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
205	Plant Management Systems	5%		5%	
402	Engineering Systems and Equipment	20%		20%	
404	Instrumentation and Control Systems	10%		10%	
511	New and Improved Non-Food Products and Processes	10%		10%	
512	Quality Maintenance in Storing and Marketing Non-Food Products	20%		20%	
601	Economics of Agricultural Production and Farm Management	15%		15%	
604	Marketing and Distribution Practices	20%		20%	
	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	3.0	0.0	2.6	0.0
Actual Paid Professional	3.0	0.0	2.6	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**
112000	0	102000	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
168000	0	153000	0
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

1) Conduct research on processing, densifing, storage, and transportation of biomass.
2) Conduct economic analyses of biomass sources for energy production.
3) Develop market quality and testing standards, including supporting infrastrature.
4) Assist growers in new producing regions with business organization, technology adoption, and market development, and formation of risk management strategies.
5) Provide educational materials and programming on production, economics, and policy analysis to decision makers, growers, and industry personnel.

2. Brief description of the target audience

- Farmers
- Policy makers
- Biomass processors
- Equipment manufacturers

3. How was eXtension used?

The Ask an Expert feature of eXtension was 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	500	1000	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	2	4	6

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- {No Data Entered}

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of growers and industry personnel who use research-based economic analyses when they assess biomass/energy beet contracts; rely on densification technologies to collect, store and transport biomass/energy beets; and employ risk management strategies when they develop their business organizations to supply biomass/energy beets.
2	Number of growers and industry personnel who are aware of the potential opportunities of growing and processing energy beets or cellulosic biomass for industrial sugars or other biofuel feedstock.

Outcome #1

1. Outcome Measures

Number of growers and industry personnel who use research-based economic analyses when they assess biomass/energy beet contracts; rely on densification technologies to collect, store and transport biomass/energy beets; and employ risk management strategies when they develop their business organizations to supply biomass/energy beets.

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Number of growers and industry personnel who are aware of the potential opportunities of growing and processing energy beets or cellulosic biomass for industrial sugars or other biofuel feedstock.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	500

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Energy beets have a strong potential for filling the niche of "advanced biofuels" as defined in the renewable fuel standard of the 2007 Energy Independence and Security Act. Energy beets also are being considered as a source for industrial sugar for other bioproducts. North Dakota farmers have strong experience growing sugar beets and this experience and the cold climate may allow for more economical beet production and storage than is possible in other areas of the country. Preliminary economic analyses suggest that energy beets may be produced in new areas of the state with strong yields and return for growers and processors.

What has been done
Research and extension personnel have worked closely with a group of ND industrial leaders to explore the agronomic and economic potential of growing energy beets through ND. The team has met with growers in a number of areas to educate them about the opportunity and discuss any questions they have. Research work and associated discussions with the public have included agricultural production, processing options, economic potential, and regulatory issues.

Results

NDSU is studying the feasibility of using new sugar beet varieties, known as energy beets, for ethanol production. Sugar beets for table sugar production are stored conventionally in open piles for up to six months under extremely low temperatures. However, storing sugar beets in open piles increases the risk of hot spots forming, which could lead to microbial degradation of sugars. Freezing also leads to the rupture of beet cell walls, making cell contents, including sugars, susceptible to leaching during thawing and washing. The thawing of sugar beets before processing requires large quantities of energy, which contributes to a less favorable greenhouse gas life cycle assessment. Because of these storage problems, new long-term storage techniques are needed to preserve fermentable sugars from energy beets to allow for ethanol production throughout the year. Results indicate that concentrating beet juice through evaporation to produce a raw, thick beet juice and subsequently adjusting the pH of the juice are effective. The technique helped retain more than 99 percent of the fermentable sugars in the juice stored for at least six months at 23 degrees Celsius (approximately 73 degrees Fahrenheit). During the study, the pH of the raw, thick juice was adjusted and controlled at alkaline and acidic levels to find the most effective ranges for sugar preservation. Although the juice was stored successfully, future research will be directed toward determining conditions for high-efficiency fermentation of the juice with the highest sugar retention during storage.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
511	New and Improved Non-Food Products and Processes
512	Quality Maintenance in Storing and Marketing Non-Food Products
601	Economics of Agricultural Production and Farm Management
604	Marketing and Distribution Practices

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Government Regulations

Brief Explanation

Although outcomes were strong, there is recognition that the local and national economic situations affect biofuels markets and the likelihood of growers adopting a new crop. Returns on agricultural land in ND are generally strong and the state is benefitting from the strong agricultural and energy industries. Enforcement of the mandated levels of advanced biofuel production is essential to the development of this opportunity in ND.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

No formal evaluations for of extension programming were completed this period as

the primary investigator was killed in a farming accident.

Key Items of Evaluation