

V(A). Planned Program (Summary)

Program # 7

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%			
133	Pollution Prevention and Mitigation	10%			
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	10%			
403	Waste Disposal, Recycling, and Reuse	10%			
601	Economics of Agricultural Production and Farm Management	10%			
602	Business Management, Finance, and Taxation	10%			
605	Natural Resource and Environmental Economics	20%			
608	Community Resource Planning and Development	20%			
	Total	100%			

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	3.0	0.0	0.0	0.0
Actual Paid	5.2	0.0	0.0	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
229495	0	0	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
229495	0	0	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

This planned program is expanded to address Sustainable Energy and Use of Natural Resources, anticipating the 2015 combined research and extension joint report. Communities are interested in developing renewable energy industries for energy independence, job creation, and economic development. Led by the Institute for Environmentally Integrated Dairy Management at the University of Wisconsin-Madison Marshfield Agricultural Research Station, UW Agricultural Experiment Station and extension campus and county faculty and staff are conducting integrated research and extension programs, building capacity for developing biomass for biofuels and scalable conversion technologies among extension colleagues, communities, farmers and industry partners.

Lake Superior Woody Biomass Initiative: Increased interest in and funding for renewable energy sources may bring new economic opportunities to Northern Wisconsin. Companies have announced plans to establish or expand their use of woody biomass for energy production using locally sourced wood. Expanded use of wood for fuel has raised concerns about increased demand on roundwood or harvest residues as this may distort pulpwood markets or reduce forest ecosystem function. Purpose-grown woody biomass crops have been proposed as a productive, reliable, and sustainable fuel supply.

Anaerobic digestion research and outreach: Wisconsin is the leading state for on-farm anaerobic digestion with more than 30 operational systems. Maintaining the economic viability of large-scale anaerobic digestion systems requires optimizing operation, assessing feedstocks, and managing manure systems in accordance with nutrient management plans. Research results are critical to provide additional guidance to operators, system owners, the industry and policy makers on decreasing system failures and downtime, increasing biogas production and profitability, and reducing environmental impacts. Feedstocks are identified and evaluated in extension biowaste specialist Rebecca Larson's lab, then implemented in the field. New tools allow operators to evaluate impacts to emissions, nutrient use efficiency, and economics. As a result, facilities are increasing biogas production and more importantly, avoiding highly toxic feedstocks that cause catastrophic failures. Her recommendations have led to more efficient systems with greater economic and environmental sustainability. And her evaluation of technology and economic constraints has been critical in guiding producers who are evaluating new anaerobic digestion projects.

2. Brief description of the target audience

Farmers and foresters are interested in supplying feedstocks to the bioenergy industry as a potential alternative market and source of revenue. Communities are interested in developing renewable energy industries for energy independence, job creation, and economic development. Given Wisconsin's wealth of resources in forests and agricultural production, there is interest among state businesses and communities

in producing alternative fuels and feedstocks from biomass. The audience includes municipalities, regional planning commissions, regional economic development initiatives, regulated and unregulated utilities, liquid biofuels, anaerobic digester and biomass conversion technology firms, biomass producers and aggregators, food processors, food services, school districts, loggers, procurement foresters, wood products professionals, haulers, farmers and their advisers, business owners, woodland owners, recycling volunteers, public and private agencies, local and tribal government officials, community leaders and policy makers, and others addressing statewide emerging bioenergy education needs.

3. How was eXtension used?

University of Wisconsin-Extension campus and county faculty and staff participate in various communities of practice, engaging with colleagues around the country to improve the educational content of research-based programs and assistance delivered to residents across the state and region. Extension colleagues are connected by email ListServ, blogs and online newsletters, and shared resources such as teleconferences and webinars, eXtension Communities of Practice, and the national Extension Disaster Education Network (EDEN) to quickly address critical and emerging issues such as responding to extreme weather. Interdisciplinary colleagues and other professionals in this network include University of Wisconsin researchers on the Madison, Platteville, River Falls, Stevens Point and Superior campuses and centers, working with 3 tribes, the Institute for Environmentally Integrated Dairy Management at the UW-Madison Marshfield Agricultural Research Station, 10 other agricultural research stations and the USDA Dairy Forage Research Center.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	4341	0	0	0

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

Patent Applications Submitted

Year: 2014
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	0	0

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	Develop biomass use for biofuels.
2	Build capacity to create, refine and implement scalable conversion technologies.

Outcome #1

1. Outcome Measures

Develop biomass use for biofuels.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Increased interest in and funding for renewable energy sources may bring new economic opportunities to Ashland and Bayfield counties. The region's forests and farmlands offer a rich supply of herbaceous and woody biomass for use in the emerging bioeconomy. A number of companies have announced plans to establish or expand their use of woody biomass for energy production. This includes Xcel Energy, which has renewed their commitment to fueling the Bayfront Power Plant in Ashland with locally-sourced wood. Expanded use of wood for fuel has raised concerns about increased demand on roundwood or harvest residues as this may distort pulpwood markets or reduce ecosystem function. Purpose-grown woody biomass crops have been proposed as a productive, reliable, and sustainable fuel supply. Little is known about how woody biomass crops such as hybrid poplar, larch or willow will perform in the climate and soils of Ashland and Bayfield counties, nor are there agronomic or management recommendations for producers.

What has been done

Jason Fischbach, Wisconsin Cooperative Extension agriculture agent for Ashland and Bayfield counties, convened stakeholders in 2009 to develop the Lake Superior Woody Biomass Initiative, which outlines education, research, and outreach efforts necessary to develop a sustainable woody biomass supply chain. Despite significant forest resources in the region and a considerable supply of harvest residues and mill waste, stakeholders recognize dedicated woody biomass crops as another important source of feedstock that could provide income opportunities for area farmers. Fischbach has secured \$55,000 in funding from Xcel Energy and the Wisconsin Office of Energy Independence to implement the Lake Superior Woody Biomass Trials. The trials consist of 25 acres of woody biomass plantings with a series of formal research projects and demonstration plantings. The trials include work on hybrid poplar, hybrid willow, and native conifers. The trials were established in 2010 and data collection and outreach education has

been occurring ever since.

Results

Evaluating and demonstrating commercially viable agroforestry: The primary focus of the Lake Superior Woody Biomass Trials is to evaluate and demonstrate production scenarios for potential biomass producers. In the first year (2010), the trials introduced people throughout Wisconsin to woody biomass crops at a production scale, and have inspired collaborations for further research and development work. Funding from the Focus on Energy program was obtained to conduct a nitrogen fertilization trial with hybrid willow. The Natural Resources Research Institute in Duluth, MN, has provided hybrid poplar clones for a replicated performance trial of their select hybrid poplar accessions. The USFS recently funded a trial planting at the Northern Great Lakes Visitor Center to demonstrate the use of woody biomass crops in commercially viable agroforestry plantings. Northland College has conducted bird habitat surveys to quantify the wildlife habitat value of the plantings. Phase 2 of the trials began in 2014 with a series of harvests. 1st generation willow yields have been measured from the clone trials. Top-performing clones from the hybrid poplar clone trials have been selected and will be established in expanded yield trials in 2015. Annual field days have been held to communicate results to area producers and stakeholders. A series of Research Bulletins are being produced to report the research results to area producers and stakeholders.

4. Associated Knowledge Areas

KA Code	Knowledge Area
403	Waste Disposal, Recycling, and Reuse
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
608	Community Resource Planning and Development

Outcome #2

1. Outcome Measures

Build capacity to create, refine and implement scalable conversion technologies.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
-------------	---------------

2014

0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Anaerobic digestion is a proven waste-to-energy technology. Wisconsin is the leading state for on-farm anaerobic digestion with more than 30 operational systems. The last decade created demand for knowledge of system components, processes and mechanisms, operation skills, safe production and use of biogas. Maintaining the economic viability of large-scale anaerobic digestion systems requires optimizing operation, assessing feedstocks, and managing manure systems in accordance with nutrient management plans.

What has been done

University of Wisconsin-Extension biowaste specialist Rebecca Larson works with USDA, OSHA, campus, county and national colleagues, industry partners and farmers developing and sustaining safe, practical and economical anaerobic digestion. Throughout 2014, Larson and colleagues conducted research on operational trouble-shooting at on-farm anaerobic digesters as well as laboratory systems. Anaerobic digestion systems were investigated for biogas production optimization, feedstock degradation, co-digestates, use of end products, and other operational issues. Results were shared around the state to increase digester owner and operator efficiency, encourage advancement of the technology, and educate the public and other educators on basic digestion function and feasibility. Research was also conducted to develop a life cycle assessment at the farm scale to evaluate the environmental factors over the life of the system such as GHG emissions and nutrient fate. Field and lab scale testing was also completed to assess the GHG and ammonia emissions from various digestate streams. These results were used to inform policy makers and producers on technology and management options to reduce environmental impacts. Larson has also updated the Anaerobic Digester Operator Training Program curriculum for a one day course prior to the Manure Summit to be held in February 2015.

Results

Anaerobic digestion research and outreach: Research results are critical to provide additional guidance to operators, system owners and the industry on decreasing system failures and downtime, increasing biogas production and profitability, and reducing environmental impacts. In addition, evaluation of technology and economic constraints has been critical in guiding producers in the state who are evaluating new anaerobic digestion projects. Feedstocks are identified and various blends evaluated in Rebecca Larson's lab, then implemented in the field. As a result, many facilities are increasing biogas production and more importantly, avoiding feedstocks with high toxicity that cause catastrophic failures. Her recommendations have led to more efficient systems with greater economic sustainability. For example, when a scalable system constructed for 200 milking cows was producing much lower biogas than predicted, she worked with the operator and company owner to double biogas production. New tools developed in the last year allow operators to evaluate the impacts to emissions, nutrient use efficiency, and economics.

4. Associated Knowledge Areas

KA Code	Knowledge Area
403	Waste Disposal, Recycling, and Reuse

601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
608	Community Resource Planning and Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Public Policy changes
- Competing Public priorities
- Populations changes (immigration, new cultural groupings, etc.)
- Other (Database development)

Brief Explanation

Database development: University of Wisconsin-Extension is in the process of replacing the legacy planning and reporting database, which was closed in 2012. For this report, the 2014 direct contacts for adults reported are the 4-year average of past performance of relevant statewide teams in 2008-2011. Program participation is in alignment with previous years.

The 2014 trained volunteers participating and direct contacts for youth reported are from the 2013-14 ES-237 form.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}