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BIOMASS POWER FOR RURAL DEVELOPMENT

**Quarterly Report for the Period
January 1, 1998 - April 2, 1998**

James T. Cooper

**CHARITON VALLEY
RESOURCE CONSERVATION & DEVELOPMENT, INC.**

Date Published - July 1998

MASTER

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EXECUTIVE SUMMARY

During the period of January 2, to April 2, 1998, efforts revolved around the design of the switchgrass materials handling/feeding system for the co-fire test and permanent system, the development of a revised "statement of work" and budget for fiscal years 1998-1999 and, the continuation of farmer/land conversion, and public relations efforts.

The weather continues to be a major problem with an unprecedented warm winter. Much of Iowa has had little or no frost in the ground. This lack of frost has prevented farmers from getting into their fields and harvesting switchgrass. Farmers are hesitant to drive processing equipment into unfrozen fields due to the large ruts left by the wheels. Local farmers are often heard giving testimonials that "this is the strangest winter we've ever seen around here". While this weather is effecting our planned harvest, it has not carried into the seeding season yet and has not as yet had a serious impact upon the project. We are hopeful that seeding season to be more normal.

Our producers group, Prairie Lands Bio-Products, Inc., has continued to gather information and develop the resources necessary to supply the switchgrass to the facility in a competitive manner.

Information and contacts are starting to be gathered which will help establish a market for the dedicated biomass generated electricity.

Efforts continue in each of the project categories with some planning details unable to be specified prior to fiscal year budget approvals. Otherwise, the project is proceeding as planned.

SWITCHGRASS CONVERSION DEVELOPMENT

Fuel Analysis

Dr. Rich Bain, and Dr. Kevin Craig, National Renewable Energy Laboratory, (NREL), collected switchgrass samples in the last quarter during a tub grinding demonstration. The samples collected included two different harvest dates. One fall harvest (October 1996) and one spring harvest (April 1997). The results of the proximate and ultimate fuel analysis are included in the attachments. (*Attachment One*) The results continue to show a reduction in the ash content of the spring harvest over the fall harvest, indicating that a "washing" of the material during the winter may be having a positive impact.

Engineering Status Report R. W. Beck

Since the first of the year we have made significant progress in the preliminary design of both the co-fire test equipment, and later permanent facilities. We have defined the test parameters in terms of tonnage, duration, load capacity, and overall scope. Our scope and preliminary design document was provided on April 15, 1998.

While Conrad Anderson has focused on the harvesting, handling and storage issues surrounding full scale collection of switchgrass, Scott Coon has developed and refined the on-site material processing and boiler feed systems. We remain committed to providing systems capable of processing and burning switchgrass brought to the facility at the Ottumwa Generating Station (OGS) in three forms; (1.) forage harvested and shredded loose bulk material; (2.) unshredded cut material in round bales; and (3.) unshredded cut material in rectangular bales.

We have contacted most of the existing hay, alfalfa and prairie grass processors in the U.S. to address specific concerns and equipment issues. We are also working closely with several major manufacturers including John Deere, ABB/CE, Williams Equipment, MAC Inc., Western Pneumatics Inc., and many others who specialize in solids bulk processing and pneumatic conveyance. We also visited the MnVAP facility in Wilmar, Minnesota to assess equipment and operations. We believe they employ several unit processes which our potential facility may benefit from.

Since submission of our Scope and Preliminary design, we have significantly refined the process based on the timely comments received from other project team members and recent developments in the industry. Our preparations for the upcoming review meeting include the submission of Revision 1 of the Scope and Preliminary design.¹

Our current efforts include refining individual unit processes such as de-twining and de-baling , also process integration, and sizing of the final pneumatic conveyance equipment to insure smooth integration with the ABB/CE burner installation. We intend to test unit processes to the extent practicable while final design efforts are undertaken. Our intent is to arrange and conduct tests, at manufacturers' facilities, of de-twining/de-baling, shredding, split flow metering, and pneumatic conveyance.

¹ (included in next quarter's report)

PRODUCTION ACTIVITIES

A cooperator agreement has been drawn up which will provide a tracking tool for the farm co-operators. A copy of the document is attached at the end of the report. (*Attachment Two*)

Soil Studies

Determine the effect of soil variability and environmental quality on switchgrass production.

Tasks:

- A cooperative agreement between Chariton Valley RC&D, Inc. and Iowa State University (ISU) Agriculture and Home Economics Experiment Station was developed that defined the terms and conditions of collaboration between these two organizations to complete the soil variability and environmental quality component of the project. (included in last Quarter's report)
- Graduate students, Neil Molestad, Soils, and Roque Lemus, Breeding and Agronomy, were assigned to work on this component of the project under the direction of Dr. Lee Burras during the course of their studies. Neil Molestad completed a status report (*Attachment Three*) *Soil and Landscape Characterization Status Report for Switchgrass Project*.
- Fertility plots have been established on approximately seven acres of switchgrass. Plots are located on a farm in Lucas County owned by a producer cooperating with the Chariton Valley Biomass Project. Plots include six replications of the following four treatments; 0, 50, 100, and 200 pounds of nitrogen.
- Initiated the assessment of soil variability including mapping the morphology variability in the nitrogen plots, collection of epipedon samples for fertility analyses, and evaluation of landscape position effect on yield for the 1997 growing season.
- Switchgrass productivity has been examined by collecting and analyzing yield resulting from four nitrogen treatments and five landscape positions.
- Assessment of environmental quality has been initiated by recording spatiality of rill and gully sizes in fertility plots. In addition, a protocol has been developed for the extensive evaluation of rill and gully development in switchgrass fields that will be implemented at multiple locations throughout the project area in 1998.

- A second site for an additional set of fertility plots has been identified. This site brings a new suite of soils into the study, which in conjunction with the existing site, will allow a good assessment of soil variability in the project area. Preliminary results indicate that soil variability in the initial fertility plots was not as great as the soil survey suggested. Even this less apparent variability still appears to significantly impact yield distributions due to landscape systematics, inherited soil fertility (e.g., available K levels, pH), and morphology differences.
- A significant limiting factor during this reporting period was unsuitable field and/or soil conditions for planned sampling. Specifically, once the switchgrass in fertility plots was mature weather conditions deteriorated such that fields remained too wet for deep soil sampling or even switchgrass harvesting.

Carbon Studies

An agreement has been reached with Professor Jerald L. Schnoor, Professor and Co-Director of the Center for Global and Regional Environmental Research, University of Iowa, to lead our efforts in verifying total carbon budgets. (*Attachment Four*) Prof. Schnoor brings many years of experience to the tasks. He is a world-respected scientist with extensive experience in Iowa carbon and carbon dioxide evaluation. Prof. Schnoor is highly regarded in Iowa and will be a valuable partner in the scientific evaluation of the switchgrass to energy industry.²

Switchgrass Production Economics

Determine the economic potential of switchgrass as an agronomic crop for bioenergy.

Tasks:

- A cooperative agreement between Chariton Valley RC&D, Inc. and Iowa State University (ISU) Department of Economics was developed that defined the terms and conditions of collaboration between these two organizations to complete the economic analysis component of the project. (Included in last quarter's report)

² Prof. Jerald L. Schnoor, Professor and Co-Director, Center for Global and Regional Environmental Research, 204 Iowa Advanced Technology Laboratories, Iowa City, Iowa 52242-1000, Ph. 319-335-3333 Fax 319-335-3337

- ISU Department of Economics recruited a graduate student in the College of Business, MBA Program, Chad Stuchis, who will work on the project's economic analysis under the direction of Dr. Michael Duffy during the course of his studies.
- Budgets for switchgrass production have been collected from several sources and are being analyzed. These budgets include Iowa estimates as well as those from other states, including Oklahoma. Review indicates that budget estimates are fairly consistent with variations explained by differences in assumptions.
- A questionnaire has been prepared and is being distributed to switchgrass producers cooperating with the Chariton Valley Biomass Project. The questionnaire is designed to collect preliminary data regarding switchgrass production including land value, previous cropping history, seeding rate, equipment used, chemicals applied, and yield. Meetings with individual producers are being planned to review and further develop information provided on the questionnaires.
- Discussions were initiated with Dan Otto and David Swenson with ISU Department of Economics, regarding analysis of the regional economic impacts of bioenergy crop production in southern Iowa. Data requirements for regional model development and application were discussed. Data sources are being identified.
- Project activities under consideration include a comparative analysis of alternative land uses with the production of switchgrass as a bioenergy crop and an ethnographic survey of the region to assess farmers' perception of switchgrass, and the ways in which they receive information regarding land use alternatives, and how they prefer to receive this information.

Switchgrass Yield Improvements

Evaluate and develop switchgrass and reed canarygrass germplasm for bioenergy production and adaptation to Iowa.

Tasks:

- A cooperative agreement between Chariton Valley RC&D, Inc. and Iowa State University (ISU) Agriculture and Home Economics Experiment Station was developed that defined the terms and conditions of collaboration between these two organizations to complete the switchgrass and reed canarygrass germplasm component of the project.

- Graduate students Neil Molestad, Soils, and Roque Lemus, Breeding and Agronomy, were assigned to work on this component of the project under the direction of Dr. Charles Brummer and Dr. Ken Moore during the course of their studies.
- Initiated assessment of yield and quality in relation to soil and landscape variability based on switchgrass samples collected from fertility plots and analysis of cell-wall components (cellulose, hemicellulose, lignin). Although final results have not been calculated over all treatments, preliminary results show significant differences among nitrogen treatments for these traits. Plans have been made with Dr. Stan Henning, ISU Soil Fertility, to evaluate S and Cl in these tissues.
- Switchgrass samples have been collected for seven points in time during the planned harvest period of October to April. An analysis of changes in biofuel characteristics of these samples over time will be performed later in 1998.
- Two plantings of twenty switchgrass cultivars and experimental germplasms were established in spring 1997 in the project area. One planting failed primarily due to herbicide damage. The second planting, located at the McNay Research Farm in Lucas County, was established successfully.
- In October 1997, the plots were rated for leaf disease symptoms and stand; no significant differences were apparent among entries. No biomass data were taken from the plots during fall/winter 1997-98 because of limited first year growth and the presence of annual weeds (foxtail predominantly). Plots have been mowed to limit the weed competition.
- A variety trial with seven commercially available cultivars of reed canarygrass germplasm (these are the only cultivars currently marketed) was established in Ames, Iowa in August 1997. This study includes two biomass harvest treatments: spring + fall and spring + late winter. The test plots established well and overwintered in excellent condition.
- All available accessions of reed canarygrass plant introductions were obtained from the USDA-NPGS, Pullman, Washington. Additionally, five accessions were obtained from Mia Sahramaa (Finland) and two collections were made by Dr. Brummer, (Jericho, Vermont and Fraser, Iowa). These will be evaluated in 1998.

- A small grant was obtained from the National Plant Germplasm System for plant introduction evaluations. These funds supplement DOE funds and will make a more substantial evaluation of this germplasm possible.
- A literature review of reed canarygrass utility for biomass was prepared. (*Attachment Five*)

Prairie Lands Bio-Products (Prairie Lands)

Prairie Lands Bio-Products, Inc., the not-for-profit farmer/producers group associated with the project, is currently holding meetings the first Monday of every month. (*Attachment Six*) The group has been gathering information on harvest and handling technologies and logistics of moving large amounts of herbaceous material. To that end, representatives attended a "Balers" meeting put on in Harlan, Iowa, by Great Lakes Chemical Company. The following summary is taken either directly or indirectly from Art Wiselogel's (NREL) trip report. Our thanks to Art.

On March 17, 1998 baler school was conducted by Tom Sheckenger and held in Harlan, Iowa. The objective of the meeting was to recruit new balers and haulers and to provide lessons learned from last year's effort. Dennis Lamb of Great Lakes Chemicals started off the meeting with introductions, background information on Great Lakes Chemicals, and a review of meeting objectives.

Next, Tom reviewed the baling effort of the previous year and covered points concerning:

- Wind row vs. broad cast spread of stover
- Paying up to \$14.16 per 1,200 lb. bale
- Incentives to maintain an average bale weight of +1,200 lb.
- Directions to the fields, maps, and checking that the correct field is being baled
- Profit to the farmer -- can increase the profit per acre by up to \$19.20
- Ruts in the field
- How weight of the bale affects the baler -- The denser the bale the higher the value of the bale
- Price for hauling -- the faster the better -- fast tractors make sense up to 30 miles
- Parts pool
- Communicating with the farmers
 - Ruts
 - Small bales
 - Broken bales
 - Progress on fields
 - Timing
 - The faster the heavier the bales -- the more efficient the baler -- the more money he can make

Net wrap increase speed by 25% over twine
Chopper can make a tighter bale
Rakes on the front of the tractor can increase number of bales per acre

Tom's final point was that the farmer is the baler's customer and that the baler should always be aware of that fact.

After Tom's presentation the vendors provided a brief description of their products.

Anderson Machinery in line wrapper

ProAg balers

Hesston balers

John Deere balers

Heartland Manufacturing – Lic. modifier of John Deere

Vermeer balers

Mercedes-Benz – Unimogs – fast tractors

Gehl balers

Golden View Fabricating – Specialty bale hauling trucks and pickup systems

JCB – fast tractors

The final section of the meeting consisted of a panel of balers and haulers who reviewed how well various baling and hauling strategies worked. This session focused on the technical aspects of baling as well as time management, repairs, and proper equipment.

February 1998

- At the February meeting of Prairie Lands there was discussion about the relative advantages and disadvantages of setting the group up under a variety of different legal structures. The Farm Bureau has offered to help with counsel and the Farm Service Agency and Small Business Development Center have become actively involved with this aspect. A grant proposal was written and submitted to the Rural Business-Cooperative Service's Cooperative Value-Added Program. (*Attachment Seven*)
- Continued work on the FY98-99 Statement of Work and Budget revisions.
- Tom Scheckenger Field Coordinator, Great Lakes Chemical Corporation, came to discuss their operation and some of the things they were finding. They figure \$1.00 to \$1.25/bale for surface wrap. The IDOT limits their trucks to 102" wide with a product load of 120". Their cost for corn stover is \$29/ton with the landowners and baler paid. They harvest a couple of months following corn harvest.

- Other interesting points brought up by Prairie Lands producers were that square balers weighed 14,000 pounds while round balers weigh 6,000, and producer stated that he could bale 35-40% more tonnage with a big square baler than with a round baler in the same time. These are important points because, the additional weight will cause soil compaction with the resulting yield losses while the faster baling reduces labor and machinery costs.

Accomplishments in the Field

- Field staff completed the harvest plan for the 1997 crop year. Three hundred twenty-five acres will be harvested which represents a combination of CRP and DNR acres that are established in switchgrass. Five hundred tons are expected to be harvested from these acres.
- Sign-up for the 4,000 acres is virtually complete. Some contracts have not yet been returned, some have been called and the problem is just neglect, they all intend to participate. Some Prairie Lands members have not yet decided how many acres they will plant.
- Cropping system alternatives put together in a draft that has been submitted to Gerald Miller and Steve Barnhart for review and comment. A conference call has been arranged to refine this proposal.
- One thousand pounds of the quality pellets were delivered to a pellet stove dealer for some test burning. Received and passed on the pellet plant drawings from the Universal Pellet Mill Company. These plans will be used as part of the feasibility study. Discussed with several of the Prairie Lands board members ways to get the members involved in the project and ways to generate dollars for the organization.
- A set of information criteria has been developed that will be included in each farmer cooperators' folder.
- Contact was made with Tim Miester, John Deere representative, regarding the harvest on the DNR land. A follow-up meeting was scheduled to work out the details.
- A final plan for a storage study to be completed on the DNR land was worked on, provided harvest takes place this season. It will include on-the-ground storage as well as inside storage - covered and uncovered -- square and round bales.

- Alan Teel attended and made presentation to the Wisconsin Ecosystems Research Project winter meeting. Seventy-five people were in attendance. This outreach activity will provide an additional opportunity for the project to be involved with other projects that have similar interests and goals.
- Tim Miester, John Deere representative, and three of his associates met with Marty Braster, Jim Schweizer and Alan Teel. A discussion was held on the possibilities of using a chopper to harvest switchgrass. John Deere expressed interest in working with the project to harvest the lodge land area.

Problems Encountered

- Weather continued to delay project field activities.
- Initiated contacts with (1.) cooperators that will seed this spring; (2.) those that have seeded switchgrass in the past two years and; (3.) those that have switchgrass established, to complete a management plan.

INFORMATION AND EDUCATION

Information and education remain a priority with the project. The project visibility has continued to increase and it is now common to hear people on the street all around the State reply that they have heard of the project. The reaction heard is always positive. No project member has received a negative response from local residents. This is unusual for any project of this scope. One reason for the success in the public support arena is our information and education efforts. A list of recent efforts is included at the end of this report. (*Attachment Eight*)

Monthly Conference Call Established

The Project has established a regular monthly conference call among the participants. The justification is to increase the level of communication among the participants and to better enable the progress of the tasks to be monitored. The members have all been very supportive of the effort and after the first two calls all have seen the benefit of these short "remote meetings".

March 1998 Call

This note is to ask you to participate in a biomass project conference call on Monday, March 2 at 2:00 p.m. We would like to have these calls on a monthly basis in an effort to ensure communication between project partners. We will try to keep most calls to less than 30 minutes. This first call will probably last a little longer. Following is a list of participants and phone

numbers that we will have the operator call. Please let me know if your schedule will not permit you to participate or if we need to contact you at a different number.

Conrad Anderson 608-833-6575

Robert Brown 515/294-7934

Charlie Brummer 515-294-1415

Lee Burras 515/294-0559

Mike Duffy 515/294-6160

Jerry Miller 515/294-1923

Gary Walling 319/398-7696

Ed Woolsey, Alan Teel, Jim Cooper, Marty Braster at RC&D office

NOTE: If it is possible for two or more participants at ISU to share a phone (one number), it would be appreciated. Please let us know. We would like to propose that agenda items for next Monday's call include updates on the following items. Please take a minute to prepare any related comments, questions and/or requests for assistance from other partners:

1. FY98 budget
2. Co-fire test
3. Design of system and facilities at OGS
4. Gasification R&D
5. Switchgrass fuel supply
 - Identification of farmer cooperators
 - Fertility and variety trials
6. Economic analysis
7. Environmental impacts and GIS analysis
8. Other items
9. Next meeting or conference call

April 1998 Call

This note is a reminder of the biomass project conference call on Monday, April 6, at 2:00 p.m. As previously mentioned, we would like to have these calls on a monthly basis. Right now, we suggest the first Monday of the month at 2:00 p.m. Let us know if this conflicts with other regularly scheduled items.

Following is a list of participants and phone numbers that we will have the operator call. Please let us know if your schedule will not permit you to participate or if we need to contact you at a different number.

Conrad Anderson 608-833-6575

Robert Brown 515-294-7934

Charlie Brummer 515-294-1415

Lee Burras 515-294-0559

Mike Duffy 515-294-6160

Jerry Miller 515-294-1923

Gary Walling 319-398-7696

Marty Braster, Jim Cooper, Alan Teel, Ed Woolsey, at RC&D Office

We would like to propose that agenda items for next Monday's call include updates on the following. Please take a minute to prepare any comments, questions, and/or requests for assistance from others:

April Agenda:

1. Status of biomass project funds
2. Design of system and facilities at OGS, ABB/CE tasks for current project phase Trip to MnVAP Comparison of harvest and transport alternatives. Resume co-fire test preparations
3. Gasification R&D work at ISU and with Energy Research Corporation
4. Switchgrass fuel supply activities with project cooperators' fertility trials early 1998 harvest
5. Economic analysis
6. Environmental impacts
7. Other items
8. Monthly/quarterly reports
9. Next meeting or conference call: Monday, May 4 at 2 P.M.

MnVAP

On January 14, 1998, a trip was made to visit the MnVAP facility at Wilmar, Minnesota. A very productive meeting was held with much being learned about harvest and handling logistics as well as bale processing. The MnVAP group was very knowledgeable and helpful. It was clear to all that by working together we could accomplish more than working separately. Some of the important points we learned:

- Twenty-three bales per load with \$1 bale being paid for loading
- Minimum of 34 bales are staged for loading and the field edge with 48-52' trailer loads
- Delivery is the biggest problem, they are moving to sector purchases
- The co-op buys in the field

- They will target a 50 mile radius for their power production purchases
- They currently process 50,000-55,000 tons per year and can go to 70,000
- Pay \$65-\$70/ton for alfalfa at plant and \$63-\$65 in the field
- Pay \$25/ton for grass
- Land prices average about \$1,800 per acre
- They successfully use Williams High Tonnage Mills 314-621-3348 and a Aerosmith cutter/grinder
- Use a consultant from Portland, Or. Brian Figelskeski, 503-852-6023

MISCELLANEOUS

Several events have happened in Iowa during the quarter. The following is a brief description, some which may affect the project or show the political mood in the State.

- The Iowa Utility Board rescinded a proposed ruling which would have overturned Iowa's Net Billing Rule. Currently investor owned utility customers are allowed to "net bill" from and Alternative Energy Production facility regardless of size. The Iowa Utility Board rescinded the proposal in response to overwhelming public response. A public hearing which was held, produced no less than 20 speakers against the ruling and only one in favor. Several organizations helped with the effort including the Solar Energy Industries Association, Union of Concerned Scientists, Izaak Walton League, and American Wind Energy Association. This kind of coalition building is very important to these types of successes.

PRESS RELEASE FOR IMMEDIATE RELEASE: March 18, 1998

CONTACT:
Lisa Davis Cook, Iowa SEED Coordinator
515-277-5077, x13
Lara Levison, Union of Concerned Scientists
800-685-8273

Yesterday, Iowa legislators and regulators reaffirmed Iowa's commitment to renewable energy. At stake was a practice known as "net-billing," which promotes investments in alternate energy systems. The Iowa Senate voted 42-0 in favor of net-billing (Senate File 2390), while the Iowa Utilities Board withdrew a December draft order to eliminate its net-billing rule.

"The Iowa Utilities Board was deluged with testimony supporting net-billing," noted Brad Lint, Executive Director of the Iowa Citizen Action Network, which coordinates the Iowa

Sustainable Energy for Economic Development (SEED) Coalition. "Iowa citizens spoke loudly and clearly in support of alternate energy, and regulators and legislators heeded the message."

For a number of years, rules promulgated by the Iowa Utilities Board have allowed customers to install alternate energy electricity generators, such as wind turbines or solar panels, to produce their own electricity. Net-billing makes it easier and more affordable for citizens to invest in alternate energy. The customer has one meter, just like other electricity users. When the renewable energy system is generating electricity, any excess power that is not used by the customer flows out through the meter into the electricity grid, making the meter spin backwards. When the customer needs extra power, he or she purchases electricity from the utility company, and the meter spins forward. The customer is charged only for the difference between electricity received from the grid and electricity supplied to the grid.

Spirit Lake Community Schools, which has one wind turbine operating under a net-billing arrangement with IES Utilities, solicited a bid for a second turbine a year ago. "We haven't been able to move ahead with our second wind project, because our utility says they won't agree to it as long as the situation with net-billing is uncertain," reported Harold Overmann, Superintendent. "Without net-billing, it is not economically feasible for Spirit Lake Community Schools to invest in another wind turbine. We are very pleased that the Iowa Utilities Board has withdrawn its order to end net-billing, and we are delighted that the Iowa Senate has overwhelmingly affirmed Iowa's net-billing policy."

"Yesterday's decisions put Iowa back in sync with other states in the region," said Lara Levison, Regional Energy Advocate with the Union of Concerned Scientists. "Minnesota and Wisconsin already have net-billing, and Illinois and Nebraska are considering it."

"Net-billing encourages the growing number of small businesses and individuals in Iowa engaged in the development of clean, Iowa-based energy," said Ed Woolsey, Iowa Renewable Energy Association board member. "This is a great victory for the SEED Campaign, and a huge boost for Iowa's up and coming renewable energy industry."

A number of national organizations helped SEED's Iowa-based groups with the effort to save net-billing, including the Solar Energy Industries Association, Union of Concerned Scientists, Izaak Walton League, and American Wind Energy Association.

Lara Levison
Field Representative, Energy Program
Union of Concerned Scientists
tel: 202-332-0900
fax: 202-332-0905

- The Iowa Senate passed 42-0 a piece of legislation which would make the Iowa net billing rule a formal law. The session ended prior to the bill making it to the House.
- Royce Stanley, Bureau Chief of the Iowa Department of Natural Resources Energy Bureau, has been replaced by Ms. Sharon Tahtinen. Sharon brings much Project experience with her to the new position.
- One of Iowa's large Investor Owned Utilities (IOUs) Mid-America Energy is attempting to add a line item charge on to customers bills which details the amount of money they claim to be spending on renewable energy/energy efficiency programs. This could seriously undermine support of for renewable energy programs if not accompanied by a public education effort.
- Project representatives met with U.S. Senator Grassley's Iowa staff to discuss the changing of wording which would allow the project to qualify for the biomass tax credit.

ATTACHMENT ONE

SWITCHGRASS SAMPLE ANALYSIS

Fuel Analysis for Lucas County IA Switchgrass Samples

	Fall Harvest 10/96	Spring Harvest 4/97
Proximate (w%) as received		
Moisture	7.88	6.51
Ash	4.53	2.93
Volatiles	72.97	78.38
Fixed Carbon	14.62	12.18
Higher Heating Value (Btu/lb)	7370	7485
Ultimate (w%) as received		
Moisture	7.88	6.51
Carbon	44.70	46.16
Hydrogen	5.57	5.25
Nitrogen	0.29	0.26
Sulfur	0.05	0.05
Ash	4.53	2.93
Oxygen*	36.98	38.84
Chlorine**	0.08	<0.01
Elemental Ash Analysis (w% of fuel) as received		
SiO ₂	3.09	4.82
Al ₂ O ₃	0.022	0.058
TiO ₂	<0.0004	0.003
Fe ₂ O ₃	0.028	0.051
CaO	0.295	0.768
MgO	0.126	0.118
Na ₂ O	0.009	0.006
K ₂ O	0.380	0.210
P ₂ O ₅	0.240	0.156
SO ₃	0.082	0.075

*Oxygen determined by difference

**Chlorine not usually reported as part of the ultimate analysis

ATTACHMENT TWO

***CHARITON VALLEY BIOMASS PROJECT
COOPERATOR AGREEMENT***

CHARITON VALLEY BIOMASS PROJECT COOPERATOR AGREEMENT

Chariton Valley Resource Conservation & Development (RC&D) together with a number of partner agencies and organizations has been working on a project that will use switchgrass as a fuel source or "biomass" to generate electricity. Plans are to one day combine switchgrass with coal as fuel for the IES Utilities power plant near Ottumwa. Biomass energy crops, like switchgrass, can reduce erosion, protect water quality, and provide a reasonable income for producers in southern Iowa. The RC&D has entered into an agreement with the USDA Farm Service Agency that allows the biomass project to use switchgrass produced on land enrolled in the Conservation Reserve Program (CRP) while the producer continues to receive his or her regular CRP payment.

TERMS OF COOPERATION IN THE BIOMASS PROJECT

- The land owner and RC&D enter into this written agreement that describes the terms of their cooperation to use the land enrolled in CRP described on the following page in the Chariton Valley Biomass Project.
- The RC&D will reimburse the land owner up to 50% of the cost of seed used to establish new switchgrass plantings on land being enrolled in CRP should the RC&D determine that the land subject to this agreement will be used in the project.
- The RC&D will reimburse the land owner 100% of the cost of seed and chemicals, up to \$100 per acre, used to convert cool season grass to switchgrass on land in CRP should the RC&D determine that the land subject to this agreement will be used in the project.
- This agreement will be effective for the period of time that the land subject to this agreement is enrolled in CRP. In the event that the land owner requests that this agreement be terminated, the land owner will reimburse the RC&D the amount paid by the RC&D to establish switchgrass on land enrolled in CRP subject to this agreement.
- The land owner will continue to receive his or her CRP payment. The land owner will continue to be responsible for the maintenance of their CRP contract requirements.
- The RC&D will be allowed to harvest switchgrass from land enrolled in CRP described on the following page during the life of this agreement. The RC&D will be responsible for all costs associated with the harvest, transportation and storage of the switchgrass.
- A biomass management plan will be developed by the RC&D and land owner for land enrolled in CRP that will be used to produce switchgrass for the biomass project. The land owner will consult with the RC&D before beginning management practices on land in CRP that is subject to this agreement.
- The RC&D will provide technical assistance on request to help land owners with the establishment and management of switchgrass plantings for the biomass project.

Please complete the information on page 2 -- sign in the space provided and
return to the address listed below.

CHARITON VALLEY BIOMASS PROJECT COOPERATOR AGREEMENT

Please help us complete the information below -- sign and date in the space provided.

1. PRODUCER'S NAME

Last

First

Initial

2. MAILING ADDRESS

City

State

Zip Code

3. TELEPHONE NUMBER ()

4. CRP CONTRACT NUMBER

5. LOCATION OF CRP TRACT

Township Name

T

N

R

W

Quarter of Section

of

County

NOTE: *Aerial photographs of land subject to this agreement will be attached.*

6. Number of acres in this CRP contract:

Acres

7. Date the CRP contract expires:

Date

8. If in switchgrass, number of acres and when was it seeded?

Acres

Date

9. If a new contract, switchgrass acres and when will it be seeded?

Acres

Date

LANDOWNER'S NAME

LANDOWNER'S SIGNATURE

DATE

OPERATOR'S NAME

OPERATOR'S SIGNATURE

DATE

RC&D REP. NAME

RC&D REP. SIGNATURE

DATE

NRCS

FSA

ATTACHMENT THREE

***SOIL & LANDSCAPE CHARACTERIZATION
STATUS REPORT
FOR
SWITCHGRASS PROJECT***

**Soil and Landscape Characterization Status Report for Switchgrass
Project**

**Neil Molstad
February 17, 1998**

My name is Neil Molstad. I was hired by as a research assistant by Dr. Lee Burras in May of 1997 to assist the Chariton Valley Resource Conservation and Development with their switchgrass biofuel project. Specifically, I was asked to intensively characterize the landscapes where test plots of switchgrass are being grown and compare these soil characteristics with plant properties. I was also asked to examine the environmental impacts of switchgrass growth on marginal soils, especially surface erosion. Mr. Roque Lemus is responsible for the plant component of this study. In addition to working on this project I am also earning a M. S. degree at Iowa State University. The purpose of this paper is to give a brief summary of what work was done on this project last year and our research plans for 1998 and the spring of 1999.

1997 Research Summary

July 1997

Reported to Iowa State University to begin research work. Traveled to Centerville, Iowa and met the Chariton Valley RC&D group. Also met Mr. Alan Teel, who works for Iowa State Extension in Clarke county, and Mr. Tyler Jacobsen, who is a GIS specialist for Golden Hills RC&D in Oakland, Iowa. Examined CRP field in Appanoose county and visited CRP research plots in Lucas county.

August 1997

Began sampling on CRP land in Lucas county. This land had four differing treatment levels of nitrogen applied in a randomized block design in the spring of 1997, giving six replication plots across the landscape. We began by flagging the edges of each plot and each nitrogen treatment level within the plot, then flagging five sample sites at each level. These sites were evenly spaced down the treatment row and kept even with other treatment sites in the plot where possible, for the plots differed in length. This added up to 20 sample sites for each plot. It is from these sites that I did surface and hand core sampling and Roque his above ground biomass measurements. After the edges of all the plots were identified, Mr. Jacobsen recorded these points with a portable GPS unit to use as an aid in mapping the plots.

September 1997

Continued with surface sampling of plots and began hand core sampling. Completed both surface and hand core sampling for replications I and II. Dried and ground up samples for testing purposes.

October 1997

Met with Mr. Jacobsen, who had produced maps of the plots from the GPS data taken in August. These maps gave an aerial view of the plots along with elevation and soil map unit data. Mr. Jacobsen and I discussed the possibility of using GPS to determine the area of each hay bale when the plots are harvested. Also used saturated soil method to obtain preliminary pH values for replications I and II from surface samples.

November 1997

Roque and I met with Mr. Teel to plan the harvest of the grass. Prepared the plots for harvest.

1997 Findings

I recorded the following observations and field notes when taking surface samples:

- Date of Collection
- Weather Conditions
- Regional, Local and Microrelief
- Slope and the Aspect of the Slope at the Site
- Erosion Characteristics Observations
- Drawn Sketch of Sampling Site
- Soil Color (using Muncell Soil Color Book)
- Moist Soil Consistence
- Soil Structure (Grade, Type)
- Soil Texture (using USDA classification)
- Amount of Nitrogen added to this plot
- Any other distinguishing characteristics (mottles, concretions, coarse fragments, etc.)
- General field notes about conditions at this site compared to other sites in the same plot- trends and inclinations

Appendix A is a table that contains surface sample observations for each of the soil types found at the Lucas county plots.

Hand core samples were taken at the same sample sites as the surface samples. Core length and A horizon depth measurements were made for these samples. All of the samples were air dried, ground, moved through a 2 mm sieve, and stored.

The following figure shows a graph of A horizon depth measurements compared with the total length of the core:

Figure 1 A Horizon Depths from Hand Cores Reps I and II

The figure shows that there is extensive variability in A horizon depth across the landscape. An important component of our research will be to determine what effects if any this depth has on switchgrass yield and other chemical properties. A general statistical analysis showed that there was no statistical difference between the average depths of the two plots sampled so far (P-value of .1341). As the rest of the Lucas county plots are sampled this spring and the results of this sampling correlated with the plant data, a more complete picture of how this depth property might effect switchgrass will fall into place.

The graph at the top of the following page shows the results of the pH tests mentioned previously. Keep in mind that these values are not precise due to the nature of the procedure used to measure this property, and that a better testing method will be used when the samples are sent to be tested for fertility.

Figure 2: Preliminary pH values for Reps I and II

The figure shows most of the pH values for the two plots to be between 6.0 and 6.4. While this value is slightly lower than optimal, it should not pose any nutrient availability problems. Again, more will be known once the samples are professionally tested.

Comments on 1997 Work

Overall I was very pleased with how smoothly the preliminary stages of the project went. Roque and I want to thank both Mr. Teel and Mr. Jacobsen for all of their help and suggestions. I was especially pleased with the way the maps using the GPS equipment turned out. I hope to make even more use of our GPS capabilities as my research progresses. Our only setback so far has been that we were not able to harvest the switchgrass last fall like we wanted to due to inclement weather. We should be easily able to get this task accomplished this spring. Roque and I are also confident that the work we did this past summer and fall have provided a good basis for our work this coming year and in 1999. The next section of this report will provide a tentative plan of action for my research for the next year and a half.

Proposed Research Plans for 1998 and 1999

After consulting with Dr. Burras, we decided that I should focus on three approaches as I continue with my research.

1. Intensive surface sampling

This will involve continuing to take surface samples for the remaining four plots at the Lucas county site. This site contains the Grundy-Haig-Arispe soil association along with Clarinda soils closer to the ditches and streambeds. These soils make up a large part of the soils found in the Lake Rathbun watershed, and can be extrapolated to include similar soil associations such as the Seymour-Edina-Clarinda and Lindley-Weller-Keswick associations. All of these soils are silty clays and silty clay loams. However, the Armstrong-Gara association is a loam soil, and I would hesitate to apply results found at the Lucas county plots to this soil association. This soil association also constitutes a part of the Rathbun watershed. I would like to find a CRP switchgrass plot similar to the Lucas county plots that have Armstrong-Gara soils and set up another set of treatment plots. This would give me intensive data from the two main soil types in the region from which I could contrast all of the major soil properties and relate the results to the plant data that Roque collects.

After I have finished collecting the surface samples they will be sent to the soil testing lab here at Iowa State. The results from these tests will be correlated with the data Roque collects in the following ways:

- Organic carbon in soil to carbon in switchgrass
- Percentage nitrogen in soil to concentration of specific proteins such as lignin in the grass
- Soil structure to above ground biomass of grass
- Soil pH to grass yield

These results will be correlated by field, by replications within fields, and by treatments within replication plots. As we progress with our sampling other statistical comparisons will probably also be found.

2. Hand and deep cores of intensively sampled plots

I will continue to hand core sample the Lucas county plots at the same sample sites as where I have surface sampled. Also, I will hand core at the surface sampling sites when another plot containing the Armstrong-Gara soil association is located. In addition to hand cores, I would like to take deep core samples of all of the intensively sampled fields. This would involve the use of a probe truck owned by the Agronomy Department. I would take a random sample of cores across the landscape of each

field. This would probably add up to approximately 50 cores. Both the hand and deep cores would be used for similar analyses with plant data as the surface samples.

3. Rill and gully measurement for soil and water quality

One of the things I have noticed when taking samples is the occasional occurrence of a few rills and gullies in the fields. Some are of small size while others have grown fairly deep. It was surprising to find this erosion occurring since the land has been under permanent cover. I feel that this is something that should be looked at more closely. What I would like to do is travel to as many CRP sites that contain switchgrass (or even other types of forage grasses similar to switchgrass) as possible and record observations of any rill or gully formation in these fields. Then I want to randomly select 10 to 20 of these fields for measurement of rills or gullies. From these measurements and the availability of histories of these fields I would be able to estimate the rate of rill and gully formation. This would provide valuable evidence on how the growth of switchgrass on marginal soils impacts the loss of soil by water erosion.

Again, I am extremely pleased with the progress I have made so far, and look forward to continuing my work on this project. If you have any questions or suggestions on how I can make my research better, please do not hesitate to contact me at (515) 294-7162 or by e-mail at shroom@iastate.edu.

Appendix A Surface Soil Sample Observations

Replication and Site Number	Replication I Site 3b	Replication I Site 2d	Replication I Site 1e
Soil Mapping Unit	364B	23C2	222C2
Regional Relief	loess over paleosol/till	loess over paleosol/till	loess over paleosol/till
Local Relief	upland sideslope	upland sideslope	upland footslope
Microrelief	slight undulations at site	rolling ground, wavy undulations at site	ground undulates very slightly
Slope in Degrees	4-5%	2-3%	1-2%
Aspect of Slope	ground slopes north/northwest	ground slopes north/northwest	ground slopes north/northwest
Erosion Observations	good ground cover, low spots seen which could indicate rill formation	poor ground cover, large bare areas seen, definite rill formation	good ground cover, slight depressions but no real rills
Soil Color Value	10 YR	7.5 YR	10 YR
Soil Color Hue		3	4
Soil Color Chroma		1	2
Moist Soil Consistence	very friable	friable	friable
Soil Structure Grade	03 (strong)	02 (moderate)	02 (moderate)
Soil Structure Type	subangular blocky	angular blocky	subangular blocky
Soil Texture	silt loam	silty clay loam	silt loam
Other Distinguishing Characteristics	no concretions or mottles	mottles seen close to surface	few mottles seen
Amount of Nitrogen Added to Plot	200 lbs N/acre	0 lbs N/acre	100 lbs N/acre

Appendix B Map of Lucas County CRP Plots West Fields

Replication II Information

Row 1 200 lbs N/acre, samples 75' apart

Row 2 0 lbs N/acre, samples 60' apart

Row 3 50 lbs N/acre, samples 45' apart

Row 4 100 lbs N/acre, samples 30' apart

All row plots are 50' wide.

Area of plots is 9 acres.

Replication I

Replication I Information

Row 1 100 lbs N/acre

Row 2 0 lbs N/acre

Row 3 200 lbs N/acre

Row 4 50 lbs N/acre

All samples 65' apart

Appendix C Map of Lucas County CRP Plots East Fields

Replication IIIB

Row 1 100 lbs N/acre, samples 30' apart
Row 2 50 lbs N/acre, samples 40' apart
Row 3 0 lbs N/acre, samples 45' apart
Row 4 200 lbs N/acre, samples 45' apart

Replication IIIS

Row 1 0 lbs N/acre
Row 2 200 lbs N/acre
Row 3 50 lbs N/acre
Row 4 100 lbs N/acre

Replication IIB

Row 1 50 lbs N/acre
Row 2 100 lbs N/acre
Row 3 200 lbs N/acre
Row 4 0 lbs N/acre
All samples 45' apart

Replication IB

Row 1 200 lbs N/acre
Row 2 50 lbs N/acre
Row 3 0 lbs N/acre
Row 4 100 lbs N/acre

All samples in Replications IIIS and IB are spaced 35' apart.

All rows are 50' wide.
Area of plots is 35 acres.

ATTACHMENT FOUR

***AGREEMENT
WITH
CENTER FOR GLOBAL REGIONAL ENVIRONMENTAL
RESEARCH***

THE UNIVERSITY OF IOWA

COPY

October 15, 1997

Jim Cooper
Chariton Valley RC & D
RR 3, Box 116A
Centerville, Iowa 52544

Dear Jim:

Enclosed is the budget and a proposal for the Center for Global and Regional Environmental Research (CGRER) to develop estimates of net greenhouse gas emissions (and savings) due to the co-firing of switchgrass from the Chariton Valley RC & D project.

CGRER would provide a full written report in terms of expected life cycle emissions of the project and the no action alternative (100% coal-fired power). We will complete the study in one year, and we will provide you with a progress report at the mid-point of the study (June 30, 1998).

We think it is an exciting project, and we look forward to working with you on it. If you have any questions, please do not hesitate to call upon me.

Sincerely yours,

Gerald L. Schnoor
Professor and Co-Director

JLS:jsf

Enc.

cc: Floyd Barwig, Iowa Energy Center

PROPOSED BUDGET
1 January, 1998 - 31 December, 1998

I.	Personnel	
A.	J.L. Schnoor, PI 1% time, academic year	\$ 1,200
B.	Richard Ney, Ph.D. student research assistantsh, 50% time	<u>15,500</u>
		\$ 16,700
II.	Fringe Benefits	
A.	J.L. Schnoor, 23% of salary	276
B.	R. Ney, 8.5% of salary	<u>1,318</u>
		\$ 1,594
III.	Travel	
A.	Travel to field site, 2 people x 2 trips	200
B.	Travel to Iowa energy meetings, 2 x 2	<u>400</u>
		\$ 600
	TOTAL DIRECT COSTS	\$ 18,894
IV.	Indirect Costs 47% of Direct Costs	<u>8,880</u>
	TOTAL COSTS	\$ 27,774

Proposal to RC&D

The Center for Global and Regional Environmental Research (CGRER) proposes to assist RC&D in development of estimates of net greenhouse gas emissions (in CO₂-equivalents) from switchgrass growth, harvest and combustion as compared to coal mining, processing and combustion in an existing electric generation facility. The difference in CO₂-equivalent greenhouse gas emissions between a switchgrass-coal cofiring scenario and a one hundred percent coal combustion scenario will then be used to generate a cost or savings figure, using the latest available data regarding the value of carbon dioxide emission credits in the international marketplace.

ESTIMATION OF LIFE-CYCLE EMISSIONS

To the extent possible, the analysis will estimate CO₂-equivalent emissions from production through combustion for both switchgrass and coal. The level of certainty will be impacted by the availability and reliability of data concerning fuel use during production of various materials or operations, most significantly including fertilizer production, herbicide production, coal mining and coal refining. The following, direct emission sources will be investigated in detail:

Switchgrass

<u>Process</u>	<u>Aspect Creating Greenhouse Gas Emission</u>
Fertilizer Production	Energy consumed during production Direct emissions from production processes
Herbicide Production	Energy consumed during production Direct emissions from production processes
Transportation of chemicals to the field	Fuel combustion, distance
Soil Preparation	Soil disturbance
Planting	Fuel combustion
Chemical Application	Fuel combustion Direct emissions from chemical application
Growth	Carbon Uptake
Harvest	Fuel combustion
Biomass Preparation for Use as Fuel	Energy used to chip or bale biomass
Transportation of Fuel to Combustion Facility	Fuel combustion, distance
Combustion	Fuel combustion
Transportation of Wastes to Landfill	Fuel combustion, amount of material hauled
Attributable Landfill Emissions	Direct emissions from decay processes
Impact of Alternative Land Use	Carbon uptake from a likely land use alternative to switchgrass

A similar cradle-to-grave approach will be undertaken to analyze coal-related greenhouse gas emissions. It will be assumed that the power plant is presently burning low-sulfur coal from the western United States (Wyoming and Utah). Confirmation will be sought from the power plant operators.

Coal

<u>Process</u>	<u>Aspect Creating Greenhouse Gas Emission</u>
Coal Mining	Energy used during mining operations Direct emissions from exposed soils
Coal Refining	Energy used during refining operations
Transportation of Coal to Rail Transport	Fuel combustion, distance
Rail Transport to Iowa	Fuel combustion, distance
Transportation to Power Plant	Fuel combustion, distance
Coal Preparation for Use as Fuel	Energy used to crush/modify coal
Combustion	Fuel combustion
Transportation to Landfill	Fuel combustion, amount of material hauled
Attributable Landfill Emissions	Direct emissions from decay processes

CONVERSION TO DOLLAR VALUES

Upon completion of the CO₂-equivalent greenhouse gas emission estimates for each fuel, CGRER will compare the emissions of the two fuels to determine the cost/benefit presented by combustion of switchgrass in place of coal at the Ottumwa Generating Station. The net reduction/increase in greenhouse gas emissions will then be converted to dollar values by utilizing the most current market value for carbon dioxide emission credits. There have been reported purchases of CO₂ emission credits, however, the future value of these credits is yet to be determined. Actions at the international global climate change summit in Kyoto, Japan in December 1997, will have significant impact on the value of CO₂ emission credits. CGRER will utilize current market values if they are clearly established by the conclusion of this study, or the best available predictions of CO₂ emission credit values at the time.

ANALYSIS OF SO₂ and NO_x EMISSIONS

In addition to performing the life cycle analysis of CO₂-equivalent emissions for switchgrass and coal, CGRER will estimate emissions of sulfur dioxide (SO₂) and nitrogen oxides (NO_x) from combustion of these fuels at the electric generation facility. The difference in SO₂ and NO_x emissions from each scenario will also be converted into dollar values by using the current established values for SO₂ emission credits and NO_x emission credits. Both SO₂ and NO_x emission credits are traded in United States markets. These pollution credit markets were established by Title IV of the 1990 Clean Air Act Amendments in response to concerns over acid rain-causing emissions. The SO₂ market is well established, having been in place for several years. The NO_x emission credit market is not yet active, however, it is expected that the United States Environmental Protection Agency (USEPA) will be able to provide an assumed market value for NO_x emission credits. Calculation of the value of SO₂ and NO_x emission reductions or increases due to the replacement of coal by switchgrass will help further clarify the economics of such an operation.

STAFF

This project will be led by Professor Jerald Schnoor who will be assisted by Richard Ney. Together, they have completed two statewide greenhouse gas emission inventories, and the Iowa Greenhouse Gas Action Plan. Richard is a Ph.D. student in Civil and Environmental Engineering, and is an environmental consultant, specializing in Air Quality issues.

ATTACHMENT FIVE

***A LITERATURE REVIEW
OF
REED CANARYGRASS UTILITY FOR BIOMASS***

A LITERATURE REVIEW OF REED CANARYGRASS UTILITY FOR BIOMASS

Biofuel Potential of Reed Canarygrass, a literature review

(submitted as part of a grant proposal to the National Plant Germplasm System)

Perennial herbaceous crops contribute a number of desirable attributes to cropping systems: limiting soil erosion, improving water quality, diversifying salable farm products, and, when grown in rotation, breaking pest cycles endemic to annual grain crop production systems. On marginal crop land, the effect of returning to perennial plants has an even greater positive effect on erosion control. Costanza et al. (1997) indicate that grasslands provide more valuable ecosystem services than crop land, but that value is often overlooked in traditional commodity-driven economics. However, given the increasing importance given to environmental issues at the national level, perennial grass crops may play an increasing role in agricultural systems. Certainly, enhancing the production and/or quality of grasses will further their adoption and integration.

In addition to forage uses, perennial herbaceous crops can be grown for other reasons, such as biomass for energy. Conversion of plant biomass to fuel, either through fermentation to ethanol (Lynd et al., 1991) or via direct burning to generate electricity (McLaughlin, 1993), has a number of desirable attributes, including a reduced dependence on foreign fossil fuels and stabilizing greenhouse gasses in the atmosphere through carbon and nitrogen cycling. Other uses of these crops include paper pulp, hardboard for building construction, and pellets for use in home heating (Thons and Prufer, 1991; A. Teel, pers. comm.). Unfortunately, little effort has been directed toward the genetic characterization and improvement of most grasses for these varied uses.

Switchgrass has been identified as a model plant for biomass production based on its productivity in various environments in the United States (Cushman and Turhollow, 1991; Sanderson et al., 1996). Though switchgrass clearly represents an important biofuels crop, it does have limitations. Being a C₄ species, switchgrass performs particularly well in hot environments. It does not produce as well relative to cool-season grasses in cooler climates typical of the upper Midwest as it does at lower latitudes; switchgrass also performs poorly on wet soils (Cushman and Turhollow, 1991; Wright, 1988).

The reliance on a single species of herbaceous crops for biomass production is risky. Abundant ecological literature suggests that increasing the diversity of species in a given area improves the temporal and spatial yield stability of the system (e.g. Tilman et al., 1996). Further, functional diversity and composition (i.e. types of species--warm-season, cool-season, legume, etc.) appear to be particularly important in developing these stable systems (Tilman et al., 1997). Crop monocultures may have higher productivity than a diverse system under uniform, highly-managed conditions, but the marginal lands on which many biomass crops will be grown, with heterogeneous soils, slopes, and productive capacities (Brummer et al., 1997), intimate that diversifying biomass species, at least on a field scale, could have a positive impact on overall productivity. Cushman and Turhollow (1991) note that an ideal biomass system would consist of one warm-season and one cool-season perennial grass, a legume, and an annual warm-season grass. Despite such ecologically sound advice, virtually all work in the past decade has emphasized switchgrass alone (McLaughlin et al., 1997).

The most promising cool-season grass for biofuel production is reed canarygrass. Because the most important restriction on cropland use in the Midwest after erosion is wet soils (USDA, 1987), reed canarygrass appears to be an ideal species. Reed canarygrass grows extremely well in wet soils, even withstanding inundation for long periods (Carlson et al., 1996). Its wet soil tolerance often overshadows its excellent drought tolerance, which makes it relatively more productive in the summer relative to other cool-season species (Carlson et al., 1996). *Biomass productivity of reed canarygrass exceeded that of switchgrass in northern Ohio (Wright, 1988) and occasionally in southern Iowa (Anderson et al., 1991).* Numerous other studies have also indicated that reed canarygrass produces excellent yields of total biomass (e.g. Smith et al., 1984; Cherney et al., 1986; Marten et al., 1980).

Reed canarygrass makes an appealing biomass crop for several reasons in addition to its yield. As a cool-season grass, it can be harvested in early summer when warm-season grass biomass is not available, facilitating a constant feedstock flow to the bioreactor (Cushman and Turhollow, 1991). Secondly, reed canarygrass biomass increases linearly with applied nitrogen (Anderson et al., 1991; Cherney et al., 1991). Though fertilization with high levels of nitrogen is generally undesirable, disposal of manure from intensive, industrial livestock and poultry farms or of municipal wastewater presents situations where the ability to take up high nutrient levels is necessary (Carlson et al., 1996). Finally, reed

canarygrass has been reported to improve the structure of clay-based soils in Ontario, Canada (Drury et al., 1991).

An important consideration in evaluating reed canarygrass yield data is that the variety tested may not represent the best type for biomass production. Cherney et al. (1991) included 'Venture' in their trials; Iowa State University yield tests indicate that Venture yields 98% of 'Vantage' (Carlson et al., 1991). Work in Sweden (Landström et al., 1997; Burvall, 1997) used 'Palaton,' an improved U.S. variety similar to Venture. All three of these varieties were selected for lower alkaloid levels to alleviate palatability and animal health problems. Thus, higher yielding varieties or germplasm containing the anti-quality factors may have been discarded in forage improvement programs. Their inclusion in a biomass breeding program would further boost the possibilities of using reed canarygrass as a biofuel.

Success as a biofuel crop requires several traits. First, yields need to be maximized. Harvest management has a large impact on the total biomass yield from a planting. Wright (1988) showed that in northern Ohio two harvests (late May and after frost) yielded 130% that produced under a single harvest. Several other characteristics are concurrently important. Ash needs to be minimized to avoid fouling the bioreactor and to limit the disposal problem. Several mineral constituents, including nitrogen, sulfur, and chlorine, have negative emissions or corrosion qualities and need to be minimized (Landström et al., 1997). Preliminary evidence indicates that reed canarygrass has higher than desirable levels of silica (Cherney et al., 1991), chlorine, and nitrogen (Burvall, 1997). Delaying harvest of material from fall to early spring before regrowth begins can significantly depress the levels of undesirable constituents (Landström et al., 1996; Burvall, 1997; Hadders and Olsson, 1997). Further, Burvall (1997) showed that soil type dramatically affects all of these traits. Genetic variation for ash content and mineral composition has not been evaluated. Generally, high levels of hemicellulose and cellulose are desirable attributes of a biofuel, particularly in fermentation, but levels of these constituents is not as high in reed canarygrass as in switchgrass (Cherney et al., 1991).

Despite the obvious potential of reed canarygrass as a biofuel, no evaluations of reed canarygrass germplasm have been undertaken to assess biofuel characteristics! All breeding research on reed canarygrass to this point have focused on forage traits--palatability, seed retention, disease resistance, persistence, leafiness, etc. (Carlson et al., 1996). Maximum biomass *per se* has not been evaluated in

available germplasm. Likewise, chemical constituents such as chlorine and sulfur have not been important in the past. Characterization of biofuel traits, under a harvesting regime designed for biofuel production, will improve our ability to breed distinctive, enhanced cultivars for this use.

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ATTACHMENT SIX

PRAIRIE LANDS BIO-PRODUCTS, INC. AGENDA

Prairie Lands Bio-Products, Inc.

AGENDA

JANUARY 5, 1998

1. INTRODUCTIONS
 - Recognize Prairie Lands members participation
2. ADMINISTRATIVE ITEMS
 - Notes from December 1, 1997 meeting
 - Invoice from Kathleen Chester
 - Approval of future invoices
 - Agreement with RC&D for feasibility studies
 - Proposal from E.L. Woolsey & Associates for assistance with feasibility studies
3. CORRESPONDENCE
4. ACTIVITY REPORTS
 - Status of 1998 harvest and co-fire test
 - Switchgrass production activities:
 - Prairie Lands members
 - Information and education activities:
 - Prairie Lands requests
 - Feasibility studies:
 - Pellet production and test marketing
 - Cooperative structure
 - Research activities:
 - Wildlife impacts
 - Biomass cropping systems
 - Soil and water quality
 - Carbon impacts
 - Economics
 - Other switchgrass markets
5. ACTION ITEMS AND RESPONSIBILITIES
6. NEXT MEETING - February 2, 1998
 - Cooperative structure

RR #3, Box 116A
Centerville, IA 52544

Phone: 515/437-4376

FAX: 515/437-4638

Prairie Lands Bio-Products, Inc.
Notes from
December 1, 1997

Report on grinding demonstration and OGS tour:

- Rate of grinding with 4" screen was 40 tons per hour
- Rate of grinding with 3" screen was 45 to 48 tons per hour
- Density of material from 4" screen was 4 pounds per cubic foot
- Density of material from 3" screen was 6 pounds per cubic foot
- Pre-grind size distribution:
 - 68% greater than 4" long
 - 20% between 2" and 4" long
 - 7% between 1" and 2" long
 - 5% less than 1" long
- Size distribution from 4" screen (square bales):
 - 2% greater than 4" long
 - 10% between 2" and 4" long
 - 17% between 1" and 2" long
 - 71% less than 1" long
- Size distribution from 3" screen (square bales):
 - 1% greater than 4" long
 - 5% between 2" and 4" long
 - 13% between 1" and 2" long
 - 81% less than 1" long
- Size distribution from 3" screen (round bales):
 - 2% greater than 4" long
 - 5% between 2" and 4" long
 - 8% between 1" and 2" long
 - 85% less than 1" long
- Additional test and analysis with 2" screen
- Review of processing and storage areas at OGS. Viewing of area of boiler to be modified with switchgrass delivery system.

Switchgrass harvest and delivery for co-fire test:

- Chariton Valley RC&D will enter into agreement with Prairie Lands to provide switchgrass for co-fire test.
- Prairie Lands responsibilities will include harvest, transport, storage, and reclaim from storage to the point of processing during the co-fire test.
- Switchgrass procurement plan activities and cost estimates, not including storage costs:

Assumptions and Notes:

1. Yields at 1.5 tons per acre
2. Average distance for transport is 70 miles @ \$2 per loaded mile
3. Full load for transport estimated at 15 tons
4. An estimated 30% of bales loaded at road (no semi access to field)
5. 3' x 4' x 8' bales unloaded continuously
6. Field size from 10 to 80 acres
7. Labor needed maintained during "down" time
8. Time and cost of frequent moving of equipment between fields

<u>Activity</u>	<u>Per acre cost</u>	<u>Per ton cost</u>
Mow and Condition	8.50	5.66
Rake	3.80	2.53
Bale		24.00
Load		6.90
Transport		9.33
Unload and Store		<u>6.00</u>
Subtotal		54.42
Reclaim for Processing		<u>6.00</u>
Subtotal		60.42
Add 25% contingency		<u>15.11</u>
TOTAL		75.53

Switchgrass Production Activities

- Land owner agreements on 2,000 acres of existing CRP
Harvest in early 1998, 1998/1999, and 1999/2000
- Land owner agreements to assist with establishment on 1,500 acres of CRP
Establish in early 1998
50% seed cost
Harvest in 1999/2000
- Land owner agreements to assist with conversion of cool season grasses on 250 acres of CRP
Convert in 1997 and 1998
100% cost of inputs
Harvest in 1999/2000
- Land owner agreements to establish biomass cropping systems on 500 acres of non-CRP
Establish in 1998
100% of inputs
Prairie Lands members' land
Biomass cropping system research
Wildlife impacts research
Initial harvest available for the project

ATTACHMENT SEVEN

***FEASIBILITY ANALYSIS AND COOPERATIVE STRUCTURE
FOR
VALUE-ADDED SWITCHGRASS PRODUCTS***

Feasibility Analysis and Cooperative Structure for Value-Added Switchgrass Products

Proposal to the Rural Business-Cooperative Service's
Cooperative Value-Added Program

by

Chariton Valley Resource Conservation and Development, Inc.
RR#3, Box 116A
Centerville, Iowa 52544
Phone: (515) 437-4376
Fax: (515) 437-4638

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PROJECT SUMMARY

Project Title: Feasibility Analysis and Cooperative Structure for Value-Added Switchgrass Products

Applicant: Chariton Valley Resource Conservation and Development, Inc.
RR#3, Box 116A
Centerville, Iowa 52544
Phone: (515) 437-4376
Fax: (515) 437-4638

Primary Contact: Martin Braster
Biomass Project Coordinator
Phone (515) 437-4376

Chariton Valley Resource Conservation and Development, Inc., a nonprofit development organization, is leading a coalition of public and private interests to develop the biomass energy industry in Iowa. These partners are cooperating in one of three US Department of Energy Biomass Power for Rural Development Projects in the United States. The Iowa project will demonstrate the production and use of switchgrass (*Panicum virgatum L.*) as a biomass energy crop. Specific plans call for the co-firing of switchgrass with coal to generate a sustained supply of 35 megawatts of electric power in southern Iowa. This level of energy generation will require the annual harvest of 200,000 tons of switchgrass from 50,000 acres of land.

Major challenges to this large scale use of biomass for energy generation include the production of an adequate supply of switchgrass and coordination of the processing and delivery of switchgrass. This project will address these challenges to the use of switchgrass biomass for energy generation. Specifically, one project goal is to assess the market potential of products that will encourage switchgrass production and facilitate development of conversion technology needed for biomass energy generation. A second goal is to support the creation and operation of a cooperative that will address the production and marketing of switchgrass for value-added products. Project objectives include: 1) determine the market feasibility of densified fuels produced from switchgrass biomass and 2) evaluate the feasibility of a producers cooperative to coordinate the production, delivery, processing, and marketing of switchgrass.

Project Partners: Chariton Valley RC&D, Inc.
Prairie Lands Bio-Products (producers group)
USDA Rural Development
Oak Ridge National Laboratory
Iowa State University Extension
Farm Bureau Federation
Small Business Development Center
Iowa Department of Natural Resources

PROJECT NARRATIVE

INTRODUCTION

Project Background

A greater emphasis on rural development issues, growing public concern about the environment, and related technological advances have generated increased interest in agriculture's potential as a source of renewable energy. Biomass is the prominent renewable energy resource in Iowa, as well as for much of the rest of the Midwest. Unlike wind energy, it is widely distributed across the state. Unlike solar energy, the technology for collecting this energy is technically mature and widely understood and practiced. Unlike either wind or solar energy, biomass energy comes in an easily storable form and is available when needed. However, despite these advantages and the importance of agriculture in the economy of Iowa, biomass is not a significant energy source in the state. Currently, biomass accounts for less than 3% of energy use in Iowa [1, 2].

In 1994 the Iowa Department of Natural Resources (DNR) released the Iowa Biomass Energy Plan. The plan describes Iowa's efforts to achieve energy sustainability through greater use of biomass. Although this plan includes several biomass resources, the largest contributors are projected to be ethanol from corn and dedicated energy crops of switchgrass for the production of electricity [3]. According to Brown et al. in The Potential for Biomass Production and Conversion in Iowa, the wide-scale adoption of biomass energy systems in the state will require the convergence of several favorable conditions [2]. These conditions include the availability of a sufficient resource base for the production of large quantities of biomass; prices for biomass crops that encourage its cultivation while at the same time make it competitive with other fuels; energy conversion processes that are of high efficiency at moderate scales; a trained work force for biomass production and conversion activities; and physical infrastructure to support a transition to biomass energy systems. In addition, Brown et al. indicate that biomass production and conversion activities must have net benefits to the environment compared to the fossil fuel technologies they would replace, and society must sufficiently value these benefits [2].

Chariton Valley Resource Conservation and Development, Inc. (RC&D), a nonprofit rural development organization in southern Iowa, is leading a coalition of public and private interests working to create the conditions necessary to merge Iowa's agricultural capacity with the state's long-term energy requirements. Chariton Valley RC&D and its partners are cooperating in one of three US Department of Energy Biomass Power for Rural Development Projects underway in the United States. The Iowa project will demonstrate the feasibility and value of producing and using switchgrass (*Panicum virgatum* L.) as a dedicated biomass energy crop. Switchgrass, a native grass of Iowa, is considered one of the most promising sources of biomass for energy generation by the two leading renewable energy research and development organizations in the United States, the National Renewable Laboratory and Oak Ridge National Laboratory. Specific plans call for the co-firing of switchgrass with coal to generate a sustained supply of 35 megawatts (MW) of biomass-derived electric power at IES Utilities Ottumwa Generating Station (OGS) in south central Iowa. This level of energy generation will equate to approximately 5% of the IES facility's capacity. An estimated 200,000 tons of switchgrass biomass harvested from as many as 50,000 acres of land will be required annually as fuel for the facility.

Project Goals and Objectives

There are two goals of the project, *Feasibility Analysis and Cooperative Structure for Value-Added Switchgrass-Based Products*. The first goal of the project is to assess the market potential of products that will encourage the production of switchgrass and facilitate development of the conversion technology necessary to support the large scale use of biomass for energy generation. A second goal of the project is to support the creation and operation of a producers cooperative that will address the production and marketing of switchgrass for value-added products and uses.

Specific objectives of the project include:

- 1) Determine the production and market feasibility of value-added switchgrass-based products that preliminary research indicates possess the highest potential for immediate commercialization and economic return. These products are a family of densified fuels produced from switchgrass biomass and include pellets, briquettes, and logs. These switchgrass biomass fuels can be used as sources of energy for residences, farms, businesses, industries, and public facilities such as schools.
- 2) Evaluate the feasibility of establishing and operating a producers cooperative that will efficiently and cost-effectively coordinate the production, delivery, and processing of switchgrass and the marketing of value-added switchgrass biomass products including densified fuels and feedstock for large scale energy production.

Project Need

Biomass-to-electric power is considered the best near-term prospect for expanding renewable energy use in the midwestern United States [1]. The co-firing of switchgrass with coal is considered one of the most technically feasible and cost-effective means of utilizing biomass as a source of fuel for the large scale production of energy in Iowa. Major challenges to the use of biomass for energy generation as proposed in the Iowa Biomass Power for Rural Development Project being coordinated by Chariton Valley RC&D include:

- 1) The production of an adequate supply of switchgrass. There is a need to establish and manage switchgrass plantings for biomass prior to full development of the market for its use on a large scale as a fuel for energy generation. Energy producers are concerned about the capability of switchgrass producers to provide a reliable and consistent supply of biomass. Energy producers are, therefore, hesitant to install technologies that would allow the use of switchgrass biomass for power generation. At the same time, switchgrass producers have little incentive, and are therefore reluctant, to establish the extensive switchgrass plantings that will be needed for energy generation but for which no market currently exists.
- 2) A means of coordinating the supply of switchgrass for its use as biomass. There is the need to establish operational procedures for the efficient production and marketing of switchgrass for use as a biomass. Even though many of these procedures are in place for other agricultural crops and processes, they have not been applied to, or modified for, the production and use of switchgrass for biomass. Switchgrass producers must develop purchasing, processing, and delivery arrangements that satisfy both their own requirements as well as those of biomass users.

This project will address these challenges to the large scale use of switchgrass biomass for energy generation by supporting: 1) the development of near-term product and market opportunities for switchgrass and 2) the creation and operation of a switchgrass producers cooperative.

RATIONALE AND SIGNIFICANCE

Impacts of Utilizing Switchgrass as a Source of Biomass for Energy Generation

The US Department of Energy's National Biomass Power Program has suggested that, more than any other energy technology, biomass power is capable of contributing to the nation's energy needs while decoupling energy production from environmental degradation. In addition, expanded investment in biomass energy technology can create new income and jobs, strengthen the industrial competitiveness of the United States, and provide economic development opportunities for rural America [1]. As previously stated, this project will support the development of near-term markets for switchgrass biomass products and creation of a switchgrass producers cooperative. These activities will, in turn, facilitate the large scale use of switchgrass as a biomass fuel for energy generation in Iowa. The positive economic and environmental impacts associated with this use of switchgrass to produce energy are enormous.

Most notable among the economic benefits of using switchgrass as a biomass fuel are the following:

- Iowa imports almost 97% of its energy at a cost of \$4.8 billion, imposing a tremendous burden on the state economy. Coal, natural gas, and oil provide for over 90% of the state's energy needs. Biomass accounts for less than 3% of energy use in Iowa. According to the Iowa DNR, a net growth of 315 jobs per year and \$5.5 million per year of additional disposable income would result if 1% of Iowa's electrical power was supplied by biomass such as switchgrass. The DNR also estimates that Iowa switchgrass could meet 20% of the state's total energy demand [3].
- The large scale establishment of switchgrass as a biomass fuel in the four county Chariton Valley RC&D area will produce more than \$5 million in related expenditures. Management, harvest, and transport of the switchgrass will generate an additional \$6 million of annual economic activity. Impacts to the local economy will be significant in an area of Iowa that chronically suffers from some of the state's highest rates of poverty and unemployment and lowest levels of farm sales and personal income. In addition, the planned use of switchgrass as a biomass fuel at the IES Utilities OGS will create 18 jobs and \$1 million in annual payroll.

Among the most significant environmental benefits of using switchgrass as a source of biomass for energy production are the following:

- No net emission of carbon dioxide to the atmosphere occurs because of the use of biomass for energy production. Since carbon dioxide is required by plants to grow, biomass cycles carbon dioxide from the atmosphere to the standing crop when it is grown renewably. The only net increase in carbon dioxide to the atmosphere is through the use of fossil fuels in the production process. The use of 200,000 tons of switchgrass as a biomass fuel at IES Utilities OGS in southern Iowa will reduce the carbon dioxide emissions from the combustion of an equivalent amount of coal. The use of biomass for energy generation also emits less sulfur dioxide and nitrogen oxides than most fossil fuels.

- Switchgrass production for biomass will provide farmers in southern Iowa a viable alternative for utilizing marginal crop land. Nearly 75% of the farm land in southern Iowa is subject to excessive soil erosion when used for row crop production. Erosion on this land can exceed 30 tons per acre per year, or more than ten times tolerable rates. A significant portion of this highly erodible land has been temporarily idled through the Conservation Reserve Program. The long-term protection of soil resources in southern Iowa necessitates the identification of viable alternatives to using highly erodible land for row crop production. Much of this land, while marginal in terms of producing grain, is well suited to the production of forages such as switchgrass. Soil loss on land maintained in switchgrass can be reduced to less than 2 tons per acre per year. Switchgrass planted on this marginal land will improve soil quality and maintain its productive capacity.
- Much of the Chariton Valley RC&D area is located in the 350,000 acre watershed of Rathbun Lake. Rathbun Lake is the raw water source for Rathbun Regional Water Association (RRWA), one of the largest rural water supply systems in the United States. RRWA provides potable water to rural residents in 13 Iowa and Missouri counties and 21 cities. Sediment and agricultural chemicals from cropland in the watershed threaten the long-term usefulness of Rathbun Lake as a source of potable water. Sedimentation has reduced water storage capacity in Rathbun Lake at a rate which is 30% greater than anticipated. In addition, herbicides have been detected in Rathbun Lake at concentrations above limits established by the US Environmental Protection Agency. The production of switchgrass in place of row crops, particularly on highly erodible land, will greatly reduce the amount of sediment and agricultural chemicals that enter the Lake and impair its capacity to serve as a source of potable water.

Importance of this Project to Utilizing Switchgrass as Biomass for Energy Production

As mentioned above, co-firing switchgrass with coal is considered one of the most technically and economically promising approaches to developing biomass as a source of fuel for large scale energy generation in Iowa. Partners in the Biomass Power for Rural Development Project plan to develop the capacity in southern Iowa to produce 35 MW of electric power at IES Utilities OGS utilizing a dedicated supply of switchgrass. The proposed level of energy production corresponds to 5% of the IES Utilities station's capacity and will require 200,000 tons of switchgrass annually. Given current technology and yields, as many as 50,000 acres per year of switchgrass will be needed to meet this demand. It is anticipated that at least 5 years will be required to complete the scale-up activities that will support this level of switchgrass biomass energy generation.

This project will address important supply related issues that are essential to the successful large scale generation of energy from co-firing switchgrass with coal in southern Iowa. The first of these issues is the need to develop a relatively large supply of switchgrass prior to the existence of a corresponding demand for its use as biomass for energy production. The second supply related issue is the need to implement the most efficient and cost-effective means to ensure the reliable delivery of an acceptable quality of switchgrass biomass for energy generation. The development of near-term market opportunities for switchgrass biomass products will encourage the growth in switchgrass supply needed for large scale energy generation. Creation of a switchgrass producers cooperative will provide the organization and procedures needed to achieve and maintain the required supply of consistently high quality switchgrass biomass. The funding assistance requested in this proposal to the Rural Business-Cooperative Service's Cooperative Value-Added Program will be used to support the feasibility analysis of product and market opportunities for switchgrass biomass, specifically densified fuels. Funds will also be used to evaluate alternative structures and operating procedures for a producers cooperative with the capacity to satisfy near and long-term demand for switchgrass biomass.

- Product and Market Opportunities for Switchgrass

A comprehensive study of the potential for biomass production and conversion in Iowa concluded that the pursuit of niche market applications was one of the most effective approaches to developing the state's leadership role in biomass energy [2]. As mentioned above, the development of near-term markets for switchgrass biomass products will encourage the increase in supply needed to support large scale energy generation from biomass in southern Iowa. As many as 10,000 acres of switchgrass currently exist in south central Iowa that could be available for use as biomass fuel. Most of these acres are not actively managed to maximize switchgrass biomass yields. An estimated four to five fold increase in switchgrass acres and two to three fold increase in biomass yields will be required to support the level of energy generation from biomass proposed by the Iowa Biomass Power for Rural Development Project. The availability of near-term markets for switchgrass products will, at a minimum, offset the costs and risks that producers incur to achieve the required increase in plantings and biomass yields. In addition, it is expected that certain niche products and markets will develop as long-term financially attractive complements to the planned large scale production and use of switchgrass for energy generation.

Densified fuels produced from switchgrass are well suited for successful near-term development as a biomass product for niche markets that will also contribute to the large scale use of switchgrass for energy generation. The technology employed in the manufacture of densified fuels which include pellets, briquettes, and logs is relatively well developed and accessible. Sources of technical knowledge and equipment for the production of densified fuels have been identified and are readily available. The investment of resources needed to establish and operate a facility for the manufacture of densified fuels is relatively moderate. Markets for similar densified fuel products, particularly those made from wood, are well established. Densified fuels can be used as a source of energy for residences, farms, businesses, industries, and public facilities. Preliminary research indicates that market demand for densified fuels could provide the economic incentive to encourage the increase in switchgrass production needed for large scale energy generation. This project will: 1) determine the feasibility of manufacturing and marketing densified fuels made from switchgrass and 2) based on the results of the feasibility analysis, use the information generated to develop a business and marketing plan for a densified fuels operation in southern Iowa.

Special mention should also be made of several other value-added products that can be manufactured from switchgrass. Preliminary research and development activities have found that there is a growing number of switchgrass-based products that possess significant market potential. While densified fuels are considered to have the greatest near-term potential, the technology and applications for other switchgrass products are rapidly developing. As with densified fuels, the commercialization of these products would complement the use of switchgrass as a biomass fuel for energy production. These products include the use of switchgrass as a component in the fabrication of paper and fiberboard; gasification of switchgrass to produce combustible bio-gas; production of furfural used in the manufacture of plastics, adhesives, solvents, and specialty chemicals; and conversion of switchgrass to ethanol fuel. Accomplishment of the goals and objectives of this project could provide the basis for pursuing the future development and marketing of these other value-added switchgrass-based products.

- Switchgrass Producers Cooperative

Creation of a switchgrass producers cooperative could provide the structure needed to ensure the availability of an adequate supply of switchgrass of an acceptable quality for use as biomass. Switchgrass supply availability and quality are critically important issues to the successful production and marketing of biomass. The procedures that are well established for other agricultural commodities have not been applied to the large scale production and use of switchgrass for biomass. Arrangements must be made for the production, storage, transport, processing, and sale of switchgrass and switchgrass-based products. A cooperative would create an environment in which producers could pool their knowledge and resources, and receive the assistance needed, to establish the most efficient and cost-effective means of supplying switchgrass to the developing biomass industry in southern Iowa.

The widely recognized benefits of agriculture related cooperatives in general will also apply to the specific case of a switchgrass producers cooperative. A cooperative structure for the switchgrass producers in southern Iowa would: 1) provide members a relative measure of economic strength and risk management in the production, storage, transport, processing, and marketing of value-added, switchgrass products and 2) facilitate the dissemination of knowledge among members regarding techniques to increase yields and improve the quality of switchgrass produced for biomass. Furthermore, preliminary market research indicates that potential users of switchgrass biomass, particularly IES Utilities and densified fuel purchasers, prefer to work with one entity as opposed to numerous individual producers. A switchgrass producers cooperative would provide biomass users with that single source of supply. This project will determine the most appropriate legal structure and internal operating procedures for a switchgrass producers cooperative.

OBJECTIVES AND APPROACH

As previously stated, project objectives are to: 1) assess the feasibility of producing and marketing a family of densified fuels made from switchgrass and 2) evaluate the feasibility of establishing and operating a switchgrass producers cooperative. Preliminary research has been completed that determined the need for, and likely success of, accomplishing these objectives as they relate to development of the switchgrass biomass industry in southern Iowa. Partner organizations, including participating producers, will continue to be primarily responsible for completing the activities required to accomplish project objectives. As such, these organizations and producers have committed a significant portion of the resources needed to carry out project activities. The financial assistance requested in this proposal to the Rural Business-Cooperative Service's Cooperative Value-Added Program will be an important complement to these resources. A description of the activities planned to accomplish each of the project objectives follows:

Product and Market Opportunities for Switchgrass

Preliminary research completed by project partners has: 1) identified and contacted sources of technical assistance and equipment required for the manufacture of densified fuel products from switchgrass; 2) determined that current densified fuels technology can be used to manufacture a range of switchgrass products; and 3) confirmed that densified fuels markets are receptive to the development and use of switchgrass products.

Principal activities that will be completed in order to accomplish the project objective of assessing the production and market feasibility of densified fuels made from switchgrass include:

- 1) Contract with consultant(s) experienced in conducting feasibility analyses for biomass projects. The consultant(s) will work closely with project partners to complete a feasibility study for the production and marketing of densified fuels made from switchgrass. The results of the study will be used to develop a business and marketing plan for a densified fuels operation.
- 2) Process and test market as many as 500 tons of switchgrass densified fuels including pellets, briquettes, and logs. Project partners consider the processing and test marketing of densified fuel products an important component in the feasibility analysis and an essential step in the commercialization process. Test marketing will provide critical information regarding product handling, packaging, promotion, consumer acceptance, and pricing.

Completion of these activities and accomplishment of the associated project objective will result in a feasibility study and business and marketing plan for densified fuels. The study and plan will provide project partners, particularly producers, with the information required to establish and operate an enterprise to manufacture and market densified fuel products made from switchgrass.

Switchgrass Producers Cooperative

Chariton Valley RC&D and project partners have worked to organize and support a switchgrass producers group in southern Iowa. This group, Prairie Lands Bio-Products, currently has more than 30 member switchgrass producers. It is anticipated that the Prairie Lands Bio-Products organization will be the precursor of a switchgrass producers cooperative. The organization has elected officers and conducts monthly membership meetings. Member producers actively participate in committees that have responsibility for technical issues related to switchgrass production, processing, and use and financial issues regarding the development and marketing of switchgrass products.

Principal activities that will be completed in order to accomplish the project objective of evaluating the feasibility of creating and operating a switchgrass producers cooperative include:

- 1) Obtain professional legal and financial assistance required to evaluate the establishment and operation of a switchgrass producers cooperative.
- 2) Evaluate alternative legal structures, e.g., traditional versus value-added cooperative, and internal operating procedures for the cooperative.
- 3) Select the most appropriate structure and operating procedures for the cooperative.
- 4) Determine the capital, managerial, and personnel resources required for successful operation of the cooperative.
- 5) Identify and describe the specific steps required to create and initiate operations of the switchgrass producers cooperative.

Completion of these activities and accomplishment of the associated project objective will result in a feasibility study for a switchgrass producers cooperative. The study will provide project partners, particularly producers, the information needed to establish and operate a switchgrass producers cooperative.

Project Budget

Project partners have committed a significant portion of the resources needed to accomplish project objectives. This application to the Rural Business-Cooperative Service's Cooperative Value-Added Program requests funds to help acquire specialize technical assistance and share other project expenses associated with conducting the proposed feasibility studies.

CATEGORIES	FEDERAL Cooperative Value-Added Program	NON-FEDERAL (g)	TOTALS
Personnel (a)		\$18,000	\$18,000
Fringe Benefits			
Travel (b)	\$ 3,500	3,500	7,000
Equipment			
Supplies (c)	1,200	1,200	2,400
Contractual (d)	20,000	7,000	27,000
Construction			
Other (e)	20,000	20,000	40,000
Total Direct Charges	\$44,700	\$49,700	\$94,400
Indirect Charges (f)		\$ 4,720	\$ 4,720
Totals	\$44,700	\$54,420	\$99,120

- (a) Contribution of time by switchgrass producers to complete project activities.
- (b) Costs associated with travel by switchgrass producers to similar organizations and projects with the purpose of gathering information relevant to project activities. Switchgrass producers will provide non-federal match.
- (c) Expenses related to researching and acquiring project related information, e.g., purchase of printed materials, internet use, long distance telephone calls. Project partners will provide non-federal match.
- (d) Costs of acquiring assistance from consultants with project related expertise. Consultants contracted to assist the project will donate a minimum of 25% of their services.
- (e) Costs associated with the test marketing of as many as 500 tons of switchgrass densified fuel products. Non-federal match is the value of switchgrass feedstock provided by producers.
- (f) Indirect charges calculated at 5% of total direct charges will be provided by project partners.
- (g) Chariton Valley RC&D, Inc. will be responsible for securing and documenting the non-federal match committed to support project activities.

TIME TABLE

Given the preliminary work accomplished, it is anticipated that the project activities described in this proposal can be completed within 12 months of the effective date of a cooperative agreement. Project milestones and activities together with a schedule for completion follows:

<u>Milestone/Activity</u>	<u>Completion (months after project initiation)</u>
Cooperative Agreement Executed	Project initiation
Contract with consultant(s) experienced in conducting feasibility analyses for biomass projects.	1
Obtain professional legal and financial assistance to evaluate the establishment and operation of a cooperative.	1
Quarterly review, evaluation, and report of project progress.	3
Quarterly review, evaluation, and report of project progress.	6
Quarterly review, evaluation, and report of project progress.	9
Process and test market as many as 500 tons of switchgrass-based densified fuel products.	10
Complete feasibility study and business and marketing plan for switchgrass-based densified fuel products.	11
Complete feasibility study for switchgrass producers cooperative.	11
Final review, evaluation, report, and presentation of project progress and findings.	12

EVALUATION

Accomplishment of the project objectives will result in feasibility studies for: 1) the production and marketing of densified fuels made from switchgrass and 2) the creation and operation of a switchgrass producers cooperative. Success in accomplishing project objectives will depend on the value of the information developed during the course of completing these feasibility studies. As previously stated, this information should enable project partners, particularly switchgrass producers, to reach decisions and take action on the establishment and operation of: 1) an enterprise to manufacture and market densified fuel products and 2) a switchgrass producers cooperative. As such, the impact of the project will be evaluated in terms of how well the information generated through the feasibility analyses assists project partners in making sound decisions regarding a densified fuels business and producers cooperative. Project partners will provide a written assessment of the application and usefulness of the information contained in the feasibility studies with the final project performance report. Quarterly performance reports will be submitted during the course of the project in addition to any other project related information requested or required by the Cooperative Value-Added Program.

COORDINATION AND MANAGEMENT PLAN

Chariton Valley RC&D has assembled a coalition of private and public entities with extensive experience in the production and use of biomass crops, cooperative structure and operation, renewable energy, rural development, and business management and marketing. As the project budget indicates, a significant portion of the resources required to accomplish the project's objectives has been committed by these partner organizations. A summary of the responsibilities and contributions of each of the project partners follows:

Project Partner (Contact)

Responsibilities and Contributions

Chariton Valley RC&D, Inc.
(Martin Braster, 515-437-4376)

Responsible for overall project coordination and performance. Staff to assist with feasibility studies, business and marketing plan, and test marketing. Project supplies.

Prairie Lands Bio-Products
(Ed Robinson, 515-724-3738)

Member producers to assist with feasibility studies, business and marketing plan, and test marketing. Travel costs, project supplies, and switchgrass for test marketing.

USDA Rural Development
(Tom Miller, 319-652-6731)

Staff to assist with feasibility studies and cooperative structure and operation.

Oak Ridge National Laboratory
(Mark Downing, 423-576-8140)

Staff to assist with feasibility studies and product and market development.

Iowa State University Extension
(Gerald Miller, 515-294-1923)

Staff to assist with feasibility studies, business and marketing plan, and test marketing.

Farm Bureau Federation
(Bill Belden, 515-724-3507)

Staff to assist with feasibility studies and business and marketing plan. Legal and financial counsel.

Small Business Development Center
(Bryan Ziegler, 515-683-5127)

Staff to assist with business and marketing plan and cooperative structure and operation.

Iowa Department of Natural Resources
Energy Bureau
(Matt McGarvey, 515-281-8094)

Staff to assist with feasibility studies and product and market development.

Project consultant(s); selected through a formal request for proposal process

Specialized expertise with feasibility studies, business and marketing plans, and cooperative structure and operation.

Representatives of partner organizations will meet monthly during the course of the project. Individuals working on activities directly related to the project will meet more frequently. These meetings will provide an opportunity to review and evaluate progress in performing activities, make any necessary modifications, and provide additional assistance and resources as needed to ensure the project's success.

REFERENCES

- [1] Brower, Michael C., et al. Powering the Midwest: Renewable Electricity for the Economy and the Environment. N.p.: Union of Concerned Scientists, 1993.
- [2] Brown, Robert C., et al. The Potential for Biomass Production and Conversion in Iowa. Ames: Iowa State University, 1994.
- [3] Tombari, Carol, et al. Iowa Biomass Energy Plan. Des Moines: Iowa Department of Natural Resources, 1994.

LETTERS OF SUPPORT

Copies of letters of support and commitment from project partners accompany this application.

PHOTOGRAPHS

An estimated 50,000 acres of switchgrass will be needed to support its large scale use as a biomass source of energy generation in southern Iowa. Currently as many as 10,000 acres of switchgrass such as appears in this photograph exist in south central Iowa that could be used as biofuel.

Chariton Valley RC&D, Inc. and the Prairie Lands Bio-Products switchgrass producers group have conducted several field days for landowners in southern Iowa to explain the potential of raising switchgrass as a biomass source for energy generation.

PHOTOGRAPHS

Chariton Valley RC&D, Inc. is conducting field-level research to evaluate alternative management practices for the production of switchgrass as a source of biomass in southern Iowa.

Chariton Valley RC&D, Inc. and the Prairie Lands Bio-Products switchgrass producers group have demonstrated management techniques such as the harvesting of switchgrass for biomass to landowners in southern Iowa.

PHOTOGRAPHS

Switchgrass harvested during research and demonstration activities has been used to conduct a series of evaluations to assess the potential for a variety of value-added products such as fuel pellets, paper and fiberboard.

Chariton valley RC&D, Inc. and the Prairie Lands Bio-Products switchgrass producers group have worked with established pellet mill operations to successfully produce fuel pellets from switchgrass.

PRAIRIE LANDS BIO-PRODUCTS INC.

July 22, 1997

Mr. Cleo Sellers, President
Chariton Valley RC&D, Inc.
RR 3, Box 116A
Centerville, Iowa 52544

Dear Mr. Sellers:

As you are well aware, Prairie Lands Bio-Products, Inc. has worked closely with Chariton Valley RC&D on the planning and developing of the emerging biomass industry in southern Iowa. Prairie Lands is dedicated to actively promoting the production and use of biomass crops such as switchgrass. Biomass crops, particularly switchgrass, offer land owners a viable alternative for the use of marginally productive cropland; protect the environment by reducing soil erosion, water quality impairment, and carbon dioxide from the burning of fossil fuels; and have the potential to yield enormous economic benefits at the local, state, and national levels.

On behalf of the producer members of Prairie Lands, I would like to express our strong support of, and commitment to, the project *Feasibility Analysis and Cooperative Structure for Value-Added Switchgrass-Based Products* being proposed by Chariton Valley RC&D. Accomplishment of the goals and objectives of this project will lay the foundation needed for the successful development of the biomass industry in southern Iowa. To that end, members of Prairie Lands will perform all assigned responsibilities in support of the feasibility analyses to be conducted as a part of the project. In addition, Prairie Lands members will make available to the project the switchgrass required for the proposed test marketing activities.

Please contact me with any questions or for additional information. The producer members of Prairie Lands Bio-Products look forward to continuing to work with Chariton Valley RC&D on this and other biomass-related projects and activities.

Sincerely,

Ed Robinson
President

cc: Prairie Lands Bio-Products Board

OAK RIDGE NATIONAL LABORATORY

MANAGED BY LOCKHEED MARTIN ENERGY RESEARCH CORPORATION
FOR THE U.S. DEPARTMENT OF ENERGY

POST OFFICE BOX 2008
OAK RIDGE, TN 37831-6422

PHONE: (423) 578-8140
FAX: (423) 578-8143
INTERNET: er30@ornl.gov

July 25, 1997

Mr. Cleo Sellers
President
Chariton Valley RC&D, Inc.
RR#3, Box 116A
Centerville, Iowa 52544

Dear Mr. Sellers:

As you are aware, Mr. Sellers, the Oak Ridge National Laboratory (ORNL) has been a principal partner with Chariton Valley RC&D in the Biomass Power for Rural Development Project underway in Iowa. As one of the nation's most experienced energy research centers, ORNL has been a source of technical expertise for Chariton Valley and other organizations working to develop the biomass energy industry in Iowa.

Growth in Iowa's biomass industry in general, and the success of the Biomass Power for Rural Development Project in particular, depend on the availability of a ready supply of high quality energy crops. ORNL has determined that, in Iowa and many other parts of the country, switchgrass is an energy crop with enormous potential to satisfy the state's and nation's biomass fuel needs. In addition to the development and testing of appropriate conversion technology, major challenges to the use of switchgrass as a source of biomass are the need to increase supply and accomplish its cost-effective processing and delivery for energy generation.

Chariton Valley's proposal to the Rural Business-Cooperative Service addresses these supply related issues that are critically important to the future large scale use of switchgrass as an energy crop in Iowa. Successful development of niche markets including densified fuels will encourage an increase in the production and improvements in the management of switchgrass for biomass. In addition, a producers cooperative could provide the coordination needed to ensure a supply of quality switchgrass for biomass users. As in the overall Biomass Power for Rural Development Project, the ORNL will continue to be a source of technical assistance for Chariton Valley RC&D. This assistance will help Chariton Valley RC&D and other project partners evaluate the feasibility of manufacturing and marketing densified fuels made from switchgrass biomass.

Please contact me with any questions or for additional information. I look forward to continuing to work with you.

Sincerely,

Mark Downing

ornl - *Bringing Science to Life*

IOWA STATE UNIVERSITY

OF SCIENCE AND TECHNOLOGY

Department of Agronomy
Ames, Iowa 50011-1010
515 294-1360
FAX 515 294-3163

July 23, 1997

Mr. Cleo Sellers, President
Chariton Valley RC&D, Inc.
Rural Route 3, Box 116A
Centerville, IA 52544

Dear Mr. Sellers:

This letter documents the Agronomy Department's support of the Chariton Valley RC&D's proposed project titled "Feasibility Analysis and Cooperative Structure for Value-Added Switchgrass-Based Products." The potential for switchgrass to serve as a traditional fuel feed-stock as well as the basis for development of value-added products presents a significant resource conservation and economic opportunity for Iowa.

As you are aware, several plant and soil scientists located here in the department are currently involved in field studies regarding site selection, establishment, growth and harvest of switchgrass. We look forward to continuing this relationship in the future with the Chariton Valley RC&D.

Sincerely,

Ronald P. Cantrell
Professor and Head

IOWA FARM BUREAU FEDERATION
Region 16: Appanoose, Davis, Jefferson, Monroe, Van Buren, Wapello

Bill Belden
Region 16 Manager
RR 2
Moravia, Iowa 52571
(515) 724-3507

Appanoose County Farm Bureau
1010 East State
Centerville, IA 52544

Davis County Farm Bureau
RR 6
Karr Street W.
Bloomfield, IA 52537

Jefferson County Farm Bureau
Highway 34 W.
Fairfield, IA 52556

Monroe County Farm Bureau
119 E. Washington
Albia, IA 52531

Van Buren County Farm Bureau
701 First
Keosauqua, IA 52565

Wapello County Farm Bureau
702 Farm Credit Drive
Box 368
Ottumwa, IA 52501

From: Bill Belden, Region 17 Manager, Iowa Farm Bureau Federation

Re: Support for the Southern Iowa Biofuels Project

The Iowa Farm Bureau and the County Farm Bureau's in the Chariton Valley RC&D area are strongly supportive of the Biofuels project in the area. The Farm Bureau support includes in-kind contributions of staff and legal service time and education assistance from our Farm Bureau Spokesman, and financial support for project related research.

We support this project, because it offers some alternative cropping systems for farmers, we are protecting our soil and water resources and it offers a real opportunity for adding value to a grass crop in this area of the state. There will be additional opportunities for economic growth in the area and rural economic development opportunities in our Southern Iowa communities.

This project makes real sense from an environmental standpoint for alternative fuels, and bi-products from agricultural production.

Bill Belden

Indian Hills SBDC
Indian Hills Community College
525 Grandview Avenue
Ottumwa, Iowa 52501
(515) 683-5127
Fax: (515) 683-5263

DATE: July 24, 1997
TO: Marty Braster
Chariton Valley RC&D
FROM: Bryan Ziegler
IHCC SBDC

I am the director of the Small Business Development Center located at Indian Hills Community College in Ottumwa. I have been working with Marty and have reviewed all the materials they have gathered concerning the switch grass energy source project. In reviewing the material, I do feel this project has potential and can be accomplished as an economically-viable project.

I have been encouraged that there is a very involved, active group of local farmers that is set up to become the ownership structure of the operation. Their activity has included research and development of the concept, to the point where they have done a variety of tests to determine what can work best.

I would be glad to respond to any further questions.

sm

TERRY E. BRANSTAD, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES

LARRY J. WILSON, DIRECTOR

July 21, 1997

Cleo Sellers, President
Chariton Valley Resource Conservation and Development, Inc.
R.R. 3
Box 116A
Centerville, IA 52544

RE: USDA Cooperative Value-Added Program

Dear Mr. Sellers:

This letter is to offer the Department's support to Chariton Valley RC&D in implementing the USDA Cooperative Value-Added Program proposal, *Feasibility Analysis and Cooperative Structure for Value-Added Switchgrass-Based Products*. The project goals of 1) assessing the market potential of products that will facilitate the establishment of switchgrass biomass for energy generation and 2) creation of a producers cooperative that will address the production and marketing of switchgrass for value-added products both support the focus of the Energy Bureau in increasing market applications of switchgrass being established as part of the Biomass Power for Rural Development Project.

The creation of market cooperatives to enhance the establishment of switchgrass by producers and analyze market applications for switchgrass will be critical in achieving the goal of making switchgrass an economic development tool and cash crop for southern Iowa producers. The Chariton Valley RC&D activities initiated through the USDA Cooperative Value-Added Program will be an instrumental component of delivering switchgrass cost-effectively for a variety of end-uses.

This project is consistent with the Department's involvement in the Biomass Power for Rural Development Project. Production of energy crops presents a unique opportunity for the southern Iowa. Besides proving the compatibility of switchgrass to the land and soil resources of southern Iowa, the development of markets for energy crops is crucial to the success of the program.

The Department is committed to this effort and will assist in any way possible. If you have any questions, please contact me at 515/281-4308.

Sincerely,

Larry L. Bean, Administrator
Energy and Geological Resources Division

JUL 22 1997

ATTACHMENT EIGHT

INFORMATION AND EDUCATION EFFORTS

- **Project Newsletter:** In an effort to keep partner organizations informed of project activities, the newsletter, *Switchgrass to Biomass*, will continue to be published and distributed on a quarterly basis. In addition to project partners, the newsletter will be sent to community leaders, producers, and others interested in the biomass project. An estimated 300 copies of the newsletter in three separate issues have been prepared and distributed to date.
- **Project Fact Sheets:** A family of project fact sheets has been developed to provide interested parties with an up-to-date, comprehensive review of project objectives, activities, and partner organizations. These fact sheets will continue to be maintained, produced, and distributed at project related events and on request during fiscal year 1999. An estimated 1,000 sets of these fact sheets have been distributed to interested parties at project events and on request.
- **Project Signage:** Approximately 50 producers are working with the project to ensure an adequate supply of switchgrass for use as biomass. Plans are to develop, fabricate, award, and install recognition signs at switchgrass fields of cooperating land owners.
- **Project Slide Set and Displays:** A slide set developed for the biomass project will be expanded and maintained. Similarly, project display materials that will include posters that highlight specific aspects of the biomass project will continue to be developed and maintained. These materials will be used during presentations at conferences, meetings, and other events during fiscal year 1999.

Press releases and news stories have been prepared and distributed to media contacts regarding all major biomass project activities. In addition, media contacts have been encouraged to attend project related events. As a result of these efforts, considerable press coverage for the project has been received and is described below. Two copies of printed press coverage are attached at the end of this report.

<u>Newspapers</u>	<u>Circulation</u>	<u>Audience</u>	<u>Published</u>
Albia Newspapers	6,000	General public	1 article
Chariton Newspapers	3,100	General public	1 article
Des Moines Register		Agricultural/	
Daily	174,412	General public	1 article
Sunday	294,794		1 article
Iowegian	3,000	General public	4 articles
Iowa Farm			
Bureau Spokesman	107,320	Agricultural	1 article
Iowa Farmer Today	77,000	Agricultural	1 article

Ottumwa Courier	19,000	General public	7 articles
Omaha World Herald	219,700	General public	1 article
<u>Magazines</u>	<u>Circulation</u>	<u>Audience</u>	<u>Published</u>
The Furrow		John Deere	
Canadian edition	110,000	publication	1 article
Midwestern edition	300,000	agricultural	1 article
Successful Farming	475,000	Agricultural	1 article
Wallace's Farmer	70,000	Agricultural	1 article
<u>Other publications</u>	<u>Circulation</u>	<u>Audience</u>	<u>Published</u>
UBECA Bulletin	unknown	Research	1 article
(United Bio-energy Commercialization Association)			

Television

KTVO television broadcasts to audiences in southern Iowa, northern Missouri, and northwestern Illinois. An interview with Marty Braster, project coordinator, and Alan Teel, project field specialist, highlighted the Chariton Valley Biomass Project in December, 1997. Viewership in the two state area covers a wide range of audience types.

Radio

An interview with Secretary of Agriculture, Dan Glickman, was broadcast live by WHO Farm Radio during his October, 1997, visit to the Chariton Valley Biomass Project.

Alan Teel, project field specialist, was interviewed on a segment of Successful Farming Radio Magazine, in Detroit Lakes, Minnesota. The program was broadcast to 72 radio stations in 13 Midwestern states. He was also interviewed on the local radio station in Centerville.

- **Project Field Days, Demonstrations and Meetings:** Field days, demonstrations and meetings conducted as part of the project's education and outreach efforts included the following:

Biomass Project Technical Field Day: A technical field day was held in 1997 to demonstrate switchgrass establishment techniques. Audience numbered ten and included professionals with the Natural Resources Conservation Service and ISU Extension, Farm Service Cooperative personnel and representatives of agricultural products companies.

Switchgrass Gasification Demonstration: The project cooperated with PrimEnergy, a private manufacturer of gasification equipment located in Tulsa, Oklahoma, to demonstrate the gasification of switchgrass to generate energy. The

demonstration was conducted in conjunction with the National Renewable Energy Laboratory's biomass project contractors meeting and workshop in September, 1997, in Stillwater, Oklahoma. Audience numbered 50 and included professionals and practitioners with public agencies and private organizations in the area of biomass production and use to generate energy.

Secretary of Agriculture Visit: Secretary of Agriculture, Dan Glickman, visited the biomass project to announce USDA support in October, 1997. Senator Tom Harkin and Representative Leonard Boswell accompanied Secretary Glickman during the visit. The visit included a demonstration of switchgrass harvest techniques. Audience numbered 150 and included representatives of public agencies, private agriculture and conservation organizations and land owners. Also in attendance was Dr. Henry Kelly, Associate Director for Technology, Office of White House of Science and Technology, who returned to Washington with a switchgrass sample to give to Vice-President Al Gore, and Natural Resource Conservation Service Chief, Paul Johnson.

Biomass Project Demonstration and Tour: A demonstration of processing equipment that will be used to prepare switchgrass biomass for co-firing with coal was conducted in November, 1997. A tour of facilities at the IES Utilities' Ottumwa Generating Station was conducted following the demonstration. Audience numbered 25 and included representatives of project partners and sponsors.

Project Meetings: A series of six informational meetings regarding the biomass project have been conducted with local field staff of USDA agencies, ISU Extension, representatives of the Farm Bureau, soil and water conservation districts and county committees and land owners. More than 30 people attended these project meetings.

- **Project Web Site:** A web site has been created and maintained since the early phases of the project. The project web site will be improved through 1) modifications to the web site format and 2) regular addition of current information regarding project activities. The web site can be located at, (<http://webbook.ameslab.gov/>). The web site complements printed project materials and expands potential audiences reached to others who use the internet as a source of information related to biomass.

Demonstration and Transfer of Energy/Crop Technology in Chariton Valley RC&D Biomass Project, presented by Jim Cooper, Chariton Valley RC&D Coordinator, at the Third Biomass Conference of the Americas in August, 1997, in Montreal, Canada. Audience numbered 75 and included professional and practitioners with public agencies and private organizations in the area of biomass production and use to generate energy.

Integration of Technical Aspects of Switchgrass Production in Iowa, presented by

Dr. Charles Brummer, ISU Department of Agronomy, at the Third Biomass Conference of the Americas in August, 1997, in Montreal, Canada. Audience numbered 50 and included professional and practitioners with public agencies and private organizations in the area of biomass production and use to generate energy.

Evaluation of an Integrated Biomass Gasification/Fuel Cell Power Plant, presented by Jarod Smeenck, project researcher, at the Third Biomass Conference of the Americas in August, 1997, in Montreal, Canada. Audience numbered 50 and included professional and practitioners with public agencies and private organizations in the area of biomass production and use to generate energy.

Energy and Fiber Crops, presented by Alan Teel, Project Field Coordinator, at the Value Added Agricultural Products Conference in Newton, Iowa. Audience numbered 160 and included professionals with public agencies, private agriculture and economic development organizations and land owners.

How to Involve Farmers in a Scale-up Project, presented by Alan Teel, Project Field Coordinator, at the National Renewable Energy Laboratory's biomass project contractors meeting and workshop in September, 1997, at Oklahoma State University in Stillwater, Oklahoma. Audience numbered 75 and included researchers, professionals and practitioners with public agencies and private organizations in the area of biomass production and use to generate energy.

Biomass Energy: Dynamic Solutions to Global Problems, presented by Jim Cooper, Chariton Valley RC&D Coordinator, at the United Bio-energy Commercialization Association (UBECA), Conference in December, 1997, in Washington, D.C. Audience numbered 100 and included professionals with public agencies and private organizations in the area of bio-energy.

Biomass and CRP; Wildlife Considerations, presented by Marty Braster, Project Coordinator, at the Iowa Pheasants Forever State Convention in January, 1998, in Ames, Iowa. Audience numbered 50 and consisted primarily of members of Pheasants Forever including professionals with public agencies, private conservation organizations and land owners.

Bio-Energy and More, presented by John Sellers, Vice Chairman of Prairie Lands Bio-Products, at the Farm Bureau National Convention in January, 1998, in Charlotte, North Carolina. Audience numbered 350 and consisted primarily of land owner members of the Farm Bureau organization at the national, state, and local levels.

- Project Field Days, Demonstrations and Meetings: Ten field days, demonstrations and meetings have been conducted since the beginning of the project's information and education activities. These events have been attended

by an estimated 265 professionals with public agencies, representatives of private organizations and land owners. The quality and effectiveness of future field days, demonstrations and meetings will be enhanced as a result of 1) planned improvements to printed materials and 2) efforts to increase attendance by targeted audiences and media contacts.