

V(A). Planned Program (Summary)

Program # 2

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
131	Alternative Uses of Land	0%		10%	
401	Structures, Facilities, and General Purpose Farm Supplies	5%		10%	
402	Engineering Systems and Equipment	3%		10%	
501	New and Improved Food Processing Technologies	5%		0%	
511	New and Improved Non-Food Products and Processes	5%		40%	
601	Economics of Agricultural Production and Farm Management	0%		10%	
605	Natural Resource and Environmental Economics	82%		10%	
610	Domestic Policy Analysis	0%		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	0.0	0.0	40.4	0.0
Actual Paid Professional	12.2	0.0	43.9	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
245741	0	534142	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1513548	0	2718906	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
1048020	0	4108407	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Extension. Sustainable Energy programming from U of M Extension is primarily carried out through the Clean Energy Resource Team project (CERTs). CERTs are a statewide partnership with a shared mission to connect individuals and their communities to the resources they need to identify and implement community-based clean energy projects. CERTs activities in the University of Minnesota Extension are carried out with the following partners: University of Minnesota Regional Sustainable Development Partnerships, Eureka Recycling, Southwest Regional Development Commission, the Minnesota Project and the Minnesota Division of Energy Resources.

In 2012, campaigns and programs demonstrated the type of work conducted by CERTs. The teams partnered with others for the "Recycle Your Holidays" campaign to encourage use of LED holiday lights, through which 200,000 pounds of electrical cordage from holiday lights were collected. CERTs conducted research demonstrating that pre-rinse spray valves can result in substantial energy and water savings, which led the Department of Commerce to add pre-rinse spray valves as technology that utilities could use to meet their energy savings goals. The team moved many people to take clean energy action through friendly competitions. Finally, CERTs funded 53 projects across the state through seed grants for a total of \$140,000. Of these, 27 projects were completed, including 19 renewable energy and eight energy efficiency projects.

MAES. In 2012 MAES researchers continued their efforts to turn readily available materials into energy without compromising food levels or polluting the atmosphere. One indication of their success is in 2012 the U of M received a \$5 million from the state to build a biomass gasification demonstration and research facility.

Some highlights from MAES research in 2012 on sustainable energy:

- Continuing work on producing algae for biofuel, discussed in last year's Federal Accomplishment Report, made further progress, identifying organisms that fix nitrogen and increase the efficiency of the process.
- Laboratory research into removing lignin from aspen biomass has developed processes that removed 40 percent of the original lignin, increasing enzymatic sugar release from 25 percent to 85 percent. This allows the production of high performance bio-plastics in one single process step. This development holds the promise of making an integrated bio-refinery more economically feasible.
- Applied land-use modeling was used to identify trade-offs and synergies in production of biofuel feed stocks, and researchers recruited participants in a multi-stakeholder fuel shed planning process.

- Work on the ecology of plant-soil interactions revealed that invasive exotic grassland plant species change soil microbial communities, creating effects that must be addressed in the establishment of semi-native biofuel production systems.
- Applied economics research into the effectiveness of voluntary and market-based programs for bio-product development has resulted in a new award from USDA for MAES researchers to explore bioenergy policy impacts on bioenergy development across the supply chain.
- Work on reducing the environmental footprint of swine building determined that the green pig barn housing systems studied saved energy in the winter due to better insulation and environmental control. An analysis showed that investment costs were offset by a projected 3-to-7 percent increase in average daily gain, and 5-to-10 percent decrease in feed consumption per pound of pork produced.
- Investigating the feasibility of a forest-based bio fuel recovery system has identified the potential of turpentine as an overlooked energy source.
- Continuing work on the evaluation of ethanol by-products in swine and turkey diets has shown that distillers dried grains does not contribute to Mulberry Heart Disease in pigs, which is valuable information being used in the feed industry and by veterinarians.

2. Brief description of the target audience

Extension programming through Clean Energy Resource Teams is delivered in seven regions spanning the entire state of Minnesota. CERTs empowers communities and their members to adopt energy conservation, energy efficiency and renewable energy technologies for their homes, businesses and local institutions. Types of communities that CERTs works with include, but are not limited to, businesses, civic organizations, economic developers, faith groups, farmers, local governments, residents and neighborhoods, schools, and utilities.

MAES research target audiences include all of those, and forest products industry, academic researchers including bio-engineering and forestry researchers, and energy and land use economists. Also, agriculture and natural resources industry representatives, biotechnology company representatives, policymakers, state and federal agency representatives, private citizens, and entrepreneurs.

3. How was eXtension used?

Although CERTS has not submitted materials to be shared on the eXtension portal, it has been a useful resource when trying to find examples of energy efforts from other Extension programs.

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	41631	47630	3938	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	1	18	19

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Graduate student research assistants

Year	Actual
2012	17

Output #2

Output Measure

- Workshops and consultation will provide unbiased information to the target audiences.

Year	Actual
2012	60

Output #3

Output Measure

- Dollar amount of seed grants awarded in 2012.

Year	Actual
2012	140000

Output #4

Output Measure

- Number of CERTs newsletter / list serve subscribers.

Year	Actual
2012	8961

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Research will provide information on new uses for ethanol byproducts.
2	Research will provide information on technologies for use of on-farm energy sources.
3	Research will provide better understanding of the economic impact and environmental trade-offs of renewable energy sources.
4	Participants of workshops and users of developed decision-making reports will report that they were able to make informed decisions about sustainable energy production and use. (Target reported as percentage of those educated who agree.)
5	Activities will contribute to quantifiable annual energy savings, either through energy efficiency and conservation efforts or by offsetting current energy sources through the use of renewable energy. (Target expressed is the total number of million BTUs saved as a result of CERTs activities this year.)
6	CERTs research will inform state efforts to achieve energy conservation and efficiency goals.
7	Forest products research will provide new options in sustainable
8	Research will investigate and develop novel sources of bioenergy.

Outcome #1

1. Outcome Measures

Research will provide information on new uses for ethanol byproducts.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	2012

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In an attempt to increase profits, modern ethanol producers are adjusting processing methods to get the most value out of corn. Now they remove corn oil either from the bran and germ prior to ethanol fermentation or by centrifuging corn syrup. This has a direct impact on the quality of the co-product.

What has been done

U of M animal scientists completed a nutrient profile survey of 159 distiller grains samples in 2012. It was the second such study in 10 years. The survey provided a good glimpse into the changes that have occurred in the ethanol industry over the past 10 years, as well as the impact these changes have on current distillers grains co-products.

Results

Extension livestock educators have used this information the survey provided to make changes in the fiber, protein, fat and mineral content of DDGS in educating livestock producers in properly balancing distillers grains based livestock diets.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management

Outcome #2

1. Outcome Measures

Research will provide information on technologies for use of on-farm energy sources.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Research will provide better understanding of the economic impact and environmental trade-offs of renewable energy sources.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	2012

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Perennial crops have been proposed as a bio-industrial feedstock because of their environmental and ecological benefits, compared to annual crops.

What has been done

A field study was completed in 2012 to quantify biomass yield across a range of perennial herbaceous and woody crops over time and environments. Field experiments were conducted at three locations in Minnesota from 2006 to 2011. Woody biomass crops included willow and poplar. Herbaceous crops included switchgrass, prairie cordgrass, native polyculture and an alfalfa plus intermediate wheatgrass mixture.

Results

The results showed that willow produced more biomass than all other woody and herbaceous biomass crops. However, taking into account harvest frequency on the economics of these systems, polycultures may offer an alternative to monoculture. The work shows that several biomass crop species can be successfully grown as part of a diversified biomass crop system.

4. Associated Knowledge Areas

KA Code	Knowledge Area
131	Alternative Uses of Land
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics
610	Domestic Policy Analysis

Outcome #4

1. Outcome Measures

Participants of workshops and users of developed decision-making reports will report that they were able to make informed decisions about sustainable energy production and use. (Target reported as percentage of those educated who agree.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	65

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The Rural Minnesota Solar Initiative is a resource developed by the Clean Energy Resource Team to help farmers and small business owners learn more about how solar energy production technologies can work for them, and provide the needed assistance to catalyze projects. This initiative solves the issue of rural farmers and business owners not having resources readily available to make decisions about solar technologies. Solar technology can provide financial advantage to small business owners by having a reliable energy source at a known expense over time.

What has been done

CERTs hosted or attended as an exhibitor at over 30 events to make connections with over 600 rural farmers and small business owners. During hosted events, CERTs arranged for one or more speakers within the region who are knowledgeable on the topic of solar technologies to present and lead discussions. CERTs takes a balanced approach to promoting solar technologies by sharing educational resources about solar electric (photovoltaic cells), solar hot air and solar thermal, and partnering with a variety of solar technology service providers in the industry.

Results

CERTs have qualitatively measured success of this initiative through a survey to participants to understand what steps they took toward completing their own solar project. A survey was sent to over 350 participants; 22 percent responded. Sixty-five percent of respondents had taken steps toward completing a project. The most common steps taken toward completing a project included: researching a solar technology, researching project costs and incentives, and then contacting vendors/contractors.

4. Associated Knowledge Areas

KA Code	Knowledge Area
401	Structures, Facilities, and General Purpose Farm Supplies
601	Economics of Agricultural Production and Farm Management
605	Natural Resource and Environmental Economics

Outcome #5

1. Outcome Measures

Activities will contribute to quantifiable annual energy savings, either through energy efficiency and conservation efforts or by offsetting current energy sources through the use of renewable energy. (Target expressed is the total number of million BTUs saved as a result of CERTs activities this year.)

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	10300

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Minnesota's energy supply is not as clean efficient, reliable and affordable as it could be. Minnesotans spent \$16 billion and consumed a total of 1,852.2 trillion BTUS of energy (electricity, natural gas, petroleum products, coal and biomass) in 2010 to supply energy needs. Energy use spreads across four main sectors: Transportation (26 percent total use covering planes, trains, buses, automobiles), residential (23 percent total use), commercial (19 percent total use) and industrial (32 percent total use).

What has been done

CERTs works with Minnesota communities to connect them to resources, research-based information, and networks that advance clean energy projects. The goal is to help Minnesota

meet its energy efficiency and renewable energy goals, many of which were signed into law in 2007 as Minnesota's Next Generation Energy Act. The law requires Minnesota utilities to produce 25 percent of energy using renewable resources by the year 2025, and established a statewide energy conservation goal of 1.5 percent of annual retail electric and gas sales each year.

Results

CERTs examines total BTUs of energy saved annually through its campaigns, its dissemination of education and local grants. The total is 10.3 billion BTUs in annual energy savings. Among these efforts, 6.35 billion in BTUs were the result of a "Recycle Your Holidays" Holiday Lights Recycling Campaign. A Family Face-Off Campaign put families in competition to take clean energy action, ultimately saving 2 billion BTUs. The 2012 Seed Grant Program saved 1.63 billion BTUs by funding local energy efficiency and renewable energy projects. Consultation on a new commercial kitchen at Bemidji State University saved 48 million BTUs, and a program offering a special discount price for spray valves, faucets and showerheads in commercial and institutional settings saved 318 million.

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics

Outcome #6

1. Outcome Measures

CERTs research will inform state efforts to achieve energy conservation and efficiency goals.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	2012

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The Minnesota Department of Commerce, Division of Energy Resources Staff oversee how utilities across the state are meeting their mandated energy savings goals, and also coordinate which technologies are "allowed" to claim deemed savings.

What has been done

After conducting pilot projects with restaurant owners on Lake Street in Minneapolis and reviewing current documents and existing research, CERTs determined that pre-rinse spray valves in commercial kitchens are a technology that can engender substantial energy and water savings.

Results

CERTs research was shared with the Department of Commerce. Because of the research, the pre-rinse spray valves are being added as technology that utilities could use to meet their energy savings goals.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
501	New and Improved Food Processing Technologies

Outcome #7

1. Outcome Measures

Forest products research will provide new options in sustainable

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	2012

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Unless there is innovation, Minnesota's roughly \$10 billion forest economy will continue to shrink. Minnesota's timber harvest has fallen near its lowest level in 30 years. One potential is increased profits through better use of the by-products of paper production in biomass. One such by-product, called black liquor, has been burned for fuel at paper mills for most of the past century.

What has been done

U of M researchers have been separating out the black liquor's components and investigating the potential of those components. They have discovered a new way to make plastic with extremely high tensile strength out of lignin. Drawing the energy from lignin has been a problem for the scientific community and has led to inefficiency in biomass energy production. MAES supported

research has found the right cocktail of enzymes to degrade lignin from cell walls so the sugars can be more effectively converted to biofuels and the lignins to plastics.

Results

This allows the production of high performance bio-plastics in one single process step. This development holds the promise of making an integrated bio-refinery more economically feasible.

4. Associated Knowledge Areas

KA Code	Knowledge Area
402	Engineering Systems and Equipment
511	New and Improved Non-Food Products and Processes
605	Natural Resource and Environmental Economics

Outcome #8

1. Outcome Measures

Research will investigate and develop novel sources of bioenergy.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	2012

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Algae as a source of oil for biofuels has been the focus of a lot of interest, because it grows fast, produces lots of oil and can be grown in large quantities without using much land. Most researchers produce algae in a relatively bacteria-free environment. But MAES supported research is taking a different approach by trying to build on the relationships where bacteria and algae already co-exist and help each other.

What has been done

Researchers are studying a wide variety of algae and how they interact with bacteria, and which bacteria provide the most benefits to algae. Research on certain bacteria has revealed they can fix nitrogen and if they can co-exist with algae, they might help the algae grow without the need for additional nitrogen fertilizers.

Results

Researchers have completed a characterization of several bacteria that were found to degrade specific strains of algae and have analyze the effect these bacteria have on lipid availability by direct extractions. These results may be an enormous boost for algae as a biofuel source.

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

- Appropriations changes

Brief Explanation

Extension is now reporting on the work of the Clean Energy Resource Teams at the U of M as part of our sustainable energy programming. The CERT team became part of Extension late in 2011. Their work is funded by a variety of Minnesota partners and U of M Extension, as well as the USDA. Their evaluated outcomes strengthen Extension's programmatic response to issues of sustainable energy in Minnesota.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

As noted earlier, the overriding charge of CERTs is to help Minnesota meet its energy efficiency and renewable energy goals by connecting communities with the resources they need to identify and implement energy efficiency and renewable energy projects. The metrics of effectiveness employed by the CERTs team considers the efficacy of the educational outreach, as well as the efficacy of programs to meet energy efficiency and renewable goals. Surveys and observations examine whether program participants take action to change their energy sources or decrease their energy use. Using information about the effectiveness of such campaigns, the team has established a way to quantify the annual energy savings in BTUs.

Key Items of Evaluation

Campaigns, educational programming and seed grants have resulted in actions that have saved 10.3 billion BTUs annually.