Thomas J. Vilsack, Governor
Sally J. Pederson, Lt. Governor

John R. Norris, Chairman
Diane Munns, Board Member
Curtis W. Stamp, Board Member

December 27, 2006

Dear Members of the Government Oversight Committee:

In the 2006 Session, the General Assembly enacted Senate File 2399, the Renewable Energy Tax Credit Bill. One part of the bill requires that the Utilities Board submit a proposal to conduct a study of the Iowa electric transmission system. Specifically, section 14 of SF 2399 provides:

> PROPOSAL FOR TRANSMISSION STUDY. The utilities board shall submit to the government oversight committee by January 1, 2007, a proposal to conduct a study on the transmission of electricity in Iowa. The proposal shall include a description of the content to be studied, which shall include examining the reliability and limitations of the primary grid system and the development of additional small wind projects in all regions of the state. The content to be studied shall also include issues related to the security of Iowa's energy supply in the event of a national or local emergency affecting the primary grid system. The proposal shall include a description of the estimated time needed to complete the study, an estimate of the cost to complete the study, and any other information the board deems necessary.

The Board's Proposal for a Study of Iowa's Electric Transmission System is attached. Please contact Joan Conrad, our legislative liaison, at 515.229.4771 or me if you would like to discuss this further or if you have questions.

Sincerely,

/s/

John Norris
Chairman

Attachment

350 Maple Street / Des Moines, Iowa 50319-0069 / 515.281.5979 / Fax 515.281.5329
http://www.state.ia.us/iub

A PROPOSAL FOR A STUDY OF IOWA'S ELECTRIC TRANSMISSION SYSTEM

Executive Summary

In its 2006 session, the General Assembly enacted Senate File 2399, the Renewable Energy Tax Credit Bill. One part of that bill requires that the Utilities Board submit a proposal to conduct a study of the Iowa electric transmission system. Specifically, section 14 of SF 2399 provides:

> PROPOSAL FOR TRANSMISSION STUDY. The utilities board shall submit to the government oversight committee by January 1, 2007, a proposal to conduct a study on the transmission of electricity in Iowa. The proposal shall include a description of the content to be studied which shall include examining the reliability and limitations of the primary grid system and the development of additional small wind projects in all regions of the state. The content to be studied shall also include issues related to the security of Iowa's energy supply in the event of a national or local emergency affecting the primary grid system. The proposal shall include a description of the estimated time needed to complete the study, an estimate of the cost to complete the study, and any other information the board deems necessary.

The Board's proposal is attached. It describes the existing transmission system and some of the electric transmission-related issues that could be studied The proposal describes some recent, more limited studies completed for the Western Area Power Administration and for the State of Minnesota, at costs of $550,000 and $700,000, respectively. Because the Iowa study described in the bill is broader in scope than either of these two studies, the Board estimates the cost to complete the proposed study would be in excess of $1 million.

Some subjects, such as the reliability and economics of the transmission system, are already being studied in depth by other entities, so it may be appropriate to eliminate those issues as potential candidates for study. Other subjects, such as the potential electric system issues presented by ethanol plants, are related to so many other issues (fuel use, road and rail use, and economic development, for example) that an electric transmission system study, by itself, may be too focused to be useful.

As an alternative to the proposed study, in this proposal the Board has provided information addressing each of the subjects in section 14, along with other information that may be helpful in understanding the electric transmission system.

A PROPOSAL FOR A STUDY OF

IOWA'S ELECTRIC TRANSMISSION SYSTEM

Introduction

Senate File 2399, the Renewable Energy Tax Credit Bill, requires that the Iowa Utilities Board submit a proposal to the General Assembly estimating the time and cost necessary to complete a study of the reliability and limitations of the electric transmission system in Iowa and the possible development of additional small wind generator projects in all parts of the State. The proposal should include any issues related to the security of Iowa's energy supply. This is that proposal.

It is difficult to estimate the cost and time required for the study because of the broad nature of the request to analyze the complex transmission system. Based on smaller, more limited studies recently completed in nearby states, the Board conservatively estimates the cost of a broad, overall study as being well in excess of $1 million and the time required would be at least 6 to 9 months.

As an alternative to such a study, the Board has included in this proposal an overview of the existing transmission system and a discussion of some of the issues associated with that system, with an emphasis on reliability, economics, and special attention to wind-driven generation and other renewable energy sources. The proposal also identifies some of the entities that have primary, and sometimes exclusive, responsibility for parts of the electric transmission grid, including the Department of Energy (DOE), the Federal Energy Regulatory Commission (FERC), and the Midwest Independent System Operator (MISO). It is the Board's belief that this document, combined with possible presentations and discussions at the convenience of the General Assembly, will make a formal study unnecessary.

This proposal starts with a basic description of electric transmission systems in general and the Iowa grid in specific. It then summarizes the planning processes that are used to ensure the transmission system provides reliable service at reasonable cost, then turns to specific subjects that may be of particular interest, including renewable energy, ethanol plants, and the security and safety of the system. Finally, the proposal includes brief summaries of the recent studies in the Montana-Dakotas region and in the State of Minnesota.

I. What is transmission?

In the electric industry, "transmission" refers to the high-voltage wire network and associated devices that are used to move electric power in bulk, typically from the power plants where it is generated to the distribution networks that deliver it to homes and businesses. In this sense, the transmission system is like the highway system, while the distribution system is like local roadways.

When electric power was being introduced to the public, most power plants were located close to the customer load they were intended to serve. As the typical generating plant size increased (to capture economies of scale, for instance), long-distance transmission became increasingly important. Initially, most transmission was built to serve in-state (or "native") load, with some inter-utility connections to help promote reliable service during outages and emergencies. Over time, this resulted in an increasingly interconnected transmission grid that offers alternative power paths and now enables wholesale power transactions between utilities, resulting in lower costs and improved reliability.

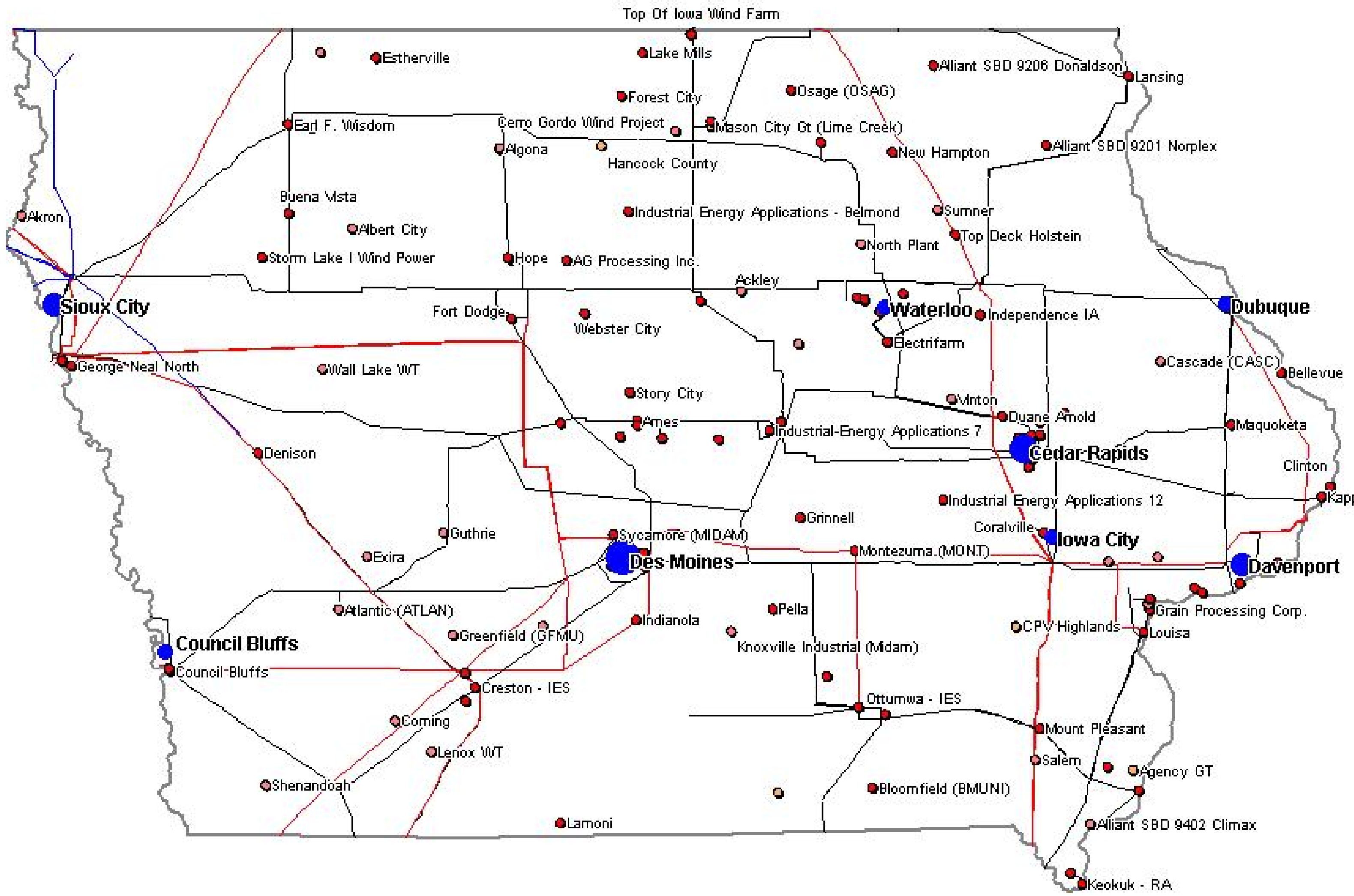
Most of the North American transmission grid is based on alternating current (AC) power. Some direct current (DC) lines are used in special circumstances, but there are no major DC lines serving Iowa.

II. What does Iowa have for an electric transmission system?

While the scope of this overview is limited to Iowa, it is important to remember that the electric transmission system is regional and there is no discrete part that is only relevant to Iowa. The transmission grid in Iowa is interconnected with each of the surrounding states and is constantly affected by what happens in those states, just as the electrical activity in Iowa affects the systems in other states. Because of the interstate nature of the grid, much of the regulatory responsibility for the interconnected grid lies with the Federal Energy Regulatory Commission (FERC). In fact, FERC has exclusive jurisdiction over many electric transmission system issues.

Briefly, Iowa has an AC transmission system that operates at nominal voltages of 345 kV, 230 kV, 161 kV, 115kV, and 69 kV. This is not to say that all 69 kV lines are considered to be "transmission" lines; the delineation between transmission and distribution depends more on the function of a line than on the voltage level. The major transmission lines in Iowa are shown on this map, along with major transmission substations and cities with population over 50,000.

Iowa Electric Generation and Electric Transmission
With Cities over 50,000 Population



Iowa has been building and operating transmission lines since the early 1900s. The higher voltage lines have typically been built more recently, as improvements in technology and increasing market demands made larger lines more economical. Many of the regional transmission interconnections were built after the North American Electric Reliability Council (NERC), a voluntary organization, was formed in the mid-1960s, following the 1965 Northeastern blackout. The following table shows the vintages of the various transmission lines owned by MidAmerican Energy Company (MidAmerican) and Interstate Power and Light Company (IPL) in Iowa as of 2003:

Miles of Line by Age

Age in Years =>		**0-9**	**10-19**	**20-29**	**30-39**	**40-49**	**50+**	**Total**
345 kV	MidAmerican	55	84	269	512	0	0	920
	IPL	2	87	47	79	0	0	214
161 kV	MidAmerican	48	60	157	290	437	344	1336
	IPL	52	106	445	428	26	5	1062
115 kV	MidAmerican	0	0	0	0	0	0	0
	IPL	8	16	11	25	201	116	378
69 kV	MidAmerican	157	232	354	494	357	255	1849
	IPL	220	598	468	371	270	120	2047
34.5 kV	MidAmerican	4	10	0	19	156	0	189
	IPL	263	293	355	435	351	585	2281

Notes: The total may exclude miles of line of unknown age. For MidAmerican, the age of 34.5 kV lines with 40 or more years of service is estimated. The numbers represent MidAmerican's and IPL's equivalent share of jointly owned lines. For IPL, the data for the 2003 report were found by running a query on IPL's GIS system. IPL data ignores age of the conductor.
Sources: Information provided by MidAmerican and IPL.

Other transmission lines in Iowa are owned and operated by rural electric cooperatives (RECs) and municipal utility systems.

III. How the transmission system is operated

For electric transmission grid purposes, the continental United States is divided into three main interconnections: the Eastern, Western, and Texas Interconnected Systems. These three systems are overseen by NERC, which ensures that the bulk electric system in North America is reliable, adequate, and secure. NERC has proposed 107 standards for Federal Energy Regulatory Commission (FERC) approval that address the reliability of the system.[1]

[1] More information about NERC and its standards can be found at the NERC Web site, http://www.nerc.com/.

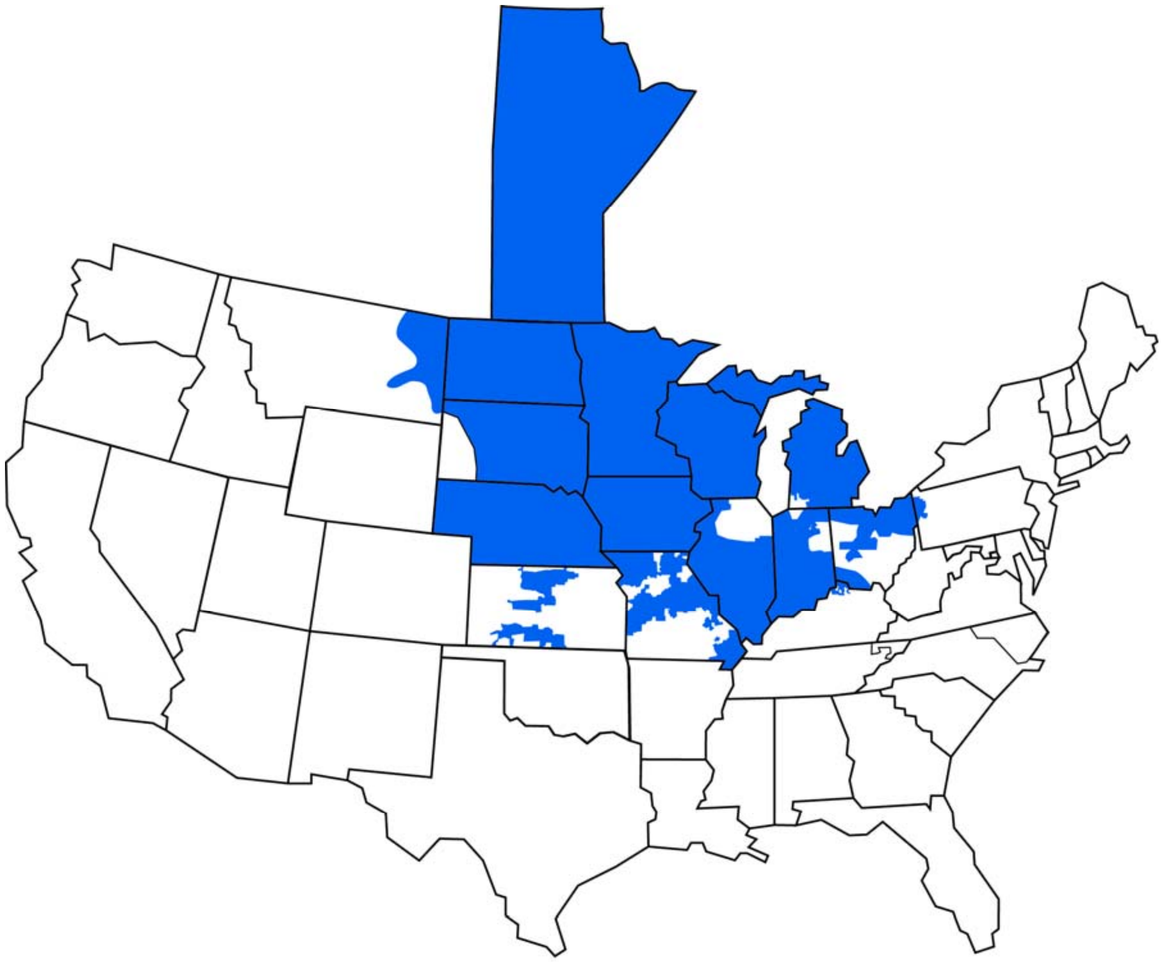
On August 8, 2005, the Energy Policy Act of 2005 was enacted. Among other things, this statute authorizes the creation of an electric reliability organization (ERO) with the statutory authority to enforce compliance with reliability standards in a bulk power marketplace. In July 2006, FERC certified NERC as an ERO for the United States. The ERO is made up of eight regional organizations; Iowa electric utilities belong to the Midwest Reliability Organization (MRO).

In 1999, FERC issued its Order 2000, which outlined a vision of a small number of large, multi-state Regional Transmission Organizations (RTOs) that would operate and manage the electric grid to create and maintain competitive regional power markets at the wholesale level while continuing to maintain the reliability of the electric system. Order 2000 set out four minimum characteristics that would qualify an RTO for operation:

- Independence from market participants
- Operational authority over the regional grid
- Scope and regional configuration of the potential market
- Responsibility for short-term reliability

The FERC envisioned that each RTO would have operational control over all transmission systems within its region in order to facilitate the most efficient use of generation and transmission. The FERC acknowledged that it could not require a utility to become a member of an RTO, but it encouraged utilities to join when appropriate. To date, many utilities have joined an RTO, but some have not, leaving parts of the United States without RTO coverage. Utilities in non-RTO areas are required to provide independent administration of their transmission service.

Two FERC-jurisdictional utilities serve customers in Iowa: MidAmerican and IPL. IPL has joined an RTO, the Midwest Independent Transmission System Operator (MISO). MISO's reliability area is approximated on the following map:



Midwest ISO Regional Reliability Area

MidAmerican has retained TranServ International, an independent transmission service coordinator, to administer MidAmerican's system. MidAmerican is a market participant in MISO (meaning it has joined for the purpose of selling electric energy in the wholesale market).

MISO began coordinating wholesale electricity markets in the Midwest region in 2005. MISO currently operates to assure regional reliability while also providing administration of the wholesale market. MISO pursues additional benefits by seeking the lowest-cost available power sources and more efficiently managing transmission congestion, a system known as "economic dispatch."

IV. Planning the transmission system

Because the transmission system is regional in nature, the system is typically planned on a regional, or even national, basis. In fact, the U.S. Department of Energy recently completed a nationwide study of electric transmission system congestion.[2] This study identified constrained transmission paths as a first step toward alleviating congestion problems. Two "critical congestion areas" and "four "congestion areas of concern" were identified, along with five "conditional congestion areas." None of the congestion areas is located in Iowa, but one of the conditional congestion areas relates to the potential issues that might arise if a large amount of wind generation capacity is located in the Dakotas, producing energy that needs to be transmitted in an eastern direction. While the solution to any such problem is likely to require construction of new transmission in the Dakotas and Minnesota, it is possible that Iowa could be involved, as well.

At the regional level, MISO and the Mid-continent Area Power Pool (MAPP) are heavily involved in transmission system planning[3]. The transmission planning processes integrate the planning activities of:

- Providing for ongoing load growth
- Interconnecting new generation and transmission
- Providing transmission service

These planning activities are performed collaboratively between MISO planning staff and the planning staffs of the transmission owners, with regular input from stakeholder groups. Planning issues are also periodically discussed with various committees of the Organization of MISO States (OMS), of which Iowa is a founding member.

MISO uses this collaborative process, combined with numerous studies, to develop a MISO Transmission Expansion Plan (MTEP) that is designed to ensure the reliability of the regional transmission system. The MTEP is also used to identify system expansion that is critically needed to support the competitive supply of electric power by this system. The MTEP considers all market perspectives, including demand-side options, generation location, and transmission expansion.

The requirements and principles of the MTEP process are consistent with those set forth in FERC's "Order 2000" for RTO regional planning. Order 2000 requires, among other things, that the RTO must have ultimate responsibility for both transmission planning and expansion within its region that will enable it to provide efficient, reliable, and non-discriminatory service and coordinate such efforts with the appropriate state authorities. Order 2000 also recognizes the statutory authority of the states to regulate siting of transmission facilities, although recent FERC action may affect this in some circumstances. As such, the RTO planning and expansion process is designed to be consistent with these state and local responsibilities.

---

[2] A summary of the study can be found on the Web at: http://www.oe.energy.gov/DocumentsandMedia/NETC_ExSum_8Aug08.pdf.

[3] Interstate participates in MISO transmission planning process. MidAmerican participates in MAPP transmission planning process through Trans Serv International.

The current MTEP process contemplates the possible addition of transmission in eastern Iowa and across southern Minnesota or northern Iowa, but does not project a route or time frame.

MAPP also uses a collaborative process, which begins with the development of transmission plans at the sub-regional level through Working Groups. One of the four MAPP Sub-regional Planning Groups is the Iowa Transmission Working Group (ITWG), which consists of representatives of investor-owned, government-owned (including municipals), and cooperative utilities from around the state. The ITWG conducts technical studies and develops plans for new transmission and substation facilities within Iowa over a ten-year time horizon and forwards its plans to the MAPP Transmission Planning Subcommittee (TPSC) for inclusion in the MAPP Regional Plan, a ten year plan which is published every two years. Informal, nonbinding regulatory input, in the form of state regulatory staff participation, is invited at MAPP meetings including the ITWG meetings.

The MAPP Transmission Reliability Assessment Working Group (TRAWG) conducts reliability assessments of the planned MAPP transmission system up to ten years into the future based on plans from the MAPP TPSC. Also, the MAPP Design Review Subcommittee (DRS) ensures that proposed generation and transmission facility additions, upgrades, or retirements maintain or enhance reliability within MAPP.

TranServ International is responsible for conducting transmission planning studies associated with transmission service request evaluation for, and generation interconnection to, the MidAmerican transmission system.

Transmission planning involves many factors. The primary concern is that the system must be reliable at a reasonable cost. Under current federal law, if existing transmission capacity is limited, and the interconnection of new generation requires an expansion or upgrade of the transmission system to maintain system reliability, the interconnecting generator must initially pay all costs associated with the upgrade. The transmission owner then must refund the upgrade costs (including interest) back to the interconnecting generator (in the form of either transmission service credits or direct payment) over a 20-year period following the in-service date of the interconnecting generator (with some exceptions). The upfront cost of new transmission can be quite high, presenting a significant potential hurdle to some projects.

If the interconnection requires an upgrade of the utility's lower-voltage distribution system, the interconnecting generator must pay all costs associated with the distribution upgrade, without refund.[4] The interconnecting generator must also

[4] According to the FERC, there is no refund for distribution because distribution facilities are generally designed to provide service to specific localities, and do not provide benefits to the system as a whole. (FERC Docket No. RM02-1, Order No. 2003, p. 140).

pay for all facilities and equipment between the generator and the point of interconnection, and all other costs associated with the interconnection.

V. Renewable energy and transmission

A. Wind and other renewable-based generation

This part of the proposal is focused on the effect of wind and other renewable-based generation on the transmission system. A brief history of renewable energy in Iowa, especially legislation since 1983, can be found in Appendix A.

Iowa has existing wind generating capacity totaling 837 MW.[5] According to the American Wind Energy Association, this 837 MW ranks Iowa third in the nation in terms of total installed wind capacity, and second in the nation on a per-capita basis.[6] Most of this capacity, 818 MW, is made up of seven large wind farms in north and northwest Iowa (see Attachment A list of Existing Wind Farms and Attachment A - Map). As a percentage of Iowa's total retail electricity sales, renewable energy production from this 818 MW would equate to a statewide renewable portfolio standard (RPS) of about 5.2 percent.[7]

MidAmerican has announced plans to build an additional 99 MW of wind capacity by year-end 2006, and another 123 MW by year-end 2007 (222 MW total). In addition, applicants for tax credit eligibility under Iowa Code § 476B are proposing four large wind farms totaling 390 MW, and applicants under Iowa Code § 476C are proposing a number of smaller wind projects totaling 224 MW.[8] As with the existing 818 MW, these planned and proposed wind projects are to be located in north and northwest Iowa (see Attachment B, a list of Planned and Proposed Wind Projects and Attachment B – Map, showing the counties in which the projects are proposed to be located). These locations roughly correspond to the best wind resources found in Iowa's north and northwestern areas (see the

---

[5] As of September 30, 2006, according to the American Wind Energy Association.

[6] More information about wind capacity installed nationwide can be found at the American Wind Energy Association web site, http://www.awea.org/projects/.

[7] Note that this percentage figure does not include renewable energy production from the 80.1 MW "Top of Iowa" wind farm. The energy production from "Top of Iowa" is currently exported to meet state-mandated RPS requirements in Wisconsin. For purposes of this analysis, it is assumed that all other renewable energy production remains in Iowa. To the extent it does not remain in Iowa, the equivalent RPS figure should be reduced.

[8] Note that the 224 MW in 476C applications exceeds the statutory 180 MW total eligibility limit (effective 2007). The full 224 MW is presented to show the current potential demand for facility eligibility – reflecting a longer-term view of the 476C statutory limit, which can be expanded by legislative action as it was in 2006.

Iowa Energy Center map of Estimated Average Annual Wind Speeds at this link).[9]

Large scale wind projects have generally been well-received in Iowa. Wind farms are increasingly competitive as an economical source of electric energy. The individual wind turbines are located in rural areas, typically in groups of 1 to 10 turbines on any single farm. The project owners pay the landowners for the use of small parcels of land pursuant to negotiated contracts. Thus, the utilities favor wind farms because they are economical energy, while the landowners favor the projects because they provide additional revenue.

As a percentage of Iowa's total retail electric sales, the 222 MW addition planned by MidAmerican would equate to a statewide wind capacity increase of about 1.6 percent (potentially raising the total to 6.8 percent).[10] This addition will also increase the state's total wind capacity beyond the goal recommended by the Governor's 2001 Energy Policy Task Force (1,000 MW by 2010) – two years ahead of schedule.

If developed, the other wind projects proposed under Iowa Code chapters 476B and 476C could provide an additional 4.4 percent in renewable energy production (potentially raising the statewide total to 11.2 percent),[11] and an additional 614 MW of wind generating capacity.

All of this new wind generation presents some potential transmission issues. Traditionally, choosing the location for new generating plant takes into account the availability of fuel resources (for example, proximity to natural gas lines, or rail lines in the case of coal) and the availability or cost of transmission resources necessary to deliver the plant's output to customer load. With wind generation, wind takes the place of fuel. Therefore, choosing the best location for new wind generation involves balancing potential transmission costs with the economic benefits of developing sites with optimal wind resources. Again, the optimal wind resources in Iowa tend to be located in the north and northwest areas of the state (see hyperlink to Iowa Energy Center map of Estimated Average Annual Wind Speeds).[12]

---

[9] http://www.energy.iastate.edu/renewable/wind/images/windmap-iowa_annual.gif

[10] Again, for purposes of this analysis, it is assumed that renewable energy production from this capacity will remain in Iowa. To the extent it does not remain in Iowa, the equivalent RPS figure should be reduced.
Also, note that this figure does not include the remainder of the 545 MW for which MidAmerican has obtained advance ratemaking principles (up to 323 MW more). MidAmerican has not yet announced plans for this additional capacity (as of November 15, 2006).

[11] Again, assuming that renewable energy production from these projects remains in Iowa.

[12] http://www.energy.iastate.edu/renewable/wind/images/windmap-iowa_annual.gif

The existing transmission system in Iowa was built primarily to connect the large population centers with traditional generating plants. As a result, the transmission system in northwest and north central Iowa was not designed for the purpose of delivering large amounts of wind power to customer loads. It is not clear whether current transmission capacity can accommodate the wind capacity additions currently planned and proposed for these areas (see Attachment B – Map), or whether transmission capacity limits in other areas might pose barriers to further renewable energy development.

A KEMA-Xenergy 2004 report prepared for the California Energy Commission[13] discussed the effects of wind generation on grid system operations. As wind generation reaches substantial levels, electric network stability issues may have to be addressed. These issues include:

1. Power flow analysis to ensure that interconnecting transmission and distribution lines are not overloaded. Both real and reactive power requirements should be studied for grid stability.
2. The effect of additional generation on the short circuit current ratings of existing electric equipment on the network.
3. Dynamic behavior of the system during contingencies, sudden load changes, and disturbances. Voltage and angular stability during these disturbances is important.
4. A detailed representation of electromagnetic transients (fast operational switching transients) for the connected equipment, wind turbines, their controls and protective devices, the converters, and DC links.
5. Operating rules, including sensitivity to generators that provide regulation and the need to minimize start-stop operations for load-following generators. (Due to the fluctuations and uncontrollable nature of wind power as well as the uncorrelated generation from wind and load, wind power generation has to be balanced with other fast-controlled generation.)

The first three of these potential issues are analyzed as part of the generation interconnection process by most utilities in Iowa. Several utilities in Iowa (including MidAmerican and Corn Belt Power Cooperative) belong to MAPP. MidAmerican and Corn Belt each have a FERC approved Open-Access Transmission Tariff (OATT) which defines the manner in which new generating facilities request and receive interconnection to the transmission system. Other utilities in Iowa, like IPL, are subject to MISO's OATT which contains similar requirements. MAPP and MISO require certain planning studies be performed to determine the effects of interconnecting new generation resources. These studies are adequate to determine what system changes are needed to reliably accommodate each new wind farm. These studies do not, however, provide analyses of how the system performs as a whole. Those types of studies are

[13] The report can be found at www.energy.ca.gov/reports/CEC-500-2004-091.pdf.

included in the MAPP and/or MISO sub-regional and regional planning processes.

Some other issues that may be important include the cost of integrating wind generation and the cost of network upgrades associated with wind generation.

B. Ethanol

Over the past 50 years or so, the vast majority of electric growth in Iowa has occurred in urban areas while demand in the rural areas has grown at a slower pace. However, in the past few years the growth pattern in the electric industry in Iowa has changed.

The development and construction of ethanol production plants is now a significant factor in electric utility planning, because they can be very large users of electric power. These plants are usually 10 MW or more in size and require electricity from large electric lines, usually 69kV or more. (For comparison purposes, 1 MW is generally considered to be equal to approximately 1,000 residential customers.) Since most of these production plants are located in rural areas, transmission line extensions or upgrades are often necessary.

Prior to the ethanol production plant boom, utilities could forecast where demand growth would occur with reasonable accuracy. However, since an ethanol plant can potentially be put at nearly any location, predicting growth in electric consumption for any particular utility in Iowa has become more difficult. This leads to new challenges in the siting of both future generating plants and transmission lines.

As of June 2006, Iowa had 21 operating ethanol plants with another 18 in the planning stages.[14] This would represent new electric demand equivalent to approximately 390,000 residential customers if all 39 units were to come online.

While the economic growth associated with these plants is generally desirable, they present new challenges. Many will require additional generation and new transmission lines and associated equipment upgrades that represent a substantial investment by the utility responsible for serving that location, an investment that may be difficult to recover if the ethanol plant in question does not develop into the projected load or is not economically sustainable. The result could be the construction of new generation, transmission lines, and other system upgrades at locations where they are not needed in the long run.

The potential issues associated with ethanol plants are not unique to electric utilities. Plants may require the construction of new roads, new rail facilities, new gas pipelines, and other infrastructure investments, depending upon where they

[14] A map showing the existing and proposed ethanol plants can be found at http://www.iowacorn.org/ethanol/ethanol_8.html.

are located. Because this is not a transmission-specific issue, it is beyond the scope of this proposal, but it may be appropriate for the State to study issues related to these plants.

VI. Security and safety

The security of the transmission system is, in part, a function of the security of the generating system. In Iowa, a reasonably diverse generation portfolio, in terms of fuel and geography, is an important factor in preventing transmission system problems. In 2004, the percentage breakdown of Iowa's electric generation, according to primary fuel or energy source, was as follows.[15]

Primary Fuel or Energy Source	2004 Percent Share
Coal	81.6%
Petroleum	0.3%
Natural Gas	1.9%
Nuclear	11.4%
Hydroelectric	2.2%
Other Renewable	2.7%

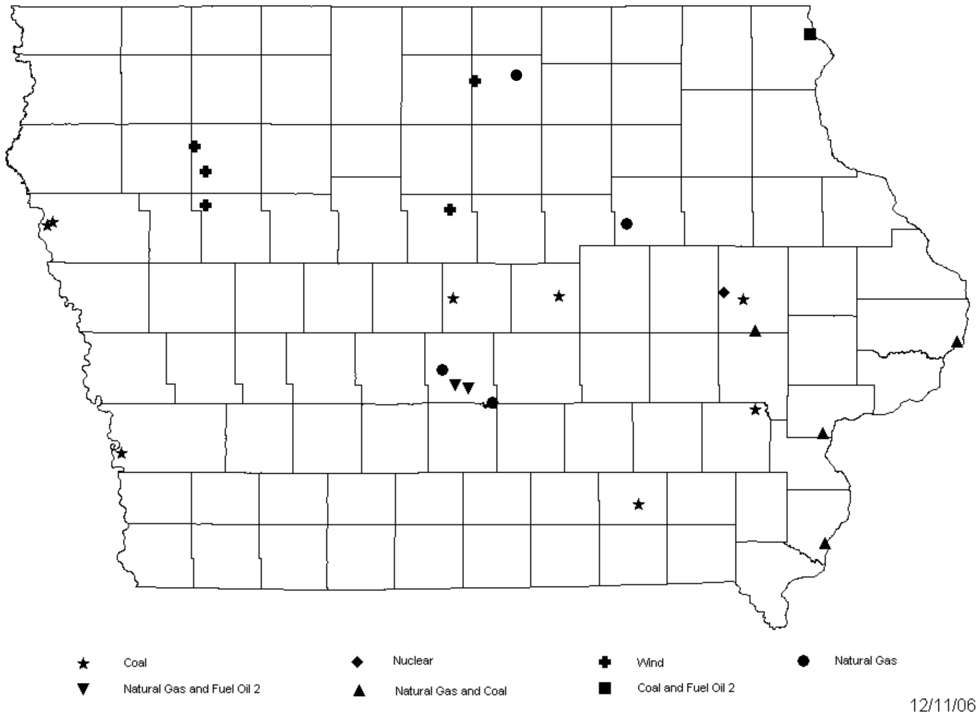
The fuel source of base load electric generation that supplies most of the electricity in Iowa is low sulfur Wyoming coal, delivered by rail. Major power plant operators maintain a supply of coal at each station allowing them to adequately manage rare interruptions in railroad deliveries. Intermediate power plants primarily operate on natural gas as a fuel and are typically used during the warmer months when gas supplies are not required for heating purposes. The major electric providers in Iowa operate with a reserve capacity margin of approximately 15 percent that provides protection against plant failure even on the highest demand days, normally in the summer months. In recent years the growth of alternate sources of electric generation, primarily wind turbines, provides additional sources of clean low-cost energy. A caveat of wind turbines is they cannot be dispatched (that is, called upon as needed) and electricity cannot be stored in any reasonable quantities. Also, the full MW capacity of a wind generator is not available during system peak load periods. For these reasons, other energy sources must be available to replace wind turbine energy in order to meet customer needs.

These various sources of electric generation are located across Iowa in such a way that it is unlikely a natural or manmade disaster would simultaneously disrupt a major part of the state's electric power supply. The major generating sources (those with a capacity over 100 MW) are shown in the following map:

---

[15] U.S. Department of Energy, Energy Information Administration, State Electricity Profiles 2004, May 2006, p. 75, Table 5.

State of Iowa
Electric Generation over 100 MW



These generation sources are tied together by a robust and highly interconnected transmission grid. The design philosophy used by transmission planners and Iowa utilities has been dispersion so that a loss of one or two transmission paths or generating units does not cripple the system. The grid is designed so that alternate transmission paths will permit the continued flow of electric supplies to customers even if there is a system disruption. This has been demonstrated on a few occasions when segments of the 345 kV transmission system were damaged by summer or winter storms or generating units were unexpectedly unavailable and the delivery of electricity to Iowa customers was uninterrupted.

In the event of a national or major regional electric grid failure, a key to recovery may be “black start” capability, that is, the ability to start a generator independently, without drawing power from the grid. Newer intermediate and peaking electric generators in Iowa have been designed and constructed with black start capability which helps Iowa’s power producers to more quickly restore electric service to the state.

VII. Further study

The Legislature directed the Board to provide information concerning the potential cost of an electric transmission study in Iowa. The proposed study would include the following subjects:

- Examining the reliability and limitations of the primary grid system
- The development of additional small wind projects in all regions of the state
- Issues related to the security of Iowa's energy supply in the event of a national or local emergency affecting the primary grid system

The Board is to provide an estimate of the time needed to complete the study, an estimate of the cost of the study, and any other information the Board believes is necessary.

Two recent studies provide useful information about the cost of an electric transmission study. The first is a study of the transmission costs associated with adding wind generation in the Dakotas; the second is a study of the cost of interconnecting additional wind generation in Minnesota. Neither of these studies was as broad in scope as the proposed Iowa study, but they both touched on some of the issues. Each of these studies cost in excess of $500,000; it is safe to assume that an Iowa study addressing each of the issues identified above would cost more than either of these studies, due to the greater scope.

A. Montana-Dakotas Wind Transmission Study

In 2002 the Western Area Power Administration commissioned a study of the transmission expansion options and projected costs for new transmission associated with the possible construction of 1,000 MW of wind generation capacity in five different areas in the Dakotas. The study was divided into two phases; in Phase 1, the study examined the effects of the new generation and transmission based on the assumption that the resulting energy would be used in the Twin Cities area. In Phase 2, the study assumed that the energy would be used in Wisconsin and in the Iowa/Illinois region. In each phase, five different scenarios were modeled and 20 or more transmission alternatives were studied.

Overall, this was a traditional study of the costs and benefits associated with various additions to the generation and transmission system. It covered only a part of the potential scope of the Iowa project. It cost in excess of $550,000 and took over 6 months to complete.

B. Minnesota Study

In 2005 the Minnesota legislature directed that a "Wind Integration Study" be completed to investigate the impact on reliability and cost that would result from increasing the state's wind generation capacity to 20 percent of its retail electric energy sales by 2020. This was not a transmission study; in fact, the study assumes that the necessary transmission system exists without considering what might be needed. Instead, the focus was on the issues associated with interconnection of wind generation.

Thus, this study also covered only a part of the potential scope of the Iowa project. It cost $700,000 and took over 7 months to complete.

VIII. Conclusion

The Board estimates that an electric transmission system study that addresses each of the issues identified in section 14 of SF 2399 would cost substantially in excess of $1 million and would take at least 6 to 9 months, and possibly longer.

As described above, the electric transmission system is very complex. This means that studies of the system tend to be expensive and take time. The cost and time can be controlled, to an extent, by focusing the study on specific issues, as opposed to conducting a broad study of multiple issues, but doing so runs the risk of missing important relationships and interactions between and among the various issues. Still, it is clear that some issues are more likely to be of value, if a study is to be conducted.

For example, it appears there is little or no reason to conduct a study of the reliability of the electric transmission system in Iowa. Reliability is already being studied on a regular basis by various entities, including the NERC, FERC, MISO, MAPP, and the various transmission system owners and operators. Moreover, the system is designed and built with a reasonable amount of redundancy, such that in past instances where generating units or major transmission lines were unexpectedly forced out of service, the system remained stable and service to customers was maintained.

Economic issues related to the electric transmission system may be a better subject for study, but the answers to the problems are unlikely to be found in Iowa. Questions like who should pay for transmission system upgrades, what upgrades should be required, and who will decide when interested persons disagree, are all regional, if not national, questions that will be answered at FERC or similar national and regional forums.

Finally, the unusual transmission system issues associated with ethanol plants may merit further study. Because each ethanol plant represents a relatively large electric load, and because they are typically being located in rural areas, they frequently require construction of dedicated transmission lines at significant cost. As a general rule, utilities and the other customers of those utilities should not be unfairly burdened with these costs. However, any such study probably should not be limited to electric transmission issues, but should also consider such issues as fuel needs, the possible sharing of steam resources, highway and railroad needs, and similar issues beyond the scope of this proposal.

Appendix A
Renewable Energy In Iowa Since 1983

The Alternate Energy Production (AEP) requirement (Iowa Code §§ 476.41-476.45) was enacted in 1983 to encourage the development of renewable energy facilities by mandating special incentive rates to be paid by utilities for purchases from AEP facilities. Federal law also requires electric utilities to purchase from AEP and other qualifying small power production facilities (QFs) at rates that are based on the utilities' incremental avoided costs.[16] In 1983, Iowa regarded the avoided-cost rates as being too low to encourage AEP development. Therefore, the Iowa AEP statutes were enacted to require utilities to pay higher rates for AEP purchases. The first rules implementing the AEP statutes were adopted by the Board in 1983.[17] However, little renewable-based generation was actually brought on-line in Iowa until 1995, due to economic factors and utility resistance.

---

[16] Avoided costs are what the utility would otherwise pay to produce the same electricity itself, or purchase it from another source. Under federal law (i.e., the Public Utility Regulatory Policies Act of 1978, or PURPA), each utility is required to interconnect with AEP facilities and other QFs, and purchase electricity from them at rates based on the utility's avoided costs. For rate-regulated utilities, avoided-cost rates are determined by state public utility commissions (for non-rate-regulated utilities, the rates are determined by the FERC).

Under Board rules, each rate-regulated utility is required to file standard avoided-cost rates for small QFs with a design capacity of 100 kW or less (199 IAC 15.5(3)). For facilities larger than 100 kW, the avoided-cost rates are to be determined in contested case proceedings before the Board, unless otherwise agreed to by the utility and QF (199 IAC 15.5(4)).

Under recent changes in federal law, a utility can be relieved of its PURPA purchase obligation, for QFs larger than 20 MW, if it can successfully demonstrate that QFs in its service territory have non-discriminatory access to competitive wholesale power markets.

[17] The rules required utilities to pay a statewide incentive rate of 6.5 cents per kWh for their AEP purchases. This mandated statewide rate was challenged by Iowa utilities and was eventually overturned by the Iowa Supreme Court in 1987. The Court ruled that the rules went beyond the AEP statutes by setting a statewide AEP rate rather than utility-specific rates, and by disregarding specific ratemaking factors listed in the statutes. The Court also ruled that the AEP statutes could not be applied to non-rate regulated utilities (i.e., generally municipal utilities and cooperatives).

The IUB proposed new rules to establish mandated AEP purchase rates that would be high enough to encourage AEP development, based on the statute's ratemaking factors. However, this goal could not be accomplished under the provisions of the original statutes. Statutory changes were needed in order to establish utility purchase rates high enough to encourage AEP developers. These statutory changes were enacted in 1990: 1) allowing the Board to set statewide AEP purchase rates; 2) changing the definition of "next generating plant" to be the "electric utility's next coal-fired base load electric generating plant, whether planned or not, based on current technology and undiscounted current cost"; and 3) allowing the Board to consider environmental and economic externality factors. A further provision limited each utility's AEP purchase obligation to 15 MW. At the time, Iowa had seven investor-owned, rate-regulated utilities. This meant the total AEP purchase obligation was 105 MW. The IUB implemented the statutory changes through rules adopted in 1991. The IUB rules established mandatory statewide AEP purchase rates based on the revised statutory ratemaking factors. The rates were adjustable, according to the length of the AEP contract, up to a maximum of 6 cents per kWh.

In 1992, each utility's AEP purchase obligation was changed to a proportional share of 105 MW, based on each utility's share of their combined Iowa electric peak demand. The IUB implemented this change through rules adopted in 1993.

In 1997, the FERC overturned the higher AEP purchase rates mandated by the AEP statute and Board rules, to the extent they required utilities to pay more than avoided cost for AEP purchases. However, the FERC also ruled that the AEP statutes and rules could require utilities to make specific purchases from AEP facilities. Therefore, in a separate proceeding the IUB required the investor-owned utilities (IOUs) to fulfill the remainder of their statutory 105 MW AEP purchase obligation, by a date-certain, without setting the rates they should pay. The IOUs responded by entering into several AEP purchase contracts, selected through competitive bidding. Most of the 105 MW purchase obligation was fulfilled through contracts with large wind farms in 1997 and 1998.

About the same time that the FERC overturned Iowa's AEP purchase rate concept, Iowa's policy focus began to shift toward providing direct incentives to renewable developers, especially for wind energy development. In 1996, the Alternate Energy Revolving Loan Program (Iowa Code Section 476.46) was enacted to provide low-interest loan incentives for development of small AEPs. The Revolving Loan Program is administered by the Iowa Energy Center. The state also provided tax incentives in the form of sales and property tax exemptions for wind generation and wind generation equipment. These incentives, combined with federal production tax incentives, improvements in wind generation operating efficiency, and per-unit cost reductions, began to make wind projects more economically viable. As a result, Iowa utilities began contracting for and building additional wind generation beyond the statutory 105 MW AEP obligation.

In 2001, Iowa enacted legislation to encourage utilities to build new electric generating capacity, including renewable generation. This change authorized the Board to grant rate-regulated utilities "advance ratemaking principles" for their proposed generation plants, prior to seeking cost recovery in a rate case. The purpose was to give utilities assurance in advance about the ratemaking treatment they could expect for new plant, reducing the regulatory risk. Soon after enactment of these changes, MidAmerican sought and obtained advance ratemaking principles for its 360 MW Intrepid and Century wind farms (completed in 2005). In April 2006, MidAmerican obtained advance ratemaking principles for up to 545 MW of additional wind generating capacity (of which 222 MW has been announced for completion by year-end 2006 and 2007).

In 2005, Iowa enacted legislation to provide tax credits for eligible renewable energy facilities, primarily wind generation (Iowa Code Sections 476B and 476C). Total eligibility under the statutes was expanded in 2006. As of November 15, 2006, the IUB had received eligibility applications for large wind farms totaling 390 MW under Iowa Code Section 476B, and for smaller wind projects totaling 224 MW under Iowa Code Section 476C.

Attachment A
Existing Large Wind Farms

Most of Iowa's existing wind generation capacity comes from seven large-scale wind farms located in Iowa's northwest and north-central counties: **838 wind turbines** totaling **818 MW** of generating capacity.

1. **Location:** Buena Vista County (1997-98)
   No. of Turbines: 259 Turbines @ 750 kW each
   Total Capacity: 194.25 MW
   Contracted to: MidAmerican Energy (112.50 MW), Interstate Power & Light (80.25 MW), and Waverly (1.50 MW)

2. **Location:** Cerro Gordo County (1997-98)
   No. of Turbines: 56 Turbines @ 750 kW each
   Total Capacity: 42 MW
   Contracted to: Interstate Power & Light

3. **Location:** Worth County – "Top of Iowa Wind Farm" (2001)
   No. of Turbines: 89 Turbines @ 900 kW each
   Total Capacity: 80.10 MW
   Contracted to: Interstate Power & Light (used to meet Wisconsin renewable energy requirements)

4. **Location:** Hancock County (2002)
   No. of Turbines: 148 Turbines @ 660 kW each
   Total Capacity: 97.68 MW
   Contracted to: Interstate Power & Light (80.52 MW) and other purchasers (17.16 MW)

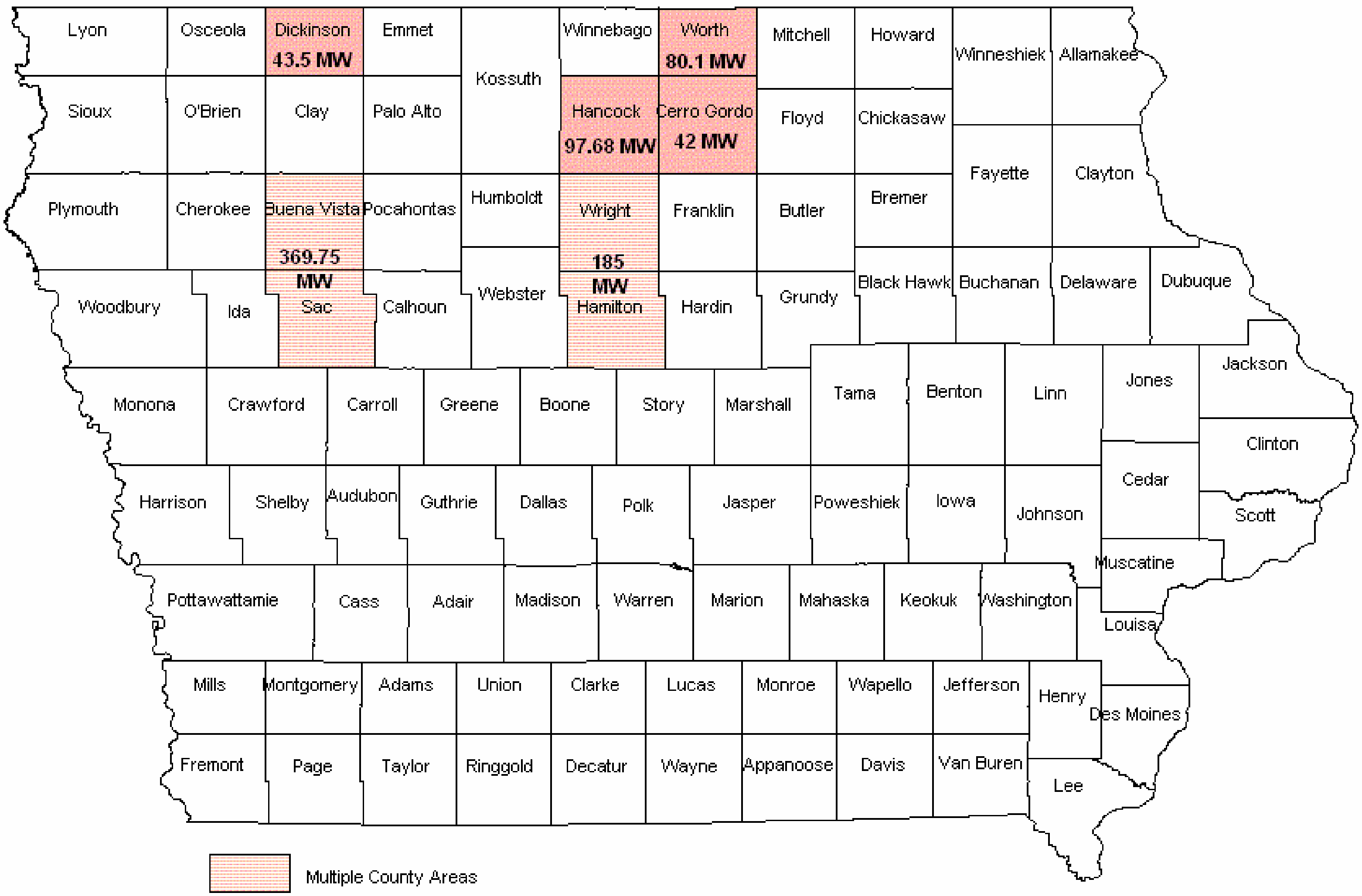
5. **Location:** Dickinson County (2003)
   No. of Turbines: 29 Turbines @ 1.5 MW each
   Total Capacity: 43.50 MW
   Contracted to: Interstate Power & Light

6. **Locations:** Hamilton/Wright Counties – "Century" (2005)
   No. of Turbines: 100 Turbines @ 1.5 MW / 35 Turbines @ 1 MW
   Total Capacity: 185 MW
   Owned by: MidAmerican Energy

7. **Locations:** Buena Vista/Sac Counties – "Intrepid" (2005)
   No. of Turbines: 107 Turbines @ 1.5 MW / 15 Turbines @ 1 MW
   Total Capacity: 175.5 MW
   Owned by: MidAmerican Energy

Attachment A - Map

Existing Large Wind Farms



Attachment B
Planned and Proposed Wind Projects

County Location	MidAmerican Planned Large Wind Farms MW	Iowa Code 476B Proposed Large Wind Farms MW	Iowa Code 476C Proposed Small Wind Projects MW
Buena Vista			2.50
Calhoun			2.10
Crawford/ Carroll	99.00		25.00
Cerro Gordo			17.50
Dickinson/ Emmet		160.00	47.20
Franklin			69.30
Greene			16.35
Guthrie			2.10
Hancock			6.65
Mitchell			1.65
Osceola		150.00	5.00
Palo Alto			25.00
Pocahontas	123.00		
Story			1.25
Winneshiek			2.50
Worth		80.00	
IOWA TOTALS	***222.00***	***390.00***	***224.10***

Attachment B - Map

Planned and Prosposed Wind Projects