V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Sustainable Energy

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
133	Pollution Prevention and Mitigation			10%	
402	Engineering Systems and Equipment			20%	
511	New and Improved Non-Food Products and Processes			40%	
609	Economic Theory and Methods			30%	
	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	3.3	0.0
Actual	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

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	166846	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
0	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

In summary:
- conduct research experiments
- develop models and simulation tools
- develop new culture strains and metabolic engineering tools.
- develop products, resources

- conduct surveys, data analyses, assessments
- conduct workshops, provide training
- partner

2. Brief description of the target audience

public sector
private sector
economists
policy makers
agricultural biotechnology firms
farmers
bioenergy and biofuel producers
industrial manufacturers of hydrogen and fuel cells

V(E). Planned Program (Outputs)

1. Standard output measures

2010	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Plan	100	600	60	60
Actual	100	600	60	60

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	10	
Actual	0	10	10

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- OTHER SCHOLARLY EXCELLENCE: participation on professional boards and panels, as well as science panels, awards, etc.

Year	Target	Actual
2010	2	10

Output #2

Output Measure

- DEVELOP IMPROVED BIOPRODUCT PRODUCTION SYSTEMS: Indicators - Type 1...Improved technologies and production systems for biofuel and bioenergy a) better solar energy capture for hydrogen production b) improved fermentation processes c) new and improved sensors for bioprocessing

Year	Target	Actual
2010	1	1

Output #3

Output Measure

- DEVELOP IMPROVED BIOPRODUCT PRODUCTION SYSTEMS: Indicators - Type 2... Improved feedstocks a) microbial and algal feedstocks for biodiesel production b) use of agricultural by-products as feedstock c) use of invasive species as feedstock d) development of a cellulosic feedstocks for hydrogen, ethanol, and biodiesel production

Year	Target	Actual
2010	1	1

Output #4

Output Measure

- PROVIDE TECHNOLOGY, MODELS AND ANALYSES THAT INFORM DECISION-MAKERS,

INDUSTRY, AND PEERS REGARDING AGRICULTURAL PRODUCTION: Indicator ...theoretical and computation tools development and application a) generate tools, both parametric and non-parametric, for evaluating technological change, capacity utilization, and productivity growth b) apply economic tools to a number of industries and products c) identify determinants of innovation in agricultural biotechnology d) examine coordination between public and private sector and the mix of public-good and private-good inventions e) test assumptions about basic research's influence on downstream applications and product development f) understand role and influence of intellectual property regimes on innovation

Year	Target	Actual
2010	3	3

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Knowledge Type 1...Improved knowledge about composition and conversion of feedstocks for biofuels, bioenergy, and co-products a) production and harvesting of algae and micro-organisms b) cellulosic feedstock composition c) essential oils found in invasive species d) metabolic engineering for photobiological hydrogen
2	Knowledge Indicators 2 ... Improved engineering applications to advance production systems for bioenergy: - biomimetic models to create biobased generators to produce molecular H2 and O2 from water and light, with these generators incorporated into integrated H2 energy systems, providing generation, storage, and utilization of H2 in one unit. - optimize the photobiological process to yield higher energy efficiencies. - demonstrate that waste biomass, such animal wastes and organic component of urban wastewater, used as feedstock can not only yield biohydrogen, but that waste can be reduced.
3	Knowledge Indicators - Type 3...Models to look at productivity and technological processes a) Model to look at production simultaneous with negative externality outputs b) Productivity in the agricultural sector and electric utilities c) Network models d) biomimetic models to create biobased generators to product molecular hydrogen and oxygen
4	Knowledge Indicators - Type 4...Productivity information a) understand reverse impact of downstream on upstream research b) understand where to distribute investments on basic-to-applied research continuum and in which fields or subfields to focus
5	Action Indicators - Type 1...Industry apply production systems a) Energy producers optimize photobiological process to yield higher energy efficiencies b) new biobased hydrogen generators are incorporated into integrated hydrogen energy systems, providing generation, storage, and utilization of hydrogen in one unit. c) microbial fuel cells provide on-farm electrical generation
6	Action Indicators - Type 2...economic activity in rural areas a) bioenergy facilities are located close to potential feedstocks to generate additional economic activity
7	Action Indicators - Type 3...improved feedstocks are produced a) algae outproduce terrestrial oilseed crops and oil is easily extracted b) organic materials harvested from animal wastes and urban wastewater generate bio hydrogen and eliminate waste

Outcome #1

1. Outcome Measures

Knowledge Type 1...Improved knowledge about composition and conversion of feedstocks for biofuels, bioenergy, and co-products a) production and harvesting of algae and micro-organisms b) cellulosic feedstock composition c) essential oils found in invasive species d) metabolic engineering for photobiological hydrogen

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Pretreatment of cellulosic biomass is an important step that determines the efficiencies of the subsequent hydrolysis and fermentation processes. Many pretreatment technologies have been proposed for different biomass. Pretreatment conditions such as the temperature, pH and residence time influence the effectiveness if the pretreatment. There is a large body of literature applying specific pretreatment conditions to individual/multiple feedstocks. There is no consolidated analysis of multiple feedstocks and pretreatment conditions. While there were few attempts to describe different pretreatment processes under various conditions, they were not complete and there is no comprehensive framework for such analysis.

What has been done
A comprehensive analysis of the chemical composition of different biomass was performed. To address the challenges mentioned, analysis of multiple feedstocks under different pretreatment conditions was carried out under standardized pretreatment conditions. Pretreated biomass was enzymatically hydrolyzed using commercially available enzyme mixtures.

Results
Different hydrolysis profiles from chemically similar feedstocks indicated that it is important to consider both physical structure and chemical composition of biomass along with the pretreatment conditions. We are using the insights from these studies to develop a unified modeling framework for the pretreatment of cellulosic biomass.

4. Associated Knowledge Areas

KA Code	Knowledge Area

133	Pollution Prevention and Mitigation
402	Engineering Systems and Equipment
511	New and Improved Non-Food Products and Processes

Outcome #2

1. Outcome Measures

Knowledge Indicators 2 ... Improved engineering applications to advance production systems for bioenergy: - biomimetic models to create biobased generators to produce molecular H2 and O2 from water and light, with these generators incorporated into integrated H2 energy systems, providing generation, storage, and utilization of H2 in one unit. - optimize the photobiological process to yield higher energy efficiencies. - demonstrate that waste biomass, such animal wastes and organic component of urban wastewater, used as feedstock can not only yield biohydrogen, but that waste can be reduced.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	0	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Hydrogen, one of the cleanest and most desirable fuels, is expected to play an increasingly important role in our economy. At present, non-renewable fossil fuels including natural gas, oils and coal are the main sources for hydrogen gas production. The finite reserve of fossil fuels and ever-increasing pressure on reducing greenhouse gas emission have generated a need for the production of hydrogen from renewable sources such as biomass.

What has been done
The overall goal of this project was to develop an efficient microbial electrochemical system to generate hydrogen from abundant, inexpensive, and readily available lignocellulosic biomass. The focus of this project was to gain a good understanding of the factors affecting hydrogen production from complex woody biomass. Such a study is critical for improving the overall efficiency of the process and ultimately achieving the application of this technology. More specially, the following tasks have been accomplished:
(1)Evaluation of how individual sugar in the hydrolysate of woody biomass, a mixture of different sugars, and other degradation byproducts affect the efficiency of hydrogen production in the microbial electrochemical system.
(2)Investigation of whether there is any compound in the hydrolysate of woody biomass that will

inhibit the growth of microorganisms and lower the efficiency of hydrogen production. (3)Maximization of the hydrogen production through the modification of electrode materials and the optimization of the operational conditions of the microbial electrochemical system.

Results
Our work significantly enhanced the understanding of some fundamental issues about the kinetics and mechanisms of biohydrogen generation from lignocellulosic biomass using microbial electrolysis cells. Our new single-chamber MEC design and the development of non-previous metal free cathode catalysts greatly increase the efficiency of the system and reduce the cost for cell fabrication, thus increase the practical application potential of this technology. The scientific publications and presentations we made not only advance the development of knowledge and attract young people to the profession, but also attracts industrial collaborations for the commercialization of this technology.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

Knowledge Indicators - Type 3...Models to look at productivity and technological processes a) Model to look at production simultaneous with negative externality outputs b) Productivity in the agricultural sector and electric utilities c) Network models d) biomimetic models to create biobased generators to product molecular hydrogen and oxygen

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Knowledge Indicators - Type 4...Productivity information a) understand reverse impact of downstream on upstream research b) understand where to distribute investments on basic-to-applied research continuum and in which fields or subfields to focus

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Quantitative Target	Actual
2010	1	1

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The biochar idea originates from research indicating that ancient cultures deliberately incorporated a mix of organic residues and charcoal into soils to improve soil fertility (the so-called Terra Preta soils of The Amazon Basin). However, the modern view of biochar is that of a relatively complex concept of sustainable resource management.
The first and most important element in this concept is the production of energy from biomass. Such energy would be carbon neutral because the carbon in biomass has been assimilated out of the atmosphere, its combustion does therefore not contribute to a net increase of the CO2 in the atmosphere. The second element of the biochar concept is the incomplete combustion of the biomass to leave a residue with long turnover times in the biosphere in general and in soils in particular. Therefore, the biochar concept removes CO2 from the atmosphere by converting part of the feedstock into a "stable" form (= char) from which it can not easily return to the atmosphere. The final element of the biochar concept is the option to take advantage of the unique physicochemical properties of artfully prepared chars to improve the soil by enhancement of soil fertility, modification of physical soil properties, or adsorption of pollutants.

What has been done
This research translates the theoretical biochar idea into practical solutions that would benefit the people of Oregon. The pyrolysis technology for biochar production holds the key to the benefits of biochar, and it is just that: a technology that needs to be developed, tested and proven. Our current research aims at developing a pyrolyses technology that captures as much energy as possible while simultaneously allowing us to create char products that are tailored to the needs of the industry. At the same we take great care to meet current and future environmental standards with our char products. From the beginning we have teamed up with private industry (Starker Forests at Philomath) and work with industrial size equipment to minimise the gap between experiment and implementation.

Results
Our most recent project investigates the usefulness of Biochar for the Oregon nursery industry. Oregon nurseries currently use approximately 5400 metric tons of vermiculite annually as a potting medium amendment, and pays about $6 per square meter annually to heat their houses. Biochar could be a way to significantly reduce these expenses. The reasons for using vermiculite are its abilities to increase both soil water retention and cation exchange capacity. Biochar is known for its ability to do the exact same thing: increase water storage and provide exchange capacity. Vermiculite is a mined and imported mineral, some coming all the way from South Africa (34%) or China (7%). To be able to store water, vermiculite must be exfoliated at temperatures exceeding 900ºC. But biochar can be produced from materials acquired on farm or from nearby waste streams. On farm biochar production can be achieved while simultaneously mitigating heating costs. After initial thermal input, pyrolysis evolves gases that can fuel maintenance of its own temperature requirements, while also heating greenhouses. This project will help the industry revisit what resources could be used and retool how they invest their funds for cost reductions and productivity improvements.

4. Associated Knowledge Areas

KA Code	Knowledge Area
609	Economic Theory and Methods

Outcome #5

1. Outcome Measures

Action Indicators - Type 1...Industry apply production systems a) Energy producers optimize photobiological process to yield higher energy efficiencies b) new biobased hydrogen generators are incorporated into integrated hydrogen energy systems, providing generation, storage, and utilization of hydrogen in one unit. c) microbial fuel cells provide on-farm electrical generation

Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Action Indicators - Type 2...economic activity in rural areas a) bioenergy facilities are located close to potential feedstocks to generate additional economic activity

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Action Indicators - Type 3...improved feedstocks are produced a) algae outproduce terrestrial oilseed crops and oil is easily extracted b) organic materials harvested from animal wastes and urban wastewater generate bio hydrogen and eliminate waste

Not Reporting on this Outcome Measure

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

Brief Explanation

{No Data Entered}

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

1. Evaluation Studies Planned

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

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}