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A Study of Rural Iowans' Challenges and Benefits in Buying and Owning a Wind Turbine as Their Source of Renewable Energy

Garth LeFevre
University of Northern Iowa

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Abstract

The purpose of this study is to interview Iowans to show some of the dramatic unforeseen problems people have trying to put up a wind turbine:

1. What were the problems or misconceptions people had with the State of Iowa government, their county/city government, and their local REC?

2. What were the big hurdles they had to deal with in construction?

3. What incentives, grants or loans, if any, were used to finance their project?

4. And what are the benefits received by putting the turbine up?

A STUDY OF RURAL IOWANS' CHALLENGES AND BENEFITS IN BUYING AND OWNING A WIND TURBINE AS THEIR SOURCE OF RENEWABLE ENERGY

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Garth LeFevre

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Dr. Recayi (Reg) Pecen (Advisor) — 12/12/2008 (Date)

Dr. Shahram Varzavand (Graduate Faculty Member) — 12/17/2008 (Date)

TABLE OF CONTENTS

Introduction

Statement of the Problem

The gas shortages in the 1970's lead the United States to push for renewable fuels research. One solution was the wind turbine, and it did not take long before wind farms were being built in California, Texas and other states. These turbines were large and cost several hundred thousand dollars. Only business and corporations could afford these large investments. There were few turbine manufacturers that built for residential or farm use at that time. Those that did provide turbines provided no real data testing results to the public to prove that the customer was receiving a quality product. Several turbine manufacturers had a strong hold in the 1970's and disappeared in the 1980's. Even today, a lot of steel tower landmarks of yesterday are still standing motionless and quiet towering over our heads.

With gas prices 400% higher in the summer 0f 2008 than in the 1970's people are searching for alternative energy for their homes and farms. With our presidential candidates and the Iowa State governor today campaigning for renewable energy research and expansion, we the people are also motivated to support this research and expansion. When it comes to electricity by means of photovoltaic cells, wind turbines or hydro, there are several stumbling blocks for individuals and families to conquer. One misconception is that obtaining and having a working turbine is a short term adventure but in reality could take years. In the state of Iowa, rural energy distribution was broken out so that no one company could price gouge energy cost. Therefore with 99 counties in Iowa, some will have different requirements for individuals to have a renewable energy facility,

depending on what rural energy company (REC), the county has. So there is no guarantee that just because people want to create their own energy that the REC will allow people to be connected on the public grid.

Interviewing people across the state of Iowa, I have listened to how people are frustrated with all the paper work, research, and costs, only to give up because the time on return of investment is extremely long or not feasible at all. Others have invested the time and money but are not receiving the benefits which they were expecting and now are ready to sell out.

Problem of Study

The problem of this study is to find commonalities in the hardships and misconceptions of trying to obtain a wind turbine for a renewable energy facility here in the State of Iowa.

Purpose of Study

The purpose of this study is to interview Iowans to show some of the dramatic unforeseen problems people have trying to put up a wind turbine:

1. What were the problems or misconceptions people had with the State of Iowa government, their county/city government, and their local REC?
2. What were the big hurdles they had to deal with in construction?
3. What incentives, grants or loans, if any, were used to finance their project?
4. And what are the benefits received by putting the turbine up?

Need for the Study

Because of high energy costs today, many people are becoming more and more financially strapped, concerned about global warming and the effects of air pollution.

They are also having a tough time trying to get a wind turbine to help reduce their energy bills. Because of the nation's lack of prior investments into renewable energy sources, people are finding themselves being the first ones carving the way through the politics to make standards for the wind energy industry. People are having a hard time trying to find outside sources to help aid in the difficulties of completing an application and an agreement with a REC, to buy back energy produced by the individual. The difficulty comes because there are RECs that have never had another energy facility in the county except themselves. This study will help people get a better understanding of what steps to go though to obtain a wind turbine and have a better chance of increasing the level of a faster return on investment.

Assumptions

This is a list of assumptions that were identified at the beginning and over the course of this study by means of interviewing people:

1. On the average the turbine will produce the amount of energy that it was intentionally sold for.
2. The period of time that people will spend to complete any applications for the purpose of having a turbine would be short.
3. Individuals will get full credit back on their energy produced from REC.
4. No external or hidden costs will be added besides the purchase and installation price of the turbine.
5. Financing will be easy with good credit.
6. The complete project will just take a few months.
7. The return on investment will be matched by the end of the loan period.

8. The dealer will stay in business through the term of the loan.
9. There is no need for lawyers for any reason.
10. There will be preventive maintenance and a service agreement for the turbine and controls.

Limitations of the study

This study was based on the following limitations:

1. Studies were done only in central and eastern Iowa because of lower wind classes in Iowa yielding a longer expectancy on return of investment.
2. Choices for the case studies were only rural residential and farms.
3. 100 foot or taller tower for larger kWh applications were chosen.
4. City residential applications were excluded because of smaller kWh sizes.

Review of Literature

The main emphasis to start my research was the subject of renewable energy resources within the State of Iowa, and the most talked about topic was wind energy. On several occasions, for several months, prior to my research, I talked with several people about wind energy at public forums, individual's homes, conventions, and at social and work environments, before ever starting my research and investigation into Iowa's individual renewable energy facility problems. As I listened to people on what the major issues and problems they had trying to reach their goals, I made a final decision to do my research on the difficulties Iowans were having getting a wind turbine financed, fully operational, and trying to meet a return on investment that was realistic to them and their financial lenders.

I began my review of literature by searching web sites on what kinds of information were applicable to buying a wind turbine. I looked at turbine manufacturers, online energy periodicals, like Home Power Magazine (2007), turbine testing facilities like National Renewable Energy Laboratory (2008), and the Iowa Energy Center (IEC) (2008). When I contacted IEC, I got a list of people who had purchase a turbine with the help of IEC's revolving loan program. I talked with them on the phone and then made a questionnaire to cover all my case studies. See appendix F for the questionnaire. Once the questionnaire was done I met with these people and I recorded their answers to the questions in general terms. I then went back home and studied what they had told me and the answers to the questions. The main focus for the questionnaire was to help find commonalties among the groups for problems here in Iowa. Once these problems were identified, I continued searching the web to find out if it was just my case studies' problems or was it a broader problem.

In my overview of literature, I did find turbine manufacturers had the general information about their products and the technical specs needed to size up the correct unit for a homeowners application. There are very few turbine manufacturers who publish testing results for their units to the public. It is left to the consumer to find any test results that were done, like with Southwest Windpower's "Storm," now called "Skystream" (Migliore & Green, 2005), and the duration report on the Bergey at NREL (van Dam, Meadors, & Link, 2003). I did find a commentary (Gipe, 2003) on the Skystream that was very helpful that lead me back to the web searching for more technical information. Another great benefit of public information was the production chart from Endurance that showed an actual comparison between their product, the Endurance, and the Enertech

Turbines which have been in operation for more than 20 years in several applications around the world (Endurance, 2008). See Chart C4 in Appendix C for results. There is a great need to have more of these informational sites to help teach people in buying a quality product that is tested and proven. I talked with NREL and they told me that there are volunteer turbine manufacturers that are working with NREL to produce some standards that manufactures must meet (www.nrel.gov, 2008).

During my research, I never did find any helpful information on how or what is needed for an energy agreement with the local utility company. I found that in one county here in Iowa, some farmers were told by their local REC that the REC would never allow a grid tie agreement. Because of the lack of published information, the public as a whole does not know that they should first see if their local REC will even agree to an energy contract before looking at purchasing a turbine. The RECs in Iowa must put out some kind of public information on guidelines on an energy agreement contract to help customers make sound and concrete decisions in starting a renewable energy facility, that not only would help secure the energy needs of the family, but also help reduce the demand for energy from state and national facilities.

That is why this research is so important. I have shown the misconceptions that people have on wind energy estimates in my case studies and shown actual documentation for energy applications and agreements with REC's. I have uncovered the problems of extensive repair times, cost and service agreements that are very short term through the dealer or manufacturer. I have displayed liability contracts, showing just one of the items the REC requires for a grid tie agreement, and USDA grants and loans for help in financing.

There is very little published that helps show an individual what it really takes to get a wind turbine on the grid. This document covers many aspects, pro's and con's, giving the reader first hand knowledge and examples, valuable information, and web sites to help in jumping those hurdles that can possibly make or break the decision for an individual purchasing a wind energy facility.

Procedure of Study

The procedure for this study was as follows;

Preliminary Research

The preliminary research consisted of three parts: (a), investigated web sites, brochures, magazines, pamphlets, journals on wind turbine usage in Iowa for residential and farm use, for the purpose of designing a questionnaire and (b), contacted the Iowa Energy Center (IEC), for permission to interview people who used the Iowa Alternate Energy Revolving Loan Program for the purpose of buying a wind turbine.
(c), Interviewed Iowans by phone who were on the IEC list and talked about their completed or in progress projects for data to use in the questionnaire.

Pilot Test of Questionnaire

Created a Beta type questionnaire and chose 5 families in different parts of Iowa to try it out. Interviewed each family at the turbine's location and presented them with the questionnaire. After the questionnaire was completed it was analyzed to find commonalities in their processes to get a turbine. After a list of commonalities was written, further research was done on the web, brochures, magazines, and journals for commonalities on schools and businesses, to see if they might share those same

commonalities of the 5 case studies. The questionnaire was rewritten and can be seen in Appendix F.

Data Collection

Visited each site and interviewed the people again. Collected monthly turbines kWh results, written REC applications and agreement documentation, took pictures, and recorded their answers on questionnaire. Data was collected from January 2007 until September 2008.

Follow up

Reviewed all the data for each case study with the families to make sure it was accurate. Then produced a rough draft of the report and dispersed backed to the families for feedback. Made adjustments to the final report and talked about possible solutions to help the efficiency of their systems. Final report is completed.

Findings

This is a complete list of my findings from my research in no special order. These findings related to common problems people here in Iowa have buying and owning a renewable energy facility.

1. People had somewhat hard time getting the turbine on time
2. Financing was difficult or wasn't achievable at all
3. Utility company agreements were hard to understand and applications were very time consuming
4. Installations were not timely
5. Return on investments are longer than previously planned
6. Costly repairs for most of the projects.

7. Considerable down time for repairs
8. Complicated warranty issues for lightning, ice storms, tornados, etc.
9. No service contracts
10. Replacement parts were hard to get
11. Long hours of paper work
12. Misconception of precise wind energy estimates
13. Very little incentives and grants
14. Very little documentation on turbine tested performance
15. Minimal maintenance agreements

Discussion of Findings

Turbine Dealer

In every case the dealer tried to be helpful to the customer in their process of obtaining a renewable energy facility. But not one dealer told customers the hard facts of the wind assessments in Iowa or the complications for serviceability. There was not one dealer who checked the efficiency of the system once it was completed. This is done by comparing what the turbine is producing on the output side and what the controller is putting on the grid. As long as there is a wind speed higher than the rated cut-in speed and lower than the cut-out speed, measurements can be checked. If possible three readings should be done: (a), cut-in speed taking an average over a given amount of samples (b), a midrange speed again taking an average for the same amount of samples and (c), a high wind speed but not cut-out speed, taking an average over a given amount of samples. Measurements also need to be done at the same time on the output side of the controller to the grid. This could be unsafe if the appropriate safety equipment is not

used for all readings, so only qualified electricians who are not afraid of heights should do this job. Fact is, people are purchasing turbine systems not knowing what kind of efficiency they are getting. The turbine manufacturer publishes the efficiency rating for a given system but this does not get communicated to the customer. Only Matt (by doing it himself) monitors the efficiency of his system. For the others, they have not been able to find a service company in Iowa to do such a job, or have been refused by the dealer or manufacturer.

The Garrett's and the Wahl's both have an excessively long length of wire from their turbine to the controller installed by the dealer. In both cases it was determined by the dealer that the controller locations were acceptable for an efficient system. The length between Garrett's turbine and controller is approximately 450 feet. Wahl's is approximately 400 feet to their controller mounted in the garage. A general overview for wiring is to be large enough so not to have a line loss for lines 300 feet or shorter. The ideal location for the controller is to be mounted at the base of the turbines tower. The greater the length of wire the more power is lost for that given size wire.

Garrett's, Widmer's and Peterson's having a Jacobs turbine need to have an environmentally controlled room to keep an efficient system running. Garrett's controls are mounted in the bathroom where there is high humidity and condensation present sometimes in the hog confinement building. When the first electronic board failed and was sent to get repaired, the vendor made the reply that there was corrosion on the board. Nothing was changed after the repaired board was reinstalled. The Jacobs controller operating humidity range is 0 – 90% relative humidity without condensation.

Widmer's controls are mounted at the base of the tower but the Jacobs controller's operating temperature range is 35 – 110 degrees Fahrenheit. There is no heater to keep it warm in the winter and no cooler to keep it cool in the summer. The dealer gave no input on these problems for Garretts and Widmer turbine systems. With these design problems efficiency will be affected. Peterson has his Jacobs controller in an environmentally controlled building and has had no problems with temperature or humidity.

For Matt and the Wahls, Matt's system has a greater operating temperature range and is located outside in a controller cabinet and Wahl's controller is in a controlled temperature garage. There are pictures for all the case studies except the Garretts, which I could not get because of the close confinements of the bathroom.

Applications and Agreements with RECs

For the four different RECs in this study, all of them had a different policy for a renewable energy facility. There were application fees for Garretts, Widmers, and Matt. All case studies had to carry some liability insurance ranging from $300,000 to $1,000,000 with each case study having a different monthly utility basic service charge.

Peterson and Matt were required to give more detailed information on site location, turbine specifics with circuit designs, construction layouts, drawing details with grid connection requirements and larger liability insurance rates for the grid connection.

The application for parallel operation with the Wahl's REC proved to be very complicated and actually the Wahls had to hire a lawyer to overview and assist them in

obtaining the correct documents for them to understand. This proved to be time consuming and costly for them.

Peterson, Matt and Wahls all started with approximately a two cent buy back for their excessive energy from their REC in the beginning. But over time, both Matt and Wahls are on net-metering like Garretts and Widmers. But it took several years, in Wahl's case it took five years and Matt's case it took over 3 years to achieve net-metering. Peterson is on net-metering today but for a commercial business and still receiving approximately two cents per kW.

Only Matt is receiving an incentive for payback of excessive energy through the Energy Wise Renewable Program given by his local REC. This incentive is not included in his agreement with the REC and is a separate entity. See the appendixes for the variation in agreements contracts, as these were up-to-date when this report was done.

Matt and Garretts did not release a copy of their agreements but Garretts said theirs is real close to what the Widmers have.

Wind Studies and the Iowa Energy Center

For the people who are looking for financing, IEC is a large benefit. It is one of few incentives the State of Iowa has to offer. It promotes a no interest loan for half of the turbine's cost, providing the other half is secured through some other means. Application forms were not confusing and the service is good. The main problem that arises is the complete misinterpretation of the wind energy estimates from the wind assessment and calculator web page. Some people just do not understand how to do research for a good wind study and analysis of that data. None of the case studies wanted to do a year long wind study using an anemometer mounted in the location and at the actual height the

turbine would be located. The main idea was it was costly and it would take a year. Every case study group knew that wind characteristics change from year to year but a good study would take longer than a year and no one wanted to do this. So they use the IEC wind assessment to look at a return on investment. As I stated in the case studies, and shown in the comparison charts, people used the IEC Wind Turbine Output Results as a basis for determining their return on investment decision. In every case that did this, all found out after one year that their actual turbine output was lower than the IEC's results. This brought up the question in my interviews, "Why are my results lower than expected and how long will my return be on investment now?" With no real data from a wind study at the actual location using an anemometer everyone except Matt used the IEC wind calculator as a precise wind analysis. But on IEC's website it clearly states that there are errors because of measuring instrumentation, mapping techniques and corrections for long-term studies. Matt with ten years being involved with wind energy was familiar with the IEC's website and knew of the error in wind assessment.

Matt talked with a family who had a turbine before in Butler county and used the county wind readings found on the web and by calling the Butler county offices. I explain this in greater detail in each case study under the appendix.

Turbine Delivery

In one case, the Garretts ordered their turbine in the summer of 2005, which was to be delivered in November 2005. Wind Turbine Industries Corp. (WTIC) called in September 2005 and told the Garretts that the turbine wouldn't be done till the spring of 2006. It finally arrived at the location in May 2006. This pushed the whole project back,

costing the Garretts production time and investment returns. So to help offset that cost, the Garretts did some of the construction themselves in the fall of 2005.

The Widmers, knowing what the Garretts went through to get their turbine, had a chance to buy a turbine right away from WTIC with one problem, WTIC could not deliver it to Widmer's location. So Widmers in January 2007, had to drive to the factory themselves with their truck and trailer and haul the turbine back to Iowa, unload it, and keep it out of the weather till spring of 2007. In Iowa, January through May is a windy part of the year, so the turbine finally became operational June 2007.

For Matts, Petersons, and Wahls, their installations took about a year each for different reasons. Matt's had purchased an older and larger turbine which needed repair and in some cases redesign. Documentation was scarce and some on the back of table napkins. But Matt's technical knowledge could get the Enertech operational again. For Petersons and Wahls, they also bought used turbines and found themselves at the mercy of their dealers to get things done in a reasonable amount of time. Both were dissatisfied with their dealers' professional services to get the systems operational.

In other interviews and in my research I found that if you want to order a turbine today, expect it will take a considerable amount of time before you get it to your site no matter what size you want.

Service

Not in one case did people get the service they expected for the money they spent. In every case they hoped that there was service to the point that their system was calibrated and was efficient. But in no one case was there anyone who followed up and showed evidence that their system was producing the energy that the wind was providing.

The only case is with Matt, who has made it his personal ambition to make wind energy work for his advantage. He is his own service maintenance company by means of self- taught experience. For the rest in this study, they have only found people who will change oil in the gear cases and tighten any loose bolts or cables in the towers. When a turbine breaks down, the owners are left to troubleshoot the problem over the phone with the manufacturer. If it is still under warranty, they are left to do the repairs or pay someone else if they can find them. The Garretts had to hire a different vendor to just change the gearbox oil and tighten the bolts on the tower. Wind Energy Booster Inc. who sold them the turbine the year before said they did not have anybody employed that could climb towers so could not offer that service. Garretts believed that service from Wind Energy Booster Inc. would be much better and that's one of the reasons they bought the turbine to begin with. At the time this report was written Widmers were coming upon the maintenance date for their oil change and tightening of the bolts on the tower. Widmer was going to ask Wind Energy Booster Inc. to do it and hoped that by now they had hired someone that could do this. Otherwise Widmer would have to call the same vendor which serviced Garrett's turbine and pay for travel time because the vendor was located in southeast Iowa.

In no case was there a reasonable period of time to get parts repaired. The lengthy period of time that it takes to get parts repaired only added extra cost because there was no production of energy during this time. For Peterson, simple bolts breaking in the tail cost 6 months to get fixed and more than a thousand dollars and the welder and labor was free. It was the crane service that was the major cost. Partly the reason for the long period of time was months of inclement weather and trying to get a

crane after the devastation of 2008 floods. But when his turbine was torn down by a tornado in 2002, he was out of service for a year. He has had no service person to calibrate his blades or inspect his controller. Peterson is part of a group of turbine owners who share parts to keep in business as long as they find someone to help. This helps minimize the long time for pcb's and other parts getting repaired by the factory or outside vendor.

Financing, Incentives and Grants

In the case studies which I performed, the only incentive people found from their research was the Energy Wise Renewable Program from Butler County REC and used by Matt. The Iowa Alternate Energy Revolving Loan Program (AERLP) from the Iowa Energy Center is used by the Garretts, Widmers, and the Petersons.

The only grant program was the United States Department of Agriculture (USDA) of Rural Developments Renewable Energy Systems. This is used by the Garretts and Widmers.

The only other incentive program was the Efficiency Improvements Loan Program which the Garretts used through the USDA. The Wahl family has no incentives or special loans or grants of any kind. They paid for their project by out of pocket expenses.

This study is not saying that this is all the help that the State of Iowa or the U.S. Government has to offer, but through all the interviews and literature research for those counties in Iowa involved in this research, there was no other financial help. Filling out all the paperwork took over 40-50 hours to complete for all who used the USDA grant and loan programs. Qualified candidates can contact the regional USDA office for that county to find an underwriter that can do the forms in one day, for a service fee. No one

knew this service was available until this study was done. The USDA underwriters can answer any questions that people have and make the problem of trying to get any financing less hectic and worry free.

For Peterson and Widmer that used a bank to help finance their turbines, they said that the banks were reluctant to loan the money because the bank considered it to be a high risk. The banks response was that it wasn't a question of having good credit, but it was the past history on other people's loans that had turbines and those people having difficulty paying the loan back for one reason or another. This resulted in a higher percentage of interest in both cases. But with the no interest loan from AERLP for 10 years made it possible to make a lower payment which was affordable by Peterson and Widmer. One of the key points is that a person cannot pay more money on the higher interest loan to help lower the interest obtained. Payments must be shared equally between the AERLP and the financing bank note. Another point the Widmers and Petersons made was that there would be no refinancing of the loan at a later date, in other words the interest rate was fixed and not variable though the period of the loan.

I have touched on the topics which I listed in my findings here, but I give more detail in each of the five case studies in their independent appendixes. Key information is listed and explained for that particular individuals study.

Conclusion

From this study I concluded that there is one key term, long time. Almost all of my recommendations deal with long time commitment, thought, investment, return on investment, maintenance and service and long time ownership. There are five

recommendations that must be thoroughly investigated before ever buying a turbine large enough for a grid tie energy facility:

Recommendation 1: One must know the requirements needed for a grid tie agreement with their local REC for either a net-metering or an excessive energy buyback agreement. If a renewable energy facility owner is conservative on the size of their facility at the beginning of a REC agreement, the owner should make sure that there is the possibility for growth in energy production for the future, since their investment is for ten or more years and our energy consumption goes up on the average from increasing family size and larger buildings. The owner needs to spend some time to find anyone else in their county that already has an agreement or is going through the process with the REC for an agreement and ask if they may look at their application and agreement. A list is available at the local REC on what renewable energy facilities are in the county. People who are inspired to have renewable energy facilities tend to help other people who also want to have renewable energy sources. In this study, anyone in my case studies would be very glad to help answer any questions or give information on where to find an answer.

Recommendation 2: Wind power planners should take time to gather enough data on wind speeds at the proposed turbine site by means of anemometers, rented or purchased through various clubs and colleges here in Iowa. Other options are wind statistics that are available at the local weather station or any other local and national weather resources for that area. For the most accurate wind site study, use an anemometer positioned at the height and exact location as the proposed turbine. Collect enough wind data to analyze what was received for the period of time by the anemometer and only compare other data

sources for the exact same period of time. The longer the period of time, like several years, the chances of a sound secure decision on investing in an energy facility can be done with very minimal risks. We should keep in mind any long term landscape changes, new buildings, new orchards or wind breaks or the possibility of a new subdivision being developed will also affect wind power, so tower height might play a very big part of the wind study.

Recommendation 3: Finding a dependable, service oriented turbine manufacturer/dealer is very important. Check the dealer's background and don't be afraid to ask for a list of customers who have purchased a turbine or service/maintenance agreement, (controls, tower or turbine). Spend some considerable time looking into what products a manufacturer makes and where their sales are, USA or elsewhere. Look for any information on those products as far as a consumer's point of interest. Possibilities are any magazine articles, business consumer articles or any renewable energy clubs or society articles. Look at different states in the U.S. for information on state studies on turbines for state incentives. States will have requirements for incentives and possibly a list of qualified turbine manufacturers. Is the dealers location accessible when needed? Is it easy to talk with them or hard to get a hold of them?

For Peterson it proved that with his dealer being only one state away it was hard to get repairs and service for one reason or another. For Garrett's and Widmer's, their dealer was in the same county but did not have the experience in their employees to give the service which was needed for basic repairs and maintenance.

Be positive and clear on the fact that the dealer is selling what is needed and it is a quality product with continuous service for the duration of the loan.

Recommendation 4: We should make every effort to have a service/maintenance agreement with a turbine manufacturer/dealer that once the system is fully functional, a system efficiency test is performed and the control system is designed to give the maximum efficiency for which it was designed. Installations by dealers need to meet or exceed the manufacturers' specifications for mechanical and electrical systems. Garrett's had their controls mounted in the bathroom of their hog confinement which has condensation at times. This is a hazard to the controls and the dealer made no adjustments once the print circuit board broke down under the warranty period. Dealers need to always make it right even if it is after the warranty period and always keep service second to none.

Recommendation 5: Iowa REC's need to work better and be supportive to the present and future small renewable energy facilities. REC's need to market incentives and publish renewable energy information in terms that everyone can understand. The REC needs to show the same technical support to small wind facilities as the larger wind facilities. If REC newsletters and public pamphlets were sent out to local county people showing pictures and information of existing facilities like Butler county REC did with Matt's interview in the Butler REC newsletter, this would help educate more people on wind energy. And that is a good feature that the REC needs to do.

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