Department of Agriculture, Trade and Consumer Protection
Division of Agricultural Development
Agricultural Development & Diversification Program (ADD)
Grant Project Final Report

Contract Number: 23062

Grant Project Title: Biomass Aggregation Project

Amount of Funding Awarded: $25,000

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Report Submitted on: March 16, 2009

Section 1
Background

1.1 Overview

Premier Cooperative (Premier) retained a team headed by RMT, Inc. (RMT), and including Agrecol Corporation; Clearspring Energy Advisors, L.L.C.; and Michael Best & Friedrich, L.L.P., to perform a Biomass Feasibility Study, pursuant to Premier's Request for Proposal (RFP) dated August 20, 2008. The project objective, as stated in the RFP, is " … to source raw biomass … from the cooperative's 3000 producer members and determine the most efficient use of the product to the end user, including processing to densify the material." The RFP cited a target biomass production of at least 300,000-360,000 tons per year.

The following specified tasks were to be completed as part of the Biomass Feasibility Study:

- Task 1. Support Premier with outreach to member producers (services to be provided as requested by Premier).
- Task 2. Perform a feasibility study of Premier's ability to sustainably source biomass materials for the production of graded biomass fuels.
- Task 3. Perform a feasibility study of Premier's ability to build and operate a biomass processing facility.

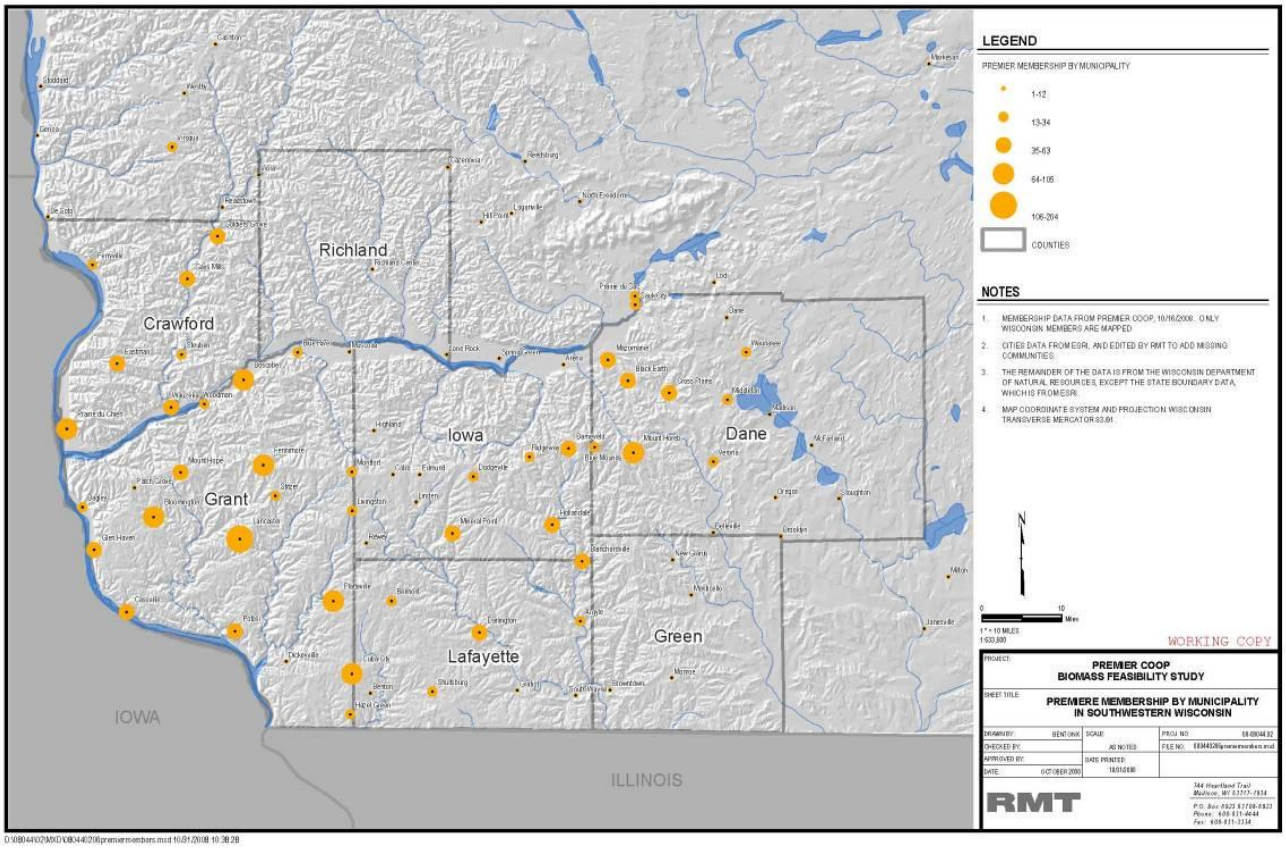
The RMT team worked closely with Premier throughout the project, and reviewed both interim work and preliminary conclusions with Premier as the results were developed. Premier was provided with a working copy of the final report, and Premier's comments on the working copy were incorporated into the final report.

The project did not examine the detailed potential environmental ramifications of producing biomass from the targeted land. These ramifications have been extensively researched and documented in numerous studies and reports by private and government entities. The biomass evaluated in this project will all arise from current cropland (excess corn stover), from certain marginal land (land currently in row crop use but better used for biomass production), from selected CRP land (which would remain in native tall grass vegetation and be harvested after the autumn die-off), and from waste woody biomass (such as excess slash and tree tops left after standard logging).

This project also did not examine or evaluate the entire potentially available grant or low-or-no interest loan programs that are or may be applicable to either defray costs or assist in minimizing the cost of capital to advance the project.

1.2 Study Area

Premier's producer-members[a] are primarily located in the following seven counties in southwestern Wisconsin: Crawford, Grant, Richland, Iowa, Lafayette, Dane, and Green. For purposes of analysis, these seven counties are defined as the biomass production market region. The location of Premier's producer-members by community, based on ZIP code, is illustrated on the following figure:



[a] Producer-members are voting members who make the majority of their income from agriculture. This is defined by the members as they join Premier and is verified with tax records.

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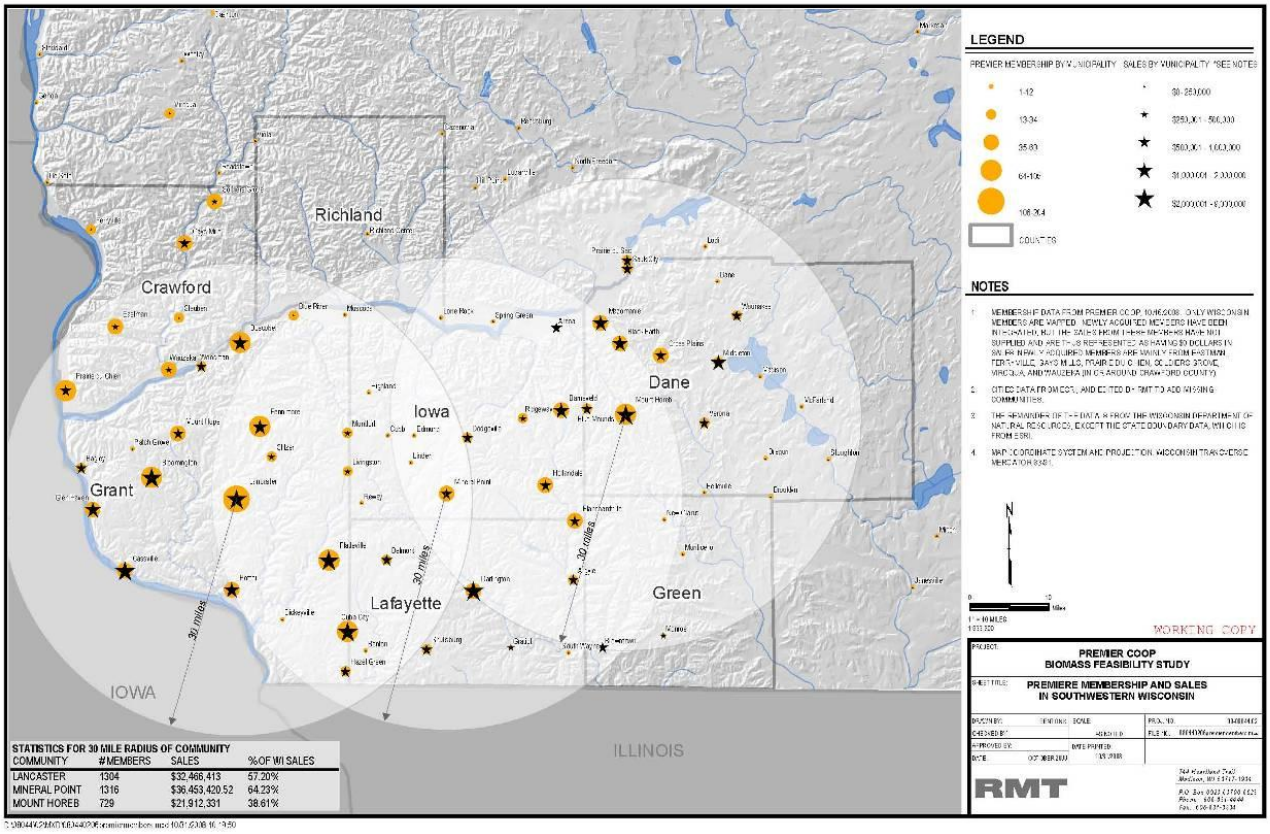


STATISTICS FOR 30 MILE RADIUS OF COMMUNITY

COMMUNITY	# MEMBERS	SALES	%OF WI SALES
LANCASTER	1304	$32,466,413	57.20%
MINERAL POINT	1316	$36,453,420.52	64.23%
MOUNT HOREB	729	$21,912,331	38.61%

Section 2
Biomass Potential and Feasibility

2.1 Biomass Production Potential

Significant biomass production potential exists in the 7-county region and within Premier's current membership. This study examines the potential biomass production from the following sources:

- Switchgrass grown on land currently in the Conservation Reserve Program (CRP)
- Switchgrass grown on marginal croplands currently in row crop production
- Corn stover collected from land currently in corn-for-grain production
- Logging residues from land in forest production

These sources do not represent a comprehensive list of potential biomass resources in the 7-county region, but are intended to represent the primary biomass resources readily available for production. Other potential biomass sources are discussed briefly at the end of this section. The following sections examine the potential volumes of biomass production from the primary sources in the 7-county region.

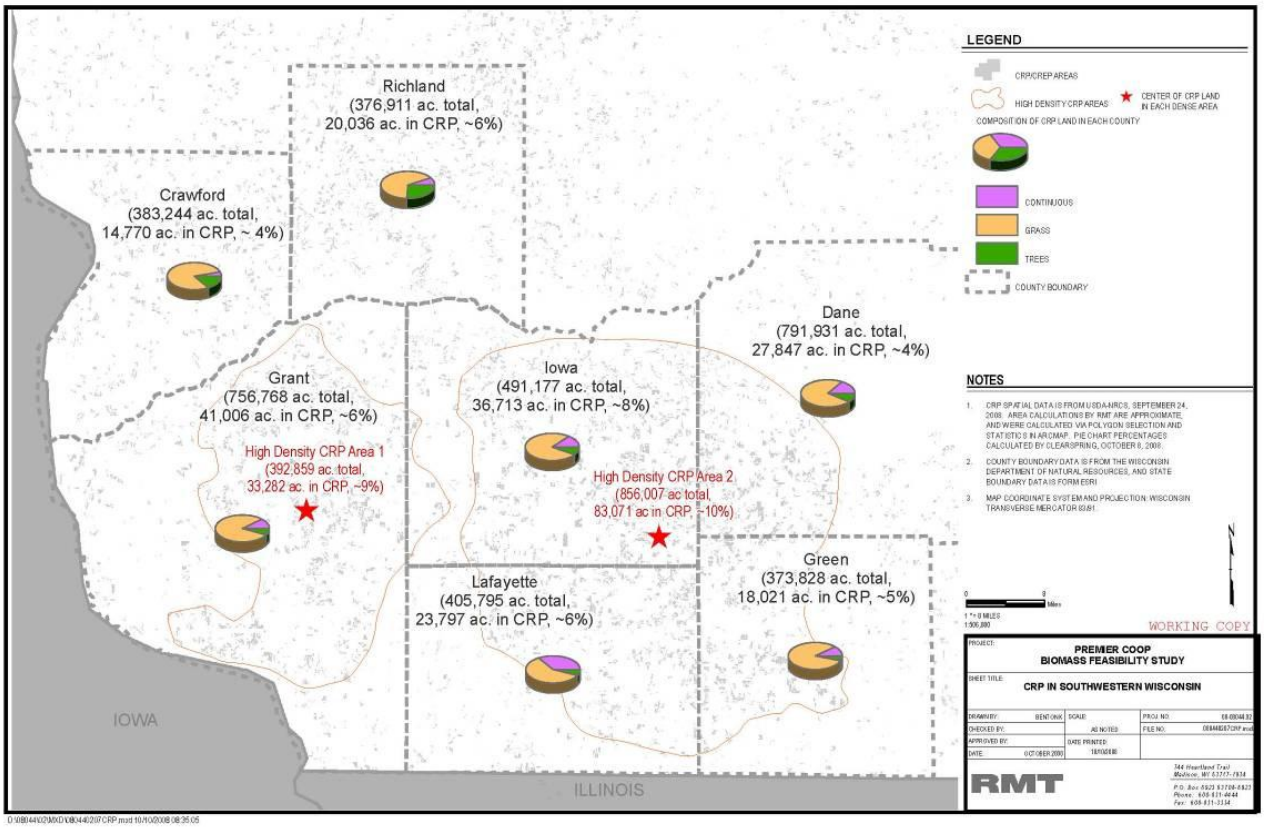
2.1.1 Switchgrass on CRP Land Production Potential

Switchgrass is a perennial warm season grass native to Wisconsin, which has been identified as a "model species" for energy potential by the U.S. Department of Energy. Although a number of native grasses can be potential biomass energy sources, switchgrass is used as the proxy native grass for purposes of analysis in this study.

One potential source of land on which to grow switchgrass is the land currently enrolled in the Conservation Reserve Program (CRP). CRP is a U.S. Department of Agriculture (USDA) program that encourages farmers to remove highly erodible or otherwise environmentally sensitive acreage from crop production and replace it with vegetative cover such as native grasses or trees. CRP contracts are generally 10 to 30 years in duration, with payments determined based on the potential crop production value from each piece of CRP land.

In 2007 (2008 CRP statistics are not yet available with the land classification detail), there were approximately 206,000 acres of land enrolled in the CRP program in the 7-county region, with 160,000 acres classified as "grass" acres. The remaining CRP land was classified as "continuous" (27,500 acres) or "trees" (18,300 acres). Only CRP grass

acres are considered for switchgrass potential in this study. The location of CRP land, the number of total CRP acres (as of September 2008), and the share of CRP defined as "grass" are illustrated on the following figure:



Of the 160,000 CRP grassland acres in the 7-county region, it is estimated that approximately 37,000 of those acres are owned by Premier producer-members. This estimate is based on the total amount of cropland tilled by Premier members (Premier estimates that its producer-members currently have 400,000 acres under till)[54] and the distribution of those members by county. The estimate of CRP grassland in the 7-county region and among Premier's membership is summarized in the following table:

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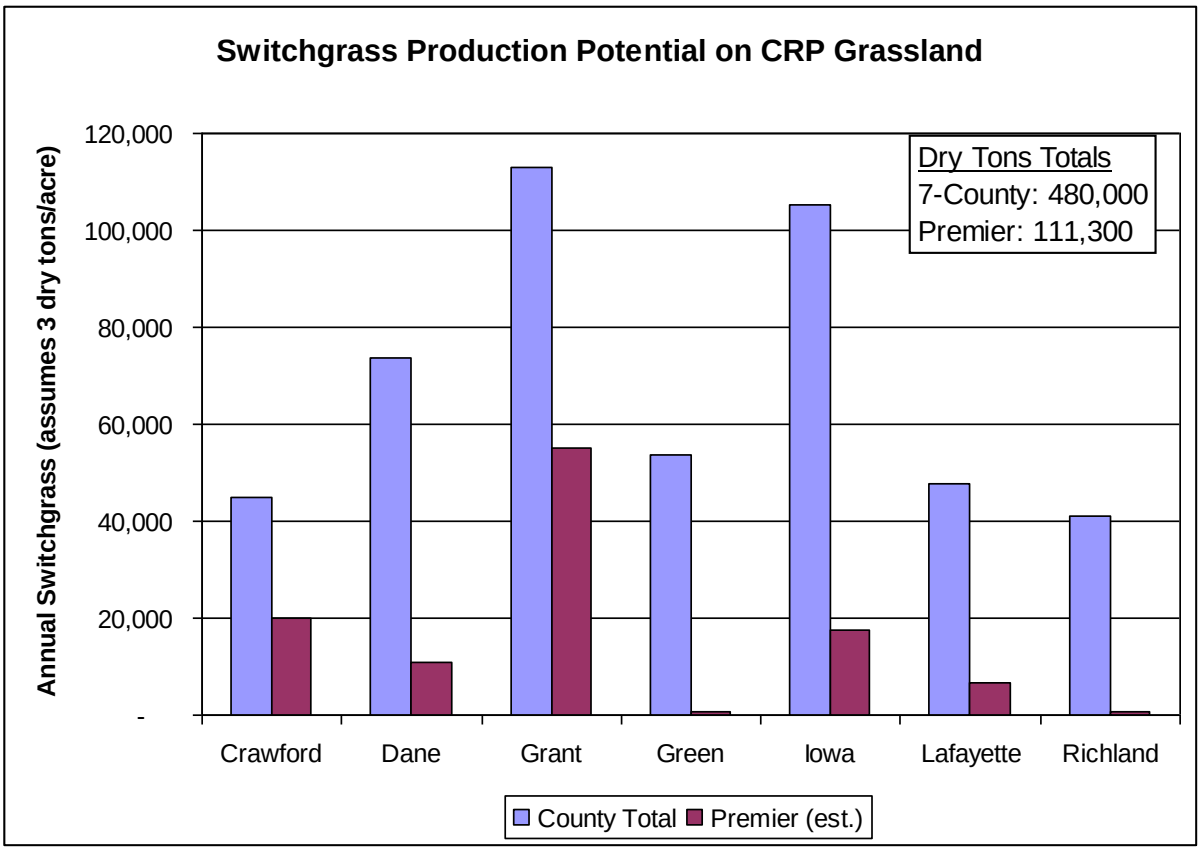
CRP Grassland Acres Estimates

COUNTY	TOTAL CROPLAND ACRES	PREMIER MEMBERS BY COUNTY	PREMIER CROPLAND ACRES*	PREMIER COUNTY SHARE	TOTAL CRP GRASS ACRES	PREMIER CRP GRASS ACRES
Crawford	129,755	14.6%	58,240	45%	14,976	6,722
Dane	415,310	15.1%	60,384	15%	24,549	3,569
Grant	374,984	45.6%	182,224	49%	37,714	18,327
Green	247,639	0.7%	2,858	1%	17,895	207
Iowa	216,882	9.0%	35,909	17%	35,145	5,819
Lafayette	264,340	9.2%	36,981	14%	15,922	2,227
Richland	133,343	0.6%	2,322	2%	13,667	238
7-County Total	**1,782,253**	**94.7%**	**378,919**	**21%**	**159,869**	**37,110**

Note:
* Based on 400,000 acres under till for all Premier members, with approximately 95 percent in these seven counties.

Source: USDA National Agricultural Statistics Service (NASS) and Premier.

Numerous studies of switchgrass production provide a wide range of production potential, depending on the location, soil quality, fertilization, and other factors. The studies provide a range of production estimates from 1.5 to 6.5 tons of switchgrass per acre per year once the land is in full production. Switchgrass generally takes 3 years to come into full production, with year one and two providing partial production estimated at 30 percent and 70 percent of full production, respectively (if harvested).(50) Fertilization is not recommended in year one because it promotes the growth of weeds. The stand will keep weeds well choked out after it is fully established. Application of fertilizer after the stand is established will increase biomass yield. Whether and how much to fertilize, and what is the best fertilizer (artificial, manure, biomass ash, etc.) needs to be determined for each stand and for each producer's preferences. Most studies conclude that no harvesting should be done in year one because of potential damage to the establishment of the stand, and because the amount harvested provides an inadequate return to justify the harvesting cost. For purposes of analysis, this study uses a realistically conservative production estimate of 3.0 dry tons per acre on marginal soil with little or no fertilizer applied. Actual production rates will vary due to soil quality and cultivation practices. Given the number of CRP grassland acres and the production of 3.0 dry tons per year, it is estimated that 480,000 tons of switchgrass could be potentially harvested annually on CRP grass land in the 7-county region, with 111,300 dry tons potentially harvested on CRP grass land currently owned by Premier producer-members.

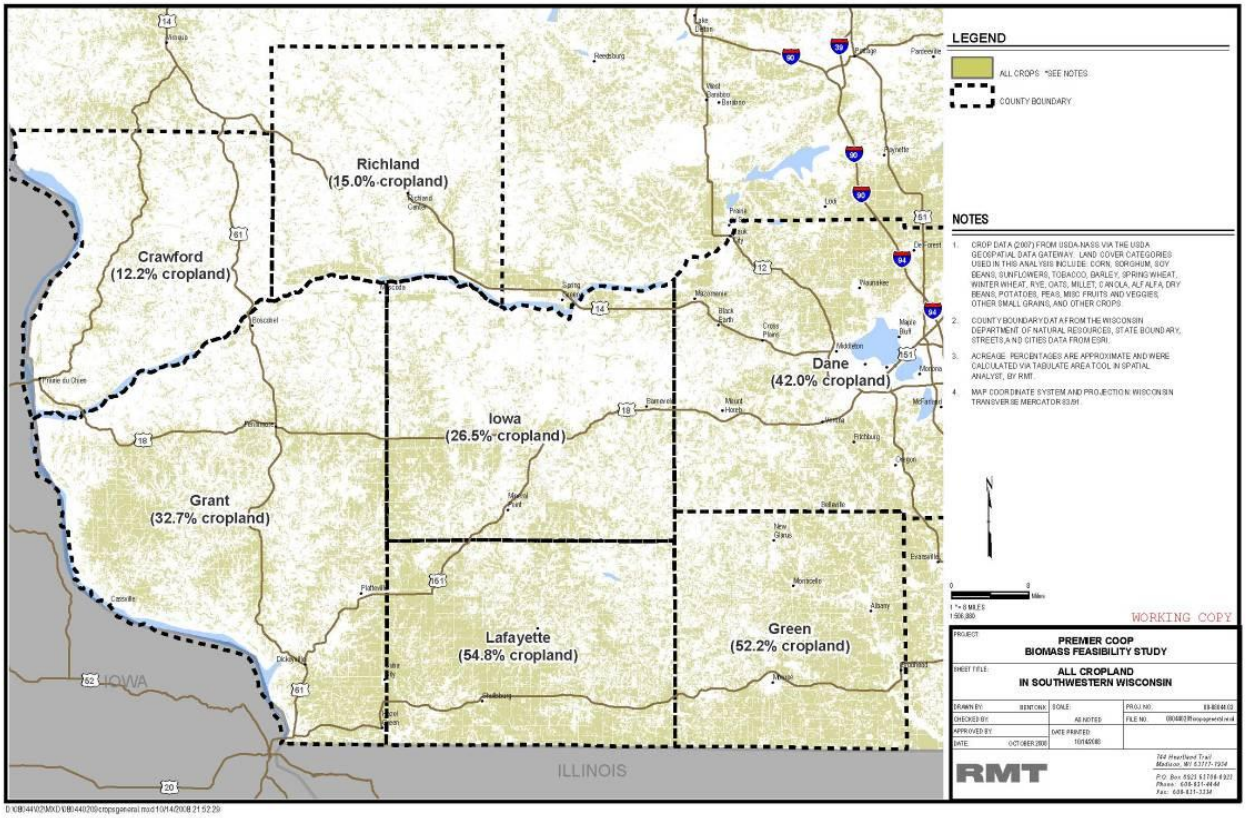


The previous production potential assumes that land is either removed from the CRP program or that future legislation allows annual bioenergy production on CRP land without penalty. (CRP land may currently be harvested one out of three years, if specified caveats are met.) It also assumes that all of the CRP land would be put into switchgrass production. However, some of the CRP land is unsuitable for any production, owing to regulatory restrictions, environmental sensitivity, or the location or configuration of the land. The extent of such land could not be determined from the available Premier data. It is important to note that contracts for 45 percent of the CRP grassland acres in the 7-county region will expire between 2009 and 2013.

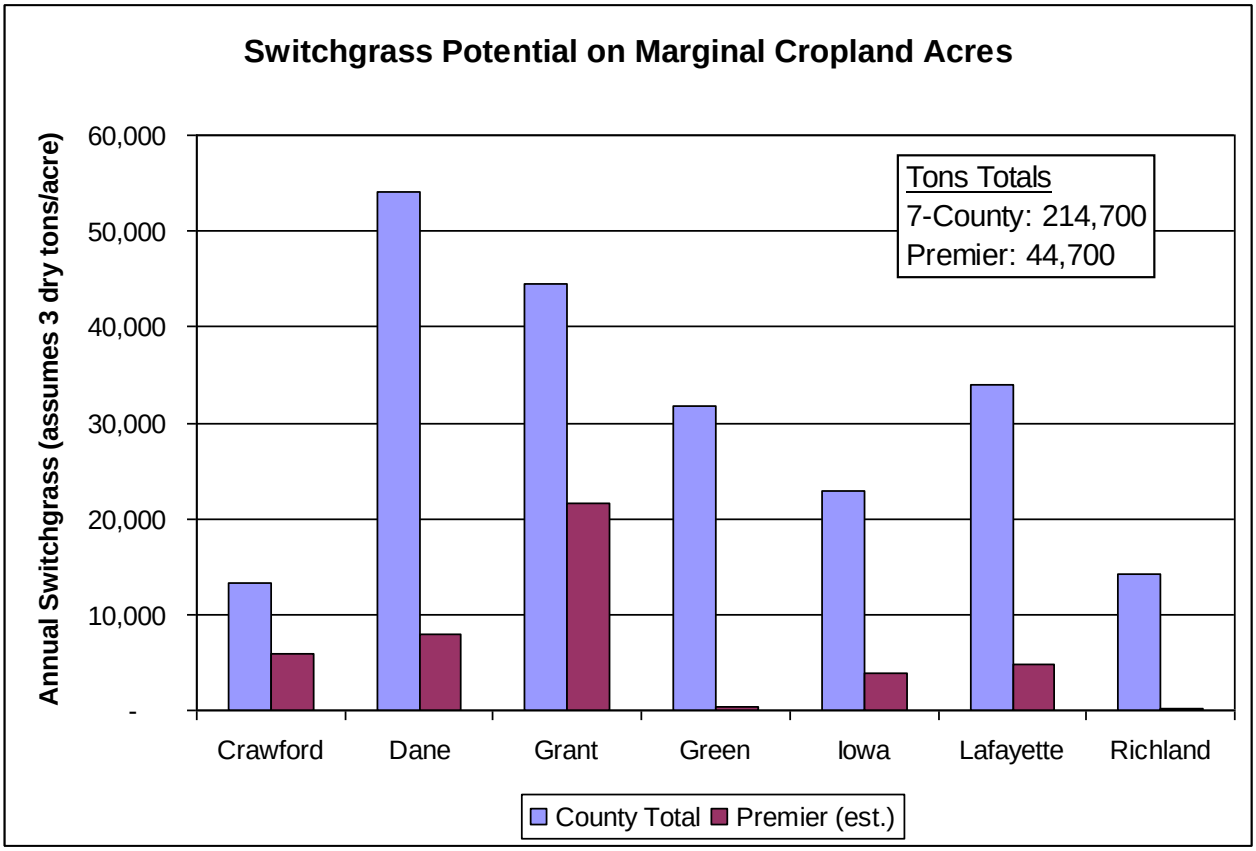
2.1.2 Switchgrass on Marginal Cropland Production Potential

Premier estimates that 5 to 10 percent of cropland currently in production is marginal, with average yields equal to, or less than, the cost of the production inputs. This may be due to the soil quality, terrain, frequent flooding, or other issues that impact the productivity of annual row crops. If switchgrass were planted on this land, it could potentially produce an energy crop from land that is not sustainable or economically viable for row cropping.

There are approximately 1.8 million acres of cropland in production in the 7-county region, with approximately 379,000 of those acres tilled by Premier producer-members, as shown previously. The distribution of cropland in the 7-county region is illustrated in the following map:



Conservatively assuming that 5 percent of the acres currently under till are marginal lands and were converted to switchgrass production at 3.0 dry tons per acre per year, they could produce 215,000 dry tons of switchgrass per year (45,000 tons on land owned by Premier's producer-members). The estimated switchgrass potential in the 7-county region and for Premier's producer-members is summarized in the following graph:

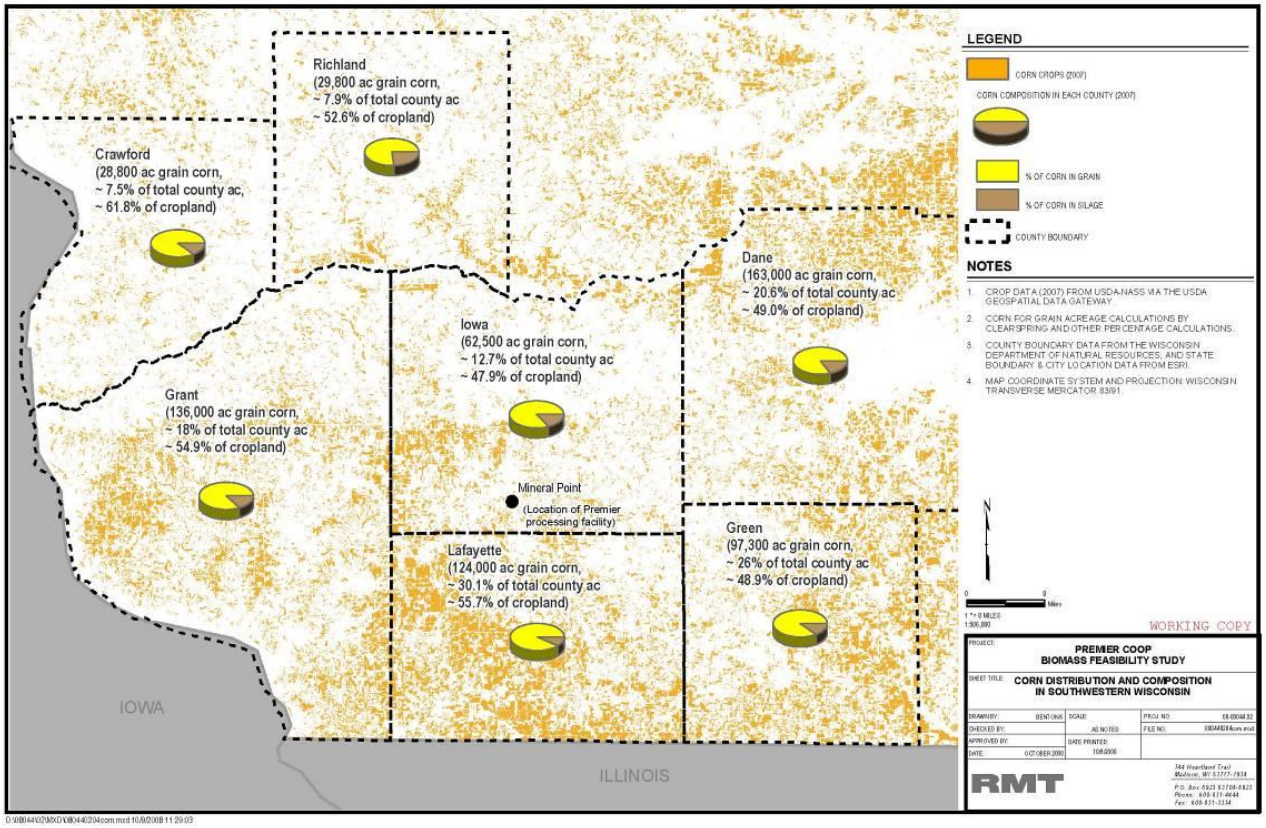


The previous estimates assume that all marginal cropland could be readily converted to switchgrass and economically harvested. The current configuration and typical parcel size of marginal land is currently unknown and may be a topic of future market research or land resource study. If it is to be harvested cost-effectively, the marginal land needs to be in sufficient geographic density rather than a broad patchwork of small areas. This study assumes that all marginal land has technical potential to be planted and harvested, some proportion of which would be economically viable for switchgrass production. An estimate of the proportion of switchgrass potential that could be realistically harvested is presented later in this section.

2.1.3 Excess Corn Stover Production Potential

Corn stover is the remaining biomass after grain has been harvested. It consists of the stalk, leaves, husk, and cob. Corn stover is generally left in the field to replenish nutrients in the soil or is harvested and used for animal bedding and feed. It is assumed that corn stover is available from all land where corn is grown for grain.

In 2007, approximately 748,000 acres of corn were planted in the 7-county region. Approximately 106,000 acres were harvested for silage and 641,000 acres were harvested for grain. A map of land planted with corn is presented as follows, with a pie chart of corn for grain and corn for silage for each county:



It is estimated that Premier's producer-members harvested 163,000 acres of corn for grain in the 7-county region in 2007. (Premier estimates that its producer-members currently have 200,000 acres of corn in rotation.[54] Approximately 95% of this is in the 7-county region, and approximately 86% is corn for grain.) The amount of corn acres, corn-for-grain acres, and Premier corn acres by county is summarized in the following table:

Corn-for-Grain Acres Estimates

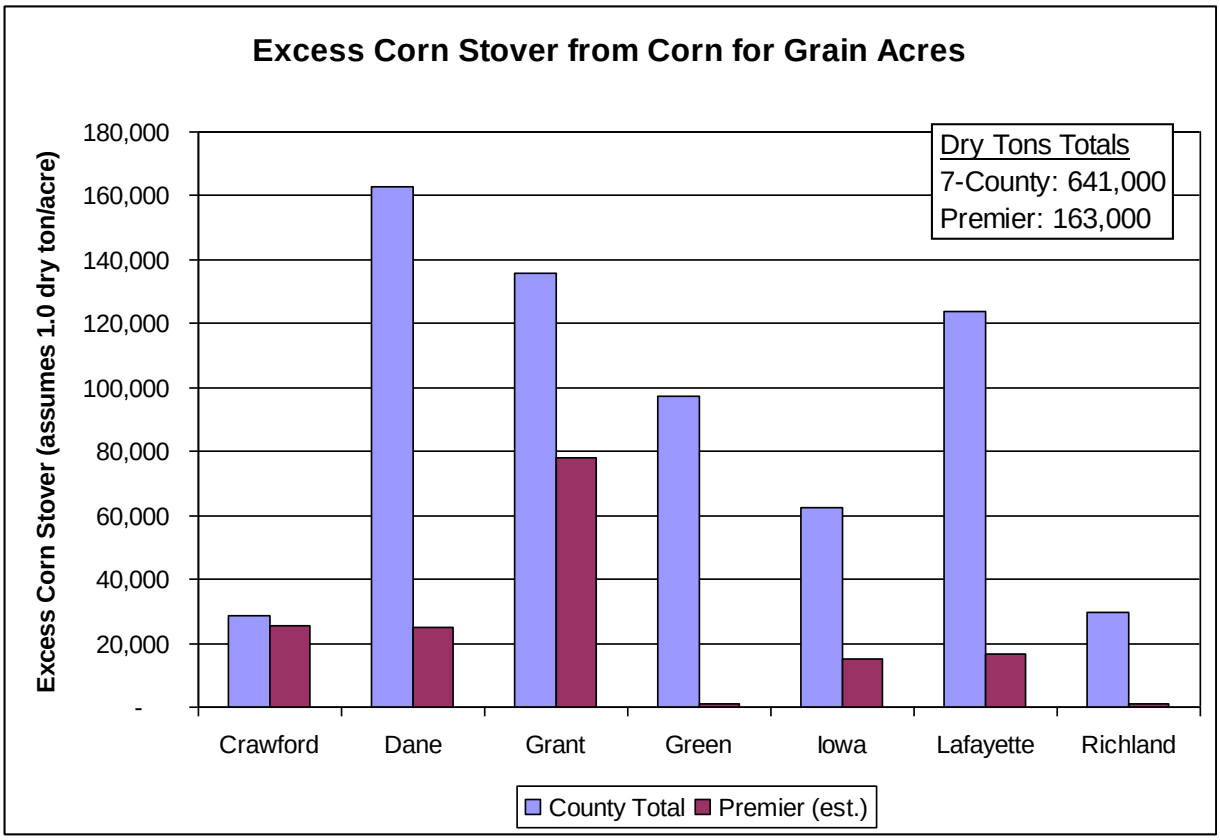
COUNTY	COUNTY 2007 CORN ACRES	PREMIER MEMBERS BY COUNTY	PREMIER CORN ACRES	PREMIER COUNTY SHARE	CORN-FOR-GRAIN SHARE	COUNTY GRAIN CORN ACRES	PREMIER GRAIN CORN ACRES
Crawford	32,900	14.6%	29,120	89%	88%	28,800	25,491
Dane	195,800	15.1%	30,192	15%	83%	163,000	25,134
Grant	158,800	45.6%	91,112	57%	86%	136,000	78,031
Green	110,900	0.7%	1,429	1%	88%	97,300	1,254
Iowa	73,900	9.0%	17,954	24%	85%	62,500	15,185
Lafayette	135,800	9.2%	18,490	14%	91%	124,000	16,884
Richland	38,900	0.6%	1,161	3%	77%	29,800	890
7-County Total	**747,000**	**94.7%**	**189,460**	**25%**	**86%**	**641,400**	**162,677**

Note:
* Based on 200,000 acres in corn rotation by Premier members, with approximately 95 percent in these seven counties.

Source: USDA National Agricultural Statistics Service (NASS) and Premier.

Approximately 3 to 4 tons of stover per acre remain after the corn has been harvested. As discussed elsewhere in this report, we will use a figure of 1.0 dry ton per acre as the amount of stover that can be sustainably removed for biomass energy production without adversely impacting the soil quality, erosion control, or requiring additional fertilizer during the following growing season (hereinafter referred to as "excess" corn stover). The remaining stover can either be returned to the field or used for the other purposes discussed previously.

Using an estimate of 1.0 dry ton per acre of excess corn stover, approximately 641,000 tons of excess corn stover could be harvested annually in the 7-county region, with 163,000 dry tons from Premier's producer-members. The amount of excess corn stover in the 7-county region and among Premier's producer-members is summarized in the following graph:



The potential to separately harvest corn cobs is discussed at the end of this section and may provide additional volume and energy potential in the future from land in corn production.

2.1.4 Logging Residues Production Potential

Logging residues are the remaining biomass left on the forest floor after the useable lumber (saw logs and pulpwood) has been removed. It generally consists of tree tops, branches, bark, and other materials collectively referred to as "slash." Although forestry is not as prevalent in this region of Wisconsin as it is in the northern part of the state, there are still substantial logging operations in the northern portions of the 7-county region.

The U.S. Forest Service maintains a database of forest production at the county level in its Timber Products Output (TPO) database.[55] A total of 103,000 green tons of logging residues were available in the 7-county region in 2007. The TPO data are provided in cubic feet, and are converted to green tons using 46 cu. ft./ton.[56] The amount of logging residue available in 2007 by county is presented in the following table:

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2007 Logging Residues

COUNTY	GREEN TONS
Crawford	21,290
Dane	4,183
Grant	21,907
Green	3,922
Iowa	18,947
Lafayette	2,147
Richland	30,640
7-County Total	**103,036**

Premier's members are primarily agricultural producers, although it is assumed that some own forested lands that are logged. The share of the total green tons of logging residue that is produced on land owned by Premier members is estimated, for the purposes of this study, by calculating the share of total county land operated by Premier members and then estimating the Premier members' share of each county's land. That share is then applied to the total county logging residues to estimate the logging residues on land owned by Premier members. Using this method, it is estimated that 10,900 green tons are produced on land owned by Premier members. This represents approximately 10 percent of all logging residues in the 7-county region.

Forested Land and Production Estimates

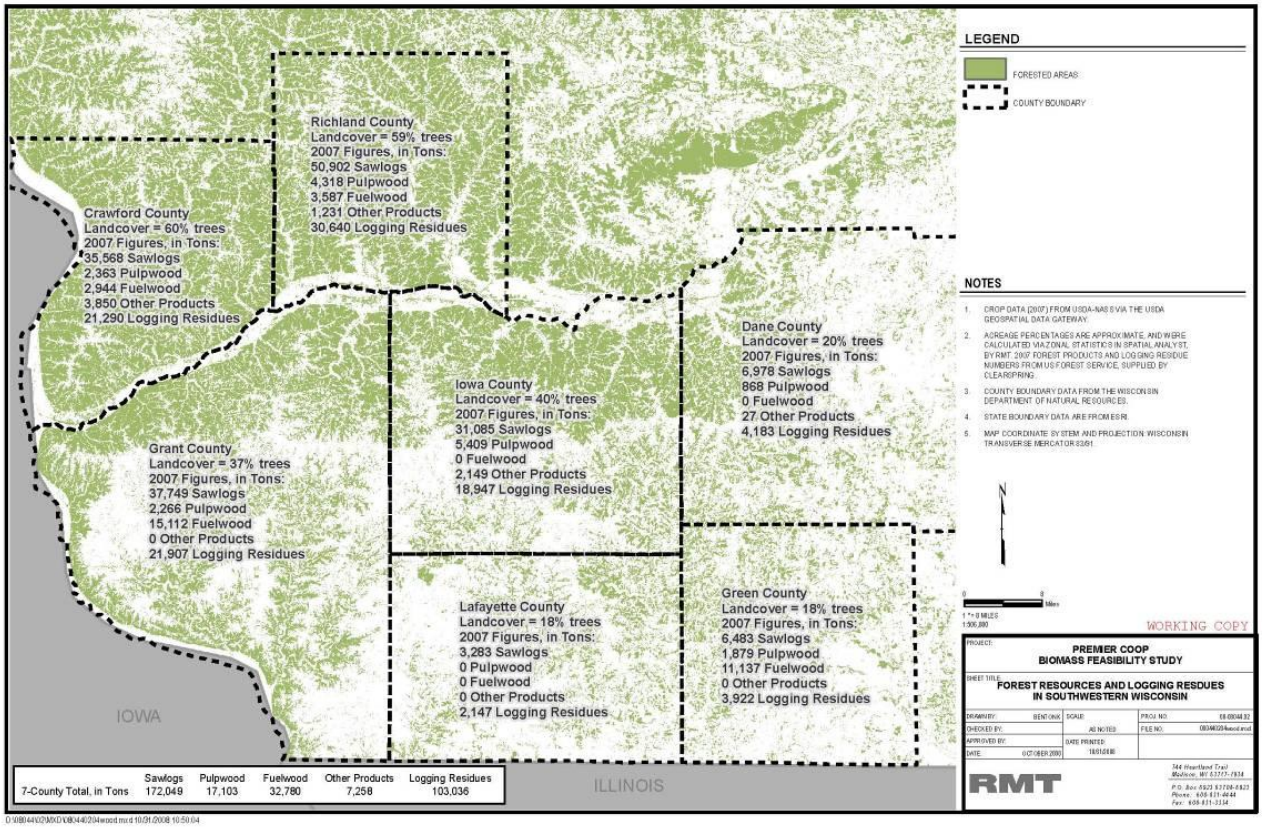
COUNTY	TOTAL COUNTY ACRES	PREMIER MEMBERS BY COUNTY	PREMIER MEMBER ACRES*	PREMIER COUNTY SHARE	LOGGING RESIDUE GREEN TONS	PREMIER LOGGING RESIDUE GREEN TONS
Crawford	383,360	14.6%	58,240	15%	21,290	3,234
Dane	792,320	15.1%	60,384	8%	4,183	319
Grant	757,120	45.6%	182,224	24%	21,907	5,273
Green	374,400	0.7%	2,858	1%	3,922	30
Iowa	491,520	9.0%	35,909	7%	18,947	1,384
Lafayette	411,520	9.2%	36,981	9%	2,147	193
Richland	376,960	0.6%	2,322	1%	30,640	189
7-County Total	**3,587,200**	**94.7%**	**378,919**	**11%**	**103,036**	**10,884**

Note:
* Based on 400,000 acres under till for all Premier members, with approximately 95 percent in these seven counties.

Source: USDA National Agricultural Statistics Service (NASS) and Premier.

For purposes of analysis, a moisture content of 44 percent is assumed for green logging residues. The equivalent annual forest residue in the 7-county region is approximately 58,000 dry tons, with approximately 6,100 dry tons by Premier producer-members.

A map of forested lands in the 7-county region is included in the following figure, along with forest production estimates by major category from 2007:



2.1.5 Total Biomass Production Potential

The potential amounts of biomass production from switchgrass on CRP land, switchgrass on marginal cropland, excess corn stover, and logging residues are summarized below.

Biomass Production Potential (Dry Tons)

BIOMASS SOURCE	7-COUNTY TOTAL	PREMIER
Switchgrass from CRP	479,606	111,329
Switchgrass from marginal cropland	214,730	44,657
Excess corn stover	641,400	162,868
Logging residues	57,958	6,122
Total	**1,393,694**	**324,976**

2.1.6 Other Potential Biomass Sources

In addition to the primary biomass sources evaluated in detail in this report, a number of other biomass sources could potentially be used in the future. Those other sources are briefly discussed in this section, but are not evaluated in detail.

Alternatives to conventional crops - Research is ongoing to increase the amount of biomass associated with various crops. Care must be taken to ensure that the increased biomass is not grown at the expense of a reduced primary crop, unless thorough economic analysis demonstrates that such a situation would be advantageous to the producer. The initial work for this project established that the 7-county area already has sufficient biomass production potential to satisfy Premier's project objectives. If the biomass business develops and grows, this matter may be reconsidered as a potential means to increase revenue.

Corn cobs are included in the corn stover estimates presented previously. Approximately 15 to 25 percent of the corn stover is cobs. Technology currently exists to separate the corn cobs from the stover in one pass, although the technology is not widely used or available in the United States. To the extent that this technology becomes mainstream, it may be possible to separately harvest and use the corn cobs for energy production. It is estimated that 0.75 to 1.0 ton of corn cobs is available per acre (some of which is already included in the excess corn stover estimates discussed previously).

Corn cobs have little or no value for animal bedding, feed, or other secondary uses, but have advantages for energy production, including a high-energy content and low alkali metal–content. While corn cobs may provide substantial additional energy potential in the future, they were not evaluated separately in this report.

Hybrid poplars are fast-growing trees that are being widely studied as a potential source of biomass energy. A review of studies regarding hybrid poplars reveals relatively long startup times for field development (at least 5 years), inconsistent yields, significant water requirements, and environmental concerns about ecological diversity from introducing a non-native species on a large scale. Most recently, the Energy Center of Wisconsin studied the potential for biomass for the Presque Isle 4 plant in Marquette, Michigan and discounted the potential for hybrid poplars in that region for a number of reasons.[56] For these reasons, the potential for hybrid poplars in the region was not evaluated in depth.

Wood manufacturing waste includes leftover wood, sawdust, and other materials from sawmills, furniture manufacturers, and other facilities that use saw logs and primary wood materials. A review of sawmills in the area revealed only eight with production greater than 1 million board feet per year, and only one with production greater than 10 million board feet per year.[57] That sawmill, the Nelson Lumber mill in Prairie du Chien, has already converted its kilns and boiler to use its wood waste. In addition, a recent report by the Energy Center of Wisconsin[56] estimated that nearly all waste wood products from primary wood manufacturers were already being used in secondary products or for heat and energy. For these reasons, the potential energy from waste products from local wood product manufacturers in the area was not evaluated in depth. The potential to blend some of this material either with the agricultural biomass before pelletizing or as wood pellets mixed with agricultural pellets in order to produce a lower ash final product merits further consideration.

Municipal wood waste includes tree trimmings, construction waste, and other wood materials that have energy production potential. The volume of these materials is not readily available, and due to the relatively rural nature of the 7-county area, it is not expected to be significant, except perhaps in Madison. In addition, production of these sources does not directly benefit Premier's members. For these reasons, the potential energy from municipal wood waste was not evaluated in depth. As with wood manufacturing waste, however, the potential to blend some of this material either with the agricultural biomass before pelletizing or as wood pellets mixed with agricultural pellets in order to produce a lower ash final product merits further consideration.

2.1.7 Conclusion

There is substantial production potential of switchgrass, excess corn stover, and logging residues in the 7-county region and within Premier's membership. In addition, other biomass sources may provide upside production potential. The following section estimates the energy potential from the primary biomass sources in the region.

2.2 Biomass Energy Potential

The total potential energy content is the product of the production volume (detailed in the previous section) and the energy content per unit of biomass. The energy potentials estimated in this section are at the farmgate, and do not account for any possible volume losses during off-site handling or transportation.

2.2.1 Switchgrass Energy Potential

The U.S. Department of Energy and other sources provide relatively consistent estimates of switchgrass energy content in the 15 to 17 MMBtu per dry ton range.[58] This study uses an estimate of 16.0 MMBtu per dry ton of switchgrass. Given 3.0 dry tons per year per acre of switchgrass harvested and 16 MMBtu per dry ton of switchgrass, it is estimated that annual switchgrass energy potential is 7.7 trillion Btu on CRP land and another 3.4 trillion Btu on marginal cropland in the 7-county region. The switchgrass energy production potential for Premier's producer-members is estimated to be 1.8 trillion Btu on CRP land and 0.7 trillion Btu on marginal croplands (2.5 trillion Btu total).

2.2.2 Excess Corn Stover Energy Potential

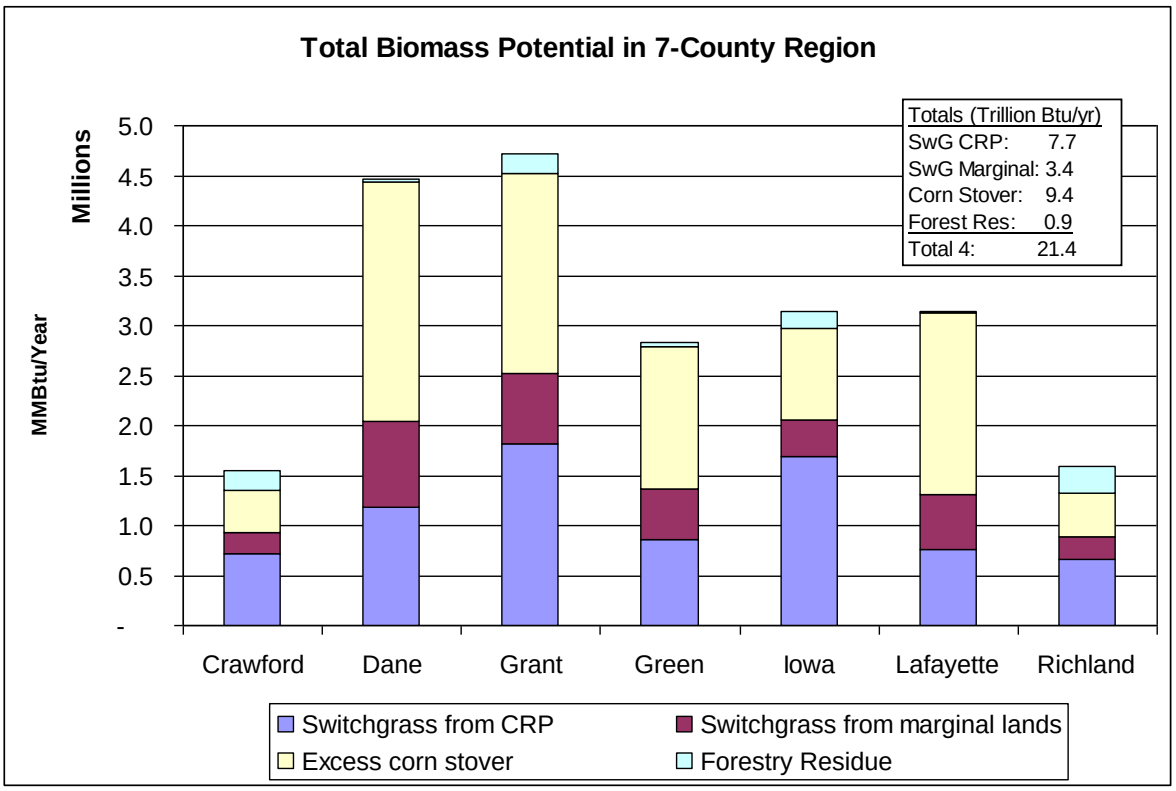
The energy content of corn stover is slightly less than that of switchgrass on average, and is estimated to be 15 MMBtu per dry ton based on estimates from the U.S. DOE.[58] Given 1.0 dry ton of excess corn stover per acre per year, the annual corn stover energy potential is 10.3 trillion Btu in the 7-county region and 2.6 trillion Btu from Premier's producer-members.

2.2.3 Logging Residues Energy Potential

The energy content of logging residues is approximately 9 MMBtu per green ton or 16 MMBtu per dry ton. A moisture content of 44 percent is assumed based on studies by the Energy Center of Wisconsin and others. The total annual logging residue energy potential is 0.9 trillion Btu in the 7-county region. The amount of logging residue on Premier members' land is estimated to be 0.1 trillion Btu.

2.2.4 Total Biomass Energy Technical Potential

The total annual biomass energy potential from the primary sources is approximately 21.4 trillion Btu in the 7-county area and 5.0 trillion Btu within Premier's producer-members. The total biomass energy potential from the primary sources in the region and within Premier's membership is illustrated by county in the following graphs:



2.2.5 Total Biomass Energy Market Potential

The previous figures showed estimates of the total biomass energy production potential from the primary sources, assuming that all of the biomass in the region or within Premier's membership is utilized. In reality, only a portion of landowners in the region and within Premier's membership will choose to participate. In addition, some portion of the potential biomass may be unavailable due to its location, terrain, parcel size, or other factors. Although these factors are not known, they are estimated here to provide a more realistic estimate of the amount of biomass that could be realized. Future land use and market research studies could provide more accurate estimates if Premier decides to pursue the biomass market.

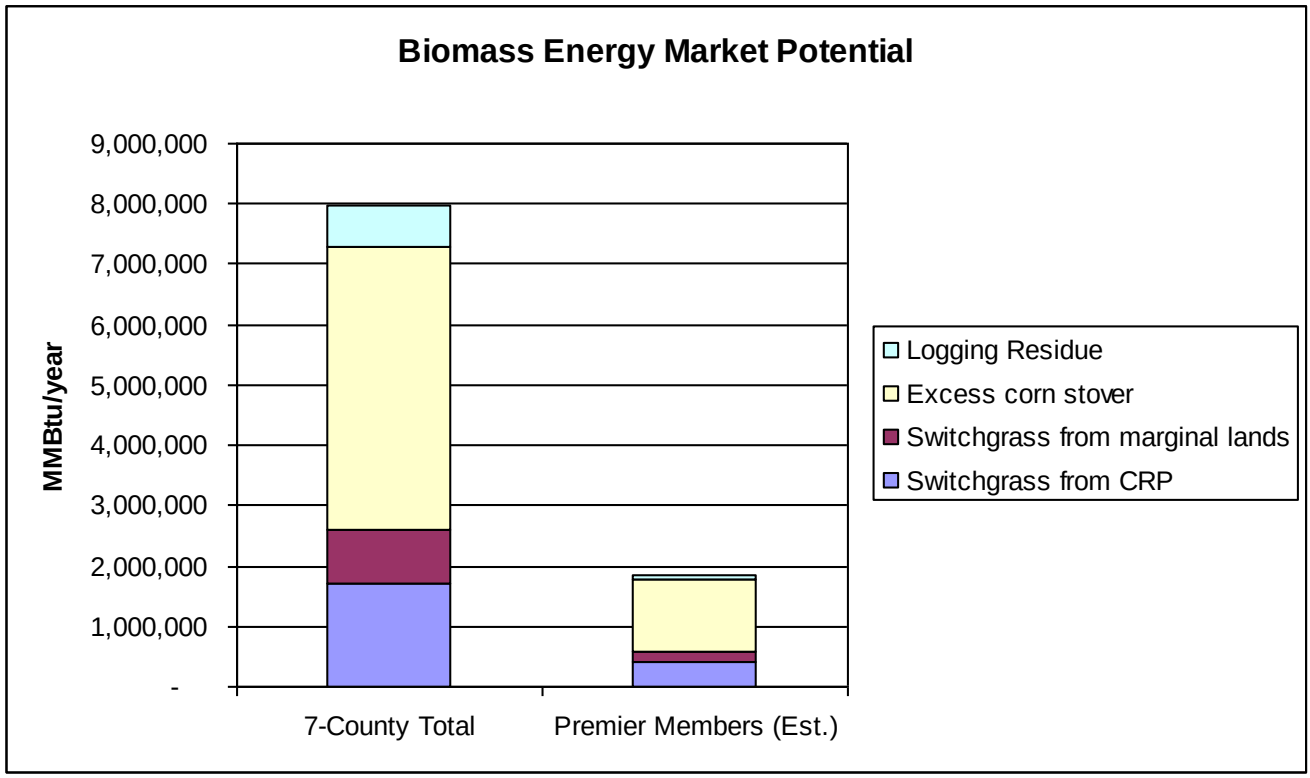
The following assumptions are applied to the technical potential to estimate the market potential:

- Approximately 45 percent of the land in the CRP has contracts expiring in the next 5 years. It is further assumed that one half of those landowners may take their land out of the CRP for switchgrass if the economics are favorable. Thus, the

switchgrass market potential in 5 years is estimated to be 22.5 percent (45% x 50%) of the total technical potential for switchgrass on CRP land. Please note that if legislative proposals allowing planting of energy crops on CRP land without penalty are enacted, it would negate the need for CRP contracts to expire prior to biomass production.

- Of the land currently under till on marginal soil, it is assumed that one half of the land is configured in parcel sizes amenable to planting and harvesting, and one half of the farmers would choose to plant that land with switchgrass if the economics were favorable. Thus, the assumed market potential is estimated to be 25 percent of the technical potential (50% x 50%).
- Corn stover is often collected and used for animal feed or bedding. It is assumed that 50 percent of the area farmers would collect excess stover for biomass energy production if the economics were favorable.
- It is assumed that 75 percent of the forest residues would be collected and used for biomass energy production if the economics were favorable.

These assumptions are highly subjective, and are used to provide an initial market potential for biomass resources in the region and within Premier's membership. More accurate estimates could be developed in the future through land use or market research studies or surveys. Using the estimates provided here, the market potential for the primary biomass products is 8.0 trillion Btu in the 7-county region and 1.8 trillion Btu for Premier's producer-members.



2.2.6 Conclusions

A substantial quantity of biomass is available in the 7-county region and within Premier's membership. The total amount of biomass is enough to support the needs that were projected for Alliant's proposed Nelson Dewey 3 plant and/or other markets in the region. The market potential for biomass, assuming that only a portion of technical potential is readily available, is also substantial and would be more than enough to fuel the electric utility and retail markets examined in this study. Premier's producer-members produce approximately one fourth of the total biomass production potential in the 7-county region.

The following sections will examine the costs of biomass production, the size of potential markets for that biomass, and the technical and logistical issues related to storing, transporting, and processing biomass into a marketable product.

Section 3
Ability To Build and Operate a Biomass Processing Facility

3.1 Storage and Delivery Needs on a Year-round Basis

3.1.1 Utilities

As discussed in a previous section of this report, and as best as could be determined within the scope of this project, no major electric utilities in the 7-county area are currently using biomass as fuel for baseload generation. Those utilities that have announced plans to use biomass intend to focus on wood, although possible use of some proportion of switchgrass and /or corn stover has been mentioned. Because, unlike coal, biofuels must be protected from the weather, the utilities would not be expected to store large quantities of biofuel on their sites. Some version of just-in-time (JIT) delivery would likely be required.

Storing the very large quantities of biofuel required for large baseload electricity generation is likewise neither physically nor economically feasible for Premier. Production would therefore have to be a version of JIT, with the product biofuel stored for only short periods before delivery to the customer. Indeed, the entire biofuel operation would be designed around the needs of the large utility. Since Premier intends to concentrate on grasses and stover, and not wood, and since there are currently no firm commitments by utilities to use large quantities of grass- or stover-based biofuels within a reasonable shipping distance of Premier, the storage needs relative to large baseload electricity generation will not be discussed further here.

Some discussions are under way with smaller utilities, who would use tens of thousands of tons per year, rather than the hundreds of thousands of tons per year required by large baseload utilities. These discussions are not sufficiently advanced to merit detailed evaluation of production or storage requirements for these potential users, but the information generated in this Feasibility Study will allow such evaluation to be performed quickly and efficiently if the demand develops.

3.1.2 Non-Utilities

Storage and delivery needs are discussed in several previous parts of this report. Smaller biofuel users such as small businesses, small institutions, and residences will typically require a convenient supply, available at any time on short notice. Because this demand can be met with bagged (usually 40 pounds) or tote (up to 1 ton per tote) quantities, the demand can be met by shipment from either a central warehouse or multiple dispersed warehouses and sale through Premier facilities or through other local retailers.

The current planned scenario is to limit initial pellet production to the throughput of the Premier pelletizer in Mineral Point. As described in several parts of Section 2 of this report, the volumes of both biomass and biofuel are small enough so as to not pose overly difficult storage challenges. The location of the Mineral Point production facility on a major year-round highway, and the experience that Premier has with servicing its members year-round, minimize seasonal delivery concerns.

3.1.3 Potential Partners

Storage and delivery are two functions for which Premier may want to consider partnering. This is discussed in more detail in other parts of this report.

3.2 Volume and Quality of Fuel Products To Be Produced

3.2.1 Volume

As discussed previously in this report, the potentially very large biomass fuel demand for Alliant Energy's NEDIII plant is now unlikely to occur. There are other potential high-volume biomass fuel users in the feasibility study area, but their plans, especially regarding agricultural biomass fuel, are still in development. There is currently no established agricultural biofuel pellet market in Premier's territory and there is no established pricing structure for agricultural biofuel pellets. There appear to be no major agricultural biomass fuel pellet producers in the country, at least not for the retail market.

Premier's Mineral Point facility has a pelletizer and associated equipment, as well as an agribusiness infrastructure and associated equipment. Much of the equipment and infrastructure could be used for an agricultural biomass fuel pellet operation, avoiding a large capital investment for startup of an agricultural biomass pellet enterprise. As discussed previously in this report, the practical capacity of the pelletizer for agricultural biomass fuel pellets is about 8,000 tons per year on a schedule of 8 hours

per day and five days per week. The quantity of biomass required to produce this quantity of pellets can be obtained within a short distance, probably about 7 miles, from the Mineral Point facility.

Considering all factors, and in the absence of a committed large-volume user, the modeled production rate is 8,000 tons of biomass pellets per year. If the business grows, this Feasibility Study provides the information to plan for production increases. Growth in the residential and small business segment can be handled incrementally at a measured pace and with measured investment. Because of the nature, timing, and capital investment needed for a large user to convert to biofuel pellets, it is likely that considerable advanced notice would be available to ramp up both biomass supply and pellet (or bulk biofuel) production.

Starting with a significant production volume, but one generally within the capabilities of Premier's existing systems, reduces the financial, operational, and management risks of the enterprise, and is the more conservative course of action considering both the enterprise itself and current economic conditions.

3.2.2 Quality

Quality considerations for biofuel pellets are discussed earlier in this report. Given the limited information about agricultural biomass fuel pellets, the differences between the Premier equipment and the Agrecol equipment, the plans to utilize agribusiness transport equipment (large gravity hopper trucks, large auger discharge trucks, moving floor trucks) to distribute the pellets, the limited experience with small stoves and furnaces to combust the pellets, the uncertainties in the native grass biomass supply (Agrecol's supply is carefully controlled and is very uniform), and the uncertainties regarding various risk mitigation techniques, establishing product quality standards is probably not possible at this point.

If one is to not simply adopt the PFI standards (which the agricultural biomass fuel pellets probably could not meet from a practical standpoint), then quality standards need to be established for Premier's particular product. What is needed is a course of research using various raw materials, processing procedures, handling procedures, and combustion tests to reduce the data gaps. Such a course of research does not need to be overly complex, lengthy, or costly; at least partial government, utility, PFI, or investor funding may be available. The research could be performed at Premier, at Agrecol, or in a laboratory/pilot-scale setting. Wisconsin, especially the University of Wisconsin system, is well situated to assist with (and perhaps help fund) such research. Considering that a market does not currently exist for the agricultural biomass fuel

pellets, the time required for the research would not be wasted opportunity. What would be a wasted opportunity is investing time, money, and reputation in an enterprise that is not sufficiently researched out and that will likely face daunting challenges.

3.3 Market Feasibility and Competitive Analysis Within Market Segments

A detailed market analysis is given previously in this report. In this part, we discuss the feasibility of Premier establishing a market for agricultural biomass fuel, and also analyze competition within market segments.

This Feasibility Study considered two biomass materials (corn stover and native grasses) and two forms of the biomass material (bulk undensified and pelletized). Initial evaluation of woody biomass indicated that it would be of little intrinsic interest to Premier, and Premier instructed the project team to concentrate on stover and grasses.

One of the driving forces of this Feasibility Study was the potential for large-scale biomass fuel use at the Alliant Energy NEDIII power plant in Cassville, Wisconsin. Alliant had announced their intention to use up to 10% switchgrass, amounting to about 100,000 tons per year, at NEDIII. Alliant did not issue technical specifications for the biomass. Based on tests performed at the Alliant power plant in Ottumwa, Iowa, and because of the considerable additional cost of pelletization, it was assumed that the NEDIII biomass would be provided in bulk undensified form. However, in November 2008, the Wisconsin Public Utility Commission (WPUC) rejected Alliant's application for a license for NEDIII, and Alliant indicated that the decision would not be appealed. While there are other potential utility-scale users of biomass that could potentially be served by Premier, at the present time (December 2008), none have made firm commitments for agricultural biomass. In the absence of such firm commitments, there is no ready market for bulk-undensified switchgrass.

The potential local utility-scale projects that could use biofuel have focused on wood or switchgrass, not stover. Whether stover would be a viable fuel for the projects cannot be determined at this time. Stover has been discussed as a biofuel source at ethanol plants, but usually via gasification. There are no such projects in Premier's area.

Premier has a large stover and native grass biofuel potential. If a large demand developed for bulk-undensified biomass, Premier could respond. Given the nature of such projects, there would likely be several years' advance notice. Stover could be delivered within a year, and switchgrass within 1-3 years, depending on economic incentives and CRP policies. Capital investment would be modest compared to a pelletizing operation. Thus, the market for bulk undensified agricultural biomass is feasible, but not current. However, such demand will

likely develop, and Premier should position itself, through personal contacts, options, and contracts, to lock in the opportunities when they develop. As discussed in several parts of this report, the competition, both now and in the future, will be wood.

Regarding densified agricultural biomass, the concentration is on pellets. As described previously in this report, virtually the entire pellet heat market is composed of wood pellets. As stated in the AURI agricultural pellet study(2), "… there is not a robust retail market for agricultural biomass pellets, and there is no price history. Thus, predicting future prices for agricultural biomass pellets is guesswork." Many basic technical and operational questions remain for agricultural biomass pellets. Compared to wood pellets, the real impact of agricultural biomass pellets' higher chlorine content, higher alkali metal content, higher ash content, and lower energy content; the need for more specialized and expensive combustion systems; and the potential storage and handling challenges have yet to be demonstrated in the U.S. marketplace.

Market segments for which these disadvantages may be overcome are primarily those that can use "utility" grade pellets, for which manpower is available to deal with larger quantities of pellets and greater quantities of ash, and for which ash disposal is convenient and low cost. Certain small non-urban businesses, agricultural enterprises, and certain government facilities (schools, prisons, hospitals) are possibilities. Storage and handling issues must still be addressed, as must the capital cost of the specialized biofuel stoves or furnaces. In addition, the agricultural biomass pellets must still be more cost-effective than wood pellets.

Another potential market segment for the agricultural biomass pellets is those enterprises that will use biomass not for economic reasons, but for "green" reasons. Market research is needed to identify such enterprises, and the overall cost of the agricultural biomass pellets must still be less than wood.

Overall, establishing a profitable agricultural biomass fuel market at the present time will be a major challenge, unless the product cost can be kept considerably lower than wood. If major new market segments open, there will likely be time for Premier to properly prepare to take advantage of the opportunity.

Better opportunities may develop in the next few years for non-fuel use of the biomass, especially the corn cobs, and/or for fuel use in a local application such as a liquid biofuel plant.

3.4 Certain Technical Issues

3.4.1 Processing Technology

Utilities and Other Large Users

These users require low cost, which in turn means minimal processing of the biomass to be used for fuel. At the same time, the quantities of biofuel that they require may necessitate transport from extended distances, and so some type of densification may be needed to reduce transportation cost. For both stover and grasses, high-density baling may address both issues. Bales can be further compacted by a processor, but this adds cost, and care must be taken to not exceed legal truckload limits. The bales will be transported to the user, who will process the bales into whatever form is needed for feeding to the furnace.

Developing technology may allow other forms of densification, such as cubing, in the field. Such methods may add cost, however, and so would likely not be widely applied.

Non-Utilities

Smaller biofuel users such as small businesses, small institutions, and residences can typically not use the type of bulk green high-moisture biomass that utilities use. They require a higher quality, densified, more uniform biofuel. For processed biofuel, pellets or some type of briquettes have become the standard, with pellets by far the dominant form. Pelletization is a well established technology, although there is much more experience with pelletizing agriculture feed and wood than there is with agricultural biomass. Based on the research done for this feasibility study, there are no technological barriers to pelletizing agricultural biomass. Likewise, stoves and furnaces using pellets have become a standard, and units are coming on the market that can handle any type of pellet.

3.4.2 Regulatory Compliance

No unusual regulatory compliance issues are anticipated for an undertaking of the modeled nature and size (8,000 tons per year) anticipated for Premier, especially if conversion is performed at a major existing Premier facility. If there is a problematic environmental concern, it will probably be related to particulate matter (PM). Grain

handling facilities, especially when large numbers of trucks are involved, can generate considerable PM. Receiving, unloading, storing, and processing the biomass may create additional PM, as will the conversion process and the bagging, transporting, and storage of finished product. The potential PM can be evaluated using standard emission factors, and the effects of the predicted PM emissions can be modeled using accepted USEPA techniques. This should be done early in the project evaluation process to determine if problems will be revealed that may affect permitting, layout, operations, or site finishing.

Some grain mill operations are covered by special Wisconsin Department of Natural Resources (WDNR) regulations. Adding a biomass conversion operation to a grain-milling site may subject the site to additional and/or different environmental requirements.

3.4.3 Proximity to Market

Potential markets are discussed previously in this report. Several locations in Premier's territory, especially those along Highway 151, are well positioned to serve the several identified markets. Just as important, as also discussed previously in this report, these same Premier locations are well positioned relative to raw material supplies.

3.4.4 Storage Requirements

Storage requirements for both biomass and finished product are discussed previously in this report, based on a modeled production rate of 8,000 tons per year. Actual storage requirements for biomass, conversion facility site, and finished product can be re-evaluated if a business plan is developed.

3.4.5 Risk Management

Premier is well familiar with the risks of fire and explosion from grain dust, and with the fire potential of storing biomass. The biomass to be used for the agricultural fuel pellet enterprise will be stored primarily outside, or in open-sided structures. If there is storage in closed structures, adequate ventilation will be provided. Finished product will be quite dry, and will be stored to protect the product from precipitation and from excessive moisture absorption. The fire potential of the agricultural biofuel pellet enterprise is not qualitatively different from other Premier biomass-related agricultural businesses, and so the insurance requirements for storage and handling are not expected to be substantially different. Premier also has experience in selling products

intended to be used in combustion systems in the home (although not products that produce ash), and so is familiar with the associated risks and insurance requirements.

A risk that must be considered is related to the inability to accept biomass from producers or to deliver product to users because of problems at the conversion facility. Regarding the ability to accept biomass, provision can be made to store the biomass temporarily until conversion can resume. Longer interruptions will have to be handled in advance via sharing arrangements and contract provisions. The risk of the inability to produce or to deliver product needs to be handled through a combination of shared supplier arrangements and contract provisions. Neither of these risks is unfamiliar to agribusiness, nor is dealing with them.

Part of an eventual business plan will be a thorough evaluation of risk management alternatives. It is likely that the preliminary plans for biomass acquisition, conversion of biomass to biofuel, and sale of biofuel will require modification in order to arrive at an overall acceptable risk management scenario. Further modifications are likely as the business grows and develops.

3.4.6 Loading/Transportation Requirements

These logistics requirements and alternatives are discussed previously in this report. A core issue is whether Premier prefers to contract many of these services or wishes to self-perform. This decision will be an important part of the eventual business plan.

3.5 Operational Issues

Operational issues related to site requirements, transportation, permitting, etc., are discussed in various parts of this report. The preferred location for conversion of the biomass to biofuel, Premier's Mineral Point facility, is fully equipped for both office and production staff. The Mineral Point staff who perform the feed-related agricultural operations include the basic disciplines needed for the biomass to biofuel conversion operation. According to the AURI report[(2)], a staffing level of at least three is needed for the conversion operation. Even if double this number was needed, the Premier Mineral Point facility can accommodate them. The additional staff needed for the conversion operation, and for the transportation operation if Premier chooses to self-perform transportation, are expected to be readily obtainable within a reasonable distance.

As projected for a production rate of 8,000 tons of pellets per year using existing equipment, conversion would operate 8 hours a day, 4 days a week. This would probably not require a

modified management arrangement and pay structure from the one that Premier currently uses. Specifics will need to be worked out in the eventual business plan.

The optimum business entity arrangement for the new enterprise relative to Premier Cooperative and relative to the major producers and customers will need to be worked out as part of the eventual business plan.