

V(A). Planned Program (Summary)**Program # 3****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	10%		10%	
131	Alternative Uses of Land	5%		5%	
201	Plant Genome, Genetics, and Genetic Mechanisms	10%		10%	
204	Plant Product Quality and Utility (Preharvest)	15%		15%	
213	Weeds Affecting Plants	5%		5%	
216	Integrated Pest Management Systems	5%		5%	
402	Engineering Systems and Equipment	10%		10%	
511	New and Improved Non-Food Products and Processes	10%		10%	
605	Natural Resource and Environmental Economics	20%		20%	
610	Domestic Policy Analysis	10%		10%	
	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	10.5	0.0	36.6	0.0
Actual Paid Professional	5.4	0.0	22.4	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
1005144	0	543988	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1577802	0	2544594	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
258177	0	1073115	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

- Conduct meetings, conferences, workshops, seminars
- Conduct research projects
- Publish research and extension publications
- Publish newsletters
- Establish web sites
- Organize field days and demonstrations
- Consultations
- Work with mass media

2. Brief description of the target audience

- Producers
- Consumers
- Youth
- Professionals related to energy
- Agribusiness
- Elected officials and public policy decision makers

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	5217	12731	2157	250

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

Year: 2012
 Actual: 5

Patents listed

8216644, 8118582, 8137418, 8070834, 8118582

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	59	59

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Extension publications written, new or revised

Year	Actual
2012	9

Output #2

Output Measure

- Number of research publications

Year	Actual
2012	59

Output #3

Output Measure

- Number of research projects

Year	Actual
2012	48

Output #4

Output Measure

- Number of consultations

Year	Actual
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2012

202

Output #5

Output Measure

- Number of educational workshops or seminars conducted

Year

Actual

2012

86

Output #6

Output Measure

- Number of volunteers
Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of energy producers, farmers, and consumers who increase their knowledge of the technical and economic implications of increased use of Indiana produced corn and soybeans in bio-fuels
2	Number of technologies developed and disseminated that will increase the efficiency of bio-fuel production
3	Number of participants who increased their knowledge of policy issues related to sustainable energy
4	Number of research-based studies, publicaitons, and reports for policy organization members and legislators on sustainable energy
5	Number of tools developed to improve agricultural productivity

Outcome #1

1. Outcome Measures

Number of energy producers, farmers, and consumers who increase their knowledge of the technical and economic implications of increased use of Indiana produced corn and soybeans in bio-fuels

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Number of technologies developed and disseminated that will increase the efficiency of bio-fuel production

2. Associated Institution Types

- 1862 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)

One of the major barriers to using biomass for products such as ethanol is the breakdown of lignin or plant cell walls to get access to the sugars. Its fairly common knowledge that termites can digest wood (cellulose) but the process by which they do this has not been understood.

Researchers exploring the digestion mechanism for degrading the cellulose in termite gut believe that process can have a significant impact on biofuel development.

What has been done

In most animal and human digestion, the enzymes in gut digestion require a bacteria to be effective. The team created synthetic enzymes based on termite digestion and learned that these synthetic enzymes can work mostly without bacteria to release sugars from biomass feedstock conversion process.

Results

This basic research shows that synthetic termite gut enzymes have the potential to more effectively convert agricultural and forest biomass into useful materials that include ethanol (from fermented sugars) and fossil fuel additives (from lignin-derived hydrocarbons). Two provisional

patents were submitted and/or appended to in 2012 and one of which was licensed by industry. The patented technology has the potential to provide licensees competitive advantages in biofuel production.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
402	Engineering Systems and Equipment
511	New and Improved Non-Food Products and Processes
605	Natural Resource and Environmental Economics

Outcome #3

1. Outcome Measures

Number of participants who increased their knowledge of policy issues related to sustainable energy

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Number of research-based studies, publications, and reports for policy organization members and legislators on sustainable energy

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Number of tools developed to improve agricultural productivity

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
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2012

0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The majority of tools and machines used in agricultural settings use non-renewable fossil fuel. Purdue is working to develop new tools, systems and sensors that improve the efficiency and reliability of machines used on-road, off-road, in agricultural and food processing applications.

What has been done

In 2012, new computer tools (sensors and systems) were developed that enabled rapid simulation, prototyping and optimization of innovative solutions, and the new systems increase the efficiency, productivity and reliability of machines used in agricultural applications.

Results

This research has produced several sensors, some of which are in the process of being commercialized, multi-domain coupled simulation of components and systems plus experimental results for a new digitally controlled four quadrant pump motor. A new high performance valve is also under development which would improve efficiency of off-road vehicles and more effective use of biofuels. Two patents have been issued (U.S. Patent Application 20120186659 Filed on January 24, 2012. Published on July 26, 2012 and U.S. Patent Application 20120233997 Filed on September 29, 2010. Published on September 20, 2012) and a provisional patent filed (Newell, B., Krutz, G., Electroactive Sealing. Provisional Patent March 2012).

4. Associated Knowledge Areas

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

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

V(I). Planned Program (Evaluation Studies)

Evaluation Results

- Outcome 2 - lab study - termite gut enzymes to break down lignin
- Outcome 5 - simulation and field study - efficiency, productivity and reliability of machines in agricultural applications

Key Items of Evaluation

- Outcome 2 - 2 provisional patents on technology for lignocellulose-digesting organism (termite) to digest plant biomass
- Outcome 5 - 2 patents, commercialization, - several sensors, digitally controlled four quadrant pump motor and high performance valve