**

Short Term - Increase knowledge, energy efficiency technologies and conservation practices related to energy use. Explore research strategies to replace fossil fuel consumption.

Not Reporting on this Outcome Measure

Outcome #2

1. **Outcome Measures**

Medium Term - Participants in direct and indirect educational methods will adopt practices to conserve energy use and reliance on fossil fuels. Business owners will create and maintain green jobs/careers as a result of bioenergy development. Newly developed plants and technologies will be adopted to enhance energy independence.

2. **Associated Institution Types**

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Reducing Greenhouse Energy Use by Investigating Current and Alternative Technologies

Controlled environment plant production systems (greenhouses and growth chambers) are used worldwide to produce high quality plant material (produce, floriculture, and nursery crops). Rising energy prices have made a significant impact on the profitability of many greenhouse operations. Engineering information and solutions can help growers reduce energy use and operating costs.

What has been done
Research was conducted on an alternative energy project originally funded by the New Jersey Department of Environmental Protection (landfill gas fired microturbines used for heat and power production at the NJ EcoComplex greenhouse in Bordentown, NJ). A graduate student completed his Ph.D. Two are ongoing projects that are collaborations with several other educational institutions from across the country. One investigates the use of light emitting diode (LED) lighting systems for photoperiodic and supplemental lighting of vegetable and flowering crops. The other

aims to develop an online (undergraduate) course consisting of individual lectures (modules) focused on engineering and crop production issues that can be integrated into a variety of courses related to controlled environment plant production.

Results
Greenhouse energy use research has resulted in new information that has been communicated with the industry through Extension bulletins, fact sheets, presentations and trade magazine articles. Growers who implemented the information resulting from the research and the various presentations and publications have been able to realize energy savings between 5 and 30%. Updating and disseminating energy conservation information is helping to further reduce dependence on scarce fossil fuel resources. Incorporation of heat pump technology to take advantage of heat storage to provide both heating and cooling can reduce total energy requirements.

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics

Outcome #3

1. Outcome Measures

Long Term - Fossil fuel consumption will be replaced with biofuels. Economic development will be enhanced through an increase of jobs and careers as a result of bioenergy development. Environment quality enhanced as a result of sustainable biofuel production and utilization.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics

Outcome #4

1. Outcome Measures

Medium Term - Microbial Processes in Bioenvironmental Engineering: Bioremediation, Bioaerosols and Bioenergy -Participants in direct and indirect educational methods will adopt practices to conserve energy use and reliance on fossil fuels. Business owners will create and maintain green jobs/careers as a result of bioenergy development. Newly developed plants and technologies will be adopted to enhance energy independence.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Microbial Processes in Bioenvironmental Engineering: Bioremediation, Bioaerosols and Bioenergy

Understanding and/or controlling microbial communities across a range of environments can allow better prediction of environmental outcomes, restore polluted environments and achieve a more sustainable environment.

What has been done
NJAES researcher continued work investigating microorganisms in natural and engineered systems whose activities have an impact on ecological and human health and environmental sustainability. The research activities associated with this project are focused in three major thrust areas in the field of bioenvironmental engineering: (1) Bioremediation, (2) Bioaerosols, and (3) Bioenergy.

Results
Outcomes and results of this research will benefit residents of New Jersey, the USA and the world by providing new information about the function and identity of microorganisms involved in atmospheric processes, environmental restoration and sustainable energy production. Specifically, during this reporting period we published in the journal Biomass and Bioenergy a theoretical model showing that the ammonia that is released by microbes during anaerobic digestion of wastes can be harvested and converted to hydrogen
(a biofuel) in a manner that improves the energy balance of the digestion process, which normally produces only methane as a fuel. This work established scientific and engineering parameters for the production of the biofuels methane and hydrogen from diverse waste biomass at different carbon to nitrogen ratios. This finding has broad implications for changing the way wastes ? human waste, municipal solid waste, food waste, or animal wastes?might be handled for energy production in the future. This work made a substantial contribution to the quest for alternative energy.

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics

Outcome #5

1. Outcome Measures

Medium Term - The Science and Engineering for a Biobased Industry and Economy - Participants in direct and indirect educational methods will adopt practices to conserve energy use and reliance on fossil fuels. Business owners will create and maintain green jobs/careers as a result of bioenergy development. Newly developed plants and technologies will be adopted to enhance energy independence.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The Science and Engineering for a Biobased Industry and Economy

The U.S. must drastically reduce its dependence on petroleum. This is not the fetish of a small proportion of the population; the U.S. society as a whole recognizes the need to reduce its dependence on petroleum as a source of fuels, chemicals and other materials. Meeting food production needs are staggering. It requires 100 fold more energy to sustain the current U.S. standard of living, than it does to nourish our bodies. For example, the U.S. consumes 100 quadrillion Btu annually for food production. Of the 100 quadrillion Btu/year used, energy necessary to sustain our population is 1.2 quadrillion Btu. The other portion of the 100 quadrillion Btu is accounted by agricultural and industrial production, liquid transportation fuels, heating and lighting needs. This means that supporting a global population of 10 billion at the current standard of living of the U.S. requires 4,000 quadrillion Btu annually worldwide. These demands cannot be sustained with the current technology base, and alternative and sustainable technologies must be developed and refined. At the same time, increasing reliance on bio-based energy technologies creates competing demands for land currently used for food production, with consequences for food prices.

What has been done

The research assessed the economic and environmental implications from the introduction of biobased products such as agricultural waste, food waste and algae. It focused on the impacts of the introduction of corn-based ethanol on the petroleum industry, including home heating fuels, residual fuels and bitumen (in addition to gasoline and diesel products). Because many of these petroleum products have significantly higher carbon content per gigajoule than gasoline and diesel, this can substantially impact the lifecycle analysis of biofuels.

Results

The introduction of biofuels can, in principle, reduce the GHG emissions of transportation fuels by 46-70%. The socioeconomic impact of biomass depends to a large extent on understanding and managing the process of adoption of viable technologies. In NJAES research, a conceptual and empirical framework was developed, that explains adoption of agricultural AD technologies while incorporating interdependencies at various production and consumption levels. When evaluating the environmental implications. The lifecycle analysis was expanded to include emissions that occur away from the site of final production or consumption. The insight developed was disseminated to the community via conferences, publications in peer-reviewed journals, conference proceedings, and book chapters. An outreach component was also developed to educate local administration in NJ of the benefits of using waste to energy methods.

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Other (Consumption Practices)

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

N NJAES research and extension outcomes related to this planned program were evaluated utilizing a variety of evaluation methods appropriate for each initiative to determine effectiveness on both a qualitative and quantitative level. For KASA and practice change we included the measurement of knowledge gained as measured by pre/post Likert-scale assessments. Surveys were used to measure increase in skills acquired, behavior change and practice adoption. For process evaluation we focused on program delivery, participation, relevance and timeliness. Data was collected at appropriate times for each initiative that supports this planned program. IRB approved evaluation instruments were used to collect research and extension data. Data analyses and comparisons relevant to basic and applied research and demonstration were collected and analyzed and reported utilizing a variety of data collection methods appropriate to each research question.

The major goal of evaluating is the demonstration of social, economic, behavior and environmental changes in conditions that contribute to improved quality of life as a result of participation in programs and benefits of research solutions. See state defined outcomes for detailed results of each initiative.

Key Items of Evaluation

None to report.