

**V(A). Planned Program (Summary)**

**Program # 8**

**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	15%	15%	15%	15%
201	Plant Genome, Genetics, and Genetic Mechanisms	25%	25%	25%	25%
205	Plant Management Systems	25%	25%	25%	25%
403	Waste Disposal, Recycling, and Reuse	10%	10%	10%	10%
601	Economics of Agricultural Production and Farm Management	15%	15%	15%	15%
605	Natural Resource and Environmental Economics	5%	5%	5%	5%
903	Communication, Education, and Information Delivery	5%	5%	5%	5%
	<b>Total</b>	100%	100%	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	1.5	0.5	1.5	0.5
Actual Paid Professional	1.6	0.4	1.6	0.1
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
16438	0	1226	170496
1862 Matching	1890 Matching	1862 Matching	1890 Matching
7798	0	1540	170496
1862 All Other	1890 All Other	1862 All Other	1890 All Other
65523	0	87072	156706

## V(D). Planned Program (Activity)

### 1. Brief description of the Activity

Research and extension programs will focus on: (1) Plant molecular biology studies with bioenergy crops. Research is now underway to identify small RNAs (short stretches of ribonucleic acid) related to stresses such as drought, temperature and nutrient deprivation and then correlate them to the emerging genetic code of *Brachypodium distachyon*, thus enhancing the plant's value as a functional genomic model for energy crops and temperate grasses. *Brachypodium* has many advantages for carrying out functional studies in the laboratory compared to energy crops such as switchgrass and *Miscanthus*, and temperate grasses that are important sources of food like wheat. (2) Plant and soil management systems for existing (e.g., corn) and newly emerging bioenergy crops (e.g., barley, sweet sorghum). While just beginning, we expect this research to address many aspects of biomass/bioenergy crop production including genetics and basic plant biology studies, especially of plant-microbe interactions that enhance growth and water use efficiency of biomass crops; production and agronomic management practices for current (barley) and innovative new cropping systems (e.g., sweet sorghum, switchgrass, poplars); equipment changes and needs for new biomass crops, especially related to planting and harvesting; improving nutrient management BMPs (reduces energy consumption for fertilizer production); mitigating potential environmental impacts of biomass energy crops and assessing their impacts on water quality relative to current cropping systems; and addressing economic, social and cultural issues related to changing from long-standing to new cropping systems. (3) Bioenergy production systems and re-use of byproducts: evaluation of farm-scale anaerobic digestion for bioenergy production, using animal manures, cover crops (e.g., forage radishes), and other by-products; evaluation of gasification/pyrolysis technologies, especially those using poultry litter. Related studies will focus on finding beneficial agricultural uses for the by-products of energy production such as biochar from litters and distillers' grains.

### 2. Brief description of the target audience

For animal agriculture, the targeted audience is broad, given the impacts of energy costs on all aspects of animal production and includes poultry integrators, growers, breeders, trade groups and allied industries; dairy and beef producers; livestock commodity groups; forage producers, equine owners, producers and interest groups; for crop and soils related research and extension programs, the audience includes existing and prospective grain crop producers, mixed (animal and crop production, e.g., dairy, horse) farms, crop commodity groups and trade associations, the "green industry" (e.g., horticulture, nurseries, landscapers), and certified crop advisors; for natural resource and ecology programs, private and not-for-profit organizations managing forests, wetlands, marshes, and other natural resource areas; state and federal agencies responsible for wildlife, forestry management, and coastal ecosystems; for our

resource economic programs the audience includes farmers, landowners, policy-makers and state and federal agencies directly related to climate change policy (Delaware Development Office; Land Use Planning and Preservation; Department of Agriculture; Department of Health and Human Services; Department of Natural Resources & Environmental Control; Department of Transportation; Economic Development Office, USDA, NRCS, USEPA). For all programs, Delaware State Government and local legislators, homeowner associations, educators, community leaders, utility managers, retail stores distributing Energy Star products, fleet managers, building industry, Delaware Clean State Program members, Delaware Farm Bureau leaders, federal-state-local agriculture businesses, state and federal agencies; federal research laboratories; peer scientists in the U.S. and international colleagues, K-12 teachers, and environmental and community groups.

**3. How was eXtension used?**

In 2013 UD and DSU eXtension Institutional Team comprised of faculty and staff from across all planned program areas completed the following:

- Training on how to incorporate eXtension into grants
- Connected the Extension website with eXtension.org
- Implemented Ask an Expert throughout the state. Staff and faculty engaged in the eXtension Learn feature
- Faculty and staff increased participation in the Communities of Practice (CoP)-DE is represented by 81 eXtension members in 43 of the 73 approved CoP

We trained 40 "experts" to use the Ask an Expert system and have fielded over 295 questions in the past 9 months. (84% of those questions were answered by Delaware experts). For Planned Program #8, Delaware eXtension involvement includes participation in the CoP on Urban Forestry and Energy Conservation as well as Wood Energy and wood products. Information from eXtension is incorporated into program fact sheets and handouts as well as presentations.

**V(E). Planned Program (Outputs)**

**1. Standard output measures**

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
<b>Actual</b>	1356	533	214	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**

<b>2013</b>	<b>Extension</b>	<b>Research</b>	<b>Total</b>
<b>Actual</b>	0	9	9

**V(F). State Defined Outputs**

**Output Target**

**Output #1**

**Output Measure**

- Number of Competitive Grants Submitted

<b>Year</b>	<b>Actual</b>
2013	12

**Output #2**

**Output Measure**

- Number of Competitive Grants Awarded

<b>Year</b>	<b>Actual</b>
2013	7

**Output #3**

**Output Measure**

- Number of Research Projects Completed

<b>Year</b>	<b>Actual</b>
2013	12

**Output #4**

**Output Measure**

- Number of Undergraduate Researchers

<b>Year</b>	<b>Actual</b>
2013	15

**Output #5**

**Output Measure**

- Number of M.S. Graduate Students

<b>Year</b>	<b>Actual</b>
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2013 8

**Output #6**

**Output Measure**

- Number of Ph.D. Graduate Students

<b>Year</b>	<b>Actual</b>
2013	2

**Output #7**

**Output Measure**

- Number of Post-doctoral Research Associates

<b>Year</b>	<b>Actual</b>
2013	3

**Output #8**

**Output Measure**

- Number of Refereed Journal Articles

<b>Year</b>	<b>Actual</b>
2013	9

**Output #9**

**Output Measure**

- Number of Books and Book Chapters

<b>Year</b>	<b>Actual</b>
2013	1

**Output #10**

**Output Measure**

- Number of Technical Reports

<b>Year</b>	<b>Actual</b>
2013	2

**Output #11**

**Output Measure**

- Number of Extension Bulletins and Factsheets

<b>Year</b>	<b>Actual</b>
2013	0

**Output #12**

**Output Measure**

- Number of Invited Presentations

<b>Year</b>	<b>Actual</b>
2013	11

**Output #13**

**Output Measure**

- Number of Volunteered Presentations

<b>Year</b>	<b>Actual</b>
2013	12

**Output #14**

**Output Measure**

- Number of Websites Established

<b>Year</b>	<b>Actual</b>
2013	1

**Output #15**

**Output Measure**

- Number of Workshops Conducted

<b>Year</b>	<b>Actual</b>
2013	19

**V(G). State Defined Outcomes**

**V. State Defined Outcomes Table of Content**

O. No.	OUTCOME NAME
1	Increased knowledge base on the part of the Delaware agricultural and natural resource community of the options to increase energy use efficiency and develop alternative energy sources that are more sustainable.
2	Greater adoption of solar energy and biomass energy technologies by animal agriculture to help reduce the operating costs of poultry and dairy production in particular.
3	Widespread use of energy conservation practices by Delaware farmers engaged in production of agronomic and vegetable crops, as a result of extension education programming.
4	A more energy-efficient poultry industry that is able to utilize alternative sources of energy cost-effectively, particularly solar energy, energy derived from by-products of poultry production, and wind energy.
5	Incorporation of sustainable energy technologies into other major agricultural technology systems, such as irrigation and major equipment used for production, harvesting, and processing of agronomic and vegetable crops.

### **Outcome #1**

#### **1. Outcome Measures**

Increased knowledge base on the part of the Delaware agricultural and natural resource community of the options to increase energy use efficiency and develop alternative energy sources that are more sustainable.

Not Reporting on this Outcome Measure

### **Outcome #2**

#### **1. Outcome Measures**

Greater adoption of solar energy and biomass energy technologies by animal agriculture to help reduce the operating costs of poultry and dairy production in particular.

Not Reporting on this Outcome Measure

### **Outcome #3**

#### **1. Outcome Measures**

Widespread use of energy conservation practices by Delaware farmers engaged in production of agronomic and vegetable crops, as a result of extension education programming.

#### **2. Associated Institution Types**

- 1862 Extension
- 1862 Research

#### **3a. Outcome Type:**

Change in Action Outcome Measure

#### **3b. Quantitative Outcome**

<b>Year</b>	<b>Actual</b>
2013	0

#### **3c. Qualitative Outcome or Impact Statement**

##### **Issue (Who cares and Why)**

Poultry growers, integrating companies, private and government energy organizations, public and not for profits concerned about increasing energy use efficiency in agricultural systems

##### **What has been done**

New, more energy efficient lighting systems have been developed and tested in research and on commercial broiler houses. The new systems use light emitting diodes (LEDs) that have led to

>50% decreases in energy use.

### **Results**

On-farm studies have shown that new LED lighting systems for broiler houses can pay for themselves in less than a year through savings in energy costs. Comparisons of different types of LED systems now on the market, in ongoing research studies, point to the importance of careful evaluation of the pros and cons of various options prior to selection and installation.

### **4. Associated Knowledge Areas**

<b>KA Code</b>	<b>Knowledge Area</b>
102	Soil, Plant, Water, Nutrient Relationships
201	Plant Genome, Genetics, and Genetic Mechanisms
205	Plant Management Systems
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics
903	Communication, Education, and Information Delivery

### **Outcome #4**

#### **1. Outcome Measures**

A more energy-efficient poultry industry that is able to utilize alternative sources of energy cost-effectively, particularly solar energy, energy derived from by-products of poultry production, and wind energy.

Not Reporting on this Outcome Measure

### **Outcome #5**

#### **1. Outcome Measures**

Incorporation of sustainable energy technologies into other major agricultural technology systems, such as irrigation and major equipment used for production, harvesting, and processing of agronomic and vegetable crops.

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**

{No Data Entered}

## **V(I). Planned Program (Evaluation Studies)**

### **Evaluation Results**

Evaluation of the Sustainable Energy planned program indicates that this area is still not a major research or extension effort at the present time. However, the emergence of the multi-disciplinary, university-wide Delaware Energy Institute is expected to foster greater basic and applied research on sustainable energy in the future. Areas of particular interest and strength will most likely be in plan molecular biology, as related to the identification and characterization of plants most suitable for use in new technologies to generate biofuels from agricultural crops. Extension programs in the near term will most likely continue to focus on improving energy use efficiency by Delaware's large poultry industry and by farmers using irrigation to produce grain crops. In FY13, there were 7 grants awarded to support the efforts of 28 graduate students, post-docs, and undergraduate researchers who conducted studies in areas that would be affected by expected changes in future climates. This led to 9 refereed journal articles, 26 invited and volunteered presentations, and 19 workshops in areas related to various aspects of the development and implementation of programs focused on alternative energy sources. Our evaluations suggest that the agricultural and environmental communities are interested in energy conservation and alternative sources of energy (solar, wind, bioenergy) and that industry, state and federal agencies and advisory are also interested in continued multi-disciplinary efforts on the development of plant-based renewable feedstocks for biofuels, which we plan to pursue through the University of Delaware Energy Institute in the future.

### **Key Items of Evaluation**

There are no major items requiring NIFA attention at this time, other than the continued need for more federal funding for research and extension programs that will support cross-disciplinary efforts to educate our constituents about energy use and conservation and support basic and applied research to identify bioenergy sources that fit Delaware agriculture.