

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Sustainable Energy - formerly Sustainable Environment and Renewable Resources

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
403	Waste Disposal, Recycling, and Reuse				100%
	Total				100%

V(C). Planned Program (Inputs)

1. Actual amount of professional FTE/SYs expended this Program

Year: 2010	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	0.0	0.3
Actual	0.0	0.0	0.0	3.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
0	0	0	165688
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	0	0	114511
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

Integration of agricultural waste utilization and bioenergy production using anaerobic digestion - a long term experiment was continued which tests the efficiency of the digester to co-digest poultry litter and cattle waste. Respicate laboratooory digesters were used to test progressively larger percentages of stillage in co-digestion and resilience of digesters following co-digestion. Microbial population responses to changes in substrate are being examined by targeting rDNA markers with pyrosequencing. Revision of

the ADM1 model of anaerobic digester performance was conducted to incorporate acetic acid utilizing bacteria.

2. Brief description of the target audience

Scientists and engineers who study anaerobic digestion; farmers and industries which use digestion to treat diverse wastes; undergraduate and graduate students.

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	5	0	0	0
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2010
 Plan: 0
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2010	Extension	Research	Total
Plan	0	0	
Actual	0	2	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Scientific presentations and publications
 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	Increased awareness of soil remediation technology among stakeholders (%)
2	Development of a novel technique for soil remediation (% completion)
3	Increase restoration of reclaimed land and its use via this technique (%)
4	Increase digester efficiency (%)
5	Develop techniques for digester control (% completion)
6	Increase knowledge of anaerobic bacteria (%)
7	Increase knowledge of microbial biomass-to-bioenergy conversion process (%)

Outcome #1

1. Outcome Measures

Increased awareness of soil remediation technology among stakeholders (%)

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Development of a novel technique for soil remediation (% completion)

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Increase restoration of reclaimed land and its use via this technique (%)

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Increase digester efficiency (%)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Farmers and industries can use digestion to treat multiple wastes, but the performance of the digester with different wastes needs to be determined experimentally.

What has been done

Conducted co-digestion experiment with poultry litter and cattle waste in a pilot plant thermophilic CSTR digester.

Results

These two wastes were effectively co-digested but at 80% cattle waste digester performance was diminished. Co-digestion experiments with poultry waste and stillage in laboratory scale digesters showed that biogas production increased until 80% stillage which caused a reduction in performance.

4. Associated Knowledge Areas

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

Outcome #5

1. Outcome Measures

Develop techniques for digester control (% completion)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Digester operators could benefit from greater knowledge of the digester processes.

What has been done

ADM1 model has been modified to incorporate a major fatty acid.

Results

ADM1 has been updated.

4. Associated Knowledge Areas

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

Outcome #6

1. Outcome Measures

Increase knowledge of anaerobic bacteria (%)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Environmental biotechnologists, microbiologists are interested in anaerobic decomposition and microbial energy conversion

What has been done

We have tracked population dynamics in replicate digesters that treated poultry litter and stillage in order to understand how the microbes respond to environmental perturbations.

Results

We found the majority of bacteria under co-digestion conditions are unique organisms in this thermophilic digester.

4. Associated Knowledge Areas

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

Outcome #7

1. Outcome Measures

Increase knowledge of microbial biomass-to-bioenergy conversion process (%)

2. Associated Institution Types

- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Engineers in the bioenergy industry and farmers/digester operators who want to recover more energy from organic waste.

What has been done

Observing changes in microbial populations during increases and decreases in biogas production during co-digestion.

Results

We conducted in depth sampling with pyrosequencing and found that the microbial community structure was altered by the new substrate and became dominated by a single unique population.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Public Policy changes
- Government Regulations
- Competing Public priorities

Brief Explanation

V(I). Planned Program (Evaluation Studies and Data Collection)

1. Evaluation Studies Planned

- Retrospective (post program)
- During (during program)

Evaluation Results

Key Items of Evaluation