Renewable Energy Economic Opportunity Assessment

Southwest Wisconsin

University of Wisconsin, Madison

Contents

Executive Summary

The southwest Wisconsin region is rich in agricultural and geographic resources. However, the economy of the region has struggled. Local economic and resource developers are looking for various ways to help jumpstart the economy, with special interest paid to the possibility of renewable energy playing a prominent role. This report looks at the technical and economic potential for renewable energy project in five counties in the southwest Wisconsin region. It also examines exogenous drivers that could affect the economic viability of renewable energy projects in the region and the state.

In order to determine these potentials, we utilize models from the National Renewable Energy Laboratory, as well as from the Agricultural Utilization Research Institute. Web-based research was also conducted concerning economic and technical factors in renewable energy projects. Our key findings include potential for wind and agricultural residue-based energy projects, especially in those counties with higher levels of agricultural production. The region also has the potential to offset its residential and industrial energy use through the production of renewable electricity.

We conclude that while there is potential, other economic drivers must be taken into account when planning for renewable energy. These include the price of fossil fuels (especially natural gas and propane), the availability of federal and state renewable energy subsidies, and the future of the state's renewable energy standard.

Introduction

UW-Madison's Urban and Regional Planning (URPL) 2012 Workshop constitutes the second phase of an effort toward identifying opportunities for renewable energy projects in southwest Wisconsin. Phase two results in a **Renewable Energy Economic Opportunity Assessment** which analyzes the existing economic framework and economic opportunities for renewable energy projects in five southwest Wisconsin counties including Grant, Green, Iowa, Lafayette, and Richland Counties. Preliminary data collection on available resources and renewable energy projects in the region was completed in 2011. This phase focused on developing a comprehensive economic analysis of renewable energy opportunities in all five comprising the region.

Specifically, phase two set out to:

1. Estimate each counties renewable energy potential.
2. Estimate each county's current energy consumption.
3. Compare each counties renewable energy potential with its current energy consumption in order to provide a regional outlook.
4. Determine the economic impact of wind and solar projects.
5. Identify relevant drivers that are influencing wind and solar projects both positively and negatively.

This study includes analysis using AURI and JEDI modeling. The AURI model was designed to calculate two things: one, the annual energy use of a given county, and two, the annual technical potential of renewable energy sources on a county level (see Discussion – Sections A and B). The JEDI model was designed to evaluate the economic development potential of wind, biofuels such as biodiesel, solar, natural gas, coal, marine, hydrokinetic, and geothermal projects (see Discussion – Section C). The raw data generated by these models can be found in Appendix A, B, and C. The drivers section was assembled using various resources, including the UW-Extension, the Environmental Protection Agency, and the Wisconsin State Legislative Bureau. These resources, and others, provide an inventory that identifies available government and energy utility financial incentives that encourage use of renewable energy which could promote projects in Southwest Wisconsin (See Discussion- Section D). However, before we enter into the Discussion Section, we will provide the context for this study, including the client and collaborators, an overview of the region, an introduction to the renewable energy types discussed, and in background information on the AURI and JEDI models, including the embedded assumptions and limitations of said models.

Phase two did not revisit studies done in phase one. The research done in phase one provides a framework on which to build for phase 2 which included a mapping team to locate and map data sets, including land cover, geology, transportation networks, municipal boundaries, wind potential, and locations of past and present renewable energy projects. Phase one's public involvement team reviewed existing survey data to augment the analysis team's report on the socio-economic profile of the region, undertook a snowball sample to aid in networking and the creation of a regional contact list, led focus groups in our study area to assess residents' attitudes toward renewable energy projects, and identified necessary outreach efforts needed to determine the potential for renewable energy projects, including public opinion and input. The final report and findings of phase one's work also provided an in-depth description of the renewable energy types studied.

Context

A. The Client and Collaborators

Our work establishes a network of partnerships to increase access to local knowledge and better identify strengths, needs, and opportunities. Initial partnerships can be built upon by additional local stakeholders, industry experts, decision-makers, and entrepreneurs. Partners involved during the second phase of the workshop include the following:

Southwest Badger
Southwest Badger RC&D (SW Badger) is a community development organization serving Crawford, Grant, Green, Iowa, La Crosse, Lafayette, Richland, Sauk, and Vernon counties in the southwest corner of Wisconsin. Southwest Badger's mission is to implement natural resource conservation, managed growth, and sustainable rural economic development in the area. Their vision is to be an incubator for innovative, economic, and sustainable use of local resources in the Southwest Badger RC&D area.

SW WI Regional Planning Commission
Southwest Badger is also working with Southwestern Wisconsin Regional Planning Commission (SWWRPC) which provides intergovernmental planning and coordination of community development planning, economic development, and transportation. In response to local and regional goals, the Commission and its staff work to enhance fiscal and physical resources and to balance local and regional development, preservation, conservation, and social priorities. SWWRPC's members include Grant, Green, Iowa, Lafayette, and Richland counties. This project supports its ongoing Regional Sustainable Communities Plan, a three-year process to develop long-range planning for its five-county region.

University of Wisconsin-Madison Department of Urban and Regional Planning
SW Badger is collaborating with URPL to produce the Renewable Energy Economic Opportunity Assessment. The URPL workshop team consisted of guidance and support from our instructor, Professor Alfonso Morales and Urban and Regional Planning master's students of various backgrounds and areas of academic specialization. Research was organized into the following sections: Literature Review; County Overview; Energy Consumption and Renewable Energy Potential; Economic Modeling; and Funding Opportunities. Within research sections, each team was responsible for summarizing data in the regional context, identifying existing research and literature on the subject, explaining methodologies, and identifying trends and considerations. URPL also employed two students in the summer months to test the AURI and JEDI models and identify a methodology for phase two's economic assessment.

Throughout the semester, work in phase two was supported by various industry professionals, and their expertise helped to guide our research. These industry professionals presented materials during Workshop meetings and included the following: Greg Nemet, PhD Lafollette: Energy 101; Deb Erwin, Public Service Commission: Energy Grid: How it Works; Dave Jenkins, Director of Commercialization and Market Development; Douglas Reinemann, PhD, Professor of Biological Systems Engineering; Andrew Kell, Public Service Commission; and H&H Electric.

B. The Region

Our study included five counties in the southwest Wisconsin area: Grant, Green, Iowa, Lafayette, and Richland. This rural region has a total land area of 3,760 square miles and a total population of 147,498. Roughly half of the population lives in urban areas. Retail, manufacturing, government, and agriculture-related businesses are major employers and constitute over half of the region's $3.9 billion economy[1]. The headquarters of Lands' End and Colony Brands are among the major regional businesses. There are also four postsecondary institutions in the region: University of Wisconsin-Platteville, UW-Richland, Southwest Wisconsin Technical College, and part of Blackhawk Technical College.

As a region rich in renewable resources, southwest Wisconsin has an economic development opportunity to develop renewable energy for use both within the region and as a supplier to the many larger urban areas within close proximity. Achieving increased economic independence and sustainability in southwest Wisconsin is challenging, and therefore hinges upon the collaboration of diverse stakeholders. The annual mean wage for the SW WI Non-metropolitan region, which intersects the study area, is $35,270[2], compared to the state average of $49,994[3]. Building a regionally focused network to share information and expertise is foundational to all future economic development work, including in renewable energy production. The findings we offer in this report illustrate the potential economic opportunities renewable energy projects can generate in the region.

C. Renewable Energy Types

This project assessed the economic potential of three types of renewable energy: solar, wind, and bioenergy, including biomass and biogas. Work and research conducted in phase two included review of energy consumption and renewable energy potentials and assessed the level at which renewable energy sources could meet consumption of traditional energy sources. That said, it behooves us to review the fundamentals of each renewable energy type discussed throughout the assessment.

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[1] Region Profile, Southwest Wisconsin Regional Planning Commission, Accessed April 25, 2013. http://swwrpc.org/wordpress/region/

[2] Occupational Employment Statistics. Bureau of Labor Statistics, U.S. Department of Labor. Accessed October 13, 2011.http://www.bls.gov/oes/current/oes_5500004.htm

[3] American FactFinder. U.S. Census Bureau. Accessed October 11, 2011. http://factfinder2.census.gov

Solar

Solar power is gathered mainly by large photoelectric panels that absorb energy from sunlight for conversion into electricity. This process requires little additional input or oversight, leading to a small number of operating jobs generating. However, the process produces no pollution, so it is attractive financially and environmentally. Many panels must be installed to harvest enough energy to offset large amounts of fossil fuel and therefore the costs of starting a solar panel project will be considered versus its long term financial paybacks and potential to be coupled with other renewable projects. Solar technology continues to be developed and improved white the price is decreasing. Proponents argue that as fossil fuel costs increase, solar power technology is on its way to becoming a favorable long-term policy. Locational principles associated with solar panels will also require due consideration, as panels require land area, direct sunlight, and often carry negative aesthetic connotations for nearby residences. According to the National Renewable Energy Laboratory, Wisconsin has installed 1,074 solar electric systems and is ranked number 13 in the nation. Epic Systems Corporation of Verona, for example, has a total of 2.2 megawatts of capacity at their campus.[4]

Wind

Wind power is derived from large turbines, pushed by air, to generate electricity. Wind power carries many of the same positive and negative considerations as solar power. For instance, operation of wind turbines will generate very little long-term jobs and are generally expensive to install. Locational principles such as wind siting, noise, and aesthetics are also important to the viability of implementing a wind system. Despite these limitations, wind resources in Southwest Wisconsin are vast and have great potential to offset fossil fuel use over a longer-term. As of 2011, there were 11 utility wind farms in Wisconsin totaling a generating capacity of 631 megawatts.[5]

Bioenergy

Biofuels are created by processing organic materials that are combusted to produce methane energy. Biofuel materials can come from crops and by-products from agriculture, food manufacturing, and animal refuse. Common food commodities, such as corn and wheat must be planned for use in biofuel production since they do not naturally occur in large enough quantities to be burned as energy. Biomass resources include logging residue, waste wood and urban forestry waste, switch grass, fast growing tree species, and corn stover. Biofuel energy, like fossil fuels, must be burned to release energy, so therefore have greater pollution considerations than solar and wind power. Many large and small scale biofuel projects have been implemented or are planned to begin throughout Wisconsin. As of June 2012, 26 dairy farms in Wisconsin manage their manure using an anaerobic digester. Alliant Energy has partnered with five of those farms to buy-back power generated. Many Wisconsin food processing companies, including cheese makers and breweries also use anaerobic digestion to process heat from methane.[6]

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[4] Ingrid Kelly, Sustainability Consultant (June 2012). *Green Power in Wisconsin.* Madison: BioEnergy Training Modular Course Series.

[5] Ibid;

[6] Ibid.

D. AURI and JEDI Models

AURI: Determining the Economic Viability of Renewable Energy Systems

Determining Renewable Energy Potential

In order to determine the energy potential of the region, we employed the Template for the Estimating County Level Energy Use and Renewable Energy Potential, a model developed by the Agricultural Utilization Research Institute (AURI). This model was designed to calculate two things: one, the annual energy use of a given county, and two, the annual technical potential of renewable energy sources on a county level. By energy potential, we mean the technical capacity of the region to accommodate renewable energy sources based on local land uses, system capacity, and geographic constraints. The technical potential is generally used as an upper limit on the amount of energy that can be produced. It does not account for the economic feasibility of the project nor the market potential based upon policies and incentives which influence the development of renewable energy sources. Both outputs are described in trillion BTUs. We applied this model to each of the five counties in order to determine what percentage of each county's energy use could potentially be replaced energy from renewable sources produced within the county.

In order to calculate bioenergy potential, we needed to derive data for crop residue, animal residue, and forest wastes and residues. We used data from the U.S. Census, the USDA Census of Agriculture, and the U.S. Forest Service in order to determine the amount of material available for the production of renewable energy in each county. For wind, we determined the number of acres available to have wind farms on them. AURI recommends that users treat solar as a potential replacement of commercial or residential heating, and it suggests that they calculate the number of BTUS created generated by solar based on a conservative estimate of the percentage of these heating costs that might be converted to solar.

Assumptions Made in Calculating Potential

These estimates were accompanied by a series of assumptions. For example, we knew that while a lot of land is physically able to accommodate wind turbines, there are many reasons that wind turbines will not be installed in some of the available locations (lack of interest in wind, opposition by neighbors, aesthetic concerns, etc.). Thus, we used conservative estimates of the land available for the wind energy, estimating that 5% of land available to wind turbines would actually build turbines. Due to the fact that wind power is only generated when the wind is blowing, we also assumed that the turbines would only produce energy 25% of the time over the course of a year. In addition, AURI recognizes that not all residues available would be used for renewable energy production, and therefore the model included some built-in assumptions in this regard. For crop residue, the model follows conservation tillage practices, meaning a portion of the crop residues are left on the field. In this case, the model assumes that 50% of total corn stover is removed from the field and that 75% of all other crops are removed. The model also assumes that 100% of animal waste will be removed. In counties that have logging, the model assumes that 33% of the available logging residues are used for renewable energy.

Determining Current Energy Use

Each group estimated the energy use by sector within its county in order to calculate the total energy use by county. The model allows the user to input residential, transportation, agricultural (on-farm), industrial, and commercial use. We used data from the U.S. Census, the Wisconsin DOT, and the USDA Census of Agriculture to determine our inputs for each sector.

Limitations of Calculating Current Energy Use

Estimates of commercial energy use are a challenge with this particular model, because no good database exists to estimate the commercial space in a city, county, or region. (Some information is available through local property tax records, but these hard to find and extremely time consuming to compile for a large region.) AURI acknowledges this deficiency, recommending that users estimate the energy use for individual buildings in the region.[7] Because only one of our groups was able to calculate commercial energy use, we decided to omit commercial energy from our analysis.

The model does not address energy conservation since the model is focused on renewable energy as it relates to economic development planning. This is something a planner focused on reducing a community's dependency on nonrenewable energy sources may wish to explore further.

Assumptions Made in Calculating Energy Use

The AURI model was built on a series of assumptions. For example, when using the AURI models, energy used for agricultural purposes is calculated from the acres in production by type of crop or the number of livestock within a county. The model utilizes an average amount of diesel, gasoline, LP gas, and electricity (kW/hr) per unit for each of these categories which contribute to the total agricultural energy usage.[8] Diesel is the primary form of agricultural energy consumption, which is highly reflective of the equipment used to grow agricultural crops and transport it to storage facilities. We averaged the energy use over a ten-year time period in

[7] 6Solutions, "Template for Estimating County Level Energy Use and Renewable Energy Potential," Agricultural Utilization Research Institute (2009). http://bit.ly/1291mcF

[8] These calculations are based off of Barry, Ryan and Douglas G. Tiffany. "Minnesota Agricultural Energy Use and the Incidence of a Carbon Tax" Minnesotans for an Energy Efficient Economy, April 1998. The values are primarily to be used as estimates due to increased technology that should have resulted in more efficient farming practices.

order to estimate the likely energy use in a single year. Additional built-in assumptions are detailed in the AURI Template Model which can be found on their website.

JEDI: Determining the Economic Impact and Job Creation

In estimating the economic impact of renewable energy projects in the five-county region, we used the JEDI Model, which was developed by the National Renewable Energy Laboratory. The JEDI model was designed to evaluate the economic development potential of wind, biofuels (such as biodiesel), solar, natural gas, coal, marine, hydrokinetic, and geothermal projects. Users input project specifications project and costs, and the model estimates economic impact on the local economy. The output includes direct, indirect, and induced impacts as well as the number of jobs created during construction and jobs required annually, post-construction. We used the JEDI model to evaluate the economic potential of solar photovoltaic and wind energy projects. We collected case studies we collected from throughout the Upper Midwest, and we used the specifications of these example projects to estimate reasonable inputs to use with the model. Case studies ranged from .6 MW to 162 MW, from small pilot projects to utility-sized projects, and we ran the model with projects of varying sizes.

JEDI models are not available for bioenergy projects (biogas and biomass). We researched an array of existing projects throughout the state to derive information regarding the economic impact or feasibility of these types of projects. The case studies take into account a variety of feedstock options, ownership arrangements, and generate various sources of energy.

Limitations

Like all input-output models, JEDI results are estimates, not precise forecasts. There are a lot of reasons why the results generated by JEDI do not perfectly predict the economic impact of a renewable energy project. First of all, JEDI reports only the direct impact of a specific project. It does not take into account other economic impacts that could occur as a result of these projects being implemented. For example, the model does not factor in the fact that new investments in renewable energy may impact electrical rates. Money spent on a wind farm could have been spent on something else (opportunity cost), and the model does not estimate what economic impact this altered spending pattern would have. In addition, the model does not take into account economies of scale that could be created by having more renewable energy projects in one place. The cost of a ten wind farms is simply the cost of one wind farm multiplied by ten. Because of this, prices do not change with demand.

It is important to note that this is a state-based economic analysis. The model was developed based on relationships between industries at a state level. Since our area of focus was at the county level, we input the population of each particular county as a proxy for the state population. However, the model estimates the local share of the economy relative to the state and may not reflect the actual industry base of the county in question. For example, the model may predict that a renewable energy project will have an impact on an industry that does exist in the county of study. Thus, the model's estimated economic impacts must be taken with a grain of salt. Finally, the model does not consider the economic viability or profitability of projects. It assumes that owners of renewable energy projects have determined that the project is financially viable before construction.

These are the considerations that were the most relevant to our analysis. The National Renewable Energy Laboratory provides a complete list of the limitations of their JEDI model on their website.[9] These limitations are generally true for all input-output models, and so it does not necessarily mean JEDI is a weak model. As long as the user understands these limitations and uses the model for the right purposes, he or she should be able to make reasonable estimates of the economic impacts of renewable energy projects.

Assumptions

When creating the JEDI model, the of JEDI had to make judgments in fitting renewable energy technologies into the fixed categories defined by the North American Industry Classification System, some of which may not have been perfect matches. In addition, the results are based on the basic assumption that factors of production and industrial inputs are used in fixed proportions and respond perfectly elastically. In other words, the economic impacts are linearly related to the size of the project without regard to potential economies of scale. Thus, a 10 MW project will have twice the impact of a 5 MW project, even though savings may have accrued through economies of scale. For smaller projects, this is a minor issue, but for larger projects, economic impacts may be overstated. The JEDI model also has certain built-in assumptions, which we did not alter. JEDI's default assumptions are based on industry averages.

Data

The data from the AURI models can be found in the appendices at the end of the report. They show the different input and output tables and the numerical assumptions used by the model. Appendix A tabulates the renewable energy potential of each county. Each county has a table for total energy potential, potential from crop residue, methane from livestock, logging residue (if applicable), and wind energy potential. Appendix B has the AURI tables for the estimated energy use for each county. These tables include estimated annual energy use, as well as break downs for residential, industrial, transportation, and agriculture uses.

Discussion

In this section, we examine each county's energy consumption and each counties renewable energy potential. The unit for these measurements is in megawatt hours annually. We will also estimate each county's megawatt potential for wind, agriculture crop residue, livestock residue, and logging residue. Finally, in an effort to provide a region outlook, we've aggregated each county's energy consumption and renewable energy potential.

[9] http://www.nrel.gov/analysis/jedi/limitations.html

Although we looked at each counties residential, transportation, agricultural, and industrial energy use, we are only factoring each county's residential and industrial energy use when comparing it to the renewable energy potential of wind, agriculture crop residue, livestock residue, and logging residue. This strategic decision is based in large part on the notion that the renewable energy potential of natural resources like wind, agriculture crop residue, livestock residue, and logging residue are most suited to offset current residential and industrial energy use and not, for instance, the diesel and gas energy consumption embedded in transportation and certain agriculture activities.

E. County and Regional Outlook

1. Iowa County

Iowa appears to have a surplus of renewable energy relative to its current industrial and residential energy use (Figure 3). The annual industrial and residential energy consumption is below 2 million megawatt hours while the annual renewable energy potential hovers around 3 million megawatt hours.

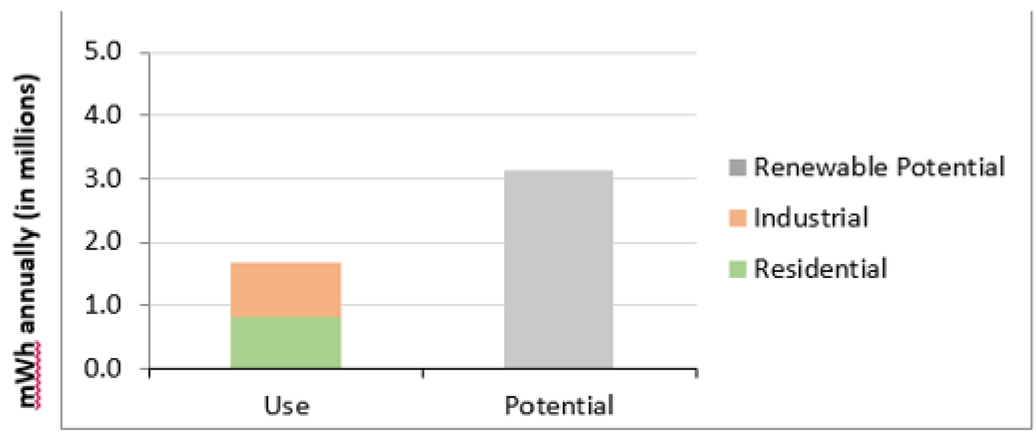

Figure 1: Iowa renewable energy v. energy consumption

In terms of energy consumption, figure 4 illuminates the current residential, transportation, agricultural, and industrial energy consumption throughout the county. Interestingly, transportation accounts for the majority of the energy use in Iowa County with approximately 2 million megawatt hours annually. Residential and Industrial energy consumption are a close second, each just under 1 million megawatt hours annually.

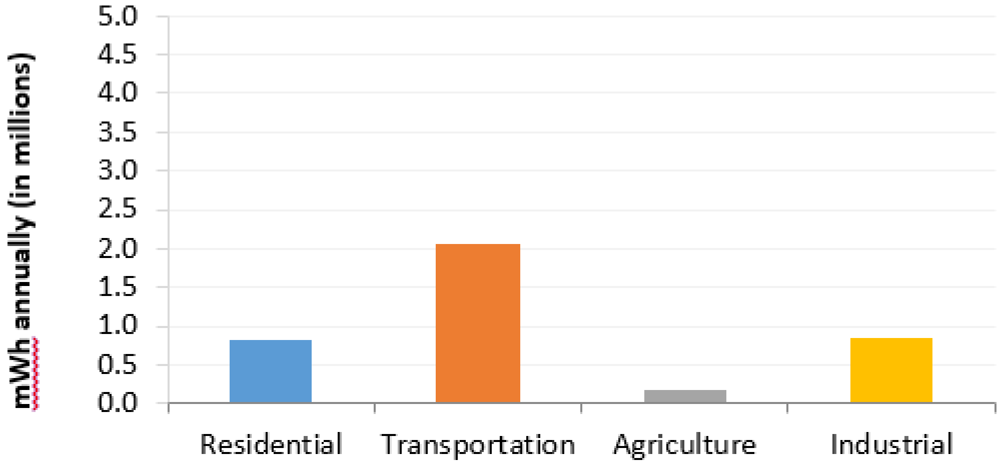

Figure 2: Iowa county energy consumption

In figure 5, we see Iowa counties renewable energy portfolio. The majority of renewable energy potential appears to come from wind. The county appears to be in a position to host up to 251 megawatts worth of wind turbines. Agricultural crop residue and livestock residue offer 89 and 15 megawatts worth of potential, respectively, while logging residue remains non-existent. Ultimately, renewable energy potential in Iowa County is nearly twice industrial and residential energy use.

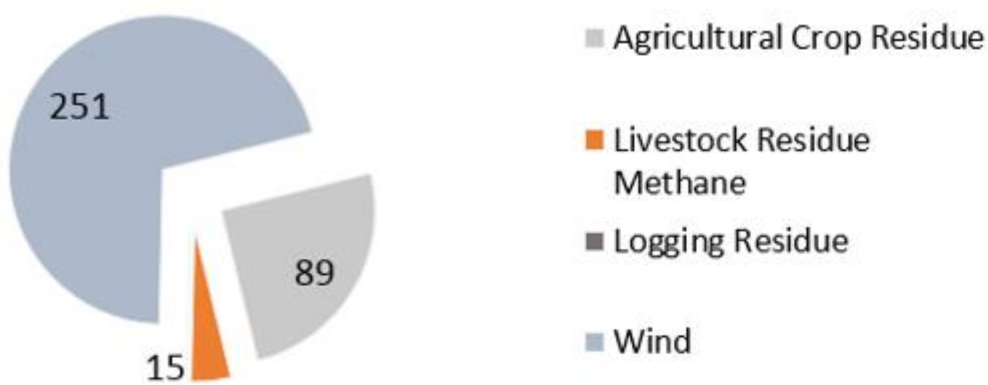

Figure 3: Iowa county renewable energy potential (megawatts)

2. Grant County

As seen in figure 6, Grant's renewable energy potential far outweighs its current annual energy consumption at 5 million megawatts hours annually and roughly 3 million megawatt hours annually, respectively.

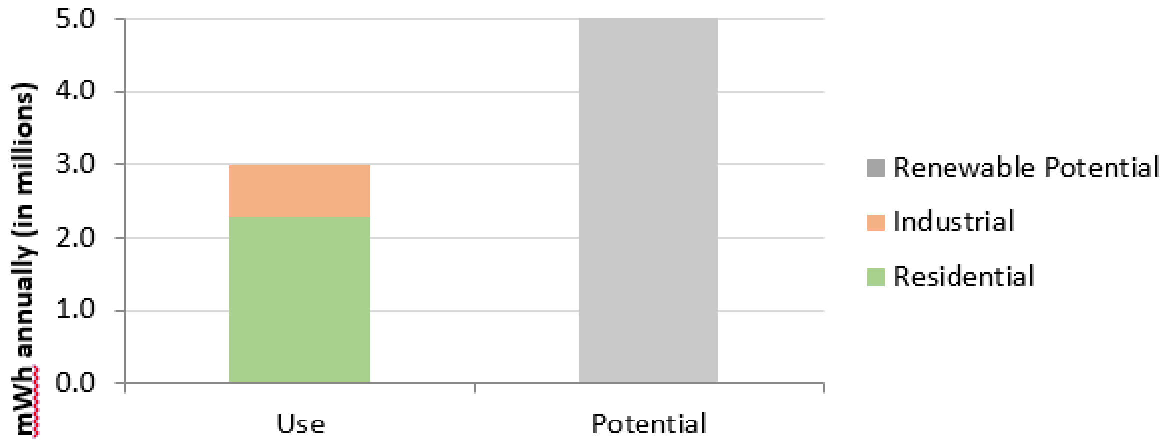

Figure 4: Consumption v. Potential of Grant County

While transportation accounts for a significant portion of the county's energy use at roughly 1.75 million megawatt hours annually, residential energy does outweigh it at about 2.3 million megawatt hours annually (Figure 7). Meanwhile, industrial and agricultural energy consumption remain relatively high compared to other counties.

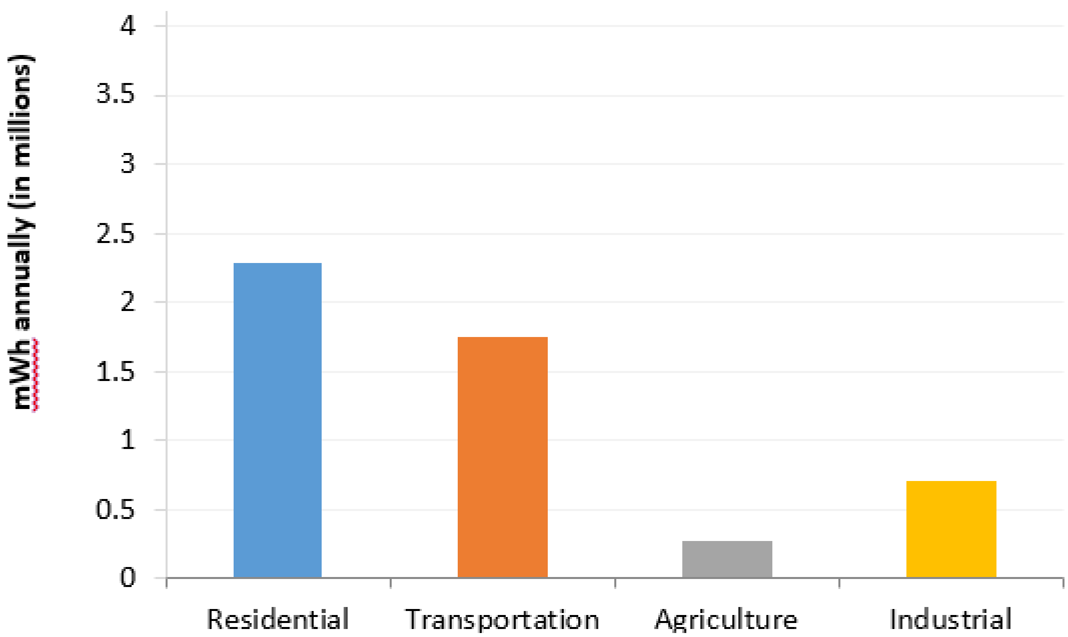

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Figure 5: Grant county energy consumption

As seen in figure 8, the majority of the renewable energy potential is situated in the wind, which has a potential for 379 megawatts worth of wind turbines, and crop residue which harbors the potential for 222 megawatts of power generation. Livestock residue and logging residue also seem to offer a combined 47 megawatts worth of power. Like Iowa County, the renewable energy potential significantly outweighs industrial and residential energy use, making Grant county another good candidate for renewable energy project investments.

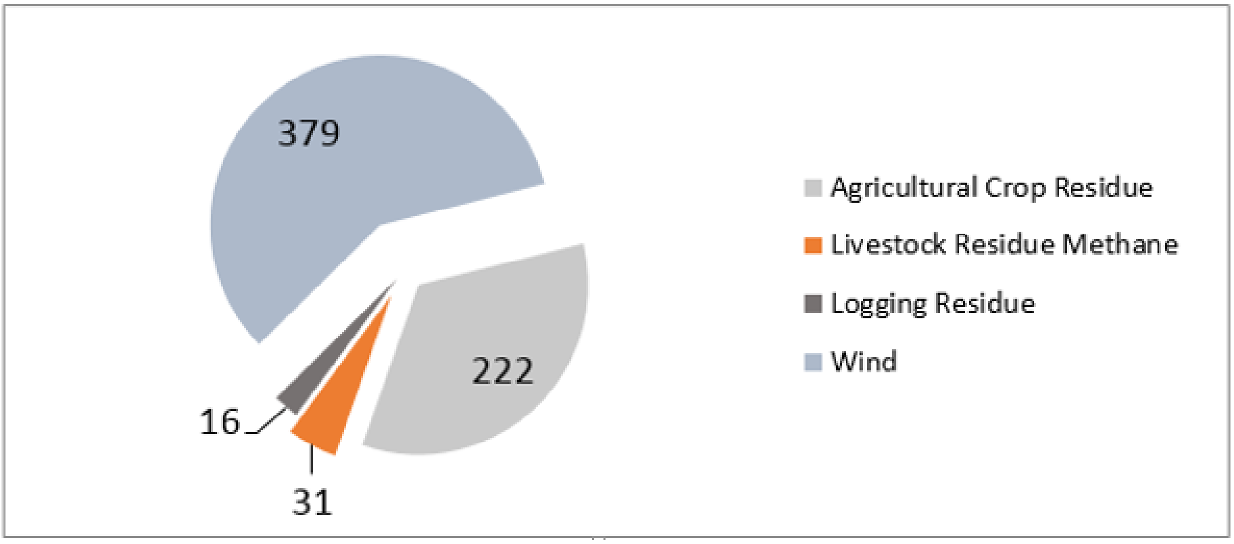


Figure 6: Grant County's renewable energy portfolio (megawatts)

3. Green County

Figure 9 illustrates how Green County's renewable energy potential does not offset its current energy use. Current energy use exceeds 4.5 million megawatt hours annually while the renewable energy potential is just under 3 million megawatt hours annually.

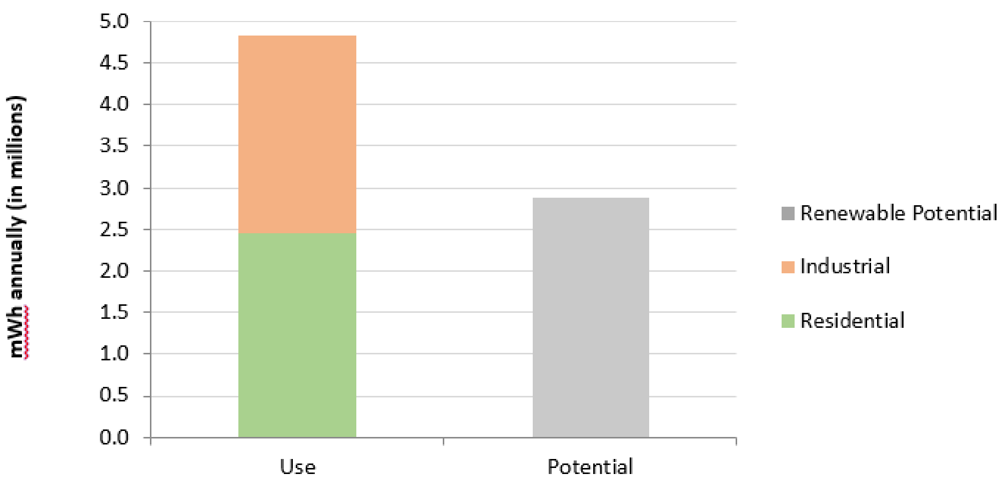


Figure 9: Green County Energy Consumption v. Renewable Energy Potential

The high energy use in Green County is in large part due to the high industrial and residential energy use, roughly 2.4 million megawatt hours and 2.45 million megawatt hours annually, respectively. Transportation energy consumption isn't far behind at just over 1.75 million megawatt hours annually (figure 10).

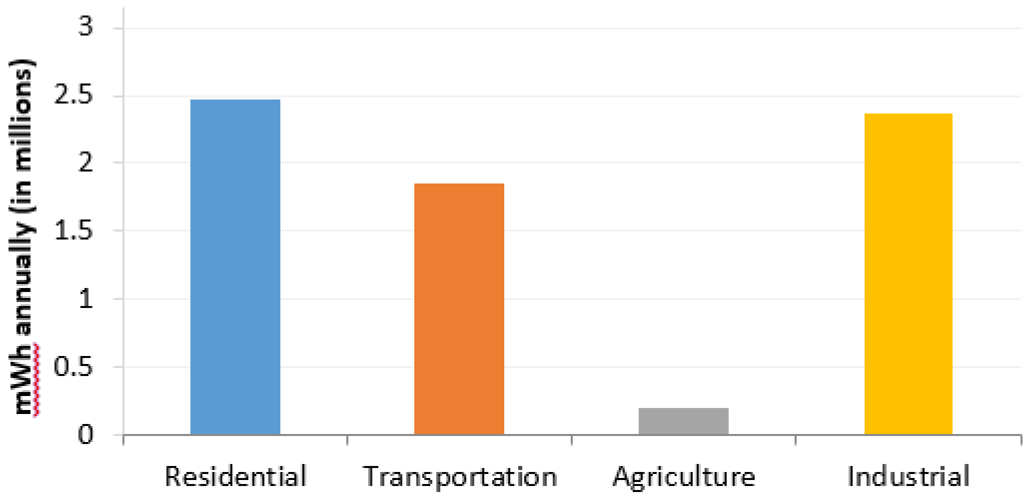


Figure 70: Green County's energy consumption

Although Green county is unlikely to completely offset its energy use with renewable sources of energy, the county still demonstrates a substantial amount of megawatt worth of wind and agricultural crop residue at 193 megawatts and 130 megawatts, respectively. That said, if pursued, this power could help offset the entire five county regions energy use (figure 9).

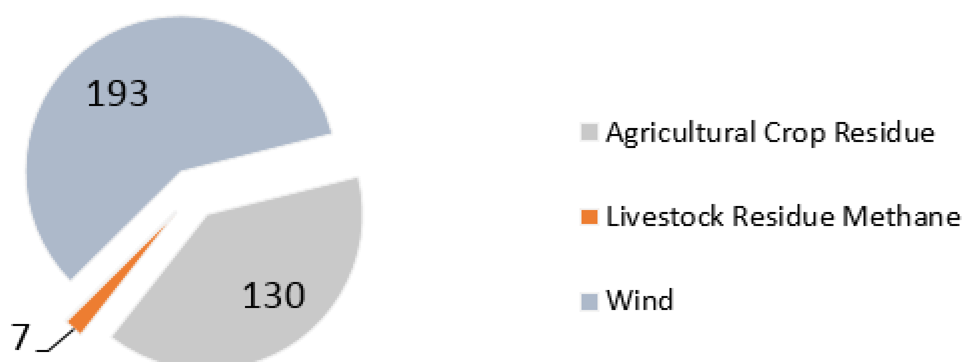


Figure 81: Green County's renewable energy potential portfolio (megawatts)

4. Lafayette County

As seen in figure 11, annual energy use in Lafayette County is lower as compared to other counties and thus enables the county's renewable energy potential to far surpass the current energy use. The counties combined residential and industrial energy use are just about 1 million megawatt hours annually, while the renewable energy potential of the county surpasses 3.5 million megawatt hours annually.

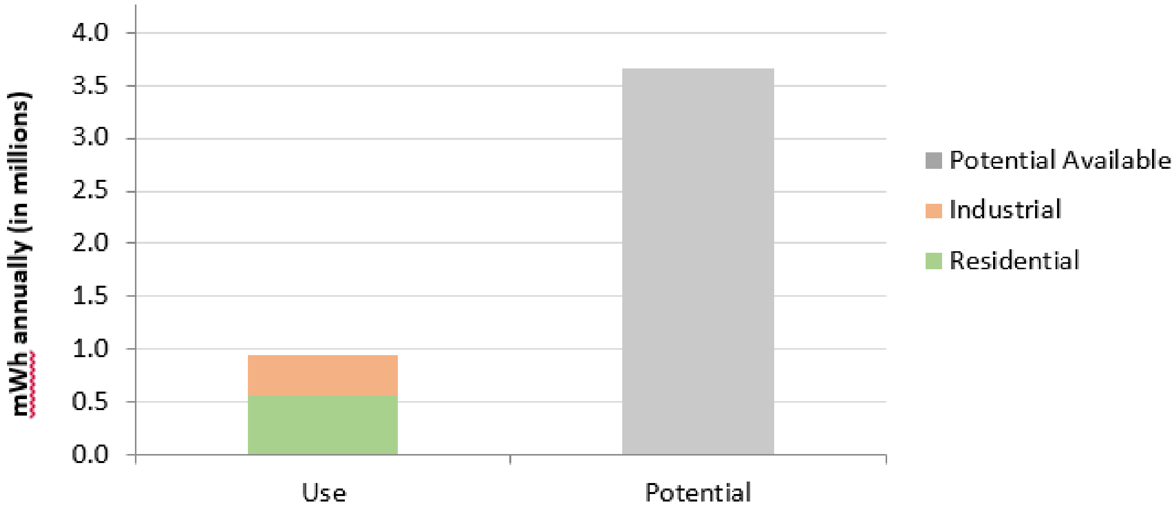


Figure 9: Lafayette Energy Consumption v. Energy Use

The biggest consumer of energy in Lafayette county is transportation in this county at 1.1 million megawatt hours annually (figure 12).

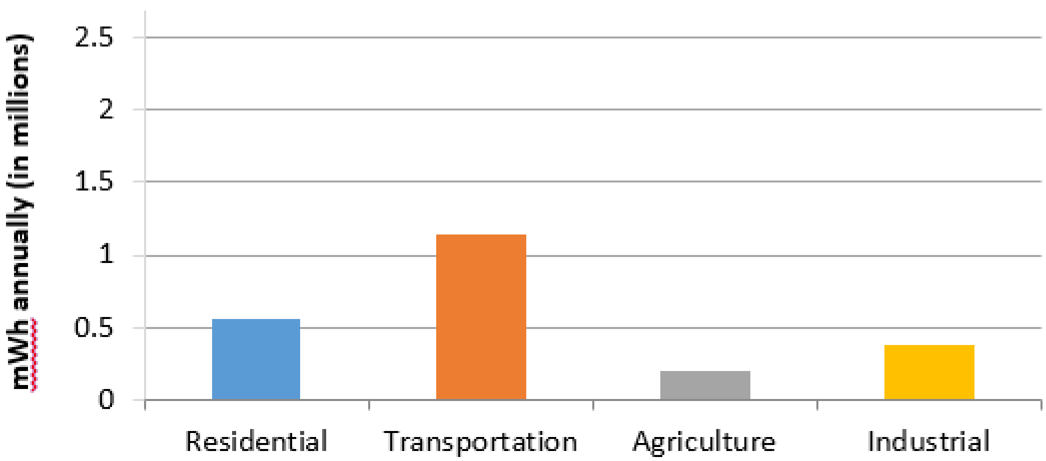


Figure 10: Lafayette County Energy Use

As seen in figure 13, wind and crop residues provide the most renewable energy potential with 254 megawatts and 149 megawatts worth of power, respectively. Given the low energy use in this county, renewable energy potential is estimated to completely offset residential and industrial energy use. In fact, it could potentially generate more than three times the current energy use.

Figure 11: Lafayette County Energy Portfolio (megawatts)

5. Richland County

Richland County also consumes less residential and industrial energy than the county's renewable energy potential. The potential is more than double the counties current use, roughly 0.75 million megawatt hours annually and 1.8 million megawatt hours annually, respectively (figure14).

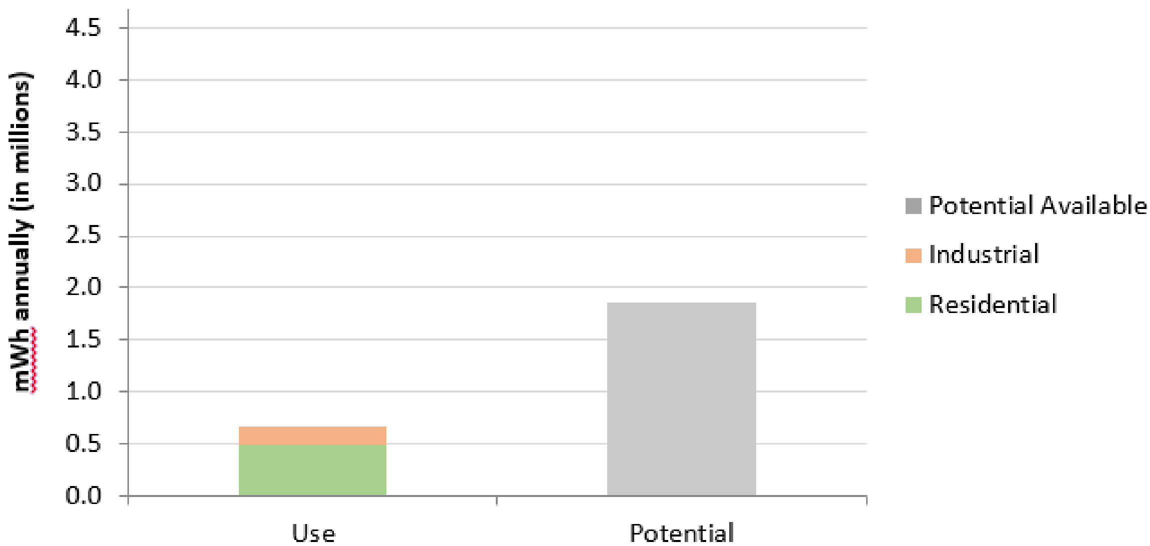


Figure 12: Richland County energy consumption v. renewable energy potential

As seen in figure 15, residential and transportation energy consumption are comparable at 0.5 million megawatt hours annually and 0.6 million megawatt hours annually, respectively. Also, there appears to be a relatively small amount of industrial and agricultural energy use relative to other counties.

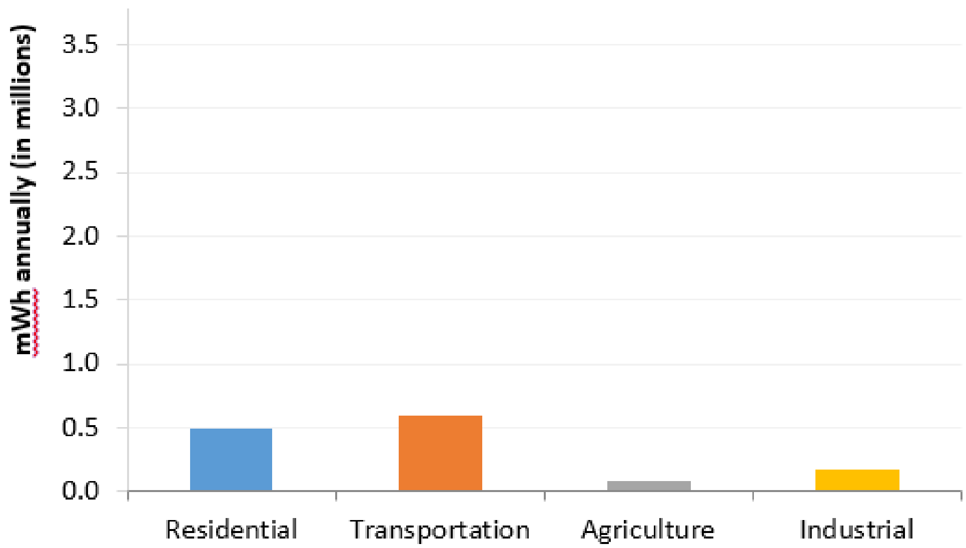


Figure 13: Richland County Annual Energy Use

Like all counties, the vast majority of renewable energy potential comes from wind, with a potential of 194 megawatts of power. The remainder of the renewable energy potential comes from livestock, logging, and crop residues at 3 megawatts, 4 megawatts, and 10 megawatts, respectively (figure 16). Indeed, this is another county in which renewable energy potential outweighs energy use by a significant margin.

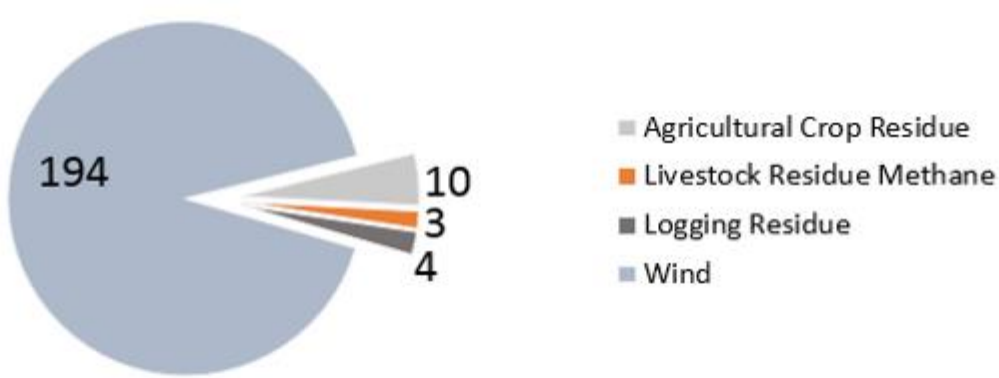


Figure 14: Richland County Energy Portfolio

6. Summary: Regional Outlook

As seen in figure 15, an aggregate of each counties data indicates that there is enough technical potential in the five-county area to offset the region's total estimated annual industrial and residential energy use. This is a significant offset, which may suggest that renewable energy projects would be a viable option should the region seek to pursue energy independence. Even though potential renewable energy did not offset current residential and industrial use in Green County, the totality of the other four counties renewable energy surplus offsets Green County's deficits. Overall, we can conclude that the total potential for renewable energy in this region is considerable.

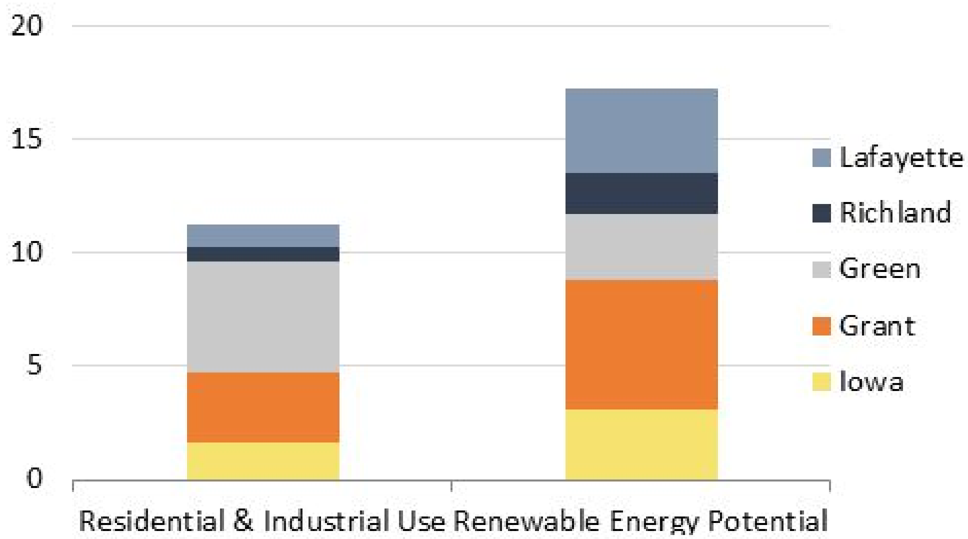


Figure 15: Regional energy consumption v. energy potential (million megawatt hours annually)

Figure 16 illustrates that the aggregation of each counties renewable energy portfolio indicates that wind is the primary generator of renewable energy potential at 1271 megawatts worth of power. Crop residue, livestock residue and logging residue also provide potential power, at 593 megawatts, 78 megawatts, and 20 megawatts, respectively.

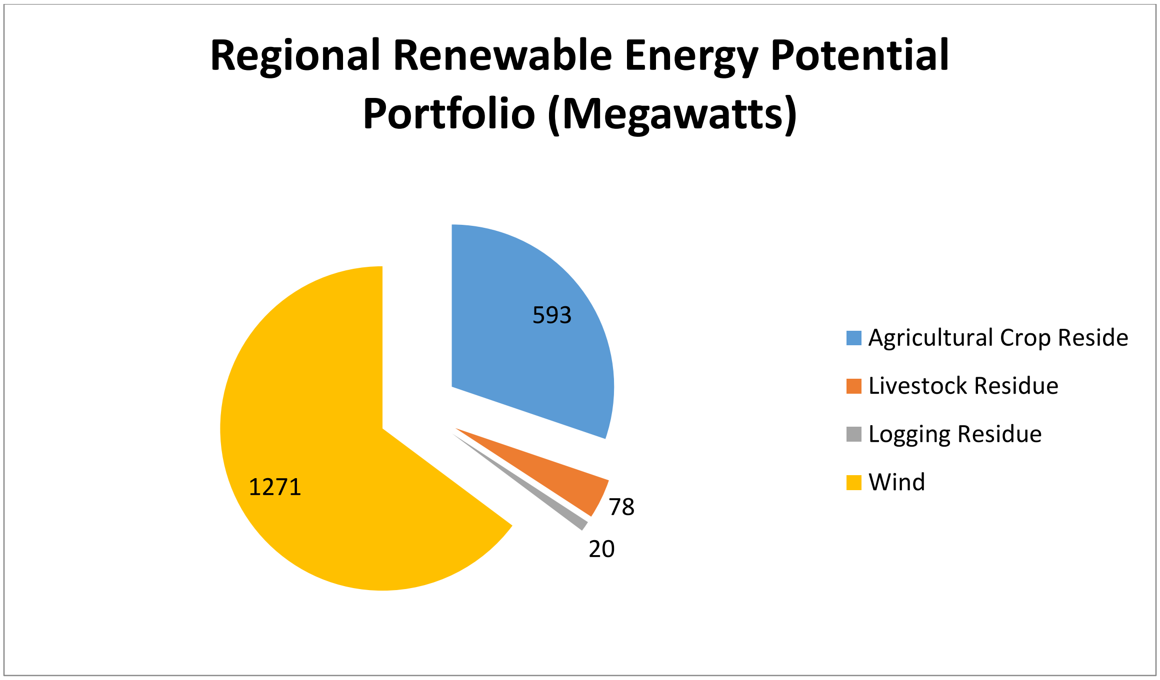


Figure 16: Regional renewable energy potential (megawatts)

F. Regional Economic Impact of Renewable Energy Projects

Overall, we found that renewable energy projects would create a potential for job creation in various industries, the majority of economic benefits occur in construction phase, and renewable energy offers a high return on investment after payback period. While investing in renewable energy may not produce a large number of jobs, it still generates a positive economic impact to the region. This is especially true because renewable energy has the potential to serve multiple functions such as reducing existing wastes and expenses.

1. Estimated Economic Impact of Solar Projects

We conducted JEDI models on 20 different solar installation case study projects covering a range of installation capacities. We used case studies in Green County as our representative sample, and Fig. 17 below shows our results. Annual Earnings represent the additional wages earned by the labor force. Output is the total economic impact (direct impacts plus indirect impacts plus induced impacts). We found that a single solar residential solar project does not create very many jobs, although larger projects would create a larger number of jobs, particularly during the construction phase. The number of jobs created as a result of operations and maintenance are minimal regardless of the scale of the project; however, they do produce a small induced impact on the economy.

Fig. 17: Solar Models

	Residential Retrofit (1 System)	Residential Retrofit (100 Systems)	Large Commercial	Utility
During Construction and Installation Period				
Total Jobs	0.5	45.6	17.9	77.3
Total Earnings	$157,000	$1,569,600	$628,000	$2,482,400
Total Output	$498,000	$4,984,700	$1,938,600	$8,050,800
During Operation Period				
Annual Jobs	0.0*	0.3	0.1	0.6
Annual Earnings	$1,000	$139,000	$37,000	$26,400
Annual Output	$3,000	$270,000	$70,000	$62,500

*Marginal, rounds to zero.

Based on the solar case studies, we learned that there would likely be more than one residential solar project installed within a region during a given timeframe, increasing the economic impact. We chose a representative example of one residential system, 100 residential systems, a large commercial system, and a utility solar project to demonstrate the ability of solar applications to generate an economic impact within the region.

2. Estimated Economic Impact of Wind Projects

The results of our wind analysis are very similar to the solar results. We ran 20 JEDI models on existing wind projects throughout Wisconsin and the upper Midwest. Our results, found in Fig. 18, were reached by using the default settings of the JEDI model which are based on industry averages. This table demonstrates the economic impact of wind projects using varying scales, while holding all other project related costs at a constant. Our findings suggest that wind projects have the potential to generate greater economic impact than that of solar, but this is strongly dependent on the scale of the project. As for solar, the majority of the jobs created occur during the development and construction phase. Yet these short-term workers have the potential to have a significant impact on the local economy during their relatively brief time in the area. The table below shows our results for wind projects.

Fig. 18: Wind Models

Total Project Size (MW)	1	5	10	25	50
Total Annual Operational Expenses	$300,000	$1,600,000	$3,200,000	$8,200,000	$16,300,000
During Construction Period					
Total Number of Jobs	6	30	61	144	253
Output	$700,000	$3,490,000	$6,970,000	$16,920,000	$31,600,000
During Operating Years (Annual)					
Total Number of Jobs	0	1	2	5	9
Output	$30,000	$120,000	$250,000	$600,000	$1,160,000

Estimated Economic Impact of Bioenergy Projects

The most feasible application of bioenergy technology in the region is the production of biogas. Biogas is the use of anaerobic digesters to convert wastes into energy sources. Anaerobic digesters typically process animal wastes, but they can be adapted to process other forms of waste as well. Costs of installing this type of energy system vary based upon number of livestock in a farming operation. In May 2010, the EPA released a bulletin titled “Anaerobic Digestion Capital Costs for Dairy Farms” which provided an estimate of the capital costs for installing digesters on farm. It also helps users determine which system best suited for their particular farming operation. According to this bulletin, most anaerobic digesters generate a return on investment within 10-15 years, depending on the capacity of the system to produce energy and selling energy back to the grid at wholesale prices.

Furthermore, bioenergy is unique because it serves to useful purposes: producing energy and disposing of unwanted waste. In addition,, anaerobic digestion can produce byproducts that can be used or sold. For example, byproducts from biodigested agricultural wastes creates materials that can be used as sanitary bedding for livestock or can be applied to fields as fertilizer. In addition to anaerobic digestion, an increasing number of bio-combustion applications are in use across the state. This technology has been used to heat residential, institutional, commercial and industrial facilities through the burning of wood pellets, woodchips, wastes from wood-based industries, or logging residues. Both of these options are highly recommended for the five-county region as they use locally available resources and complement existing economic activities like agriculture or logging. The number of jobs created depends on scale of production and type of technology utilized to produce energy.

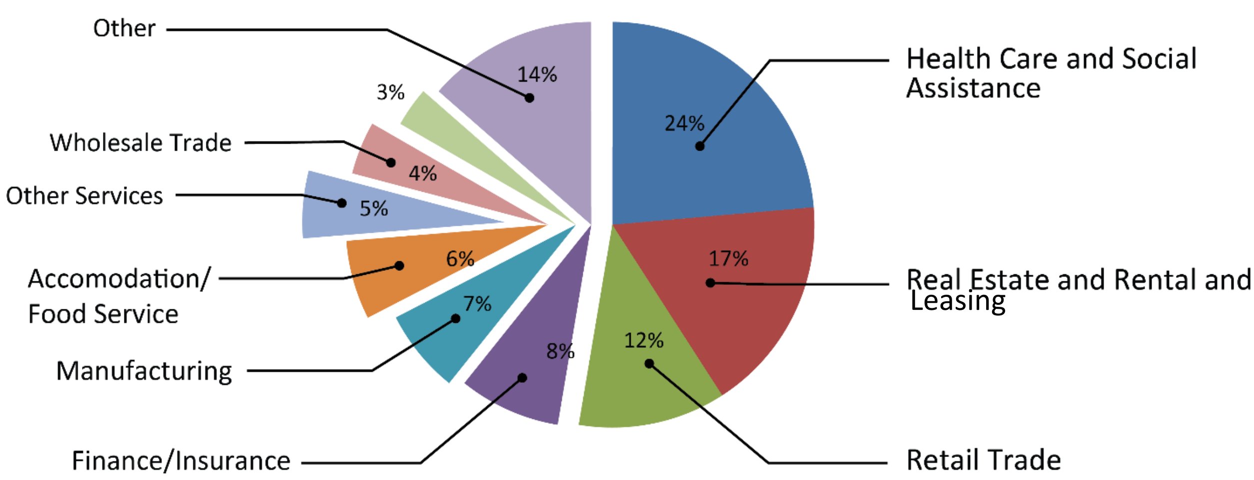
The economic impact of bioenergy projects will be based on the scale of the project, technology, and feedstock utilized to produce sources of energy. There are multiple factors to consider and economic impact will be impacted by decisions made by a single individual, business, or farming operation. Due to this fact, it is hard to simply summarize the economic impact of these projects. Of the many case studies we identified, we found the following to be the most instructive and worthy of further consideration:

- Xcel Energy Bay Front Plant
- Vesper Pallet Company and Woodruff Lumber
- Barron Area School District
- Action Floor Systems, LLC
- Flambeau River Paper Mill and Flambeau River Biofuels
- French Island Generating Station
- Wild Rose Dairy
- Janesville Wastewater Treatment Facility
- Emerald Dairy Biodigester

3. The Economic Impact of One Additional Job

In addition to calculating the economic impact of the renewable energy system itself, we also sought to identify the distribution of these economic impacts as they would occur in the region based on local spending patterns and interrelated industries. We ran two IMPLAN models that reflect two different income levels of an additional worker within the community. We assumed that the worker would earn between $30,000 and $50,000 per year; the upper limit was suggested by the JEDI models and the lower value provides a reasonable estimate. The following chart is a breakdown of the economic impacts to various sectors of the local economy as estimated by the JEDI model. Based on the increased amount of money in the local economy, the induced spending is most likely to be spent on healthcare, housing, and retail – this primarily reflects that individuals are going to pay off existing debts such as their medical bills and mortgages and act as rational consumers to purchase the goods and services that they either want or need.

Fig. 19: Induced Impacts



4. Economic Tradeoffs

It is important to consider the economic tradeoffs of investing in renewable energy projects against the potential loss of crop income. This is a particular issue with wind turbines, as the footprint of the turbine reduces the total amount of land that can support income-producing crops. We calculated this tradeoff and determined that the income from energy produced by the turbine would easily surpass the crop loss. The wind turbine would pay for itself in less than 20 years. After 20 years, I would be making a profit equivalent to growing either corn or soybeans for over 100 years in the turbine's footprint. The estimated loss of crop income is based on the regional average yields in bushels per acre for corn and soybeans, USDA season average prices, and NREL's estimated size of a turbine footprint and standard service road. The production and potential of a wind turbine is based on the following assumptions: the turbine produces energy 25% of the time (a conservative estimate), the buy-back price by the utility is $0.05 (a low estimate), and that the cost of installation is $2,000 per KW (the industry standard). Our estimate does not account for operation and maintenance costs; nor does it include any subsidies or grants that help pay for the installation.

Significantly, this estimate does not take into account the fact that wind turbines disrupt the usual paths of farming implements, and farmers have to take special efforts to navigate around them. Further research is necessary to determining the optimal siting of wind turbines on a given parcel in order to minimize possible negative economic effects that erode the benefits of building a wind turbine.

5. Additional Sources of Income

In addition to the effects projected by JEDI and IMPLAN, there are other economic factors to consider. For example, owners of renewable energy projects can earn additional income by selling surplus renewable energy to utility companies. Although wholesale prices are lower than consumer prices, they present a great opportunity for renewable energy projects to generate income that can be used to pay for loans on the initial investment as well as ongoing operation and maintenance costs. The return on investment is the highest for wind and agriculturally based anaerobic digesters. Additionally, the byproducts created from biogas production can be sold, as discussed previously.

6. Summary – Economic Opportunity

While the number of jobs produced through the installation of renewable solar, wind or bioenergy projects is not large, these projects still have a positive economic impact on their local communities. The jobs that are created, mainly in the construction phases, have important effects on the local economy. Furthermore, these projects yield additional sources of income through the sale of surplus energy and/or byproducts from the biodigestion process. Bioenergy also has the added benefit of finding a productive use for wastes created through the process of farming or logging. In light of these findings, it would be wise for southwestern Wisconsin to consider renewable energy systems as positive economic forces and worthy of continued investment.

G. Drivers

Work and research conducted in phase two included a review of funding opportunities for renewable energy projects. In this research component, we worked to identify existing funding sources for renewable energy projects, including grants, subsidies, loans, tax credits, etc., and how these were used in existing projects. We also worked to estimate the potential for each to stimulate renewable energy investments to shift reinvestment from traditional practices to renewable, for each county and the region. This section also examined how costs are off-set by short and long-term revenue creation, either through byproducts, incomes, or tax revenues. We also examine a few drivers related to policy and economics, including the renewable energy standard and the current and future states of natural gas prices.

1. Subsidies

Subsidies are monetary grants given by governments to private organizations to assist them in an enterprise considered useful to the public. There are generally two types of subsidies: direct and indirect. Direct subsidies involve the direct distribution of funds to organizations, while indirect subsidies involve reducing the expenditures of subsidy beneficiaries. For renewable energy, these can be broken down further into construction and operational. Construction subsidies are given at the outset of a project to assist with the capital costs of the project. Operational are ongoing subsidies designed to bring energy costs to market rates.

There are a variety of federal and state subsidies available for renewable energy in the state of Wisconsin. Focus on Energy, a public benefits program in Wisconsin that focuses on energy-related projects, has been a primary source for renewable energy incentives in the state. Programs by Focus offer cash back rewards for residential, commercial, and industrial sector renewable energy projects. For 2013-2014, Focus will allocate $10 million for renewable energy projects in the state, dedicated mostly to bioenergy and geothermal with the rest allocated to solar and wind projects (UW-Ex Training Module).

At the federal level, the renewable electricity production tax credit (PTC) is an indirect operation subsidy used to encourage the growth of the renewable energy sector. It is given as a per-kilowatt-hour tax credit for electricity generated by qualifying sources, such as wind, biomass, geothermal, and anaerobic digestion. The amount ranges from 1.1 to 2.3 cents per kilowatt-hour, based on the technology of generation. This credit was enacted in 1992 and has been renewed many times since, most recently in January 2013.

The major concern with these subsidies and others relates to their being contingent on funding sources as well as political will. If a group were to come to power who was not friendly to renewable energy, then subsidies such as the ones mentioned above could be greatly reduced or done away with altogether. During times of economic downturn, those subsidies might be also be subject to budget cuts.

2. Renewable Energy Standard

The Renewable Energy Standard is a policy instrument that aims to increase the production of electricity from renewable energy sources with desirable social and environmental benefits. The RES requires the market to deliver a set minimum percentage of renewable electricity generation or capacity requirement from targeted fuels or technologies. There is also a deadline dictated as to when this minimum percentage must be reached, i.e. 20% by the years 2020. The RES has emerged as a popular mechanism to increase the penetration of renewables into the electricity market. Renewable fuel sources included in RES policy typically include solar, wind, geothermal heat, hydroelectric, and bioenergy. Renewables usually have much lower social and environmental impacts, compared to electricity derived from conventional sources. Environmental benefits might be local—less smog contributing emissions—or global—reduced emissions of greenhouse gases. Investing in renewables also increases supply diversity, making energy systems less vulnerable to changing fuel prices or disruptions in the supply chain (Berry & Jaccard, 2006).

Despite notable environmental and societal implications of renewable energy, there is still debate as to whether it is more expensive than conventional electricity sources when compared on a financial cost basis. Traditionally, utilities have concentrated their investments on conventional technologies, such as coal and natural gas power plants, which tend to have lower capital, fuel and operations and maintenance costs. The RES addresses this problem by mandating that utilities generate or purchase a certain amount of electricity from renewable as a portion of their overall electricity supply. Additionally, many state officials view the RES as a way to respond to public demand for reliable, inexpensive, and environmentally friendly source of electricity. Another factor that contributes to diverse support of the RES is the perception that promoting renewable energy through these standards produces economic benefits for the state, in the form of economic development. Development is particularly attractive if the renewable sources are developed within state boundaries, in lieu of imported fossil fuels (Rabe, 2007, p. 10).

One of the main challenges of the RES is determining the target or quota. Wisconsin approached the issue of integrating renewable source in a two-step manner. In 1998, state passed legislation used a fixed 50-megawatt renewable capacity target for a portion of the state, with mandated completion by 2000. In 1999, the state enacted a second RES, applicable to the entire state, which required that at least .5 percent of the electricity sold in 2001—increasing to 2.2 percent by 2011—be derived from renewable sources. In 2006, Wisconsin increased RES to 10 percent by 2015, which is where it currently stands. Under the Wisconsin state law, there are a range of technologies and eligible resources: tidal or wave power, wind power, solar photovoltaic, geothermal activity, fuel cell using renewable fuel (as determined by the PSC), hydroelectric, and biomass. Exclusions consist of energy deriving from coal, oil, nuclear, or natural gas (except for natural gas used in a fuel cell). Under current law, electric utilities are permitted to recover the costs of providing renewable energy generation that equal or exceed the RES requirements using alternative price structures, which include asking customers pay a premium for using electricity generated through renewable resources.

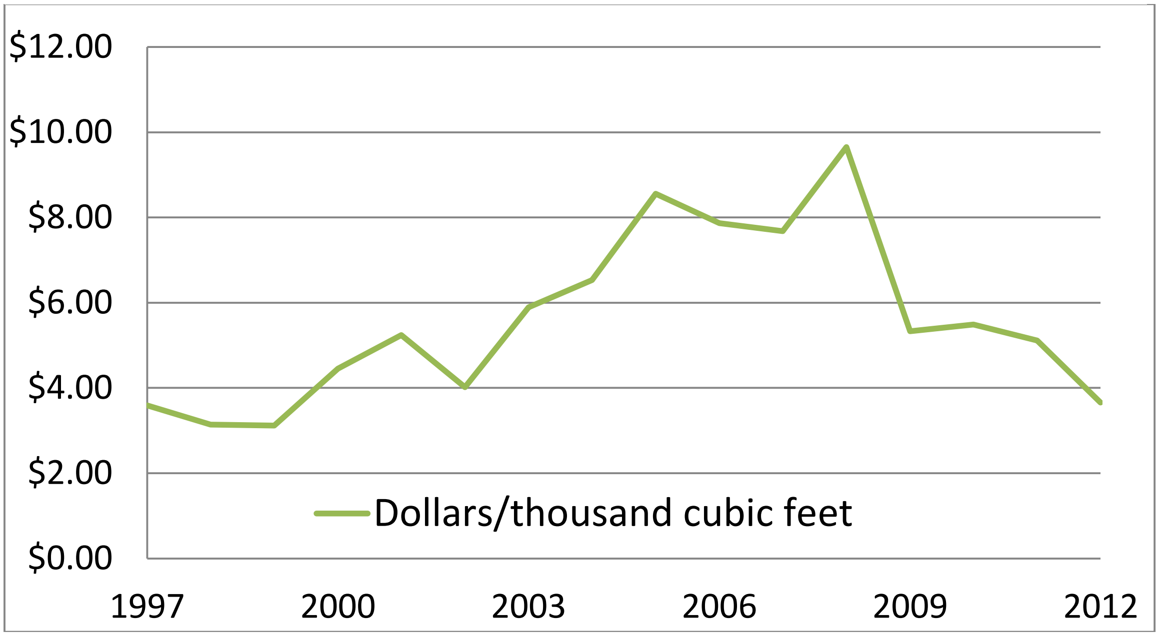
Wisconsin is well on its way to meeting the 2015 goal; however it is difficult to assume that those electric utility companies will continue to invest in renewable energies beyond their mandated levels of compliance. Other states have begun to raise the bar for the amount of electricity required by an RES, which has resulted in somewhat of a "race to the top," where states are committing to renewable energy levels that might not have seemed fathomable a decade ago (Rabe, 2007, p.15). Additionally, state RES programs are increasingly complemented by other initiatives to promote renewable energy and energy efficiency, such as third party solar programs. The RES serves as an important policy tool, encouraging a commitment to renewable energy, by both markets and consumers. It remains unseen whether legislative action will be taken to increase or extend the state's RES.

3. Natural Gas

Another contributing driver that we consider in our analysis of renewable energy potential in Southwestern Wisconsin is the role of decreasing North American gas prices, as shown in figure 20. Estimates find that demand for natural gas will increase significantly over the next decade, given the rapid rise of domestic production (Navigant, "North American Natural Gas Market Outlook, Fall 2012). New drilling technologies, pioneered in America, are allowing gas to be extracted from deposits that were formerly technologically and economically out of reach. There is a growing awareness of natural gas as a source of domestic energy supply, with producers seeking new markets for natural gas, such as transportation. Additionally, there is growing recognition of the low carbon content of natural gas relative to other fossil fuels, which some scholars say could act as a "bridge" to a low carbon future (Ejaz, p. 40).

In the short term, low natural gas prices do not appear to significantly undercut investment in renewable energy. For example, current prices for wind, since those prices are usually based on fixed 20-year prices, not market prices. Additionally, while the cost per kilowatt hour of wind is more expensive than natural gas, utilities often still encourage the presence of renewable energy in order to have a more robust portfolio of generation sources and to guard against the volatility of natural gas prices. In the long term, if low natural gas prices persist, the political will for renewable energy—in the form of tax subsidies for solar and wind installations—could potentially wane. While we found a few sources that suggested that a reduction in natural gas resources could mean less investment in renewable energy, we were unable to find substantial literature to completely support this claim. One factor to consider is that while natural gas produces half as much carbon dioxide per watt of power as coal, it is still a considered a "dirty energy," so investment for renewable energy still presents viable alternative for a clean energy future.

Fig. 20: United States Natural Gas Industrial Price



Source: US Energy Information Administration

Conclusion

In reviewing the findings for the project, our Renewable Energy Economic Opportunity Assessment revealed a variety of important opportunities and challenges to advancing the economic viability of renewable energy within the five-county region. Despite our findings that suggest minimal long-term job creation in the region in general, our results uncover the region's potential. For example, employing an AURI model—which calculated annual energy use of a given county and the annual technical potential of renewable energy sources on a county level—we found the potential for renewable energy projects to be significant. More specifically, for bioenergy, wind, and solar, residential and industrial uses could couldn't 87.2% of use with renewable energy. This suggests that renewable energy should be considered as a viable option in pursuing energy independence. However, it is important to note that our model required a number of assumptions, particularly in terms of usable land.

After discovering the potential for renewable energy project in the region, we turned to establishing an estimate of the economic impact of renewable energy projects in the five-county region, utilizing a JEDI model, which accounted for the development potential of solar photovoltaic and wind projects? Overall, we found that renewable energy projects have the potential to create jobs in various industries. More specifically, the majority of economic benefits for these projects are experienced through the project construction phase. However, our model predicted that long-term job potential and growth is minimal. Despite this reality, it is important to note that there tends to be a high return on investment after the project payback period for renewable energy projects, and projects can serve multiple functions, such as waste and expenses reduction.

Lastly, our analysis takes into account that renewable energy projects are significantly affected by outside sources, independent of potential or economic impact. We identified a number of factors that may contribute to feasibility of renewable energy projects. For example, the availability of subsidies— federal or state, indirect or direct, or during construction and operation phase construction or operation phase— could boost or stall the number of project in the region. However, the subsidy environment is often dependent on political will, which is often complicated an unpredictable. Similarly, a change in Wisconsin's Renewable Portfolio Standards could potentially boost investment in renewable energy projects, as the market is required to deliver a particular minimum of renewable electricity. However, as Wisconsin has nearly reached its 2015 Renewable Portfolio Standards, and no legislation has passed that would raise the percentage; it is unclear as to whether electric utility companies will continue to invest in renewable energy projects. Finally, as natural gas prices drop, it becomes more appealing as lower carbon emitting, form of energy. All of these factors should be taken into consideration when considering the potential for renewable energy in the region.

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Appendix A: **Renewable Energy Potential**

A. Grant County

1. Table 1.1: Estimated Annual Renewable Energy Potential Summary

Resource	Quantity	Units	Energy Content
			Trillion Btu/yr
Agricultural Crop Residue		Tons	6.6336
Livestock Residue Methane		SCF	0.9333
Logging Residue		Tons	0.4762
Wind		kW-hr	11.3232
Total			**19.3663**

2. Table 1.2: Estimated Annual Crop Residue Potential

Total Number of Households	**19,396**		
Column	B	C	D
Formula		=household number * B	
Energy Type	**Million Btu/household per year**	**Annual Energy Million Btu/yr**	**On Site**
Electricity - Primary	*111.5*	2,162,654.00	––
Electricity - Site	*37.3*	723,470.80	723,470.80
Natural Gas	*85.0*	1,648,660.00	1,648,660.00
Fuel Oil	*75.4*	1,462,458.40	1,462,458.40
Kerosene	*0.0*	-	-
LPG	*63.9*	1,239,404.40	1,239,404.40
Wood	*29.3*	568,302.80	568,302.80
Total Energy Use	***402.4***	**7,804,950.40**	**5,642,296.40**
Trillion Btu/yr		**7.8050**	**5.6423**

3. Table 1.3: Estimated Annual Livestock Residue Potential

Herd Inventory	Assumed Herd Composition	Animal Count	Typical Animal Mass (lbs)	Volatile Solids per lb TAM/yr	Total Volatile Solids/yr	Volatile Solids % Destruction	Cu ft Methane Yield per lb VS Destroyed	Methane Yield cu ft/yr	Methane Yield mm Btu/yr
Enter herd or flock inventory reported by USDA in column C.									
Beef Cattle	**Enter %'s below & total here ->**	171,400							
Feedlot Steers and Heifers	33.33%	57,127.62	915.00	2.60	135,906,607.98	45%	5.29	323,525,680.30	313,819.91
Calves	33.33%	57,127.62	397.00	2.60	58,967,129.36	45%	2.72	72,175,766.34	70,010.49
Steers		0.00	794.00	2.60	-	45%	2.72	-	-
Heifers		0.00	794.00	2.60	-	45%	2.72	-	-
Cows	33.33%	57,127.62	1,102.00	2.60	163,682,056.82	45%	2.72	200,346,837.55	194,336.43
Bulls		0.00	1,587.00	2.60	-	45%	2.72	-	-
	99.99%								578,166.84
Dairy Cattle	**Enter %'s below & total here ->**	48,000							
Calves	18.00%	8,640.00	397.00	2.60	8,918,208.00	35%	3.84	11,986,071.55	11,626.49
Heifers	18.00%	8,640.00	903.00	3.65	28,477,008.00	35%	3.84	38,273,098.75	37,124.91
Cows	64.00%	30,720.00	1,345.00	3.65	150,812,160.00	35%	3.84	202,691,543.04	196,610.80
	100.00%								245,362.19
Swine	**Enter %'s below & total here ->**	77,636							
Market	92.00%	71,425.12	101.00	3.10	22,363,205.07	50%	7.53	84,197,467.10	81,671.54
Breeding	8.00%	6,210.88	399.00	3.10	7,682,237.47	50%	5.77	22,163,255.11	21,498.36
	100.00%								103,169.90
Poultry	**Enter %'s below & total here ->**	25,563							
Layers	92.91%	23,750.58	3.50	4.40	365,758.98	60%	5.45	1,196,031.87	1,160.15
Broilers	6.82%	1,743.40	1.50	6.20	16,213.59	60%	4.81	46,792.42	45.39
Turkeys	0.27%	69.02	7.50	3.32	1,718.60	60%	4.81	4,959.88	4.81
	100.00%								1,210.35
Sheep	**Enter total here ->**	3,372	154.00	3.36	1,744,807.68	55%	5.77	5,537,147.17	5,371.03
Total Energy Potential MM Btu/yr									**933,280.3115**
Trillion Btu/yr									**0.9333**

4. Table 1.4: Estimated Annual Logging Residue Potential

Column	B	C	D	E	F	G
Formula				=B*C/D		=E*F
Units	**cu ft/yr**	**% harvested**	**cu ft/cord**	**cords/yr**	**million Btu/cord**	**million Btu/yr**
Hardwood	4,350,080.0	33%	80	17,944.1	25	448,602.00
Softwood	473,984.0	33%	85	1,840.2	15	27,602.60
Total Energy Potential MM Btu/yr						**476,204.5976**
Trillion Btu/yr						**0.4762**

5. Table 1.5: Estimated Annual Wind Energy Potential

County Area in sq miles	**1,148.0000**	sq miles	
Acres/sq mile	640	acres/sq mile	
County Area in acres	734,720.00	acres	=a*b
% Available for Wind Development	5.00%		
Acres Available for Development	36,736.00	acres	=A*B
Turbine Size	1.65	MW	
Acres per Unit	40	acres	
MW Installed per Acre	0.04125	MW/acre	=D/E
Capacity Factor (%)	25.00%		
Annual Hours	8,760	hours/year	
MW hrs/yr	**3,318,638.4000**		=C*F*G*H
Trillion Btu/yr	**11.3232**		=I*3.412/10^6

B. Green County

1. Table 2.1: Estimated Annual Renewable Energy Potential Summary

Resource	**Energy Content**
	Trillion Btu/yr
Agricultural Crop Residue	3.8834
Livestock Residue Methane	0.1958
Logging Residue	-
Wind	5.7601
Total	**9.8393**

2. Table 2.2: Estimated Annual Crop Residue Potential

Crop	Acres Harvested	Yield	Units	Convert to lbs	Removal Fraction	Moisture %	Residue to Crop Ratio	Annual Biomass Potential (lbs)	Btu Content per dry lb	Million Btu/yr
Barley (Barley All)	554.40	57.67	bu	48	0.75	14.5%	1.2	1,180,858.69	7,500	8,856.44
Canola			lbs	1	0.75	8.0%	2.2	-	7,500	-
Corn for Stover (Corn For Grain)	85,522.50	154.04	bu	56	0.5	15.5%	1.0	311,694,140.39	7,768	2,421,240.08
Cotton			lbs	1	0.75	12.0%	4.5	-	7,500	-
Dry Beans (Beans Dry Edible)			lbs	1	0.75	13.0%	1.2	-	7,500	-
Flaxseed			bu	1	0.75	8.0%	1.2	-	7,500	-
Oat Straw (Oats)	5,281.18	70.56	bu	32	0.75	14.0%	1.3	9,998,051.76	7,626	76,245.14
Peanuts			lbs	1	0.75	9.9%	1.0	-	7,500	-
Peas (Green Peas for Processing)			tons	2,000	0.75	9.8%	1.5	-	7,500	-
Potatoes	5.00		cwt	100	0.75	13.3%	0.4	-	7,500	-
Rice			lbs	1	0.75	15.0%	1.4	-	7,500	-
Rye	77.50		bu	56	0.75	10.0%	1.6	-	7,500	-
Safflower			lbs	1	0.75	8.0%	1.2	-	7,500	-
Sorghum			bu	56	0.75	12.0%	1.4	-	7,500	-
Soybeans	44,990.17	44.79	bu	60	0.75	13.0%	2.1	165,672,232.89	7,500	1,242,541.75
Sugar Beets			tons	2,000	0.75	62.8%	1.0	-	7,500	-
Sugar Cane			tons	2,000	0.75	62.8%	1.6	-	7,500	-
Sunflower (Sunflower All)			lbs	1	0.75	10.0%	2.1	-	7,500	-
Wheat Straw (Wheat All)	5,501.78	65.50	bu	60	0.75	13.5%	1.3	18,235,443.01	7,375	134,486.39
CRP and similar grassland		2.00	tons	2,000	0.75	20.0%	1.0	-	7,500	-
Brushland on 5 yr cycle		0.84	tons	2,000	0.75	20.0%	1.0	-	7,500	-
Total Energy Potential MM Btu/yr										**3,883,369.8043**
Trillion Btu/yr										**3.8834**

3. Table 2.3: Estimated Annual Livestock Residue Potential

Herd Inventory	Assumed Herd Composition	Animal Count	Typical Animal Mass (lbs)	Volatile Solids per lb TAM/yr	Total Volatile Solids/yr	Volatile Solids % Destruction	Cu ft Methane Yield per lb VS Destroyed	Methane Yield cu ft/yr	Methane Yield mm Btu/yr
Enter herd or flock inventory reported by USDA in column C.									
Beef Cattle	**Enter %'s below & total here ->**	5,294							
Feedlot Steers and Heifers	33.33%	1,764.49	915.00	2.60	4,197,722.19	45%	5.29	9,992,677.66	9,692.90
Calves	33.33%	1,764.49	397.00	2.60	1,821,306.78	45%	2.72	2,229,279.50	2,162.40
Steers		0.00	794.00	2.60	-	45%	2.72	-	-
Heifers		0.00	794.00	2.60	-	45%	2.72	-	-
Cows	33.33%	1,764.49	1,102.00	2.60	5,055,617.32	45%	2.72	6,188,075.60	6,002.43
Bulls		0.00	1,587.00	2.60	-	45%	2.72	-	-
	99.99%								17,857.73
Dairy Cattle	**Enter %'s below & total here ->**	30,709							
Calves	18.00%	5,527.64	397.00	2.60	5,705,626.25	35%	3.84	7,668,361.69	7,438.31
Heifers	18.00%	5,527.64	903.00	3.65	18,218,813.07	35%	3.84	24,486,084.77	23,751.50
Cows	64.00%	19,653.82	1,345.00	3.65	96,485,506.91	35%	3.84	129,676,521.29	125,786.23
	100.00%								156,976.04
Swine	**Enter %'s below & total here ->**	12,692							
Market	88.84%	11,275.57	101.00	3.10	3,530,381.84	50%	7.53	13,291,887.64	12,893.13
Breeding	11.16%	1,416.43	399.00	3.10	1,751,978.80	50%	5.77	5,054,458.85	4,902.83
	100.00%								17,795.96
Poultry	**Enter %'s below & total here ->**	5,272							
Layers	3.07%	161.85	3.50	4.40	2,492.50	60%	5.45	8,150.46	7.91
Broilers	40.31%	2,125.14	1.50	6.20	19,763.83	60%	4.81	57,038.42	55.33
Turkeys	56.62%	2,985.01	7.50	3.32	74,326.66	60%	4.81	214,506.74	208.07
	100.00%								271.30
Sheep	**ıter total here ->**	1,846	154.00	3.36	955,194.24	55%	5.77	3,031,308.92	2,940.37
Total Energy Potential MM Btu/yr									**195,841.4010**
Trillion Btu/yr									**0.1958**

4. Table 2.4: Estimated Annual Wind Energy Potential

County Area in sq miles	583.99	sq miles
Acres/sq mile	640	acres/sq mile
County Area in acres	373,753.60	acres
% Available for Wind Development	5.00%	
Acres Available for Development	18,687.68	acres
Turbine Size	1.65	MW
Acres per Unit	40	acres
MW Installed per Acre	0.04125	MW/acre
Capacity Factor (%)	25.00%	
Annual Hours	8,760	hours/year
MW hrs/yr	**1,688,198.2920**	
Trillion Btu/yr	**5.7601**	

C. Iowa County

1. Table 3.1: Estimated Annual Renewable Energy Potential Summary

Resource	Energy Content
	Trillion Btu/yr
Agricultural Crop Residue	2.6644
Livestock Residue Methane	0.4459
Logging Residue	-
Wind	7.5216
Total	**10.6319**

2. Table 3.2: Estimated Annual Crop Residue Potential

Crop	Acres Harvested	Yield	Units	Convert to lbs	Removal Fraction	Moisture %	Residue to Crop Ratio	Annual Biomass Potential (lbs)	Btu Content per dry lb	Million Btu/yr
Barley (Barley All)	1,075.00	55.80	bu	48	0.75	14.5%	1.2	2,215,605.96	7,500	16,617.04
Canola	0.00	0.00	lbs	1	0.75	8.0%	2.2	-	7,500	-
Corn for Stover (Corn For Grain)	57,730.00	157.33	bu	56	0.5	15.5%	1.0	214,895,756.89	7,768	1,669,310.24
Cotton	0.00	0.00	lbs	1	0.75	12.0%	4.5	-	7,500	-
Dry Beans (Beans Dry Edible)	0.00	0.00	lbs	1	0.75	13.0%	1.2	-	7,500	-
Flaxseed	0.00	0.00	bu	1	0.75	8.0%	1.2	-	7,500	-
Oat Straw (Oats)	3,980.00	67.16	bu	32	0.75	14.0%	1.3	7,172,496.07	7,626	54,697.46
Peanuts	0.00	0.00	lbs	1	0.75	9.9%	1.0	-	7,500	-
Peas (Green Peas for Processing)	812.50	1.94	tons	2,000	0.75	9.8%	1.5	3,194,876.95	7,500	23,961.58
Potatoes	772.86	389.14	cwt	100	0.75	13.3%	0.4	7,822,555.27	7,500	58,669.16
Rice	0.00	0.00	lbs	1	0.75	15.0%	1.4	-	7,500	-
Rye	0.00	0.00	bu	56	0.75	10.0%	1.6	-	7,500	-
Safflower	0.00	0.00	lbs	1	0.75	8.0%	1.2	-	7,500	-
Sorghum	0.00	0.00	bu	56	0.75	12.0%	1.4	-	7,500	-
Soybeans	28,710.00	46.04	bu	60	0.75	13.0%	2.1	108,672,477.61	7,500	815,043.58
Sugar Beets	0.00	0.00	tons	2,000	0.75	62.8%	1.0	-	7,500	-
Sugar Cane	0.00	0.00	tons	2,000	0.75	62.8%	1.6	-	7,500	-
Sunflower (Sunflower All)	0.00	0.00	lbs	1	0.75	10.0%	2.1	-	7,500	-
Wheat Straw (Wheat All)	1,080.00	64.70	bu	60	0.75	13.5%	1.3	3,535,900.29	7,375	26,077.26
CRP and similar grassland	0.00	2.00	tons	2,000	0.75	20.0%	1.0	-	7,500	-
Brushland on 5 yr cycle	0.00	0.84	tons	2,000	0.75	20.0%	1.0	-	7,500	-
Total Energy Potential MM Btu/yr										**2,664,376.3277**
Trillion Btu/yr										**2.6644**

3. Table 3.3: Estimated Annual Livestock Residue Potential

Herd Inventory	**Assumed Herd Composition**	**Animal Count**	**Typical Animal Mass (lbs)**	**Volatile Solids per lb TAM/yr**	**Total Volatile Solids/yr**	**Volatile Solids % Destruction**	**Cu ft Methane Yield per lb VS Destroyed**	**Methane Yield cu ft/yr**	**Methane Yield mm Btu/yr**
Enter herd or flock inventory reported by USDA in column C.									
Beef Cattle	**Enter %'s below & total here ->**	87,000							
Feedlot Steers and Heifers	33.33%	28,997.10	915.00	2.60	68,984,100.90	45%	5.29	164,216,652.19	159,290.15
Calves	33.33%	28,997.10	397.00	2.60	29,930,806.62	45%	2.72	36,635,307.30	35,536.25
Steers		0.00	794.00	2.60	-	45%	2.72	-	-
Heifers		0.00	794.00	2.60	-	45%	2.72	-	-
Cows	33.33%	28,997.10	1,102.00	2.60	83,082,490.92	45%	2.72	101,692,968.89	98,642.18
Bulls		0.00	1,587.00	2.60	-	45%	2.72	-	-
	99.99%								293,468.58
Dairy Cattle	**Enter %'s below & total here ->**	24,509							
Calves	18.00%	4,411.64	397.00	2.60	4,553,691.05	35%	3.84	6,120,160.78	5,936.56
Heifers	18.00%	4,411.64	903.00	3.65	14,540,532.87	35%	3.84	19,542,476.18	18,956.20
Cows	64.00%	15,685.82	1,345.00	3.65	77,005,602.91	35%	3.84	103,495,530.31	100,390.66
	100.00%								125,283.42
Swine	**Enter %'s below & total here ->**	17,436							
Market	91.00%	15,867.09	101.00	3.10	4,967,986.16	50%	7.53	18,704,467.91	18,143.33
Breeding	9.00%	1,569.27	399.00	3.10	1,941,033.44	50%	5.77	5,599,881.46	5,431.89
	100.00%								23,575.22
Poultry	**Enter %'s below & total here ->**	94,791							
Layers	50.00%	47,395.45	3.50	4.40	729,890.00	60%	5.45	2,386,740.30	2,315.14
Broilers	50.00%	47,395.45	1.50	6.20	440,777.73	60%	4.81	1,272,084.52	1,233.92
Turkeys	0.00%	0.00	7.50	3.32	-	60%	4.81	-	-
	100.00%								3,549.06
Sheep	**Enter total here ->**	0	154.00	3.36	-	55%	5.77	-	-
Total Energy Potential MM Btu/yr									**445,876.2817**
Trillion Btu/yr									**0.4459**

4. Table 3.4: Estimated Annual Wind Energy Potential

County Area in sq miles	762.58	sq miles
Acres/sq mile	640	acres/sq mile
County Area in acres	488,051.20	acres
% Available for Wind Development	5.00%	
Acres Available for Development	24,402.56	acres
Turbine Size	1.65	MW
Acres per Unit	40	acres
MW Installed per Acre	0.04125	MW/acre
Capacity Factor (%)	25.00%	
Annual Hours	8,760	hours/year
MW hrs/yr	**2,204,466.2640**	
Trillion Btu/yr	**7.5216**	

D. Lafayette County

1. Table 4.1: Estimated Annual Renewable Energy Potential Summary

Resource	Energy Content
	Trillion Btu/yr
Agricultural Crop Residue	4.4450
Livestock Residue Methane	0.4389
Logging Residue	-
Wind	7.5918
Total	**12.4757**

2. Table 4.2: Estimated Annual Crop Residue Potential

Crop	Acres Harvested	Yield	Units	Convert to lbs	Removal Fraction	Moisture %	Residue to Crop Ratio	Annual Biomass Potential (lbs)	Btu Content per dry lb	Million Btu/yr
Barley (Barley All)	0.00	0.00	bu	48	0.75	14.5%	1.2	-	7,500	-
Canola	0.00	0.00	lbs	1	0.75	8.0%	2.2	-	7,500	-
Corn for Stover (Corn For Grain)	105,558.00	150	bu	56	0.5	15.5%	1.0	374,625,342.00	7,768	2,910,089.66
Cotton	0.00	0.00	lbs	1	0.75	12.0%	4.5	-	7,500	-
Dry Beans (Beans Dry Edible)	0.00	0.00	lbs	1	0.75	13.0%	1.2	-	7,500	-
Flaxseed	0.00	0.00	bu	1	0.75	8.0%	1.2	-	7,500	-
Oat Straw (Oats)	4,013.00	67	bu	32	0.75	14.0%	1.3	7,214,346.67	7,626	55,016.61
Peanuts	0.00	0.00	lbs	1	0.75	9.9%	1.0	-	7,500	-
Peas (Green Peas for Processing)	0.00	0.00	tons	2,000	0.75	9.8%	1.5	-	7,500	-
Potatoes	0.00	0.00	cwt	100	0.75	13.3%	0.4	-	7,500	-
Rice	0.00	0.00	lbs	1	0.75	15.0%	1.4	-	7,500	-
Rye	0.00	0.00	bu	56	0.75	10.0%	1.6	-	7,500	-
Safflower	0.00	0.00	lbs	1	0.75	8.0%	1.2	-	7,500	-
Sorghum	0.00	0.00	bu	56	0.75	12.0%	1.4	-	7,500	-
Soybeans	50,633.00	47.40	bu	60	0.75	13.0%	2.1	197,316,345.30	7,500	1,479,872.59
Sugar Beets	0.00	0.00	tons	2,000	0.75	62.8%	1.0	-	7,500	-
Sugar Cane	0.00	0.00	tons	2,000	0.75	62.8%	1.6	-	7,500	-
Sunflower (Sunflower All)	0.00	0.00	lbs	1	0.75	10.0%	2.1	-	7,500	-
Wheat Straw (Wheat All)			bu	60	0.75	13.5%	1.3	-	7,375	-
CRP and similar grassland		2.00	tons	2,000	0.75	20.0%	1.0	-	7,500	-
Brushland on 5 yr cycle		0.84	tons	2,000	0.75	20.0%	1.0	-	7,500	-
Total Energy Potential MM Btu/yr										**4,444,978.8541**
Trillion Btu/yr										**4.4450**

3. Table 4.3: Estimated Annual Livestock Residue Potential

Herd Inventory	Assumed Herd Composition	Animal Count	Typical Animal Mass (lbs)	Volatile Solids per lb TAM/yr	Total Volatile Solids/yr	Volatile Solids % Destruction	Cu ft Methane Yield per lb VS Destroyed	Methane Yield cu ft/yr	Methane Yield mm Btu/yr
Enter herd or flock inventory reported by USDA in column C.									
Beef Cattle	**Enter %'s below & total here ->**	68,838							
Feedlot Steers and Heifers	33.33%	22,943.71	915.00	2.60	54,583,075.15	45%	5.29	129,935,010.39	126,036.96
Calves	33.33%	22,943.71	397.00	2.60	23,682,492.71	45%	2.72	28,987,371.08	28,117.75
Steers		0.00	794.00	2.60	-	45%	2.72	-	-
Heifers		0.00	794.00	2.60	-	45%	2.72	-	-
Cows	33.33%	22,943.71	1,102.00	2.60	65,738,304.71	45%	2.72	80,463,684.97	78,049.77
Bulls		0.00	1,587.00	2.60	-	45%	2.72	-	-
	99.99%								232,204.48
Dairy Cattle	**Enter %'s below & total here ->**	30,100							
Calves	18.00%	5,418.00	397.00	2.60	5,592,459.60	35%	3.84	7,516,265.70	7,290.78
Heifers	18.00%	5,418.00	903.00	3.65	17,857,457.10	35%	3.84	24,000,422.34	23,280.41
Cows	64.00%	19,264.00	1,345.00	3.65	94,571,792.00	35%	3.84	127,104,488.45	123,291.35
	100.00%								153,862.54
Swine	**Enter %'s below & total here ->**	21,673							
Market	50.00%	10,836.50	101.00	3.10	3,392,908.15	50%	7.53	12,774,299.18	12,391.07
Breeding	50.00%	10,836.50	399.00	3.10	13,403,666.85	50%	5.77	38,669,578.86	37,509.49
	100.00%								49,900.56
Poultry	**Enter %'s below & total here ->**	674							
Layers		0.00	3.50	4.40	-	60%	5.45	-	-
Broilers		0.00	1.50	6.20	-	60%	4.81	-	-
Turkeys		0.00	7.50	3.32	-	60%	4.81	-	-
	0.00%								-
Sheep	**Enter total here ->**	1,812	154.00	3.36	937,601.28	55%	5.77	2,975,477.66	2,886.21
Total Energy Potential MM Btu/yr									**438,853.8007**
Trillion Btu/yr									**0.4389**

4. Table 4.4: Estimated Annual Wind Energy Potential

County Area in sq miles	635.00	sq miles
Acres/sq mile	640	acres/sq mile
County Area in acres	406,400.00	acres
% Available for Wind Development	5.00%	
Acres Available for Development	20,320.00	acres
Turbine Size	2	MW
Acres per Unit	40	acres
MW Installed per Acre	0.05	MW/acre
Capacity Factor (%)	25.00%	
Annual Hours	8,760	hours/year
MW hrs/yr	**2,225,040.0000**	
Trillion Btu/yr	**7.5918**	

E. Richland County

1. Table 5.1: Estimated Annual Renewable Energy Potential Summary

Resource	Quantity	Units	Energy Content
			Trillion Btu/yr
Agricultural Crop Residue		Tons	0.6591
Livestock Residue Methane		SCF	0.1000
Logging Residue		Tons	0.1340
Wind		kW-hr	5.7814
Total			**6.6745**

2. Table 5.2: Estimated Annual Crop Residue Potential

Crop	Acres Harvested	Yield	Units	Convert to lbs	Removal Fraction	Moisture %	Residue to Crop Ratio	Annual Biomass Potential (lbs)	Btu Content per dry lb	Million Btu/yr
Barley (Barley All)	266.70	47.24	bu	48	0.75	14.5%	1.2	465,353.27	7,500	3,490.15
Canola	0.00	0.00	lbs	1	0.75	8.0%	2.2	-	7,500	-
Corn for Stover (Corn For Grain)	9,326.70	17.20	bu	56	0.5	15.5%	1.0	3,795,519.22	7,768	29,483.59
Cotton	0.00	0.00	lbs	1	0.75	12.0%	4.5	-	7,500	-
Dry Beans (Beans Dry Edible)	0.00	0.00	lbs	1	0.75	13.0%	1.2	-	7,500	-
Flaxseed	0.00	0.00	bu	1	0.75	8.0%	1.2	-	7,500	-
Oat Straw (Oats)	1,766.70	55.82	bu	32	0.75	14.0%	1.3	2,646,096.55	7,626	20,179.13
Peanuts	0.00	0.00	lbs	1	0.75	9.9%	1.0	-	7,500	-
Peas (Green Peas for Processing)	0.00	0.00	tons	2,000	0.75	9.8%	1.5	-	7,500	-
Potatoes	0.00	0.00	cwt	100	0.75	13.3%	0.4	-	7,500	-
Rice	0.00	0.00	lbs	1	0.75	15.0%	1.4	-	7,500	-
Rye	0.00	0.00	bu	56	0.75	10.0%	1.6	-	7,500	-
Safflower	0.00	0.00	lbs	1	0.75	8.0%	1.2	-	7,500	-
Sorghum	0.00	0.00	bu	56	0.75	12.0%	1.4	-	7,500	-
Soybeans	9,026.70	43.20	bu	60	0.75	13.0%	2.1	32,060,022.07	7,500	240,450.17
Sugar Beets	0.00	0.00	tons	2,000	0.75	62.8%	1.0	-	7,500	-
Sugar Cane	0.00	0.00	tons	2,000	0.75	62.8%	1.6	-	7,500	-
Sunflower (Sunflower All)	0.00	0.00	lbs	1	0.75	10.0%	2.1	-	7,500	-
Wheat Straw (Wheat All)	309.00	42.30	bu	60	0.75	13.5%	1.3	661,410.10	7,375	4,877.90
CRP and similar grassland	20,036.00	2.00	tons	2,000	0.75	20.0%	1.0	48,086,400.00	7,500	360,648.00
Brushland on 5 yr cycle		0.84	tons	2,000	0.75	20.0%	1.0	-	7,500	-
Total Energy Potential MM Btu/yr										**659,128.9401**
Trillion Btu/yr										**0.6591**

3. Table 5.3: Estimated Annual Livestock Residue Potential

Herd Inventory	Assumed Herd Composition	Animal Count	Typical Animal Mass (lbs)	Volatile Solids per lb TAM/yr	Total Volatile Solids/yr	Volatile Solids % Destruction	Cu ft Methane Yield per lb VS Destroyed	Methane Yield cu ft/yr	Methane Yield mm Btu/yr
Enter herd or flock inventory reported by USDA in column C.									
Beef Cattle	**Enter %'s below & total here ->**	6,164							
Feedlot Steers and Heifers	33.33%	2,054.46	915.00	2.60	4,887,563.19	45%	5.29	11,634,844.19	11,285.80
Calves	33.33%	2,054.46	397.00	2.60	2,120,614.85	45%	2.72	2,595,632.58	2,517.76
Steers		0.00	794.00	2.60	-	45%	2.72	-	-
Heifers		0.00	794.00	2.60	-	45%	2.72	-	-
Cows	33.33%	2,054.46	1,102.00	2.60	5,886,442.23	45%	2.72	7,205,005.29	6,988.86
Bulls		0.00	1,587.00	2.60	-	45%	2.72	-	-
	99.99%								20,792.42
Dairy Cattle	**Enter %'s below & total here ->**	15,161							
Calves	18.00%	2,728.98	397.00	2.60	2,816,853.16	35%	3.84	3,785,850.64	3,672.28
Heifers	18.00%	2,728.98	903.00	3.65	8,994,581.63	35%	3.84	12,088,717.71	11,726.06
Cows	64.00%	9,703.04	1,345.00	3.65	47,634,649.12	35%	3.84	64,020,968.42	62,100.34
	100.00%								77,498.67
Swine	**Enter %'s below & total here ->**								
Market		0.00	101.00	3.10	-	50%	7.53	-	-
Breeding		0.00	399.00	3.10	-	50%	5.77	-	-
	0.00%								-
Poultry	**Enter %'s below & total here ->**	5,315							
Layers	69.29%	3,683.00	3.50	4.40	56,718.20	60%	5.45	185,468.51	179.90
Broilers	29.16%	1,550.00	1.50	6.20	14,415.00	60%	4.81	41,601.69	40.35
Turkeys	1.54%	82.00	7.50	3.32	2,041.80	60%	4.81	5,892.63	5.72
	100.00%								225.97
Sheep	**Enter total here ->**	942	154.00	3.36	487,428.48	55%	5.77	1,546,854.28	1,500.45
Total Energy Potential MM Btu/yr									**100,017.5109**
Trillion Btu/yr									**0.1000**

4. Table 5.4: Estimated Annual Logging Residue Potential

Units	cu ft/yr	% harvested	cu ft/cord	cords/yr	million Btu/cord	million Btu/yr
Hardwood	1,155,740.8	33%	80	4,767.4	25	119,185.77
Softwood	253,699.2	33%	85	984.9	15	14,774.25
Total Energy Potential MM Btu/yr						**133,960.0175**
Trillion Btu/yr						**0.1340**

5. Table 5.5: Estimated Annual Wind Energy Potential

County Area in sq miles	586.15	sq miles
Acres/sq mile	640	acres/sq mile
County Area in acres	375,136.00	acres
% Available for Wind Development	5.00%	
Acres Available for Development	18,756.80	acres
Turbine Size	1.65	MW
Acres per Unit	40	acres
MW Installed per Acre	0.04125	MW/acre
Capacity Factor (%)	25.00%	
Annual Hours	8,760	hours/year
MW hrs/yr	**1,694,442.4200**	
Trillion Btu/yr	**5.7814**	

Appendix B: **Estimated Energy Use**

A. Grant County

1. Table 6.1: Estimated Annual Energy Use Summary

Energy Type	Residential (Tbl 7)	Transport (Tbl 8b)	Agriculture (Tbl 9)	Industrial (Tbl 10)	Commercial/ Public Building (Tbl	Totals
All Units in Trillion Btu/yr						
Gasoline		3.1174	0.0546		0.0000	3.1720
Diesel Fuel		2.8780	0.4917			3.3697
Fuel/Heating Oil	1.4625			0.0414		1.5039
Natural Gas (& LPG)	2.8881		0.2220	0.8946	0.4076	4.4123
Other				0.5995		0.5995
Coal/Coke				0.3944		0.3944
Wood	0.5683					0.5683
Electricity	2.8861		0.1440	0.4778	0.5373	4.0452
Total	**7.8050**	**5.9954**	**0.9123**	**2.4077**	**0.9449**	**18.0653**
	260.9478	**200.4467**	**30.5013**	**80.4976**	**31.5912**	**603.9846**

2. Table 6.2: Estimated Annual Residential Energy Consumption by Household Number

Total Number of Households	**19,396**		
Column	B	C	D
Formula		=household number * B	
Energy Type	**Million Btu/househol d per year**	**Annual Energy Million Btu/yr**	**On Site**
Electricity - Primary	*111.5*	2,162,654.00	--
Electricity - Site	*37.3*	723,470.80	723,470.80
Natural Gas	*85.0*	1,648,660.00	1,648,660.00
Fuel Oil	*75.4*	1,462,458.40	1,462,458.40
Kerosene	*0.0*	-	-
LPG	*63.9*	1,239,404.40	1,239,404.40
Wood	*29.3*	568,302.80	568,302.80
Total Energy Use	***402.4***	**7,804,950.40**	**5,642,296.40**
Trillion Btu/yr		**7.8050**	**5.6423**

3. Table 6.3: Estimated Annual Residential Energy Consumption by Age of Household – N/A

4. Table 6.4: Estimated Annual Fuel Consumption Based on VMT

Total Annual VMT in County	619092119.5			
Formula		=B*Total VMT		=C/D
Composition of VMT	**% of VMT**	**Miles Traveled**	**MPG**	**Annual Fuel Use**
Passenger Cars	55.8%	345,453,402.68	22.4	15,422,026.91
Light Trucks/SUV	36.1%	223,492,255.14	18.0	12,416,236.40
Single Unit Trucks	2.7%	16,715,487.23	8.2	2,038,474.05
Combination Trucks	4.7%	29,097,329.62	5.1	5,705,358.75
Total Energy Use	**99.3%**	**614,758,474.66**		**35,582,096.10**
Formula			=B*C	=D/10^12
Convert Fuel Use to Btu's	**Gallons/yr**	**LHV Btu/gallon**	**Btu/yr**	**Trillion Btu/yr**
Gasoline (Cars & Light Trucks/SUVs)	27,838,263.30	116,090	3,231,743,986,733.9000	**3.2317**
Diesel (Trucks)	7,743,832.80	129,060	999,419,061,212.5940	**0.9994**

5. Table 6.5: Estimated Annual Fuel Consumption Based on Vehicle Registration

	Cars	**Light Trucks**	**Heavy Trucks**	
	20114	25670	5186	
Annual Fuel Use per Vehicle	554	612	4300	gallons
Btu/gallon LHV at 60F	116090	116090	129060	Btu/gallon
Total Energy Use	**1,293,608.98**	**1,823,778.54**	**2,878,012.19**	Million Btu/yr
Trillion Btu/year		**3.1174**	**2.8780**	

6. Table 6.6: Estimated Annual On Farm Energy Use

Commodity	Acres Planted	Energy Input/Unit Diesel gallons	Gasoline	LP Gas gallons	Electric kW-hr	Unit	Annual Energy Use Diesel gallons	Gasoline gallons	LP Gas gallons	Electric kW-hr
Barley - All	983.00	7.24	0.89	0.82	29.88	acre	7,116.92	874.87	806.06	29,372.04
Beans - Dry Edible		7.43	0.91	0.75	27.50	acre	-	-	-	-
Canola		4.50	0.75	0.00	26.80	acre	-	-	-	-
Corn for Grain	154,000.00	9.37	1.15	9.58	35.63	acre	1,442,980.00	177,100.00	1,475,320.00	5,487,020.00
Corn for Silage (Corn)		9.37	1.15	9.58	35.63	acre	-	-	-	-
Flaxseed		7.24	0.89	0.82	29.88	acre	-	-	-	-
Hay Alfalfa - Dry (Alfalfa)		9.80	0.81	0.00	32.73	acre	-	-	-	-
Hay - All (Alfalfa)	132,220.00	9.80	0.81	0.00	32.73	acre	1,295,756.00	107,098.20	-	4,327,560.60
Hay Other - Dry (Alfalfa)		9.80	0.81	0.00	32.73	acre	-	-	-	-
Oats	17,390.00	7.24	0.89	0.82	29.88	acre	125,903.60	15,477.10	14,259.80	519,613.20
Peas for Processing - Green		5.19	0.64	0.35	12.75	acre	-	-	-	-
Potatoes - Dry Land		24.18	2.00	0.00	205.27	acre	-	-	-	-
Potatoes - Irrigated		48.89	2.00	0.00	319.22	acre	-	-	-	-
Rye		7.24	0.89	0.82	29.88	acre	-	-	-	-
Soybeans	52,730.00	7.43	0.91	0.75	27.50	acre	391,783.90	47,984.30	39,547.50	1,450,075.00
Sugarbeets		28.92	3.54	2.76	100.75	acre	-	-	-	-
Sunflower - All		5.70	1.00	2.00	30.72	acre	-	-	-	-
Sunflower Seed for Oil		5.70	1.00	2.00	30.72	acre	-	-	-	-
Sunflower Seed Non-Oil Uses		5.70	1.00	2.00	30.72	acre	-	-	-	-
Sweet Corn for Processing		7.99	0.98	0.49	18.00	acre	-	-	-	-
Wheat - All	1,183.00	7.24	0.89	0.82	29.88	acre	8,564.92	1,052.87	970.06	35,348.04
Wheat Durum		7.24	0.89	0.82	29.88	acre	-	-	-	-
Wheat - Other Spring		7.24	0.89	0.82	29.88	acre	-	-	-	-
Winter Wheat - All		7.24	0.89	0.82	29.88	acre	-	-	-	-
	Head Count									
Dairy	48,000.00	0.13	0.02	0.11	4.00	cwt	936,000.00	144,000.00	792,000.00	28,800,000.00
Swine Farrow	6,588.00	9.05	1.11	4.06	148.25	litter	119,242.80	14,625.36	53,494.56	1,953,342.00
Swine Finish	71,049.00	0.91	0.11	0.34	12.38	head	129,309.18	15,630.78	48,313.32	1,759,173.24
Beef Cow-Calf	114,256.00	6.07	0.74	1.62	59.25	head	693,533.92	84,549.44	185,094.72	6,769,668.00
Beef Cattle (Finishing)	57,128.00	3.78	0.46	1.08	39.38	head	215,943.84	26,278.88	61,698.24	2,249,700.64
Turkey	68.00	0.09	0.01	0.50	1.24	head	6.12	0.68	34.00	84.32
Total Energy Use							**5,366,141.20**	**634,672.48**	**2,671,538.26**	**53,380,957.08**
Conversion Factor Btu/unit							**129,090**	**116,090**	**91,547**	**3412**
Trillion Btu/yr							**0.6927**	**0.0737**	**0.2446**	**0.1821**

7. Table 6.7: Estimated Annual Industrial Energy Use

Ex. 1 Manufacturing Shipments Method (County Level)		***Ex. 2 Manufacturing Employees Method (County Level)***	
Manufacturing shipments ($1000) - Grant County, (American FactFinder2, QuickFacts & 2007		Manufacturing employees - Grant County (American FactFinder2, 2007 Economic Census)	2390
Total energy use per $ of GDP - State of MN, 2000	8700	Energy consumption per Employee (million Btu) - Midwest Census Region (Table 6.2)	1007.4
Energy budget (trillion Btu)	0.0000	Energy budget (trillion Btu)	2.4077

Ex. 3a Composition of Industrial Energy Use - Manufacturing Shipments (County Level)

Energy Type	Total	Net Electricity	Residual Fuel Oil	Distillate Fuel Oil	Natural Gas	LPG & NGL	Coal	Coke & Breeze	Other
Energy use in Trillion Btu - Midwest Census Region (Table 1.2)	4707	934	45	36	1619	130	554	217	1172
Energy use in %	100.00%	19.8428%	0.9560%	0.7648%	34.3956%	2.7618%	11.7697%	4.6102%	24.8991%
Energy Use Trillion Btu/yr (Total from Ex. 1)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Ex. 3b Composition of Industrial Energy Use - Manufacturing Employees (County Level)

Energy Type	Total	Net Electricity	Residual Fuel Oil	Distillate Fuel Oil	Natural Gas	LPG & NGL	Coal	Coke & Breeze	Other
Energy use in Trillion Btu - Midwest Census Region (Table 1.2)	4707	934	45	36	1619	130	554	217	1172
Energy use in %	100.00%	19.8428%	0.9560%	0.7648%	34.3956%	2.7618%	11.7697%	4.6102%	24.8991%
Energy Use Trillion Btu/yr (Total from Ex. 2)	2.4077	0.4778	0.0230	0.0184	0.8281	0.0665	0.2834	0.1110	0.5995

8. Table 6.8: Energy Consumption Estimates Based on Population Data

Population Makeup				Energy Consumption by Sector (Trillion Btu)				
	Population	% of WI	WI	427.7000	352.0000	577.3000	443.1000	1800.1000
Grant County	51208	0.9004%		*Residential*	*Commercial*	*Industrial*	*Transportation*	*Total*
		0.0000%	Becker	3.8512	3.1696	5.1983	3.9899	16.2089
		0.0000%	Clay	0.0000	0.0000	0.0000	0.0000	0.0000
		0.0000%	Otter Tail	0.0000	0.0000	0.0000	0.0000	0.0000
Grant County	51208	0.9004%	Wilkin	0.0000	0.0000	0.0000	0.0000	0.0000
WI	5,686,986	100.0000%	Four Counties	3.8512	3.1696	5.1983	3.9899	16.2089
WI	316.3	Million Btu/Capita		Energy Consumption by Source (Trillion Btu)				
Total Energy Per Capita Consumption			WI	458.4	376.6	557.4	234.6	
	Million Btu	Trillion Btu		*Coal*	*Natural Gas*	*Petroleum*	*Electricity*	*Total*
Grant County	16197090	16.1971	Grant County	4.1276	3.3911	5.0191	2.1124	14.6502
	0	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
	0	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
	0	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000
Grant County	16197090.4	16.1971	Grant County	4.1276	3.3911	5.0191	2.1124	14.6502

B. Green County

1. Table 7.1: Estimated Annual Energy Use Summary

Energy Type	Residential	Transport	Agriculture	Industrial	Commercial/ Public Building	Totals
All Units in Trillion Btu/yr						
Gasoline		4.1162	0.0421			4.1583
Diesel Fuel		2.2252	0.3912			2.6165
Fuel/Heating Oil	2.3124			0.1858		2.4982
Natural Gas (& LPG)	3.9421		0.1480	4.0117		8.1018
Kerosene	0.1937					0.1937
Coal/Coke				1.7684		1.7684
Wood	0.8991					0.8991
Electricity	1.0668		0.1006	2.1423		3.3097
Total	**8.4143**	**6.3414**	**0.6819**	**8.1082**	**-**	**23.5458**

2. Table 7.2: Estimated Annual Residential Energy Consumption by Household Number

Total Number of Households	**15,814**		
Column	B	C	D
Formula		=household number * B	
Energy Type	**Million Btu/household per year**	**Annual Energy Million Btu/yr**	**On Site**
Electricity - Primary	*111.5*	1,763,261.00	--
Electricity - Site	*37.3*	589,862.20	589,862.20
Natural Gas	*85.0*	1,344,190.00	1,344,190.00
Fuel Oil	*75.4*	1,192,375.60	1,192,375.60
Kerosene	*0.0*	-	-
LPG	*63.9*	1,010,514.60	1,010,514.60
Wood	*29.3*	463,350.20	463,350.20
Total Energy Use	***402.4***	**6,363,553.60**	**4,600,292.60**
Trillion Btu/yr		**6.3636**	**4.6003**

3. Table 7.3: Estimated Annual Residential Energy Consumption by Age of Household

	1990 to 2000	**1980 to 1989**	**1970 to 1979**	**1960 to 1969**	**1950 to 1959**	**1949 or before**		
Electricity Primary	130.9	127.9	122.1	97.8	97.2	85		
Electricity Site	43.8	42.8	40.8	32.7	32.5	28.4		
Natural Gas	70.9	64.3	63	64.6	72.9	84.3		
Fuel Oil	77.8	91.4	77.3	68.3	79	87.5	All units in million Btu/household.	
Kerosene	21.3	13.5	23.2		11.4	11.6		
LPG	41.1	36.6	37.5	34.2	26.3	51.6		
Wood	14.8	20	23	21.1	27.06	48.5		
Total	254.9	248.6	241.8	199.8	222.1	263.4		
Houses per Group (Green County)	**2,139**	**1,200**	**2,316**	**1,223**	**1,269**	**5,499**		
Energy Use in Million Btu/yr							**Total**	**On Site**
Electricity Primary	279,995.1	153,480.0	282,783.6	119,609.4	123,346.8	467,415.0	1,426,629.90	--
Electricity Site	93,688.2	51,360.0	94,492.8	39,992.1	41,242.5	156,171.6	476,947.20	476,947.20
Natural Gas	151,655.1	77,160.0	145,908.0	79,005.8	92,510.1	463,565.7	1,009,804.70	1,009,804.70
Fuel Oil	166,414.2	109,680.0	179,026.8	83,530.9	100,251.0	481,162.5	1,120,065.40	1,120,065.40
Kerosene	45,560.7	16,200.0	53,731.2	-	14,466.6	63,788.4	193,746.90	193,746.90
LPG	87,912.9	43,920.0	86,850.0	41,826.6	33,374.7	283,748.4	577,632.60	577,632.60
Wood	31,657.2	24,000.0	53,268.0	25,805.3	34,339.1	266,701.5	435,771.14	435,771.14
Total Energy Use							**5,240,597.8400**	**3,813,967.9400**
Trillion Btu/yr							**5.2406**	**3.8140**

4. Table 7.4: Estimated Annual Fuel Consumption Based on VMT

Total Annual VMT in Green County (2011)	**328,209,095**			
Formula		=B*Total VMT		=C/D
Composition of VMT	**% of VMT**	**Miles Traveled**	**MPG**	**Annual Fuel Use**
Passenger Cars	55.8%	183,140,675.01	22.4	8,175,922.99
Light Trucks/SUV	36.1%	118,483,483.30	18.0	6,582,415.74
Single Unit Trucks	2.7%	8,861,645.57	8.2	1,080,688.48
Combination Trucks	4.7%	15,425,827.47	5.1	3,024,672.05
Total Energy Use	**99.3%**	**325,911,631.34**		**18,863,699.27**
Formula			=B*C	=D/10^12
Convert Fuel Use to Btu's	**Gallons/yr**	**LHV Btu/gallon**	**Btu/yr**	**Trillion Btu/yr**
Gasoline (Cars & Light Trucks/SUVs)	14,758,338.73	116,090	1,713,295,543,180.6700	**1.7133**
Diesel (Trucks)	4,105,360.54	129,060	529,837,830,711.2910	**0.5298**

5. Table 7.5: Estimated Annual Fuel Consumption Based on Vehicle Registration

2010 Green County	**Cars**	**Light Trucks**	**Heavy Trucks**	
	15,715	19,595	3,055	
Annual Fuel Use per Vehicle	554	612	4300	gallons
Btu/gallon LHV at 60F	116090	116090	129060	Btu/gallon
Total Energy Use	**1,010,692.31**	**1,392,167.53**	**1,695,396.69**	Million Btu/yr
Trillion Btu/year		**2.4029**	**1.6954**	

6. Table 7.6: Estimated Annual On Farm Energy Use

Commodity	Acres Planted	Diesel gallons	Gasoline gallons	LP Gas gallons	Electric kW-hr	Unit	Diesel gallons	Gasoline gallons	LP Gas gallons	Electric kW-hr
Barley - All	650.00	7.24	0.89	0.82	29.88	acre	4,706.00	578.50	533.00	19,422.00
Beans - Dry Edible		7.43	0.91	0.75	27.50	acre	-	-	-	-
Canola		4.50	0.75	0.00	26.80	acre	-	-	-	-
Corn for Grain	85,282.00	9.37	1.15	9.58	35.63	acre	799,092.34	98,074.30	817,001.56	3,038,597.66
Corn for Silage (Corn)	15,755.00	9.37	1.15	9.58	35.63	acre	147,624.35	18,118.25	150,932.90	561,350.65
Flaxseed		7.24	0.89	0.82	29.88	acre	-	-	-	-
Hay Alfalfa - Dry (Alfalfa)		9.80	0.81	0.00	32.73	acre	-	-	-	-
Hay - All (Alfalfa)	69,563.00	9.80	0.81	0.00	32.73	acre	681,717.40	56,346.03	-	2,276,796.99
Hay Other - Dry (Alfalfa)		9.80	0.81	0.00	32.73	acre	-	-	-	-
Oats	5,230.00	7.24	0.89	0.82	29.88	acre	37,865.20	4,654.70	4,288.60	156,272.40
Peas for Processing - Green		5.19	0.64	0.35	12.75	acre	-	-	-	-
Potatoes - Dry Land		24.18	2.00	0.00	205.27	acre	-	-	-	-
Potatoes - Irrigated		48.89	2.00	0.00	319.22	acre	-	-	-	-
Rye		7.24	0.89	0.82	29.88	acre	-	-	-	-
Soybeans	46,627.00	7.43	0.91	0.75	27.50	acre	346,438.61	42,430.57	34,970.25	1,282,242.50
Sugarbeets		28.92	3.54	2.76	100.75	acre	-	-	-	-
Sunflower - All		5.70	1.00	2.00	30.72	acre	-	-	-	-
Sunflower Seed for Oil		5.70	1.00	2.00	30.72	acre	-	-	-	-
Sunflower Seed Non-Oil Uses		5.70	1.00	2.00	30.72	acre	-	-	-	-
Sweet Corn for Processing		7.99	0.98	0.49	18.00	acre	-	-	-	-
Wheat - All	5,413.00	7.24	0.89	0.82	29.88	acre	39,190.12	4,817.57	4,438.66	161,740.44
Wheat Durum		7.24	0.89	0.82	29.88	acre	-	-	-	-
Wheat - Other Spring		7.24	0.89	0.82	29.88	acre	-	-	-	-
Winter Wheat - All	5,620.00	7.24	0.89	0.82	29.88	acre	40,688.80	5,001.80	4,608.40	167,925.60
	Head Count									
Dairy	30,715	0.13	0.02	0.11	4.00	cwt	598,942.50	92,145.00	506,797.50	18,429,000.00
Swine Farrow		9.05	1.11	4.06	148.25	litter	-	-	-	-
Swine Finish	15,139	0.91	0.11	0.34	12.38	head	27,552.98	3,330.58	10,294.52	374,841.64
Beef Cow-Calf	47,265	6.07	0.74	1.62	59.25	head	286,898.55	34,976.10	76,569.30	2,800,451.25
Beef Cattle (Finishing)	5,294	3.78	0.46	1.08	39.38	head	20,011.32	2,435.24	5,717.52	208,477.72
Turkey	161	0.09	0.01	0.50	1.24	head	14.49	1.61	80.50	199.64
Total Energy Use							**3,030,742.66**	**362,910.25**	**1,616,232.71**	**29,477,318.49**
Conversion Factor Btu/unit							**129,090**	**116,090**	**91,547**	**3412**
Trillion Btu/yr							**0.3912**	**0.0421**	**0.1480**	**0.1006**

7. Table 7.7: Estimated Annual Industrial Energy Use

Ex. 1 Manufacturing Shipments Method (County Level)		***Ex. 2 Manufacturing Employees Method (County Level)***	
Manufacturing shipments ($1000) - Becker County, 2002 (QuickFacts)	$925,781	Manufacturing employees - Becker County (FactFinder, 2005-2007)	2722
Total energy use per $ of GDP - State of MN, 2000	8700	Energy consumption per Employee (million Btu) - Midwest Census Region (Table 6.2)	1007.4
Energy budget (trillion Btu)	8.0543	Energy budget (trillion Btu)	2.7421

Ex. 3a Composition of Industrial Energy Use - Manufacturing Shipments (County Level)

Energy Type	Total	Net Electricity	Residual Fuel Oil	Distillate Fuel Oil	Natural Gas	LPG & NGL	Coal	Coke & Breeze	Other
Energy use in Trillion Btu - Midwest Census Region (Table 1.2)	4707	934	45	36	1619	130	554	217	1172
Energy use in %	100.00%	19.8428%	0.9560%	0.7648%	34.3956%	2.7618%	11.7697%	4.6102%	24.8991%
Energy Use Trillion Btu/yr (Total from Ex. 1)	8.0543	1.5982	0.0770	0.0616	2.7703	0.2224	0.9480	0.3713	2.0054

Ex. 3b Composition of Industrial Energy Use - Manufacturing Employees (County Level)

Energy Type	Total	Net Electricity	Residual Fuel Oil	Distillate Fuel Oil	Natural Gas	LPG & NGL	Coal	Coke & Breeze	Other
Energy use in Trillion Btu - Midwest Census Region (Table 1.2)	4707	934	45	36	1619	130	554	217	1172
Energy use in %	100.00%	19.8428%	0.9560%	0.7648%	34.3956%	2.7618%	11.7697%	4.6102%	24.8991%
Energy Use Trillion Btu/yr (Total from Ex. 2)	2.7421	0.5441	0.0262	0.0210	0.9432	0.0757	0.3227	0.1264	0.6828

8. Table 7.8: Energy Consumption Estimates Based on Population Data

Population Makeup					Energy Consumption by Sector (Trillion Btu)				
	Population	% of WI		WI	427.7	352.0	577.3	443.1	1800.0
Green	36,891	0.6459%			*Residential*	*Commercial*	*Industrial*	*Transportation*	*Total*
Iowa	23,599	0.4132%		Green	2.7624	2.2735	3.7286	2.8619	11.6258
Lafayette	16,815	0.2944%		Iowa	1.7671	1.4543	2.3852	1.8307	7.4370
Grant	51,210	0.8966%		Lafayette	1.2591	1.0363	1.6995	1.3045	5.2991
Four Counties	128,515	2.2500%		Grant	3.8346	3.1559	5.1759	3.9727	16.1383
WI	5,711,767	100.0000%		Four Counties	9.6233	7.9200	12.9893	9.9698	40.5001
WI	316.3	Million Btu/Capita			Energy Consumption by Source (Trillion Btu)				
Total Energy Per Capita Consumption				WI	458.4	376.6	557.4	234.6	
	Million Btu	Trillion Btu			*Coal*	*Natural Gas*	*Petroleum*	*Electricity*	*Total*
Green	11,668,623	11.6686		Green	2.9607	2.4324	3.6001	1.5152	10.5084
Iowa	7,464,364	7.4644		Iowa	1.8939	1.5560	2.3030	0.9693	6.7222
Lafayette	5,318,585	5.3186		Lafayette	1.3495	1.1087	1.6409	0.6906	4.7898
Grant	16,197,723	16.1977		Grant	4.1099	3.3765	4.9975	2.1034	14.5872
Four Counties	40,649,295	40.6493		Four Counties	10.3140	8.4735	12.5415	5.2785	36.6076

C. Iowa County

1. Table 8.1: Estimated Annual Energy Use Summary

Energy Type	Residential	Transport	Agriculture	Industrial	Commercial/ Public Building	Totals
All Units in Trillion Btu/yr						
Gasoline		1.7133	0.0354			1.7487
Diesel Fuel		5.2984	0.3399			5.6383
Fuel/Heating Oil	0.7318			0.0722		0.8040
Natural Gas (& LPG)	1.4451		0.1039	1.3254		2.8744
Kerosene						-
Coal/Coke				0.6873		0.6873
Wood	0.2844					0.2844
Electricity	0.3620		0.0889	0.8327		1.2836
Total	**2.8232**	**7.0117**	**0.5681**	**2.9176**	**-**	**13.3205**

2. Table 8.2: Estimated Annual Residential Energy Consumption by Household Number

Total Number of Households	9,705		
Column	B	C	D
Formula		=household number * B	
Energy Type	**Million Btu/household per year**	**Annual Energy Million Btu/yr**	**On Site**
Electricity - Primary	*111.5*	1,082,107.50	--
Electricity - Site	*37.3*	361,996.50	361,996.50
Natural Gas	*85.0*	824,925.00	824,925.00
Fuel Oil	*75.4*	731,757.00	731,757.00
Kerosene	*0.0*	-	-
LPG	*63.9*	620,149.50	620,149.50
Wood	*29.3*	284,356.50	284,356.50
Total Energy Use	***402.4***	**3,905,292.00**	**2,823,184.50**
Trillion Btu/yr		**3.9053**	**2.8232**

3. Table 8.3: Estimated Annual Residential Energy Consumption by Age of Household

	1990 to 2000	**1980 to 1989**	**1970 to 1979**	**1960 to 1969**	**1950 to 1959**	**1949 or before**		
Electricity Primary	130.9	127.9	122.1	97.8	97.2	85		
Electricity Site	43.8	42.8	40.8	32.7	32.5	28.4		
Natural Gas	70.9	64.3	63	64.6	72.9	84.3		
Fuel Oil	77.8	91.4	77.3	68.3	79	87.5	All units in million Btu/household.	
Kerosene	21.3	13.5	23.2		11.4	11.6		
LPG	41.1	36.6	37.5	34.2	26.3	51.6		
Wood	14.8	20	23	21.1	27.06	48.5		
Total	254.9	248.6	241.8	199.8	222.1	263.4		
Houses per Group	**1,829**	**1,074**	**1,278**	**795**	**591**	**3,829**		
Energy Use in Million Btu/yr							**Total**	**On Site**
Electricity Primary	239,416.1	137,364.6	156,043.8	77,751.0	57,445.2	325,465.0	993,485.70	--
Electricity Site	80,110.2	45,967.2	52,142.4	25,996.5	19,207.5	108,743.6	332,167.40	332,167.40
Natural Gas	129,676.1	69,058.2	80,514.0	51,357.0	43,083.9	322,784.7	696,473.90	696,473.90
Fuel Oil	142,296.2	98,163.6	98,789.4	54,298.5	46,689.0	335,037.5	775,274.20	775,274.20
Kerosene	38,957.7	14,499.0	29,649.6	-	6,737.4	44,416.4	134,260.10	134,260.10
LPG	75,171.9	39,308.4	47,925.0	27,189.0	15,543.3	197,576.4	402,714.00	402,714.00
Wood	27,069.2	21,480.0	29,394.0	16,774.5	15,992.5	185,706.5	296,416.66	296,416.66
Total Energy Use							**3,630,791.9600**	**2,637,306.2600**
Trillion Btu/yr							**3.6308**	**2.6373**

4. Table 8.4: Estimated Annual Fuel Consumption Based on VMT

Total Annual VMT in County	**328,209,095**			
Formula		=B*Total VMT		=C/D
Composition of VMT	**% of VMT**	**Miles Traveled**	**MPG**	**Annual Fuel Use**
Passenger Cars	55.8%	183,140,675.01	22.4	8,175,922.99
Light Trucks/SUV	36.1%	118,483,483.30	18.0	6,582,415.74
Single Unit Trucks	2.7%	8,861,645.57	8.2	1,080,688.48
Combination Trucks	4.7%	15,425,827.47	5.1	3,024,672.05
Total Energy Use	**99.3%**	**325,911,631.34**		**18,863,699.27**
Formula			=B*C	=D/10^12
Convert Fuel Use to Btu's	**Gallons/yr**	**LHV Btu/gallon**	**Btu/yr**	**Trillion Btu/yr**
Gasoline (Cars & Light Trucks/SUVs)	14,758,338.73	116,090	1,713,295,543,180.6700	**1.7133**
Diesel (Trucks)	4,105,360.54	129,060	529,837,830,711.2910	**0.5298**

5. Table 8.5: Estimated Annual Fuel Consumption Based on Vehicle Registration

	Cars	**Light Trucks**	**Heavy Trucks**	
	10,328	13,344		
Annual Fuel Use per Vehicle	554	612	4300	gallons
Btu/gallon LHV at 60F	116090	116090	129060	Btu/gallon
Total Energy Use	**664,233.55**	**948,052.24**	**-**	Million Btu/yr
Trillion Btu/year		**1.6123**	**-**	
	Gasoline		**Diesel**	

6. Table 8.6: Estimated Annual On Farm Energy Use

Commodity	Acres Planted	Energy Input/Unit Diesel gallons	Gasoline gallons	LP Gas gallons	Electric kW-hr	Unit	Annual Energy Use Diesel gallons	Gasoline gallons	LP Gas gallons	Electric kW-hr
Barley - All	1,075.00	7.24	0.89	0.82	29.88	acre	7,783.00	956.75	881.50	32,121.00
Beans - Dry Edible	0.00	7.43	0.91	0.75	27.50	acre	-	-	-	-
Canola	0.00	4.50	0.75	0.00	26.80	acre	-	-	-	-
Corn for Grain	57,730.00	9.37	1.15	9.58	35.63	acre	540,930.10	66,389.50	553,053.40	2,056,919.90
Corn for Silage (Corn)	0.00	9.37	1.15	9.58	35.63	acre	-	-	-	-
Flaxseed	0.00	7.24	0.89	0.82	29.88	acre	-	-	-	-
Hay Alfalfa - Dry (Alfalfa)	37,333.33	9.80	0.81	0.00	32.73	acre	365,866.67	30,240.00	-	1,221,920.00
Hay - All (Alfalfa)	43,870.00	9.80	0.81	0.00	32.73	acre	429,926.00	35,534.70	-	1,435,865.10
Hay Other - Dry (Alfalfa)	0.00	9.80	0.81	0.00	32.73	acre	-	-	-	-
Oats	3,980.00	7.24	0.89	0.82	29.88	acre	28,815.20	3,542.20	3,263.60	118,922.40
Peas for Processing - Green	812.50	5.19	0.64	0.35	12.75	acre	4,216.88	520.00	284.38	10,359.38
Potatoes - Dry Land	772.86	24.18	2.00	0.00	205.27	acre	18,687.69	1,545.71	-	158,644.39
Potatoes - Irrigated	0.00	48.89	2.00	0.00	319.22	acre	-	-	-	-
Rye	0.00	7.24	0.89	0.82	29.88	acre	-	-	-	-
Soybeans	28,710.00	7.43	0.91	0.75	27.50	acre	213,315.30	26,126.10	21,532.50	789,525.00
Sugarbeets	0.00	28.92	3.54	2.76	100.75	acre	-	-	-	-
Sunflower - All	0.00	5.70	1.00	2.00	30.72	acre	-	-	-	-
Sunflower Seed for Oil	0.00	5.70	1.00	2.00	30.72	acre	-	-	-	-
Sunflower Seed Non-Oil Uses	0.00	5.70	1.00	2.00	30.72	acre	-	-	-	-
Sweet Corn for Processing	806.82	7.99	0.98	0.49	18.00	acre	6,446.48	790.68	395.34	14,522.73
Wheat - All	1,172.73	7.24	0.89	0.82	29.88	acre	8,490.55	1,043.73	961.64	35,041.09
Wheat Durum	0.00	7.24	0.89	0.82	29.88	acre	-	-	-	-
Wheat - Other Spring	101.11	7.24	0.89	0.82	29.88	acre	732.04	89.99	82.91	3,021.20
Winter Wheat - All	1,488.89	7.24	0.89	0.82	29.88	acre	10,779.56	1,325.11	1,220.89	44,488.00
	Head Count									
Dairy	24,509.09	0.13	0.02	0.11	4.00	cwt	477,927.27	73,527.27	404,400.00	14,705,454.55
Swine Farrow	1,569.27	9.05	1.11	4.06	148.25	litter	28,403.84	3,483.79	12,742.49	465,289.36
Swine Finish	15,867.09	0.91	0.11	0.34	12.38	head	28,878.11	3,490.76	10,789.62	392,869.17
Beef Cow-Calf	57,994.20	6.07	0.74	1.62	59.25	head	352,024.79	42,915.71	93,950.60	3,436,156.35
Beef Cattle (Finishing)	28,997.10	3.78	0.46	1.08	39.38	head	109,609.04	13,338.67	31,316.87	1,141,905.80
Turkey	0.00	0.09	0.01	0.50	1.24	head	-	-	-	-
Total Energy Use							**2,632,832.50**	**304,860.67**	**1,134,875.74**	**26,063,025.41**
Conversion Factor Btu/unit							**129,090**	**116,090**	**91,547**	**3412**
Trillion Btu/yr							**0.3399**	**0.0354**	**0.1039**	**0.0889**

7. Table 8.7: Estimated Annual Industrial Energy Use

Ex. 1 Manufacturing Shipments Method (County Level)		*Ex. 2 Manufacturing Employees Method (County Level)*	
Manufacturing shipments ($1000) - Iowa County, 2002 (QuickFacts)	$395,500	Manufacturing employees - Iowa County (FactFinder, 2005-2007)	750
Total energy use per $ of GDP - State of WI, 2000	8700	Energy consumption per Employee (million Btu) - Midwest Census Region (Table 6.2)	1007.4
Energy budget (trillion Btu)	3.4409	Energy budget (trillion Btu)	0.7556

Ex. 3a Composition of Industrial Energy Use - Manufacturing Shipments (County Level)

Energy Type	Total	Net Electricity	Residual Fuel Oil	Distillate Fuel Oil	Natural Gas	LPG & NGL	Coal	Coke & Breeze	Other
Energy use in Trillion Btu - Midwest Census Region (Table 1.2)	4707	934	45	36	1619	130	554	217	1172
Energy use in %	100.00%	19.8428%	0.9560%	0.7648%	34.3956%	2.7618%	11.7697%	4.6102%	24.8991%
Energy Use Trillion Btu/yr (Total from Ex. 1)	3.4409	0.6828	0.0329	0.0263	1.1835	0.0950	0.4050	0.1586	0.8567

Ex. 3b Composition of Industrial Energy Use - Manufacturing Employees (County Level)

Energy Type	Total	Net Electricity	Residual Fuel Oil	Distillate Fuel Oil	Natural Gas	LPG & NGL	Coal	Coke & Breeze	Other
Energy use in Trillion Btu - Midwest Census Region (Table 1.2)	4707	934	45	36	1619	130	554	217	1172
Energy use in %	100.00%	19.8428%	0.9560%	0.7648%	34.3956%	2.7618%	11.7697%	4.6102%	24.8991%
Energy Use Trillion Btu/yr (Total from Ex. 2)	0.7556	0.1499	0.0072	0.0058	0.2599	0.0209	0.0889	0.0348	0.1881

8. Table 8.8: Energy Consumption Estimates Based on Population Data – N/A

D. Lafayette County

1. Table 9.1: Estimated Annual Energy Use Summary

Energy Type	Residential	Transport	Agriculture	Industrial	Commercial/ Public Building	Totals
All Units in Trillion Btu/yr						
Gasoline		1.1699	0.0411			1.2110
Diesel Fuel		2.7187	0.3715			3.0902
Fuel/Heating Oil	0.4983			0.0294		0.5277
Natural Gas (& LPG)	0.9841		0.1677	0.6366		1.7883
Kerosene						-
Coal/Coke				0.2807		0.2807
Wood	0.1936					0.1936
Electricity	0.2465		0.0965	0.3400		0.6830
Total	**1.9226**	**3.8886**	**0.6767**	**1.2867**	**-**	**7.7745**

2. Table 9.2: Estimated Annual Residential Energy Consumption by Household Number

Total Number of Households	**6,609**		
Column	B	C	D
Formula		=household number * B	
Energy Type	**Million Btu/household per year**	**Annual Energy Million Btu/yr**	**On Site**
Electricity - Primary	*111.5*	736,903.50	--
Electricity - Site	*37.3*	246,515.70	246,515.70
Natural Gas	*85.0*	561,765.00	561,765.00
Fuel Oil	*75.4*	498,318.60	498,318.60
Kerosene	*0.0*	-	-
LPG	*63.9*	422,315.10	422,315.10
Wood	*29.3*	193,643.70	193,643.70
Total Energy Use	***402.4***	**2,659,461.60**	**1,922,558.10**
Trillion Btu/yr		**2.6595**	**1.9226**

3. Table 9.3: Estimated Annual Residential Energy Consumption by Age of Household

	1990 to 2000	1980 to 1989	1970 to 1979	1960 to 1969	1950 to 1959	1949 or before		
Electricity Primary	130.9	127.9	122.1	97.8	97.2	85		
Electricity Site	43.8	42.8	40.8	32.7	32.5	28.4		
Natural Gas	70.9	64.3	63	64.6	72.9	84.3		
Fuel Oil	77.8	91.4	77.3	68.3	79	87.5	All units in million Btu/household.	
Kerosene	21.3	13.5	23.2		11.4	11.6		
LPG	41.1	36.6	37.5	34.2	26.3	51.6		
Wood	14.8	20	23	21.1	27.06	48.5		
Total	254.9	248.6	241.8	199.8	222.1	263.4		
Houses per Group	**578**	**482**	**921**	**627**	**581**	**3,545**		
Energy Use in Million Btu/yr							**Total**	**On Site**
Electricity Primary	75,660.2	61,647.8	112,454.1	61,320.6	56,473.2	301,325.0	668,880.90	--
Electricity Site	25,316.4	20,629.6	37,576.8	20,502.9	18,882.5	100,678.0	223,586.20	223,586.20
Natural Gas	40,980.2	30,992.6	58,023.0	40,504.2	42,354.9	298,843.5	511,698.40	511,698.40
Fuel Oil	44,968.4	44,054.8	71,193.3	42,824.1	45,899.0	310,187.5	559,127.10	559,127.10
Kerosene	12,311.4	6,507.0	21,367.2	-	6,623.4	41,122.0	87,931.00	87,931.00
LPG	23,755.8	17,641.2	34,537.5	21,443.4	15,280.3	182,922.0	295,580.20	295,580.20
Wood	8,554.4	9,640.0	21,183.0	13,229.7	15,721.9	171,932.5	240,261.46	240,261.46
Total Energy Use							**2,587,065.2600**	**1,918,184.3600**
Trillion Btu/yr							**2.5871**	**1.9182**

4. Table 9.4: Estimated Annual Fuel Consumption Based on VMT

Total Annual VMT in County	**210,855,025**			
Formula		=B*Total VMT		=C/D
Composition of VMT	**% of VMT**	**Miles Traveled**	**MPG**	**Annual Fuel Use**
Passenger Cars	55.8%	117,657,103.95	22.4	5,252,549.28
Light Trucks/SUV	36.1%	76,118,664.03	18.0	4,228,814.67
Single Unit Trucks	2.7%	5,693,085.68	8.2	694,278.74
Combination Trucks	4.7%	9,910,186.18	5.1	1,943,173.76
Total Energy Use	**99.3%**	**209,379,039.83**		**12,118,816.45**
Formula			=B*C	=D/10^12
Convert Fuel Use to Btu's	**Gallons/yr**	**LHV Btu/gallon**	**Btu/yr**	**Trillion Btu/yr**
Gasoline (Cars & Light Trucks/SUVs)	9,481,363.95	116,090	1,100,691,541,134.0100	**1.1007**
Diesel (Trucks)	2,637,452.50	129,060	340,389,619,734.8670	**0.3404**

5. Table 9.5: Estimated Annual Fuel Consumption Based on Vehicle Registration

	Cars	Light Trucks	Heavy Trucks	
	7,102	10,038	4,899	
Annual Fuel Use per Vehicle	554	612	4300	gallons
Btu/gallon LHV at 60F	116090	116090	129060	Btu/gallon
Total Energy Use	**456,757.03**	**713,170.59**	**2,718,739.24**	Million Btu/yr
Trillion Btu/year		**1.1699**	**2.7187**	
	Gasoline		**Diesel**	

6. Table 9.6: Estimated Annual On Farm Energy Use

		Energy Input/Unit					Annual Energy Use			
Commodity	**Acres Planted**	**Diesel gallons**	**Gasoline gallons**	**LP Gas gallons**	**Electric kW-hr**	**Unit**	**Diesel gallons**	**Gasoline gallons**	**LP Gas gallons**	**Electric kW-hr**
Barley - All	0.00	7.24	0.89	0.82	29.88	acre	-	-	-	-
Beans - Dry Edible	0.00	7.43	0.91	0.75	27.50	acre	-	-	-	-
Canola	0.00	4.50	0.75	0.00	26.80	acre	-	-	-	-
Corn for Grain	127,200.00	9.37	1.15	9.58	35.63	acre	1,191,864.00	146,280.00	1,218,576.00	4,532,136.00
Corn for Silage (Corn)	0.00	9.37	1.15	9.58	35.63	acre	-	-	-	-
Flaxseed	0.00	7.24	0.89	0.82	29.88	acre	-	-	-	-
Hay Alfalfa - Dry (Alfalfa)	0.00	9.80	0.81	0.00	32.73	acre	-	-	-	-
Hay - All (Alfalfa)	43,785.00	9.80	0.81	0.00	32.73	acre	429,093.00	35,465.85	-	1,433,083.05
Hay Other - Dry (Alfalfa)	0.00	9.80	0.81	0.00	32.73	acre	-	-	-	-
Oats	4,013.00	7.24	0.89	0.82	29.88	acre	29,054.12	3,571.57	3,290.66	119,908.44
Peas for Processing - Green	0.00	5.19	0.64	0.35	12.75	acre	-	-	-	-
Potatoes - Dry Land	0.00	24.18	2.00	0.00	205.27	acre	-	-	-	-
Potatoes - Irrigated	0.00	48.89	2.00	0.00	319.22	acre	-	-	-	-
Rye	0.00	7.24	0.89	0.82	29.88	acre	-	-	-	-
Soybeans	49,467.00	7.43	0.91	0.75	27.50	acre	367,539.81	45,014.97	37,100.25	1,360,342.50
Sugarbeets	0.00	28.92	3.54	2.76	100.75	acre	-	-	-	-
Sunflower - All	0.00	5.70	1.00	2.00	30.72	acre	-	-	-	-
Sunflower Seed for Oil	0.00	5.70	1.00	2.00	30.72	acre	-	-	-	-
Sunflower Seed Non-Oil Uses	0.00	5.70	1.00	2.00	30.72	acre	-	-	-	-
Sweet Corn for Processing	0.00	7.99	0.98	0.49	18.00	acre	-	-	-	-
Wheat - All	0.00	7.24	0.89	0.82	29.88	acre	-	-	-	-
Wheat Durum	0.00	7.24	0.89	0.82	29.88	acre	-	-	-	-
Wheat - Other Spring	0.00	7.24	0.89	0.82	29.88	acre	-	-	-	-
Winter Wheat - All	1,775.00	7.24	0.89	0.82	29.88	acre	12,851.00	1,579.75	1,455.50	53,037.00
	Head Count									
Dairy	30,100.00	0.13	0.02	0.11	4.00	cwt	586,950.00	90,300.00	496,650.00	18,060,000.00
Swine Farrow		9.05	1.11	4.06	148.25	litter	-	-	-	-
Swine Finish		0.91	0.11	0.34	12.38	head	-	-	-	-
Beef Cow-Calf		6.07	0.74	1.62	59.25	head	-	-	-	-
Beef Cattle (Finishing)	68,838.00	3.78	0.46	1.08	39.38	head	260,207.64	31,665.48	74,345.04	2,710,840.44
Turkey		0.09	0.01	0.50	1.24	head	-	-	-	-
Total Energy Use							**2,877,559.57**	**353,877.62**	**1,831,417.45**	**28,269,347.43**
Conversion Factor Btu/unit							**129,090**	**116,090**	**91,547**	**3412**
Trillion Btu/yr							**0.3715**	**0.0411**	**0.1677**	**0.0965**

7. Table 9.7: Estimated Annual Industrial Energy Use

Ex. 1 Manufacturing Shipments Method (County Level)			***Ex. 2 Manufacturing Employees Method (County Level)***	
Manufacturing shipments ($1000) - Lafayette County, 2007 (QuickFacts)	209,683		Manufacturing employees - Lafayette County (FactFinder, 2005-2007)	1635
Total energy use per $ of GDP - State of WI, 2010	316.6		Energy consumption per Employee (million Btu) - Midwest Census Region (Table 6.2)	1007.4
Energy budget (trillion Btu)	0.0664		Energy budget (trillion Btu)	1.6471

Ex. 3a Composition of Industrial Energy Use - Manufacturing Shipments (County Level)									
Energy Type	Total	Net Electricity	Residual Fuel Oil	Distillate Fuel Oil	Natural Gas	LPG & NGL	Coal	Coke & Breeze	Other
Energy use in Trillion Btu - Midwest Census Region (Table 1.2)	4707	934	45	36	1619	130	554	217	1172
Energy use in %	100.00%	19.8428%	0.9560%	0.7648%	34.3956%	2.7618%	11.7697%	4.6102%	24.8991%
Energy Use Trillion Btu/yr (Total from Ex. 1)	0.0664	0.0132	0.0006	0.0005	0.0228	0.0018	0.0078	0.0031	0.0165

Ex. 3b Composition of Industrial Energy Use - Manufacturing Employees (County Level)									
Energy Type	Total	Net Electricity	Residual Fuel Oil	Distillate Fuel Oil	Natural Gas	LPG & NGL	Coal	Coke & Breeze	Other
Energy use in Trillion Btu - Midwest Census Region (Table 1.2)	4707	934	45	36	1619	130	554	217	1172
Energy use in %	100.00%	19.8428%	0.9560%	0.7648%	34.3956%	2.7618%	11.7697%	4.6102%	24.8991%
Energy Use Trillion Btu/yr (Total from Ex. 2)	1.6471	0.3268	0.0157	0.0126	0.5665	0.0455	0.1939	0.0759	0.4101

8. Table 9.8: Energy Consumption Estimates Based on Population Data

	Population Makeup			
	Population	**% of WI**		
Lafayette	16815	0.2944%		
		0.0000%		
WI	5,711,767	100.0000%		
WI	353.5	Million Btu/Capita		
Total Energy Per Capita Consumption				
	Million Btu	Trillion Btu		
Lafayette	5944103	5.9441		

	Energy Consumption by Sector (Trillion Btu)				
WI	426.4000	355.4000	459.3000	402.6000	1643.7000
	Residential	*Commercial*	*Industrial*	*Transportation*	*Total*
Lafayette	1.2553	1.0463	1.3521	1.1852	4.8389
Lafayette	1.2553	1.0463	1.3521	1.1852	4.8389
	Energy Consumption by Source (Trillion Btu)				
WI	499	391.4	470.8	319.9	
	Coal	*Natural Gas*	*Petroleum*	*Electricity*	*Total*
Lafayette	1.4690	1.1523	1.3860	0.9418	4.9490

E. Richland County

1. Table 10.1: Estimated Annual Energy Use Summary

Energy Type	Residential	Transport	Agriculture	Industrial	Commercial / Public Building	Totals
All Units in Trillion Btu/yr						
Gasoline		0.0003	0.0190			0.0193
Diesel Fuel		0.0001	0.1721			0.1722
Fuel/Heating Oil	0.0001			0.1146		0.1147
Natural Gas (& LP	0.0001		0.0699	2.4742	0.0851	2.6293
Kerosene						-
Coal/Coke				1.0907		1.0907
Wood	0.0000					0.0000
Electricity	0.0001		0.0493	1.3213	0.0860	1.4567
Total	**0.0003**	**0.0004**	**0.3103**	**5.0008**	**0.1711**	**5.4829**

2. Table 10.2: Estimated Annual Residential Energy Consumption by Household Number

Total Number of Households	**7,349**		
Column	B	C	D
Formula		=household number * B	
Energy Type	**Million Btu/household per year**	**Annual Energy Million Btu/yr**	**On Site**
Electricity - Primary	*111.5*	819,413.50	--
Electricity - Site	*37.3*	274,117.70	274,117.70
Natural Gas	*85.0*	624,665.00	624,665.00
Fuel Oil	*75.4*	554,114.60	554,114.60
Kerosene	*0.0*	-	-
LPG	*63.9*	469,601.10	469,601.10
Wood	*29.3*	215,325.70	215,325.70
Total Energy Use	***402.4***	**2,957,237.60**	**2,137,824.10**
Trillion Btu/yr		**2.9572**	**2.1378**

3. Table 10.3: Estimated Annual Residential Energy Consumption by Age of Household

	1990 to 2000	**1980 to 1989**	**1970 to 1979**	**1960 to 1969**	**1950 to 1959**	**1949 or before**		
Electricity Primary	130.9	127.9	122.1	97.8	97.2	85		
Electricity Site	43.8	42.8	40.8	32.7	32.5	28.4		
Natural Gas	70.9	64.3	63	64.6	72.9	84.3		
Fuel Oil	77.8	91.4	77.3	68.3	79	87.5	All units in million Btu/household.	
Kerosene	21.3	13.5	23.2		11.4	11.6		
LPG	41.1	36.6	37.5	34.2	26.3	51.6		
Wood	14.8	20	23	21.1	27.06	48.5		
Total	254.9	248.6	241.8	199.8	222.1	263.4		
Houses per Group	**1,141**	**746**	**1,246**	**664**	**1,289**	**3,088**		
Energy Use in Million Btu/yr							**Total**	**On Site**
Electricity Primary	149,356.9	95,413.4	152,136.6	64,939.2	125,290.8	262,480.0	849,616.90	--
Electricity Site	49,975.8	31,928.8	50,836.8	21,712.8	41,892.5	87,699.2	284,045.90	284,045.90
Natural Gas	80,896.9	47,967.8	78,498.0	42,894.4	93,968.1	260,318.4	604,543.60	604,543.60
Fuel Oil	88,769.8	68,184.4	96,315.8	45,351.2	101,831.0	270,200.0	670,652.20	670,652.20
Kerosene	24,303.3	10,071.0	28,907.2	-	14,694.6	35,820.8	113,796.90	113,796.90
LPG	46,895.1	27,303.6	46,725.0	22,708.8	33,900.7	159,340.8	336,874.00	336,874.00
Wood	16,886.8	14,920.0	28,658.0	14,010.4	34,880.3	149,768.0	259,123.54	259,123.54
Total Energy Use							**3,118,653.0400**	**2,269,036.1400**
Trillion Btu/yr							**3.1187**	**2.2690**

4. Table 10.4: Estimated Annual Fuel Consumption Based on VMT

Total Annual VMT in County	**6,902**			
Formula		=B*Total VMT		=C/D
Composition of VMT	**% of VMT**	**Miles Traveled**	**MPG**	**Annual Fuel Use**
Passenger Cars	55.8%	3,851.32	22.4	171.93
Light Trucks/SUV	36.1%	2,491.62	18.0	138.42
Single Unit Trucks	2.7%	186.35	8.2	22.73
Combination Trucks	4.7%	324.39	5.1	63.61
Total Energy Use	**99.3%**	**6,853.69**		**396.69**
Formula			=B*C	=D/10^12
Convert Fuel Use to Btu's	**Gallons/yr**	**LHV Btu/gallon**	**Btu/yr**	**Trillion Btu/yr**
Gasoline (Cars & Light Trucks/SUVs)	310.36	116,090	36,029,366.7031	**0.00003603**
Diesel (Trucks)	86.33	129,060	11,142,106.5512	**0.00001114**

5. Table 10.5: Estimated Annual Fuel Consumption Based on Vehicle Registration

	Cars	**Light Trucks**	**Heavy Trucks**	
Annual Fuel Use per Vehicle	554	612	4300	gallons
Btu/gallon LHV at 60F	116090	116090	129060	Btu/gallon
Total Energy Use	-	-	-	Million Btu/yr
Trillion Btu/year		-	-	
	Gasoline		**Diesel**	

6. Table 10.6: Estimated Annual On Farm Energy Use

Commodity	Acres Planted	Energy Input/Unit Diesel gallons	Gasolin e	LP Gas gallons	Electric kW-hr	Unit	Annual Energy Use Diesel gallons	Gasoline gallons	LP Gas gallons	Electric kW-hr
Barley - All		7.24	0.89	0.82	29.88	acre	-	-	-	-
Beans - Dry Edible		7.43	0.91	0.75	27.50	acre	-	-	-	-
Canola		4.50	0.75	0.00	26.80	acre	-	-	-	-
Corn for Grain	45,000.00	9.37	1.15	9.58	35.63	acre	421,650.00	51,750.00	431,100.00	1,603,350.00
Corn for Silage (Corn)		9.37	1.15	9.58	35.63	acre	-	-	-	-
Flaxseed		7.24	0.89	0.82	29.88	acre	-	-	-	-
Hay Alfalfa - Dry (Alfalfa)	22,600.00	9.80	0.81	0.00	32.73	acre	221,480.00	18,306.00	-	739,698.00
Hay - All (Alfalfa)		9.80	0.81	0.00	32.73	acre	-	-	-	-
Hay Other - Dry (Alfalfa)		9.80	0.81	0.00	32.73	acre	-	-	-	-
Oats	2,600.00	7.24	0.89	0.82	29.88	acre	18,824.00	2,314.00	2,132.00	77,688.00
Peas for Processing - Green		5.19	0.64	0.35	12.75	acre	-	-	-	-
Potatoes - Dry Land		24.18	2.00	0.00	205.27	acre	-	-	-	-
Potatoes - Irrigated		48.89	2.00	0.00	319.22	acre	-	-	-	-
Rye		7.24	0.89	0.82	29.88	acre	-	-	-	-
Soybeans	11,800.00	7.43	0.91	0.75	27.50	acre	87,674.00	10,738.00	8,850.00	324,500.00
Sugarbeets		28.92	3.54	2.76	100.75	acre	-	-	-	-
Sunflower - All		5.70	1.00	2.00	30.72	acre	-	-	-	-
Sunflower Seed for Oil		5.70	1.00	2.00	30.72	acre	-	-	-	-
Sunflower Seed Non-Oil Uses		5.70	1.00	2.00	30.72	acre	-	-	-	-
Sweet Corn for Processing		7.99	0.98	0.49	18.00	acre	-	-	-	-
Wheat - All		7.24	0.89	0.82	29.88	acre	-	-	-	-
Wheat Durum		7.24	0.89	0.82	29.88	acre	-	-	-	-
Wheat - Other Spring		7.24	0.89	0.82	29.88	acre	-	-	-	-
Winter Wheat - All	1,300.00	7.24	0.89	0.82	29.88	acre	9,412.00	1,157.00	1,066.00	38,844.00
	Head Count									
Dairy	14,800.00	0.13	0.02	0.11	4.00	cwt	288,600.00	44,400.00	244,200.00	8,880,000.00
Swine Farrow		9.05	1.11	4.06	148.25	litter	-	-	-	-
Swine Finish		0.91	0.11	0.34	12.38	head	-	-	-	-
Beef Cow-Calf	47,000.00	6.07	0.74	1.62	59.25	head	285,290.00	34,780.00	76,140.00	2,784,750.00
Beef Cattle (Finishing)		3.78	0.46	1.08	39.38	head	-	-	-	-
Turkey		0.09	0.01	0.50	1.24	head	-	-	-	-
Total Energy Use							**1,332,930.00**	**163,445.00**	**763,488.00**	**14,448,830.00**
Conversion Factor Btu/unit							**129,090**	**116,090**	**91,547**	**3412**
Trillion Btu/yr							**0.1721**	**0.0190**	**0.0699**	**0.0493**

7. Table 10.7: Estimated Annual Industrial Energy Use

Ex. 1 Manufacturing Shipments Method (County Level)		***Ex. 2 Manufacturing Employees Method (County Level)***	
Manufacturing shipments ($1000) - Becker County, 2002 (QuickFacts)	$613,108	Manufacturing employees - Becker County (FactFinder, 2005-2007)	1315
Total energy use per $ of GDP - State of MN, 2000	8700	Energy consumption per Employee (million Btu) - Midwest Census Region (Table 6.2)	1007.4
Energy budget (trillion Btu)	5.3340	Energy budget (trillion Btu)	1.3247

Ex. 3a Composition of Industrial Energy Use - Manufacturing Shipments (County Level)

Energy Type	Total	Net Electricity	Residual Fuel Oil	Distillate Fuel Oil	Natural Gas	LPG & NGL	Coal	Coke & Breeze	Other
Energy use in Trillion Btu - Midwest Census Region (Table 1.2)	4707	934	45	36	1619	130	554	217	1172
Energy use in %	100.00%	19.8428%	0.9560%	0.7648%	34.3956%	2.7618%	11.7697%	4.6102%	24.8991%
Energy Use Trillion Btu/yr (Total from Ex. 1)	5.3340	1.0584	0.0510	0.0408	1.8347	0.1473	0.6278	0.2459	1.3281

Ex. 3b Composition of Industrial Energy Use - Manufacturing Employees (County Level)

Energy Type	Total	Net Electricity	Residual Fuel Oil	Distillate Fuel Oil	Natural Gas	LPG & NGL	Coal	Coke & Breeze	Other
Energy use in Trillion Btu - Midwest Census Region (Table 1.2)	4707	934	45	36	1619	130	554	217	1172
Energy use in %	100.00%	19.8428%	0.9560%	0.7648%	34.3956%	2.7618%	11.7697%	4.6102%	24.8991%
Energy Use Trillion Btu/yr (Total from Ex. 2)	1.3247	0.2629	0.0127	0.0101	0.4556	0.0366	0.1559	0.0611	0.3298

8. Table 10.8: Energy Consumption Estimates Based on Population Data

Population Makeup					Energy Consumption by Sector (Trillion Btu)				
	Population	**% of MN**		WI	427.6610	351.9980	577.3140	443.1000	1800.0730
Richland Coun	18021	0.3169%			*Residential*	*Commercial*	*Industrial*	*Transportation*	*Total*
		0.0000%		Richland	1.3552	1.1154	1.8294	1.4041	5.7041
		0.0000%			0.0000	0.0000	0.0000	0.0000	0.0000
		0.0000%			0.0000	0.0000	0.0000	0.0000	0.0000
Four Counties	18021	0.3169%			0.0000	0.0000	0.0000	0.0000	0.0000
WI	5,686,986	100.0000%		Four Counties	1.3552	1.1154	1.8294	1.4041	5.7041
WI	353.5	Million Btu/Capita			**Energy Consumption by Source (Trillion Btu)**				
Total Energy Per Capita Consumption				WI	25.517	372.916	104.5		
	Million Btu	Trillion Btu			*Coal*	*Natural Gas*	*Petroleum*	*Electricity*	*Total*
Richland	5694636	5.6946		Richland	0.0809	1.1817	0.3311	0.0000	1.5937
	0	0.0000			0.0000	0.0000	0.0000	0.0000	0.0000
	0	0.0000			0.0000	0.0000	0.0000	0.0000	0.0000
	0	0.0000			0.0000	0.0000	0.0000	0.0000	0.0000
Four Counties	5694636	5.6946		Four Counties	0.0809	1.1817	0.3311	0.0000	1.5937