Premier Co-op
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Biomass Feasibility Study

March 2009

Biomass Feasibility Study

March 2009

Prepared For
Premier Cooperative

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Senior Project Manager

Richard P. Fish
Vice President

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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, hereinafter referred to as the 7-county region or study area. 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 Figure 1 that follows this page.

Approximately 95 percent of Premier's producer-members are located in the 7-county region. The number of Premier's producer-members by county is summarized in the following table:

Producer-Member County Shares

COUNTY	MEMBERS	% TOTAL
Crawford	326	14.6%
Dane	338	15.1%
Grant	1,020	45.6%
Green	16	0.7%
Iowa	201	9.0%
Lafayette	207	9.2%
Richland	13	0.6%
7-County Total	**2,121**	**94.7%**
Other counties	118	5.3%
Premier Total	**2,239**	**100.0%**

Source: Premier producer database 10/20/08.

1.1 Geographic Location of Premier's Members

Premier's members are widely dispersed geographically throughout the 7-county area, with a heavier concentration in the agricultural areas than in the forested areas. Geographic data for the number of Premier's members by their address (ZIP codes) are shown on the figure and table in Subsection 1.2. The heaviest concentration is in Grant County, although there is a considerable concentration in western Dane/eastern Iowa County. Localized concentrations occur in towns in

[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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Lafayette and Crawford Counties. Figure 2 presents the same information with superimposed 30-mile radii from Mt. Horeb, Mineral Point, and Lancaster. In reviewing these figures, keep in mind that the points are based on the number of Premier members by their address (ZIP codes), not on the acres of land owned/farmed by Premier members. Developing more precise geographic analyses will require more detailed land data regarding Premier's members. Nevertheless, for the purpose of this Feasibility Study, the table and figures provide a good indication of the location of potential sources of biomass from Premier members.

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1.2 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.

1.2.1 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 (U.S. DOE). 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 CRP. The 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), approximately 206,000 acres of land were enrolled in the CRP 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 Figure 3 that follows on the next page.

Of the 160,000 CRP grassland acres in the 7-county region, an estimated 37,000 acres are owned by Premier producer-members. This estimate is based on the assumption that the percentage of the total amount of cropland tilled by Premier members (Premier estimates that its producer-members currently have 400,000 acres under till)[54] divided by the total of all cropland tilled in the 7-county region (1,782,253 acres) is approximately the same percentage of CRP lands in a county that is owned by Premier members 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:

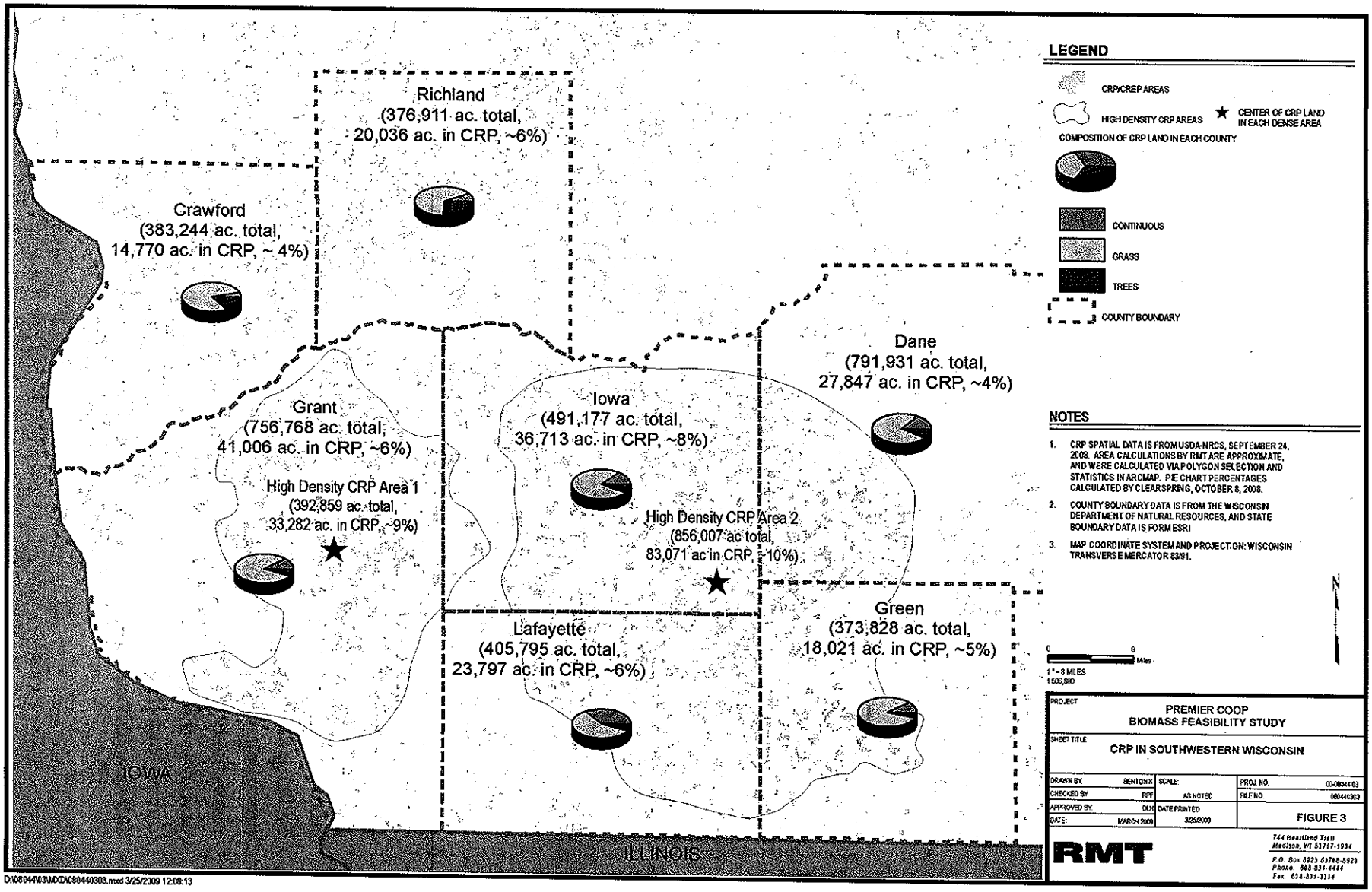
CRP Grassland Acre Estimates

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 climate (length of growing season), soil quality, fertilization, prior land use, 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 years 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. Weed control with herbicides may be needed, especially during establishment of the stand. The stand will keep weeds well choked out after it is fully established. Application of fertilizer after the stand is established will increase


Richland
(376,911 ac. total,
20,036 ac. in CRP, ~6%)
Crawford
(383,244 ac. total,
14,770 ac. in CRP, ~ 4%)
Grant
(756,768 ac. total,
41,006 ac. in CRP, ~6%)
High Density CRP Area 1
(392,859 ac. total,
33,282 ac. in CRP, ~9%)
Iowa
(491,177 ac. total,
36,713 ac. in CRP, ~8%)
High Density CRP Area 2
(856,007 ac total,
83,071 ac in CRP, ~10%)
Dane
(791,931 ac. total,
27,847 ac. in CRP, ~4%)
Lafayette
(405,795 ac. total,
23,797 ac. in CRP, ~6%)
Green
(373,828 ac. total,
18,021 ac. in CRP, ~5%)
IOWA
ILLINOIS
LEGEND
CRP/CREP AREAS
HIGH DENSITY CRP AREAS
CENTER OF CRP LAND IN EACH DENSE AREA
COMPOSITION OF CRP LAND IN EACH COUNTY
CONTINUOUS
GRASS
TREES
COUNTY BOUNDARY
NOTES
1. CRP SPATIAL DATA IS FROM USDA-NRCS, SEPTEMBER 24, 2008. AREA CALCULATIONS BY RMT ARE APPROXIMATE, AND WERE CALCULATED VIA POLYGON SELECTION AND STATISTICS IN ARCMAP. PIE CHART PERCENTAGES CALCULATED BY CLEARSPRING, OCTOBER 8, 2008.
2. COUNTY BOUNDARY DATA IS FROM THE WISCONSIN DEPARTMENT OF NATURAL RESOURCES, AND STATE BOUNDARY DATA IS FORM ESRI
3. MAP COORDINATE SYSTEM AND PROJECTION: WISCONSIN TRANSVERSE MERCATOR 83/91.
N
0
6
Miles
1" = 6 MILES
1:506,880
PROJECT
PREMIER COOP
BIOMASS FEASIBILITY STUDY
SHEET TITLE
CRP IN SOUTHWESTERN WISCONSIN
DRAWN BY: BENTON K
SCALE:
PROJ. NO. 00-0804403
CHECKED BY: RPF
AS NOTED
FILE NO. 080440303
APPROVED BY: DLH
DATE PRINTED
DATE: MARCH 2009
3/25/2009
FIGURE 3
RMT
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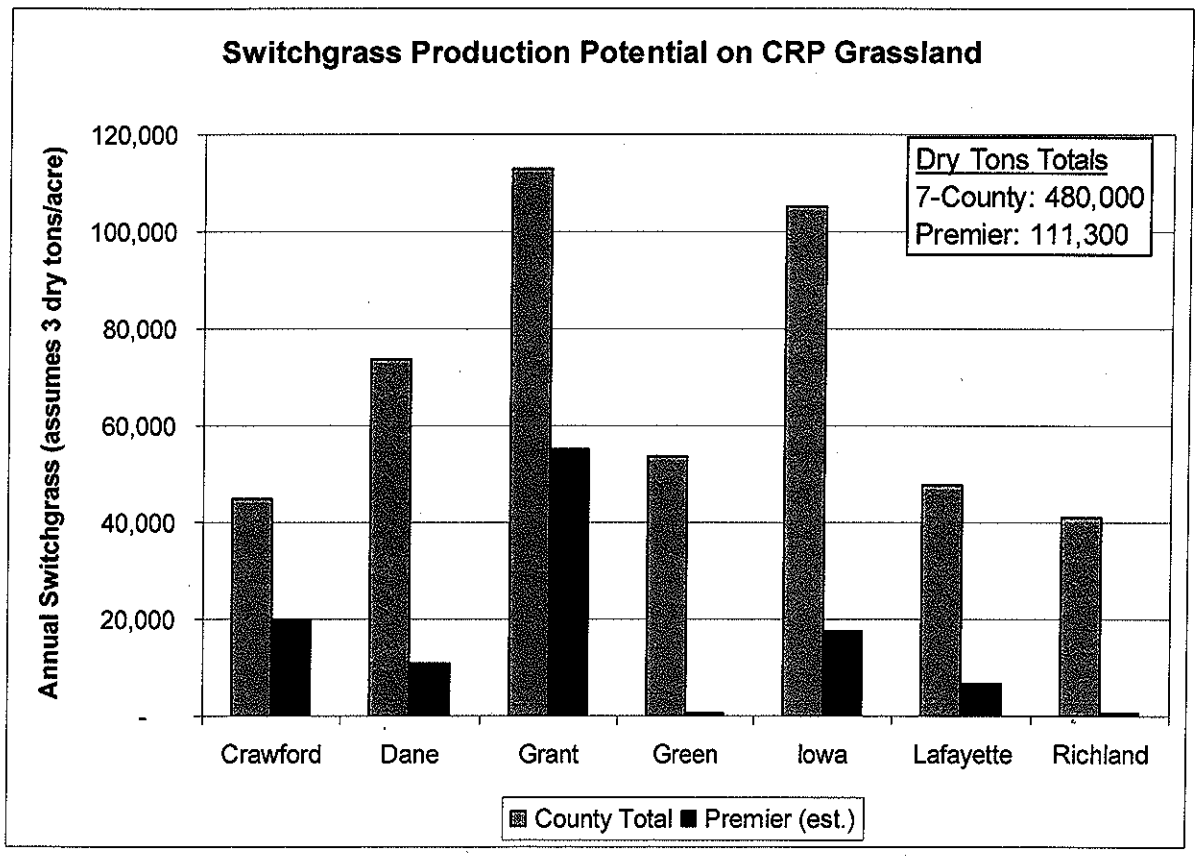
biomass yield. Whether and how much to fertilize, and what the best fertilizer is (artificial, manure, biomass ash, etc.) need to be determined for each stand and for each producer's preferences. Most studies conclude that no harvesting should be done in year one because of potential damage to the establishment of the stand, and because the amount harvested provides an inadequate return to justify the harvesting cost. Some studies have found that cutting or burning the stand in years that the stand is not harvested may increase yield in subsequent years. Typically, yields will diminish in approximately 10 years, at which time switchgrass would need to be replanted. 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, an estimated 480,000 tons of switchgrass could be potentially harvested annually on CRP grassland in the 7-county region, with 111,300 dry tons potentially harvested on CRP grassland currently owned by Premier producer-members.



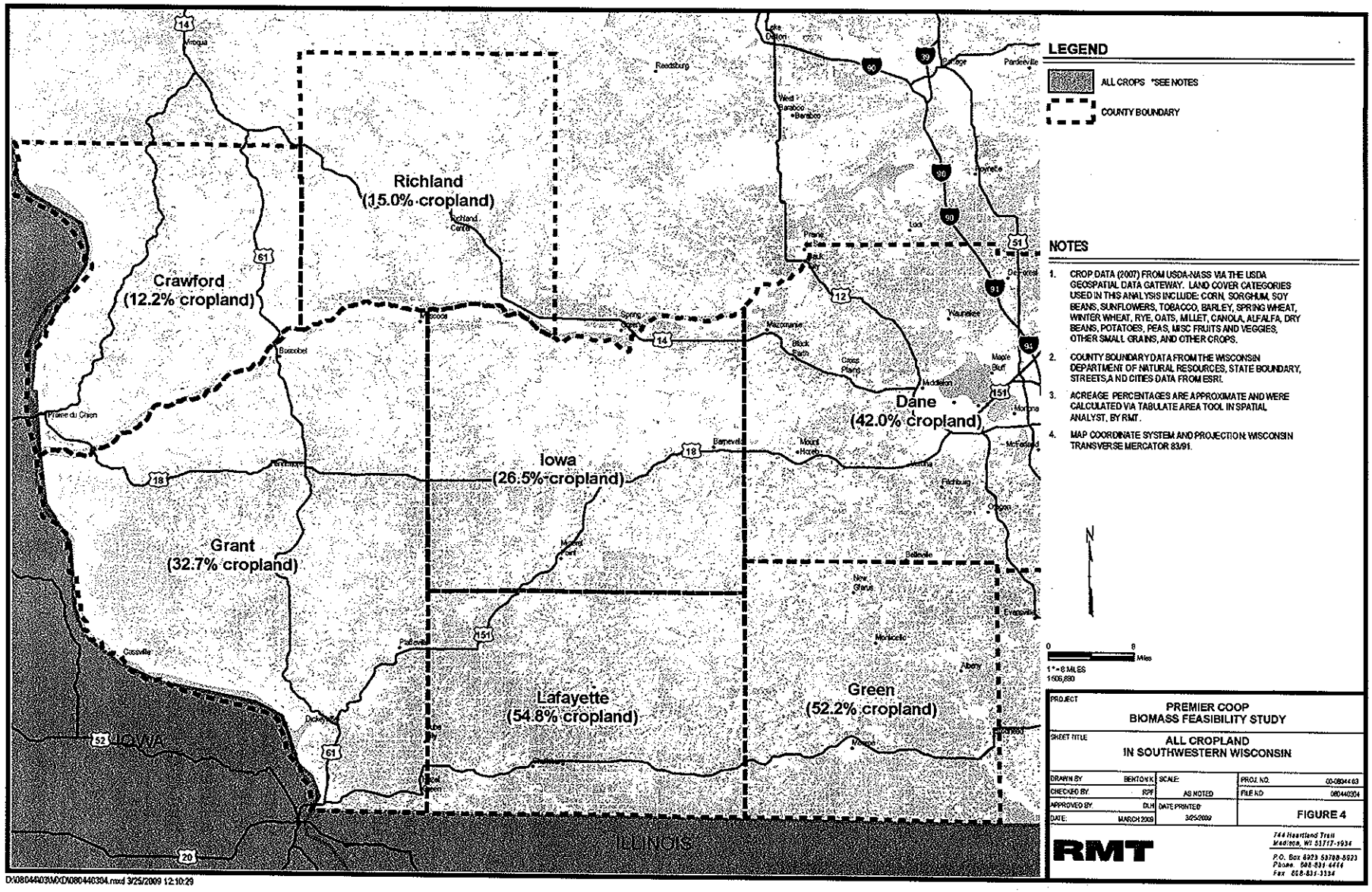
The previous production potential assumes that land is either removed from the CRP program or that future legislation allows bioenergy production and annual harvesting on CRP land without penalty. (CRP land may currently be harvested one out of three years, if specified caveats are met.) It also assumes 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, the location and size of CRP lands, or the configuration of the land. The extent of such land that may not be conducive to growing and/or harvesting bioenergy crops 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 and renewal of those lands in the CRP may reduce lands available for bioenergy production.

1.2.2 Switchgrass on Marginal Cropland Production Potential

Premier estimates that 5 to 10 percent of cropland currently in production is marginal, with yield value 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.

Approximately 1.8 million acres of cropland are 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 on Figure 4 that follows.

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 graph that follows.



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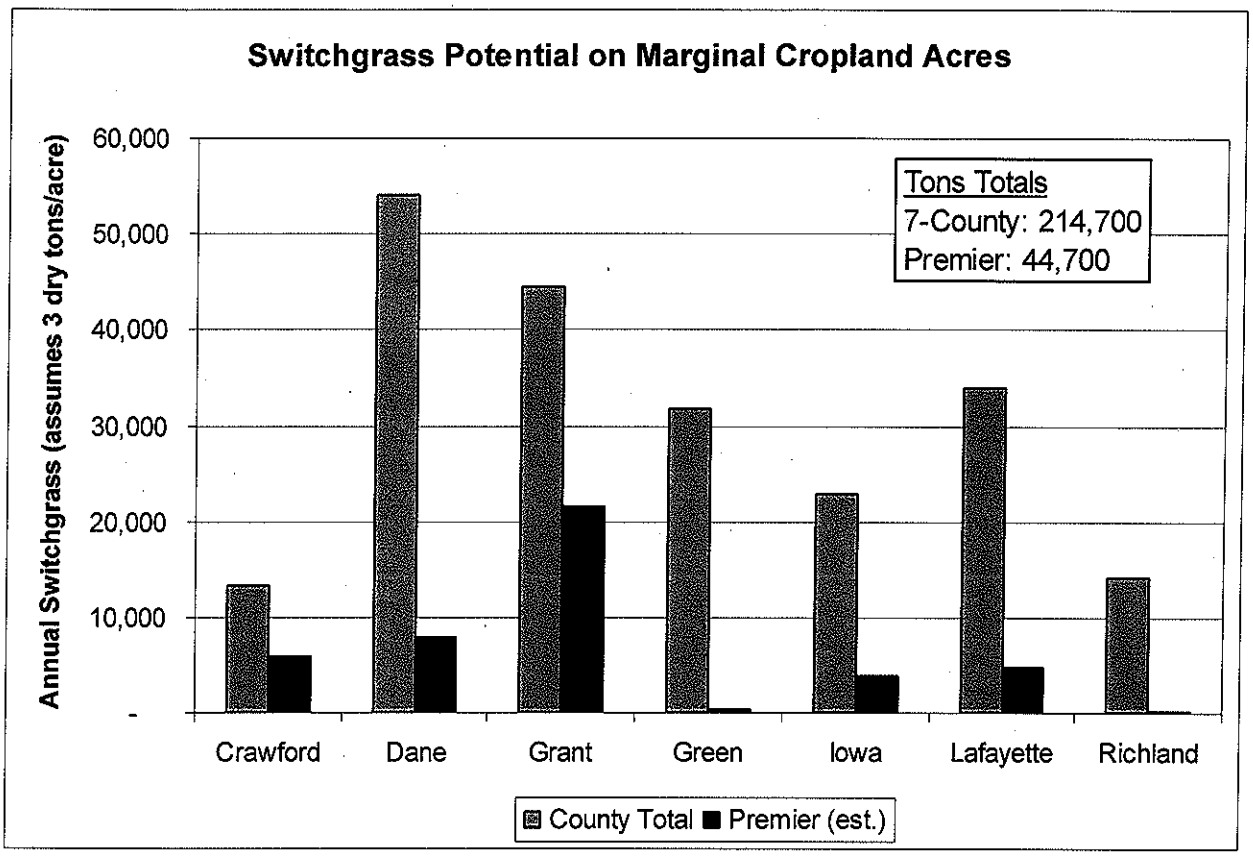


The previous estimates assume that all marginal cropland could be readily converted to switchgrass and economically harvested. The current configuration and typical parcel size of marginal land are currently unknown and may be a topic of future market research or land resource study. If it is to be harvested cost-effectively, the marginal land needs to be in larger plots rather than a broad patchwork of small areas. The conclusions in this study regarding marginal land are based on an assumption that marginal land currently being farmed with row crops is of a large enough plot size and a suitable configuration to be economically viable for native grass production.

1.2.3 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 on Figure 5 on the following page, with a pie chart of corn for grain and corn for silage for each county.

Premier's producer-members harvested an estimated 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 below.

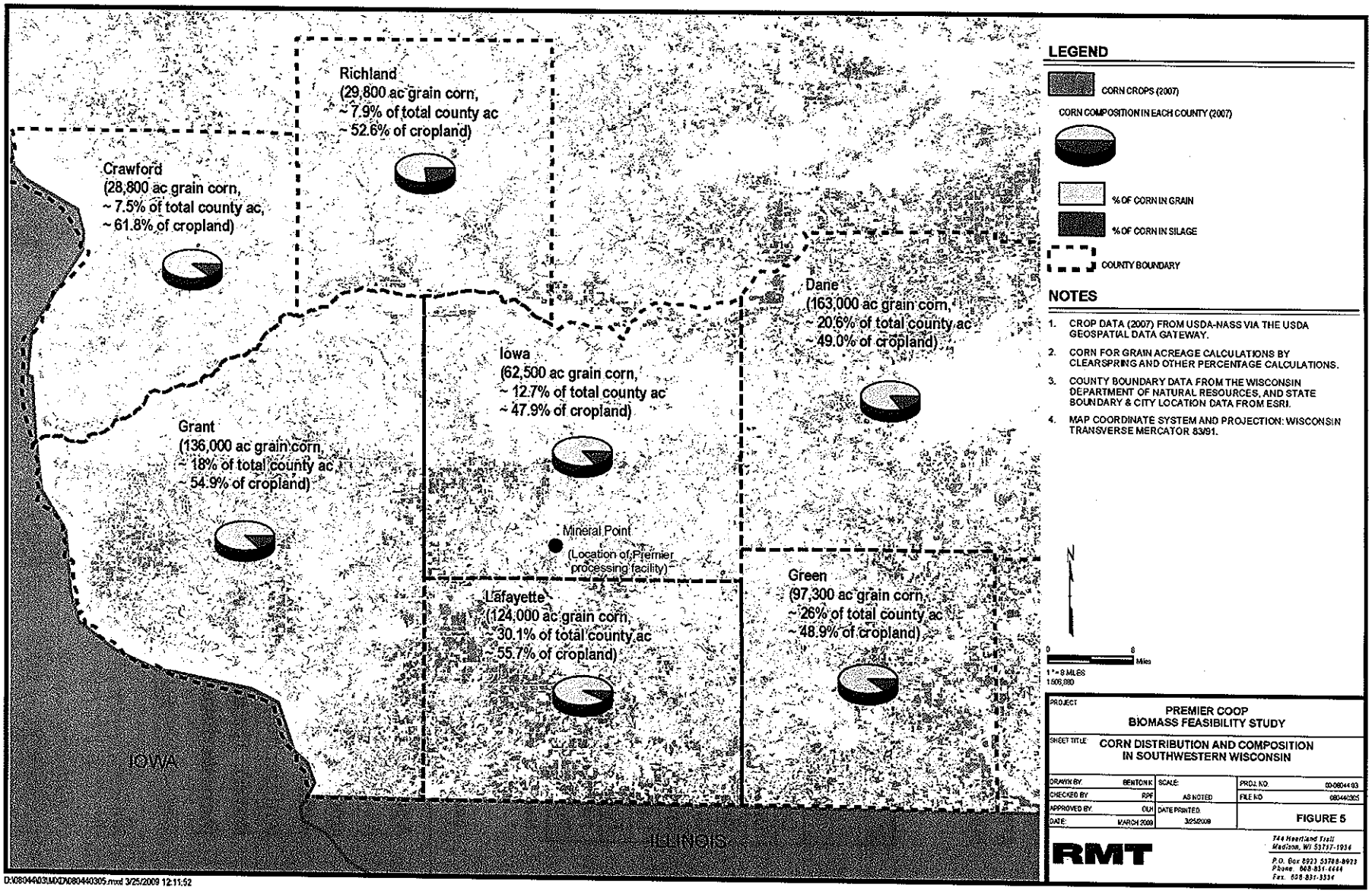
Corn-for-Grain Acres Estimates

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.


Richland
(29,800 ac grain corn,
~ 7.9% of total county ac
~ 52.6% of cropland)
Crawford
(28,800 ac grain corn,
~ 7.5% of total county ac,
~ 61.8% of cropland)
Dane
(163,000 ac grain corn,
~ 20.6% of total county ac
~ 49.0% of cropland)
Iowa
(62,500 ac grain corn,
~ 12.7% of total county ac
~ 47.9% of cropland)
Grant
(136,000 ac grain corn,
~ 18% of total county ac
~ 54.9% of cropland)
Mineral Point
(Location of Premier processing facility)
Lafayette
(124,000 ac grain corn,
~ 30.1% of total county ac
~ 55.7% of cropland)
Green
(97,300 ac grain corn,
~ 26% of total county ac
~ 48.9% of cropland)
IOWA
ILLINOIS
LEGEND
CORN CROPS (2007)
CORN COMPOSITION IN EACH COUNTY (2007)
% OF CORN IN GRAIN
% OF CORN IN SILAGE
COUNTY BOUNDARY
NOTES
1. CROP DATA (2007) FROM USDA-NASS VIA THE USDA GEOSPATIAL DATA GATEWAY.
2. CORN FOR GRAIN ACREAGE CALCULATIONS BY CLEARSPRING AND OTHER PERCENTAGE CALCULATIONS.
3. COUNTY BOUNDARY DATA FROM THE WISCONSIN DEPARTMENT OF NATURAL RESOURCES, AND STATE BOUNDARY & CITY LOCATION DATA FROM ESRI.
4. MAP COORDINATE SYSTEM AND PROJECTION: WISCONSIN TRANSVERSE MERCATOR 83/91.
N
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8
Miles
1" = 8 MILES
1:505,080
PROJECT
PREMIER COOP
BIOMASS FEASIBILITY STUDY
SHEET TITLE
CORN DISTRIBUTION AND COMPOSITION
IN SOUTHWESTERN WISCONSIN
DRAWN BY: BENTON K
CHECKED BY: RPF
APPROVED BY: OLH
DATE: MARCH 2009
SCALE: AS NOTED
DATE PRINTED: 3/25/2009
PROJ. NO. 00-08044 03
FILE NO. 080440305
FIGURE 5
RMT
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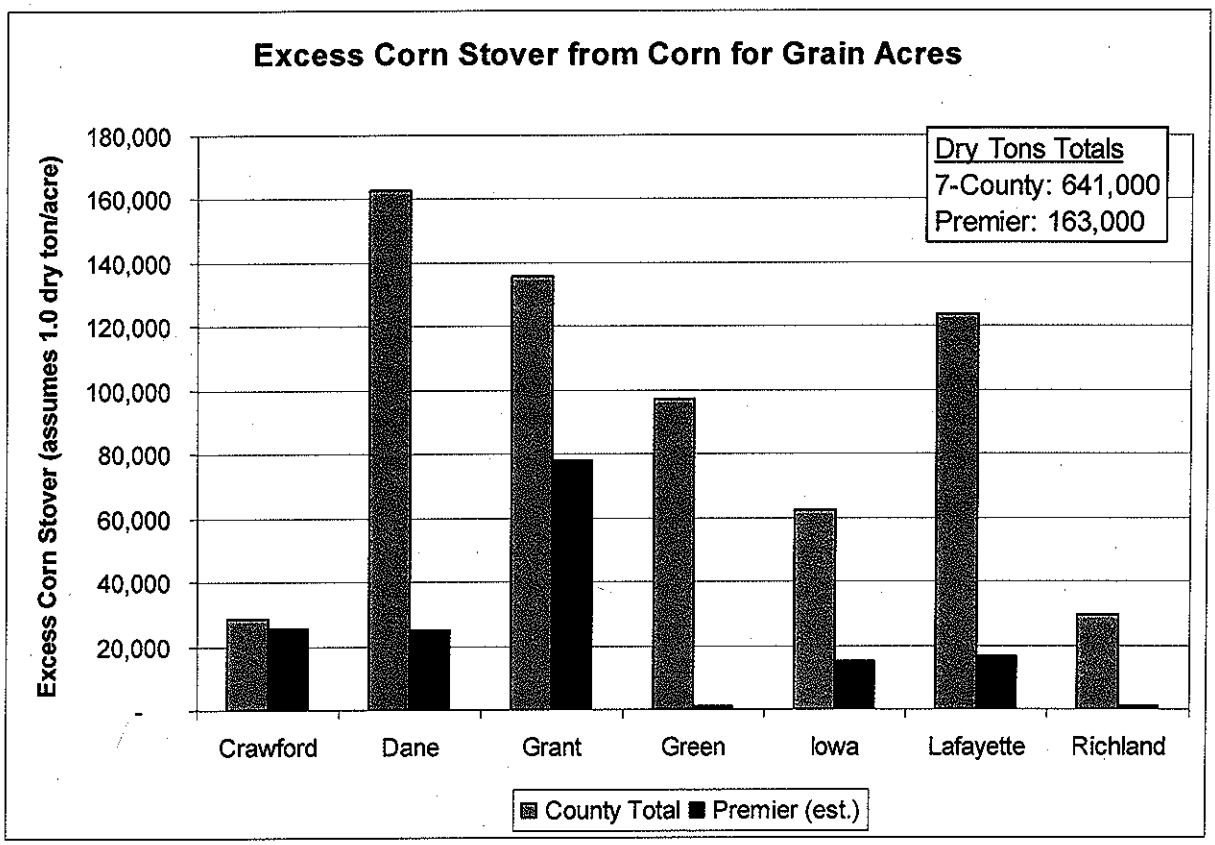
Using an estimate of 1.0 dry ton per acre of excess corn stover, approximately 641,000 tons of excess corn stover could be harvested annually in the 7-county region, with 163,000 dry tons from Premier's producer-members. The amount of excess corn stover in the 7-county region and among Premier's producer-members is summarized in the graph below.



1.2.4 Logging Residue Production Potential

Logging residue is the remaining biomass left on the forest floor after the useable lumber (saw logs and pulpwood) has been removed. It generally consists of treetops, branches, bark, and other materials collectively referred to as "slash." Although forest harvesting is not as prevalent in this 7-county 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 residue 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:

2007 Logging Residue

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 residue to estimate the logging residue 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 residue 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, to determine dry tons, a moisture content of 44 percent is assumed for green logging residue. 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 on Figure 6 on the following page, along with forest production estimates by major category from 2007.

1.2.5 Total Biomass Production Potential

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

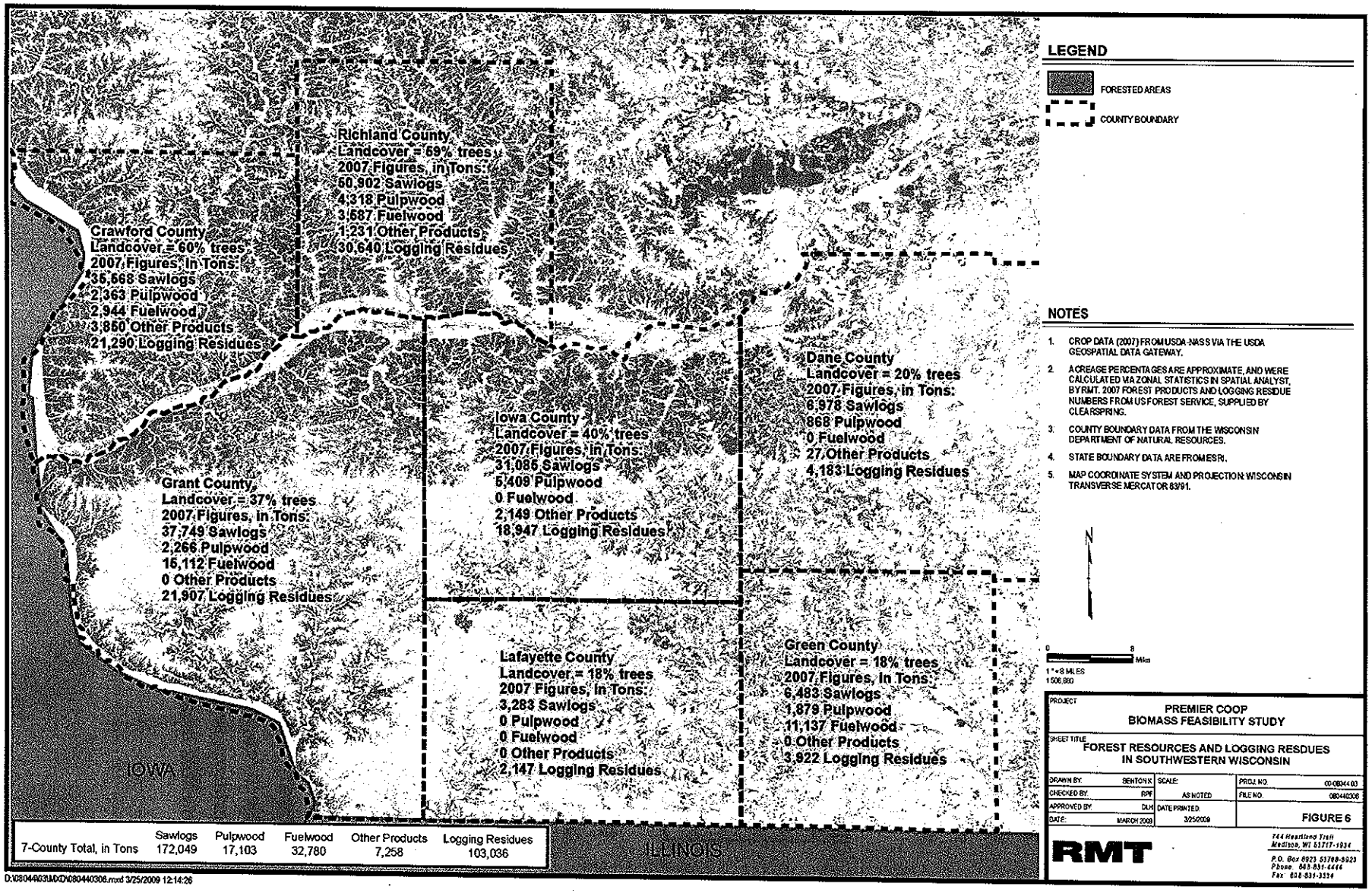
Biomass Production Potential (Dry Tons)

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 residue	57,958	6,122
Total	**1,393,694**	**324,976**

1.2.6 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 may exist. 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, and if the cost of inputs (fertilizer, seed, fuel, etc.) continue to increase, this matter may be reconsidered as a potential means to increase revenue.



7-County Total, in Tons	Sawlogs	Pulpwood	Fuelwood	Other Products	Logging Residues
	172,049	17,103	32,780	7,258	103,036

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 in specialized corn harvesting combines 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 7-county region 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 in the 7-county area, 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.

1.2.7 Conclusion

There is substantial production potential of switchgrass, excess corn stover, and logging residue 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.

1.3 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.

1.3.1 Switchgrass Energy Potential

The U.S. Department of Energy (U.S. DOE) 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).

1.3.2 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]

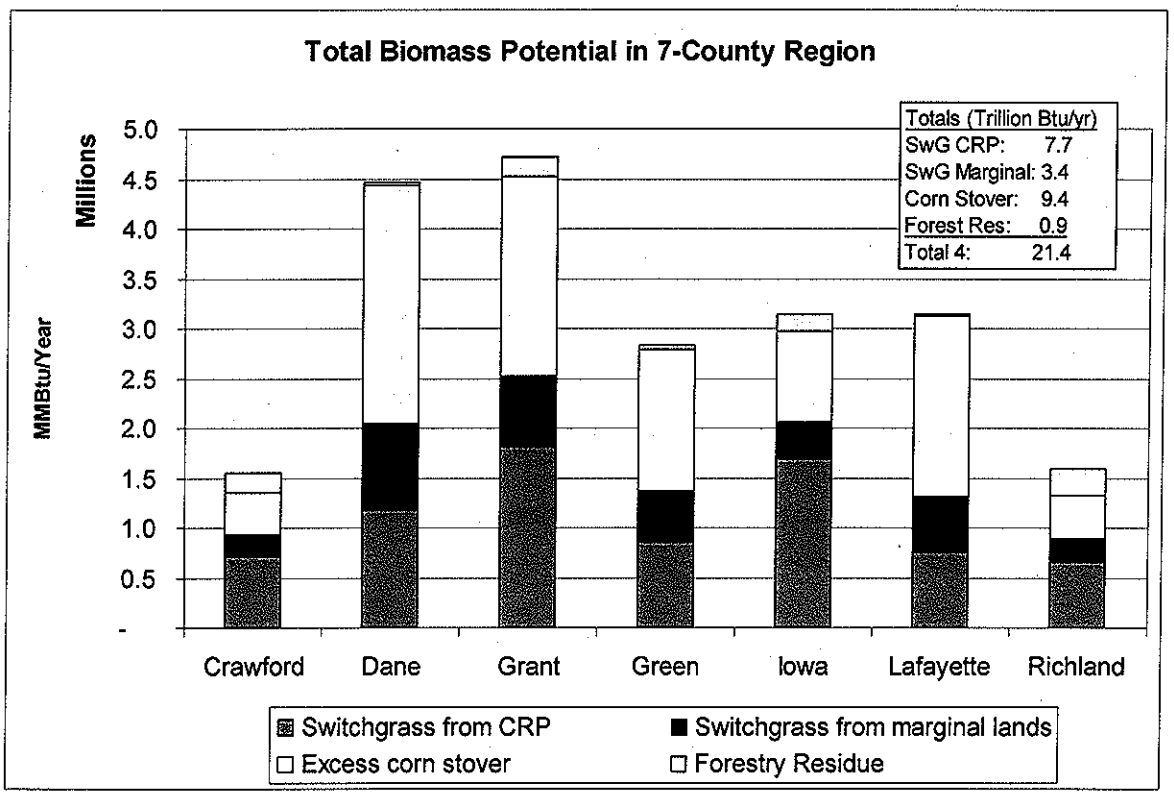
Given 1.0 dry ton of excess corn stover per acre per year, the annual corn stover energy potential is 10.3 trillion Btu in the 7-county region and 2.6 trillion Btu from Premier's producer-members.

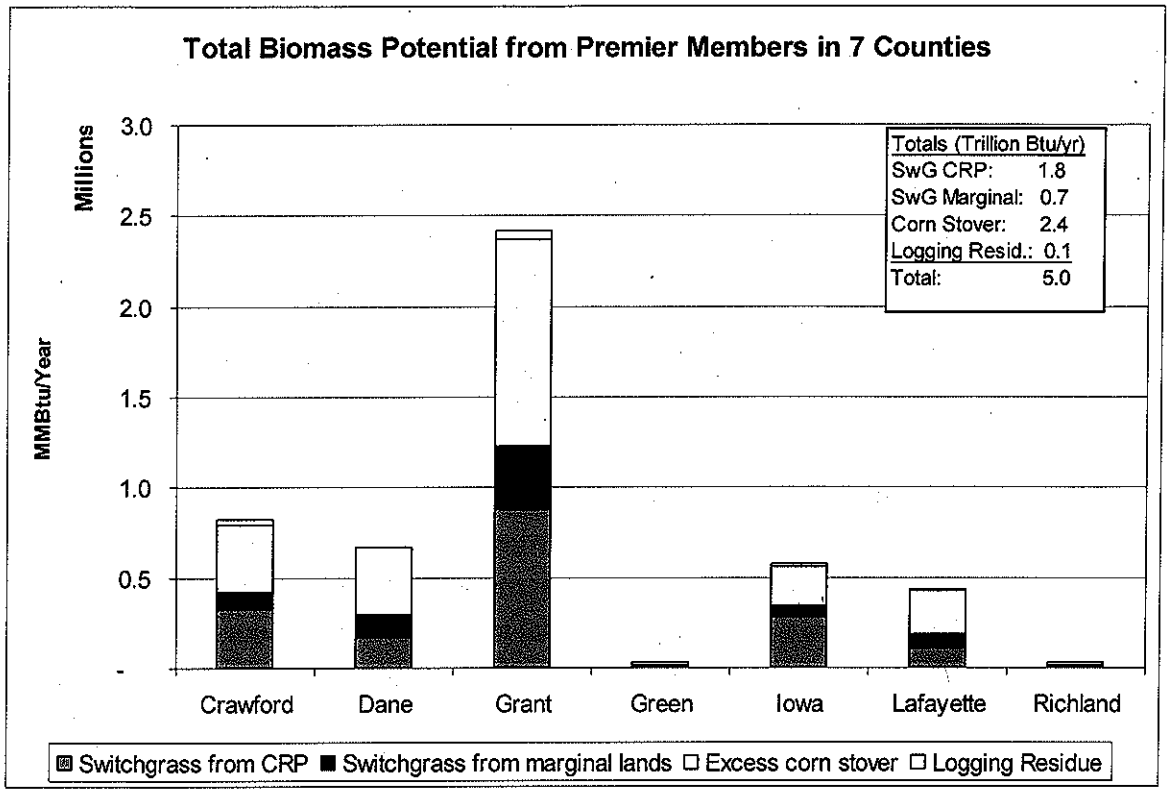
1.3.3 Logging Residue Energy Potential

The energy content of logging residue 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.

1.3.4 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 graphs that follow.





In perspective, the total amount of biomass energy potential within Premier's existing producer membership in these seven counties (5.0 trillion Btu) would be more than enough to meet the biomass requirements that were projected for Alliant Energy's proposed Nelson Dewey III (NED III) plant in Cassville. This plant would require an estimated 4.6 trillion Btu[b] of biomass energy to meet its goal of co-firing 20 percent of its 300 MW capacity with biomass energy. (Half of this 20 percent was projected to be from wood, and half from switchgrass.) In fact, the total biomass potential in the 7-county region would be nearly sufficient to fuel the entire plant without coal.

The following section discusses the proportion of the markets that may be realistically available for biomass energy.

1.3.5 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

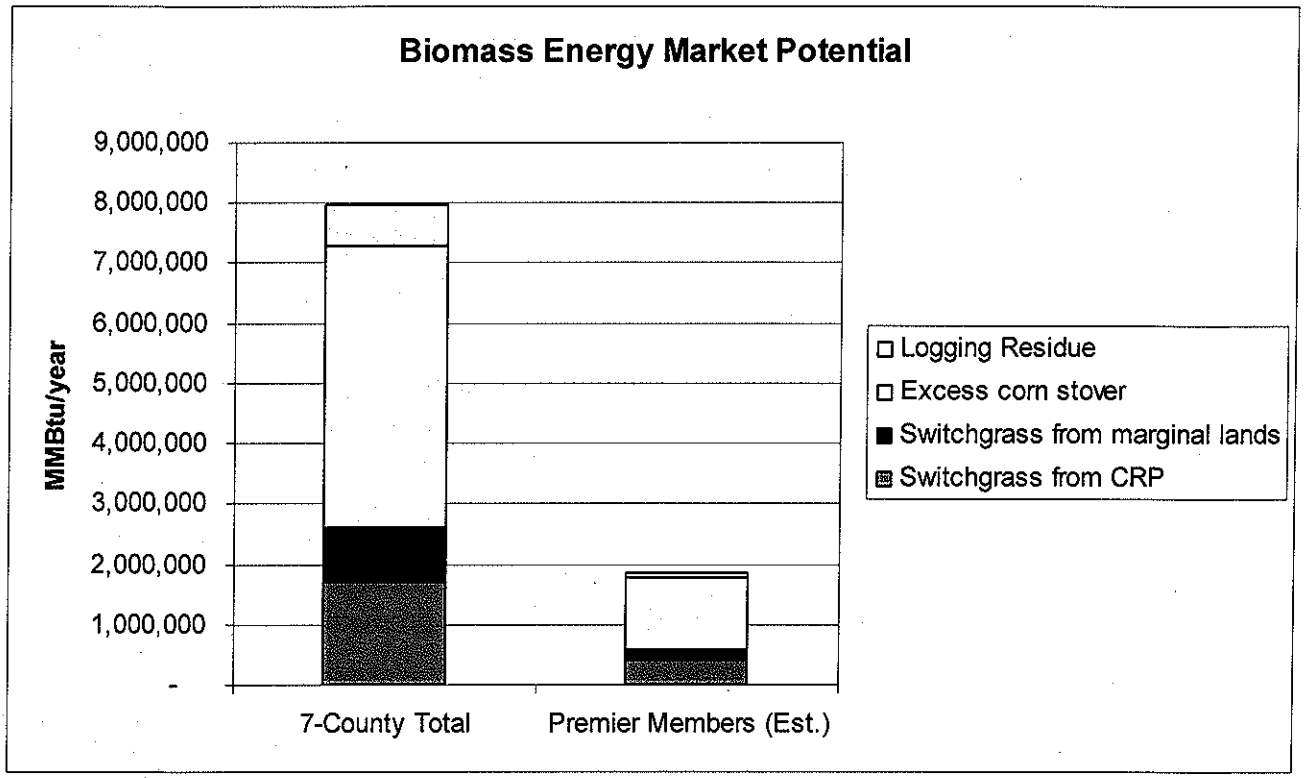
[b] Key assumptions: 20% of the plant's 300 MW output from biomass; 90% annual capacity factor; 35% plant efficiency.

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 potential for switchgrass on CRP land. Please note that if legislative proposals allowing planting of energy crops on CRP land without penalty are enacted, the need for CRP contracts to expire prior to biomass production would be negated.
- 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 7-county 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.



1.3.6 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 III (NED III) 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 2
Costs

2.1 Production Cost

Subsection 2.2 of this report concludes that substantial quantities of biomass fuel are available in the 7-county region. This section evaluates the costs of producing the biomass at the farmgate. Other sections evaluate the costs and logistics of transportation, storage, processing, and delivery to end users.

2.1.1 Switchgrass Production Cost

Switchgrass can be harvested using existing haying and baling equipment. Switchgrass is harvested once per year, usually in November after row crops have been harvested and seasonal birds (which use the grassland habitat for nesting) have migrated for the winter. A discussion of the land use and harvesting process can be found in a number of reports, including a recently-released report by Agrecol.[3]

The cost of producing switchgrass on either CRP land or on marginal cropland is composed of land, fuel, equipment, and miscellaneous costs. The Agrecol report provides a detailed quantification of the production costs of switchgrass.[3] That template is used, with slight modifications, to estimate the switchgrass production costs on CRP land or marginal cropland. Modifications include removing any fertilizer costs (the production rates used here assume no fertilizer), a reduction in crop insurance due to lower anticipated yield per acre, and a change in the land rent due to the use of marginal lands. The estimated price of switchgrass at the farmgate is $60 per dry ton, or $3.75 per MMBtu. This includes a producer margin assumed at 10 percent of production costs.

Production Costs of Switchgrass Baled As Hay

INPUT EXPENSES ($/acre; reference Agrecol, p. 23)[3]		
$	--	Fertilizer (assume none used)
$	7.96	Crop insurance (@ 3 tons/acre)
$	8.76	Energy expenses
$	4.02	Repair and maintenance
$	6.06	Input interest expense
$	90.00	Land rent value (CRP average)
$	13.84	Labor
$	16.05	Interest and equipment insurance
$	17.07	Depreciation
$	163.76	Total costs/acre
$	16.38	Producer margin @ 10%
$	180.14	Farmgate price/acre
	3	Tons/Acre
$	60.05	Price/Dry ton at the farmgate
$	3.75	Price/MMBtu at farmgate

The costs detailed in the previous table are comprehensive, with the exception of fertilizer and herbicides, if needed, and include equipment interest, insurance, and depreciation cost allocations. The conservative switchgrass production estimate used in this report, 3 tons per acre, is based on the use of no additional fertilizer. Yields can be increased with the application of fertilizer. As an initial projection, the cost for additional fertilizer needed as a result of corn stover harvesting ($9.10 per dry ton) could be used for switchgrass. Because fixed costs per ton would decrease as yield per acre increases, the biomass cost per dry ton would be expected to decrease with fertilization. Likewise, the switchgrass production cost estimates in this report assume no use of herbicides. Herbicides may be needed, especially when establishing a new stand, and perhaps at times during the life of the stand. As with fertilizer, the use of herbicides may increase switchgrass yields, so the net cost per dry ton is difficult to project. If a farmer chooses not to allocate these costs to switchgrass production (but rather to existing uses), the production costs detailed here may be lower and/or the producer margin may be higher.

Storage of the harvested chopped grasses in tubes is discussed in Subsection 2.3.1 of this report. Agrecol estimates that the total harvesting cost (the combination of the harvester/chopper unit operation and the transport of the chopped biomass to the bagging location) exceeds $40 per ton, calculated as if the total was a custom hire. Assuming a packing density of 0.5 ton per foot into a 10-foot–diameter plastic bag, Agrecol estimates a cost of about $6 per ton for the bag, and another $6 per ton to fill the bag. Emptying the bag, loading the chopped material onto transport, and transporting the material to a conversion facility would add more cost. Agrecol has not yet developed specific cost estimates for these post-storage costs.

2.1.2 Corn Stover Production Costs

Corn stover is usually collected and baled following the grain harvest, after the stover has been allowed to dry in the field (usually within 40 days of harvest).

The corn stover direct costs consist of shredding, raking, baling, and transporting the bales to the farmgate. The estimated cost of corn stover at the farmgate is summarized in the following table. This estimate is based on an NREL study[59] of stover collection costs, modified for additional detail in other studies and escalated for increased costs since the study date. Note that the cost includes a margin to the farmer on top of the costs of baling, staging, and fertilizer costs.

Production Cost of Corn Stover

INPUT EXPENSES ($/dry ton; reference: NREL, June 2002, p. 10)[59]		
$	28.17	Bailing cost
$	5.63	Staging cost
$	9.10	Added fertilizer costs
$	10.00	Margin to farmers
$	52.90	Total farmgate cost per ton
	15	MMBtu/Dry ton
$	3.53	$/MMBtu at farmgate

This cost is somewhat higher than much of the existing literature[60] largely due to the inclusion of farmer margin based on the NREL study.

The cost per MMBtu of corn stover is slightly lower than the cost of switchgrass. This is due to the fact that no land rent is assumed for corn stover since the land is already being used for corn production, mitigated somewhat by the lower volumes (and thus higher costs) of biomass harvested per acre.

2.1.3 Logging Residue Production Costs

Logging residue must be collected from the forest floor after the saw logs and pulpwood have been removed. The removal process entails bringing equipment on the land to shred or chip logging residue and transport it to the processing site or end user.

The costs for collecting logging residue are estimated in a recent report from the Energy Center of Wisconsin (ECW).[56]

Production Cost of Logging Residue

COSTS ($/green ton; reference: ECW, August 2008)		
$	6.00	Stumpage fee (margin to landowner)

$	13.50	Harvesting cost
$	19.50	Total farmgate cost/green ton
	2.75	Green tons/cord
$	53.63	Farmgate cost/cord (for comparison only)
	0.5625	Dry tons/Green tons (44% moisture)
	16.00	MMBtu/dry ton
$	2.17	$/MMBtu at farmgate

The harvesting cost includes wood chipping, but not transportation costs to the processing facility or end user. The ECW report estimates transportation costs of approximately $10.50 per green ton within a 50-mile radius (average).

The cost of logging residue per MMBtu is less than the cost of switchgrass or excess corn stover, largely due to the assumed zero land charge (which is already captured in the saw log or pulp wood logging costs) and the somewhat lower collection costs per unit of biomass.

Despite the lower cost, it should be noted that the potential volume of logging residue in the 7-county region is much less than the potential volume of switchgrass or corn stover. Thus, there may be sufficient market demand for all biomass sources. The sizes of potential markets are discussed later in this report.

2.1.4 Farmgate Cost Summary and Conclusions

The farmgate of biomass is summarized in the following graph. The farmgate cost of switchgrass and corn stover is somewhat higher than the cost of forestry residue, but the potential volumes are much larger.