FINAL REPORT

U.S. Department of Energy

Grant DE-EE-002512

Wind Resources on Tribal Land

Iowa Tribe of Oklahoma

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Wind Resource on Tribal Land Project

1 Executive Summary

The Iowa Tribe of Oklahoma has ambitious goals of energy self- sufficiency. The overall objective of the Wind Resource on Tribal Land grant was to conduct a wind resource assessment in order to quantify the wind resource potential available on the Iowa Tribe's land. A successful wind resource assessment for the Iowa Tribe would provide the data needed to implement a viable and effective commercial wind energy project which would allow the Tribe to be energy independent and offer an additional revenue stream.

The scope of the grant was to determine the feasibility of a utility scale wind energy project on Tribal Lands. Under a Department of Energy (DOE) grant (DE-EE-002512), AWS Truepower was retained by BKJ Solutions Inc. to perform detailed studies to develop methodology and compare the economics of commercial renewable generation procurement options and distributed generation. These studies compare the economic viability of stand-alone and utility grade wind and solar power generation systems when compared to the Tribe's connected meter loads as documented by Central Rural Electric Cooperative (CREC).

The wind studies evaluate procurement options in three test sites. Wind resource data collection began on site 1 in November 2011 at a single 60-meter measurement mast (designated Mast 0149) located near Fallis, Oklahoma. A SoDAR unit was also installed at the site which was being used to extrapolate the data collected from the MET tower. After monitoring the wind at the MET site for approximately 9 months and conducting correlations with long-term data, it was determined that the wind resource in the area was not likely to be sufficient for a utility-scale wind project.

A new area for a proposed project site was identified using a wind resource map that was created to identify areas in the vicinity with higher wind speeds. This map was overlayed on tribal parcels to determine if the projected wind speeds at parcels associated with the tribal parcels could potentially support a utility scale wind project. The new area was located approximately 20 miles north-northeast of the MET mast in Fallis. The conclusions drawn as a result of the study determined that site 2 was not economically viable for utility grade wind generation.

During the course of determining feasibility for utility scale wind on Tribal lands, the Tribe became interested in exploring whether small wind could help the Tribe not only reduce third party utility costs, but also help to build a sustainable model for the future. As information was collected and analyzed for the utility feasibility project, additional information was collected and analysis was performed to determine self-generation.

The project was extended to evaluate the Iowa Tribal Complex as a small wind distribution generation option. Research from the National Renewable Energy Laboratory for the DOE maps the Oklahoma annual wind power at 50-m height, which conclusively shows the tribal complex has poor to marginal wind resource potential.

2 Background

The Iowa Tribe of Oklahoma is a federally recognized Indian Tribe eligible for the special programs and services provided by the United States to Indian Tribes. In 1883, an Iowa reservation was created in Indian Territory (Oklahoma) in parts of what is now Lincoln, Logan, Oklahoma and Payne Counties, and encompasses an area of approximately 1250 square miles. Of the 39 Tribes that are located in Oklahoma, the Iowa Tribe is one the smallest with an enrollment membership of 818 (March 2015). The Tribe was organized under a Tribal constitution drafted pursuant to the Thomas-Rogers Oklahoma Indian Welfare Act of 1936. The Tribal constitution empowers a five member elected Business Committee with the authority to act on behalf of the Tribe including the right to engage in any business that will further the economic and social development of the Tribe.

Beginning in 2001 the Iowa Tribe of Oklahoma has pursued a goal of energy independence by developing the means to generate energy on Tribal land from a clean self-sustainable source. Significant project milestones to date:

- During 2001-2002, the Iowa Tribe participated in a wind-monitoring program, the Native American Anemometer Loan Program, which was administered by the U.S. Department of Energy – National Renewable Energy Laboratory (NREL).

- From 2004-2007, the Iowa Tribe developed, and adopted by form resolution, a comprehensive Integrated Resource Management Plan (IRMP) to provide management direction for the use and/or protection of natural and cultural resources within Iowa Indian Country. Goals and objectives for the development of Wind Energy are addressed in the IRMP.

- During 2008, the Iowa Tribe hired staff to oversee the Wind Energy Project.

- From August 2008 through 2009, an extensive, and ultimately successful, search for high qualified Technical Consultant was conducted.

- From August 2008 through 2009, detailed project objectives, action steps and preliminary budgets were developed to achieve the long term goal of a commercially wind energy farm to offset the Tribe's electrical loads and sell the excess power back into the grid to provide the much-needed renewable energy source to local utilities and neighboring communities.

2.1 Project Objectives

The goals of the project are specified as follows:

Objective 1: Identify and address technical issues concerning wind energy development.

- Identify issues related to land access and sitings of wind turbines, including installation of assessment equipment, permits, and other considerations specific to Tribal lands.
- Identify electrical interconnection and transmission requirements, constraints, and opportunities.
- Identify issues related to generation of electricity with intermittent wind resources and integration into the electricity supply system.
- Address plans for overcoming wind resource barriers.

Objective 2: Conduct an in-depth feasibility study of wind energy to evaluate the actual value of wind turbine generated energy for the Iowa Tribe and Community.

- The Iowa Tribe needs to install a 60-meter tower along with supporting SoDAR unit in order to further evaluate the wind resources a heights equivalent to a wind generator that is suitable for the Tribe's power needs.
- An analysis of the solar potential resources available will also be studied via a pryanometer attached to the MET tower.
- Perform a preliminary economic (cost) assessment for wind turbines that would be sited on Tribal lands based on wind data and wind turbine performance data.
- Examine and collect information for a hybrid wind turbine/diesel backup system to supply electricity to the Tribal Complex and community. A hybrid wind turbine/diesel back-up system could be engineered to supply the majority of the electrical needs of the Iowa Tribal complex using the available wind resources.

Objective 3: Identify and address environmental issues concerning wind energy development and educate stakeholders about the challenges of implementation.

- Identify and address issues related to noise, visibility, and avian issues.
- Conduct an environmental assessment in preparation for a wind turbine.
    - Establish methods for assessing potential environmental impact.
    - Identify resources and natural resources impacted by wind turbine development.
- Develop recommendations concerning how noise, visibility and avian considerations should be addressed and incorporated into any potential wind energy development in Iowa Indian Country.
- Increase awareness of wind power technologies and their costs, benefits, and challenges.
- Conduct studies of the wind resources in the Tribal jurisdictional boundary. The MET Tower in conjunction with the SoDAR unit will allow the Tribe to develop expertise and experience with mobile equipment that will assist in locating other potential wind sites

on Tribal land and/or assist other Indian Tribe in the development of their wind resources.

The actual accomplishments of the project were in line with the projected goals concerning the development of a commercial scale Tribal utility. A business structure was created and in-depth feasibility studies of wind energy were conducted to evaluate the actual cost-benefit of wind as a sustainable energy development model.

The feasibility and development of a commercial wind farm proved to be not feasible, therefore the project goals hinged to commercial wind generation were shifted toward the analysis of a local cooperative to explore small wind development and solar as an alternate source of generation. Additional studies were conducted and proved these options as not feasible.

2.2 Tasks To Be Performed

This project revolves around the permitting, purchasing and erection of a 60-meter tower with the wind sensors and data logger and SoDAR unit in order to collect wind speed data for 12 months. The collected data, once analyzed and quantified, will provide an 8760-hour indication of the potential for wind energy at any given hour during the year. With this data, power curves can be constructed, which will allow the Iowa Tribe to effectively develop business plan and wind energy strategy. Purchasing the anemometer and SoDAR unit conducting the wind resource assessment are essential for the realization of the tribal long-term energy vision. Without the anemometer and SoDAR unit, and the wind resource assessment, the Iowa Tribe will not be able to capitalize on this unique investment opportunity.

The actions steps to complete these tasks are as follows:

1. Conduct a wind resource assessment: micrositing of MET mast, purchase, install, and manage wind data collection at up to 200 meters with a 60 meter anemometer and SoDAR unit.
2. Collect data for a 12-month period, 8,760 hours.
3. Data collection, data verification and certification; such verification procedures are required for negotiation of power purchase agreements and as collateral for financing. Data will be verified on a weekly basis by a certified meteorologist.
4. Data analysis to determine the feasibility of constructing a commercial scale wind energy project to offset local and distributed electrical loads and sell the excel power back into the grid.
5. Economic assessment for wind turbines that would be sited on tribal lands based on wind data and wind turbine performance data.
6. Environmental assessment for cultural resources, natural resources and avian considerations that may be impacted by wind turbines' noise and visibility. Work cooperatively with the Iowa Tribe's Office of Environmental Services (OES) to obtain all necessary FAA and environmental permits and approvals.
7. Completion of business plan and model ready for submission to potential lenders.
8. Obtain letters of intent from local utilities for the sale of excess energy.

All of these steps were completed with the exception of steps 6-8. These steps were based on the assumption that the data analysis would conclude that pursuing a utility-scale wind energy project was a viable alternative energy option for the Iowa Tribe. Wind data for the proposed site and an alternate site determined that there were in-sufficient wind speeds for pursing this option. The Tribe requested a budget modification and a revision to the scope of project objectives to conduct the energy assessment with the local cooperative for the tribal electricity usage for the small wind assessment for the final report. Analysis of the Tribe's energy usage concluded that annual kWh use and dollars spent did not justify the cost of pursuing wind for the Tribal facilities. Tasks 6-8 were no longer relevant to the project.

3 Wind Farm Design

Phase 1. Under a DOE grant, wind resource data collection began in November 2011 at a single 60 meter measurement mast (designated Mast 0149) located near Fallis, Oklahoma. A SoDAR unit (Figure 1) was also installed at the site which was being used to extrapolate the data collected from the MET tower. After monitoring the wind at the met site for approximately 9 months and conducting correlations with long term data, it was determined that the wind resource in the area near Fallis was not likely to be sufficient for a utility-scale wind project.

Figure 1. ASC SODAR Unit
Solar Panel and Battery Pack

Phase 2. AWS Truepower (Appendix 1) was commissioned in 2011 to generate a wind resource map of the counties of Lincoln, Logan and southern Payne utilizing coupled mesoscale and microscale mapping technology and data from the met mast. The purpose of this wind resource map was to determine the most likely areas for the best regional wind resource that might support a project.

The wind resource map was then graphically overlayed on land parcel information obtained from the respective counties so that land ownership in conjunction with wind resource could be analyzed (Figure 1). A new area for a proposed project site was identified using the parcel map, which would maximize the use of tribal parcels while targeting areas with the highest wind speeds.

As the feasibility study continued the tribe became interested in a small wind scale project for self-generation. The DOI study provided a detailed analysis of the tribe's electricity usage

(Figure 2), and potential size of wind turbine installation, the regulations and requirements through the current service was conducted.

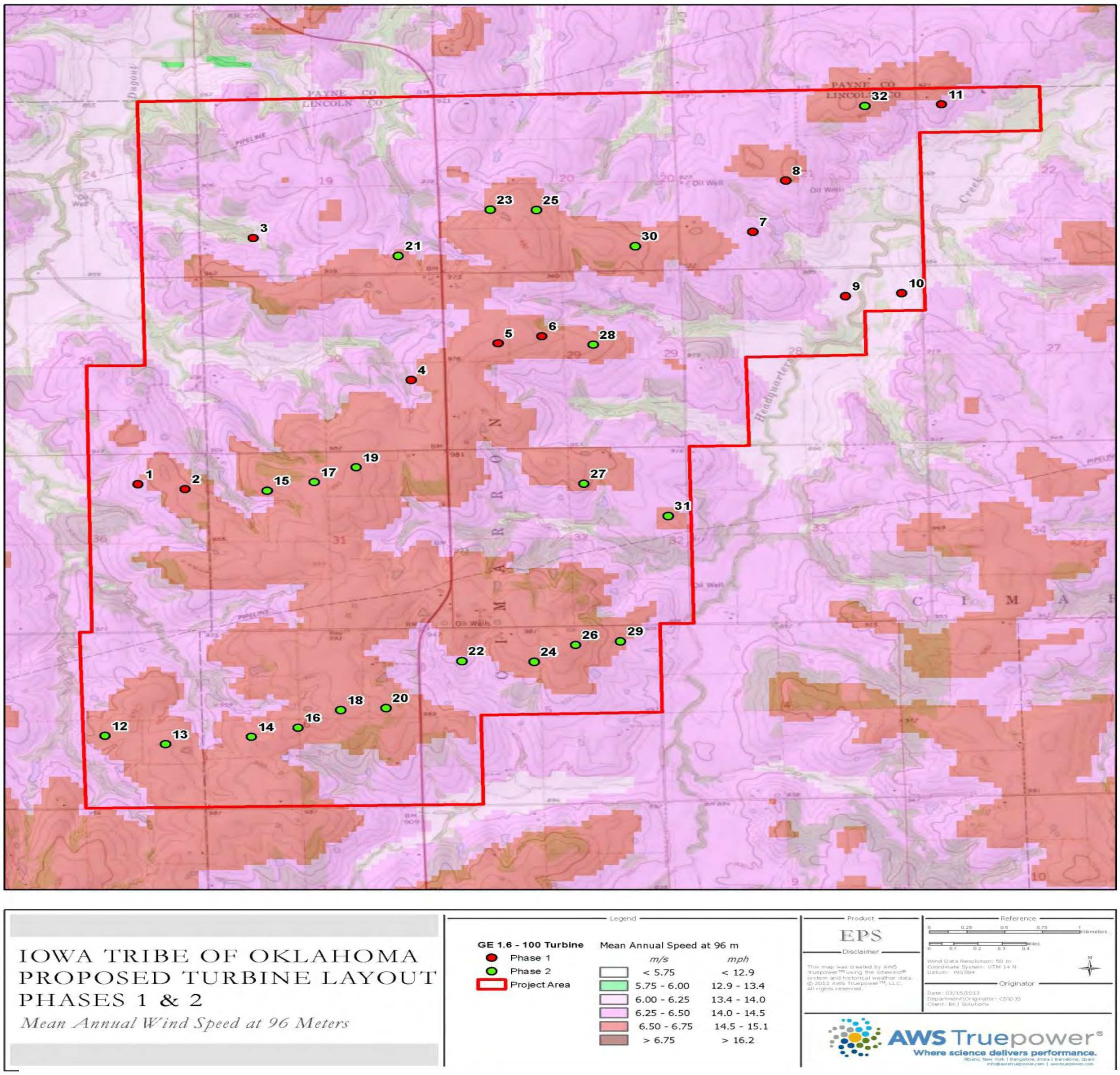

Figure 2, Proposed Turbine Layout (GE-1.60100 - Phases 1 Layout)

The ground elevation at the location where the MET mast was installed is notably lower than the project site, and additionally the MET mast was located within a draw, which would have lower wind speeds. AWS Truepower was retained by BKJ Solutions Inc. to evaluate the long-term wind resource and energy production potential of the proposed project site (Appendix 1).

In order to determine the feasibility of a wind project at the proposed location, the Tribe commissioned environmental consultant Ecology and Environment (E&E) to perform a critical issues analysis (CIA) (Appendix 2) to determine potential project constraints . The most prominent environmental issue identified within the CIA was the potential impact to avian species. Although potential for impacts to avian species exists, no critical issues were identified that would have prevented construction of a wind energy facility within the area reviewed in the CIA.

During the course of the feasibility study, the Tribe became increasingly interested in looking at their own electricity consumption patterns and determining if a small wind turbine distributed generation could be feasible to serve for their own electric loads. Although there was opportunity, it was concluded that small wind was not necessarily the ideal technology for the Tribe for self-generation. Studies were also conducted to determine feasibility for long-term solar resource at the Mast 1049 location. Analysis deemed solar not commercially viable based on the energy assessment performed by Smart Energy Source, LLC (Appendix 2).

3.1 Wind Measurements

Wind monitoring at the Iowa Tribe project began in November 2011 with the installation of a single monitoring mast, designated Mast 0149. The proposed project area is located approximately 20-25 km to the northeast of the Mast 0149 Fallis location. The Iowa Tribe provided the data to AWS Truepower. Each data file contained 10-minute average wind speed, direction, and temperature records, along with their standard deviations.

3.2 Estimation of Long-Term Mean Wind Speed

AWS Truepower obtained historical wind speed data from several nearby potential reference stations operated by the National Weather Service (NWS) and assessed them for suitability as long-term references. In addition to these data sources, they also assessed data from the AWS Truepower *WindTrends**55*** database. Their findings are listed below:

Energy Assessment Findings

Key Findings	
1	The wind resource in the vicinity of the installed met mast near Fallis is not rigorous enough to support a project.
2	The wind resource in the new proposed project area is a class III, low wind resource. The wind resource is in the outer bounds of feasibility and the economics will be driven largely by the achievable power price for the project.
3	A high degree of uncertainty regarding the wind resource exists at the proposed site and additional on-site information should be obtained to verify the projections in the report.

Solas Energy Consulting US Inc. was retained by BKJ Solutions Inc., a tribal company of the Iowa Tribe of Oklahoma, to provide project management services and oversee the project feasibility study for the Iowa Tribe Wind Project. The technical project feasibility was conducted by a variety of consultants coordinated by Solas Energy Consulting US Inc. Each of those consultants was tasked with a specific technical area, and Solas worked with those consultants to develop cost assumptions for the project.

The cost for the full development of this project, in either the 20 MW or the 50 MW scenario, is expected to be high. The typical project developer is willing to take a risk on the development capital for the project if the project looks fairly feasible. The development costs are considered 'at-risk' capital, and the developer takes a project fee during the sale of the project from a third party to take a satisfactory rate of return on that development risk capital.

A development budget was developed for this project in both the 20 MW and the 50 MW scenarios. The development budget includes the costs likely to be required to get the project ready for sale, and includes additional wind monitoring, land acquisition, interconnection queue studies, project permitting, preliminary engineering, legal, and consulting fees. The development budget was estimated to be as follows:

Estimations

Task	20 MW	50MW
Land Work[1]	$ 260,000	$ 572,000
Meteorology[2]	$ 286,000	$ 416,000
Interconnection[3]	$ 175,000	$ 175,000
Permitting[4]	$ 440,000	$ 625,000

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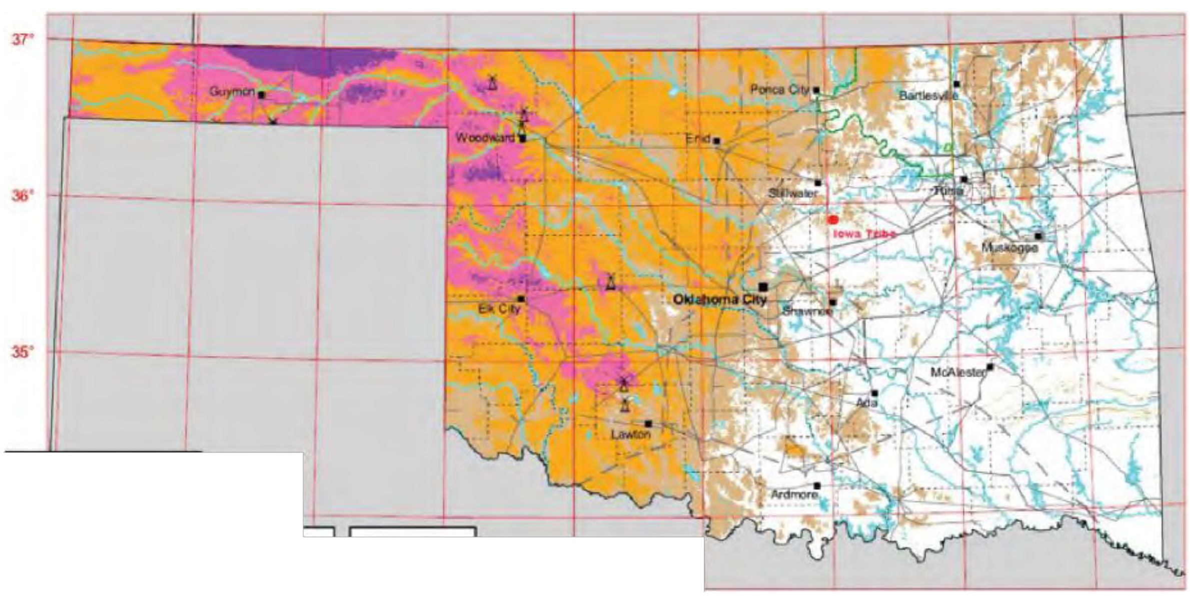
Engineering[5]	$ 240,000	$ 240,000
Legal Fees[6]	$ 500,000	$ 750,000
Consulting[7]	$ 120,000	$ 120,000
Total	$2,021,000	$2,989,000

Reports were compiled for the Iowa Tribe by Smart Energy Source LLC (SES) certified energy professionals, Stillwater, Oklahoma. Information was provided to SES by the Iowa Tribe in regard to the Iowa Tribe Wind Project Report prepared by AWS Truepower for Johnson Controls dated March 27, 2013 and the Wind Study Report for the Iowa Tribe of Oklahoma Wind Project provided to the Bureau of Indian Affairs by Solas Energy Consulting U.S. Inc., dated June 26, 2013 (Appendix 3). This information was used to continue the analysis of the Tribe's electricity consumption and load and determine the economic viability of stand-alone and utility grade wind and solar power generation systems. The Tribe's connected meter loads as documented by Central Rural Electric Cooperative (Table 1, pg. 15) required a further energy assessment.

The objective of this report is to define the viability of alternative energy systems in relationship to the Iowa Tribe of Oklahoma's historical electrical usage of individual meters and the aggregated load of all meters on the Central Rural Electric Cooperative's electrical distribution grid.

Figure 3. Oklahoma Annual Wind Power at 50m-height



Interpretation

Research from the National Renewable Energy Laboratory for the Department of Energy maps the Oklahoma annual wind power at 50-m height, which conclusively shows the Iowa Tribal

Complex has poor to marginal wind resource potential.

3.4 Assessment Resources

Facility and electric meter data for proposed project sites 1 and 2 was used to identify actual aggregated load for contiguous and non-contiguous electrical meters located on Central Rural Electric Cooperative's distribution grid to provide base load, peak and operational electrical use. Wind and solar characteristics used in the report were supplied in the two alternative energy wind and solar data projects reports.

3.5 Assessment Constants

• Current load profiles for the metered locations served by Central Rural Electric Cooperative's distribution system, January 2013 through December 2013.
• Cost per watt for installed wind and solar systems are $3 per watt. The prices of solar systems are typically less expensive (per unit) for larger systems than smaller systems (economy of scale).
• Typical residential cost for electrical generation by wind is $4 per watt produced/installed – this cost is typically in the $5 to $6 range, based on research analysis of average cost across the United States.
• Typical, utility grade cost for electric generation by wind is $3 per watt. (large scale)
• Typical residential cost for electrical generation by solar is $4 per watt produced/installed – this cost is typically in the $7 to $9 range based on research analysis of the average cost across the United States.
• Typical utility grade cost for electrical generation by solar is $3 per watt. (large scale)
• Capacity factor for wind is 37.4 percent (capacity factor is the difference from time of actual use compared to full production) based on referenced report findings.
• Capacity factor for solar is 94 percent – First year (capacity factor is the difference from time of actual use compared to full production) based on referenced report findings.
• The estimated cost of interconnection engineering study (KAMO Power), $50,000.
• The estimated cost of interconnection substation (KAMO Power), $2,000,000.
• The estimated cost of transmission line per mile (KAMO Power), $350,000.
• Potentially, more costs could be associated with infrastructure upgrades depending on the results of the Interconnection Engineering Study.
• The estimated avoided cost of power is $0.02 per kWh.

3.6 Wind - Utility Revenue Grade System - Cost Avoidance Contract

This assessment is based on the installation of 11 1.62MW GE1.6-100 turbines (Figure 4) as specified in referenced reports. As a result of the local wind characteristics documented in the referenced reports, the system will operate at a 37.4 percent production factor, and based on the production factor the system will produce 57.6MWh per year. The system will have an estimated payback of 32 years with a ROI of 3.2 percent.

Figure 4. GE's 1.6-100

Evaluation (Appendix 2)

Project Description	Cost/Revenue
Generator Plant Cost (equipment only at $1.83 per watt installed)	$32,967,000
Transmission Line Cost ($350,000 per mile - 2.5 miles)	$875,000
Interconnection Study (Impact to system)	$50,000
Interconnect Substation	$2,000,000
Maintenance and Operations (average per year is 1.7% of capital for 25 years)	$560,439
Total Project Cost	$36,452,439
Revenue (Cost avoidance contract, estimated at $0.02 per kWh) per year	$ 1,151,657
Payback = 32 years	
ROI = 3.2%	

3.7 Wind - Net Metering Contract

This analysis is based on the installation of one 1.62 MW GE1.6 turbine. The system will operate at a 37.4 percent production factor, and based on the production factor the system will produce 5.23 MWh per year. The system will have an estimated payback of 51.9 years with a ROI of 1.9 percent.

Evaluation (Appendix 2)

Project Description	Cost/Revenue
Generator Plant cost (equipment only at $1.85 per watt installed)	$ 2,997,000
Distribution Line Cost ($120,000 per mile - 2.5 miles)	$300,000
Interconnection Study (impact to system)	$50,000

Interconnection Substation	**$2,000,000**
Maintenance and Operations (average per year is 4.7% of capital for 25 years)	**$50,949**
Total Project Cost	**$5,397,949**
Net Metering cost reduction contract	
Payback = 51.9 years	
ROI = 1.9%	

The cost to add a high voltage transmission line for the utility grade system ($875,000) or a distribution line ($300,000) for a distributive generation option are cost prohibitive for the Iowa Tribe. Combined with the additional infrastructure costs for a substation and the interconnection study cost, the project is not economically viable. The CREC's distributed generation tariff for net metering for electricity generated under 100 kW,on the surface may seem advantageous, however, the power generated by the Iowa Tribe fed back to the electric grid isn't significant enough when you compare the payback over 30 to 50 years.

3.7 Electricity Consumption and Load

The first step toward understanding whether renewable energy was a suitable option for the tribe was determining the Tribe's current energy usage. Both the profile of usage (seasonal

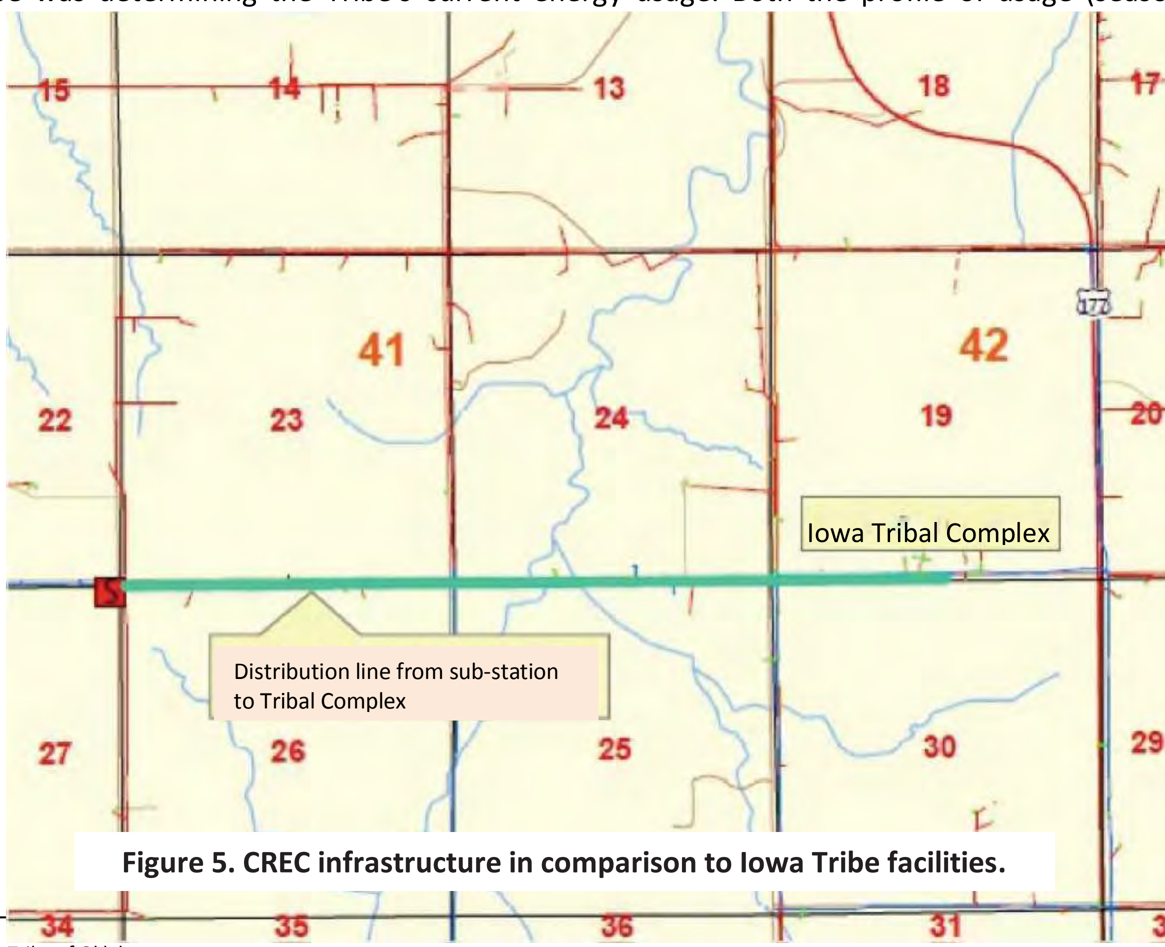


Figure 5. CREC infrastructure in comparison to Iowa Tribe facilities.

load, time of day (or diurnal) load, peak activities) and quantity of usage is important, as well as the actual cost of the electricity consumed. The Tribe is serviced by two electric utilities - the Central Rural Electric Cooperative (CREC), which has the bulk of the Tribe's load, and Oklahoma Gas and Electric.

3.9 Central Rural Electric Cooperative

An analysis of the Tribe's usage helped to highlight some of the limitations of small wind. The Tribe has approximately 24 customer accounts with CREC. Those facilities include the Tribal Complex, Pow-wow grounds, two water wells, the Eagle Aviary, the Fire and Police Stations, a Cemetery, and other facilities. CREC charges a fixed cost of $27/month per account service availability fee for being interconnected to their system, regardless of how much or how little power is drawn. In order to determine the actual cost paid by the tribe per kWh for their services at their various facilities, the $27/month charge was subtracted from each bill prior to calculating out the $/kWh paid by the tribe. The Table below summarizes those accounts.

Facility Meter Data

The table below (Table 1) show Iowa Tribe accounts with CREC. Annual kWh use and dollars spent are shown for each account (Appendix 2).

Account	Account Number	Map Location	Electric Rate	Annual kWh Use	Annual $ Spent
Transitional Living	3142800	42 19 16	SMC 4	0	$354.96
Cemetery Water Well	2237100	42 14 08	SMC 4	63	$362.18
Chena Building	3192600	42 30 12	SMC 4	660	$414.07
Southwest Water Well	2194300	42 30 06	SMC 4	1,076	$442.55
Pow Wow Arena	2448900	42 30 09	SMC 4	1,355	$473.98
Pow Wow Area	1906500	42 30 04	SMC 4	2,227	$556.68
Gate at Eagle Aviary	3231100	42 19 18	SMC 4	2,444	$567.45
Sign-Hwy 177	2988600	42 30 10	SMC 4	2,632	$581.87
Community Building	1764000	42 22 06	SMC 4	4,107	$708.56
Fire Station	3217600	42 19 17	SMC 4	4,540	$733.64
The Farm	414207	42 19 03	SMC 4	8,934	$1,134.67
Northeast Water Well	2194100	42 30 05	SMC 4	13,837	$1,538.56
Baseball Field Site	3072600	42 30 11	SMC 4	22,960	$2,325.01
Vocational Rehab.	2202600	42 19 09	SMC 4	48,901	$4,586.49
Need Address	1368600	42 19 04	SMC 4	53,379	$4,891.46
Police/Fire Building	2281200	42 19 10	SMC 4	55,925	$5,224.13
Office Annex	2280800	42 19 11	SMC 4	62,566	$5,759.58
Multi-event Building	2222200	42 30 07	SMC 4	62,800	$5,773.77
Multipurpose Building	1623200	42 19 05	SMC 4	77,360	$7,088.79

Eagle Aviary	2617100	42 19 15	SMC 4	79,120	$7,085.02
Youth Shelter	1777000	42 19 06	SMC 4	86,564	$7,842.92
White Cloud	1912100	42 19 08	SMC 4	135,520	$12,148.90
Child Development Center	2427701	42 19 13	SMC 4	138,840	$12,267.97
			Totals	865,810	$82,863.21

Table 1. Iowa Tribal Enterprises Accounts
Facility Meter Data

As illustrated in the Table above, the annual kWh use and dollars spent does not justify the cost of pursuing small wind for the Tribal facilities, even taking into account the two highest loads of the White Cloud and Child Development Center.

Phase 3. The Tribe was spending in excess of $90,000 a year in electric utility bills. A feasibility study for utility scale wind on Tribal lands sparked a strong interest in exploring whether small wind could help the Tribe not only reduce third party utility costs, but also help to build a sustainable development model for the future. As information was being collected and analyzed for the utility feasibility project, additional information was collected and analysis was performed to determine the feasibility of self-generation.

The project was extended to evaluate the Iowa Tribal Complex as a small wind distribution generation option. Research from the National Renewable Energy Laboratory for the DOE maps the Oklahoma annual wind power at 50-m height, which conclusively shows the tribal complex has poor to marginal wind resource potential.

Figure 6.Location of Selected Wind Turbine **Longitude and Latitude coordinates (35.929130, -97.024637)**

Final Conclusions on Small Wind

The small wind analysis concluded the following:

- An opportunity exists for the Tribe to reduce its energy costs through energy efficiency, energy management and renewable energy.
- Small wind is not necessarily the ideal technology for the Tribe for self-generation due to the lack of suitable small wind technologies for the Tribe's low wind resource.
- The current local net metering provisions with the electricity provider show the disadvantages

of wind generation with their policies for monthly energy generation true-ups, as well as limitations on size of small wind turbines allowed.

3.11 NEPA, FAA, Biological and Environmental Studies

In order to determine the feasibility of a wind project at the proposed location, the Iowa Tribe commissioned environmental consultant Ecology and Environment, Inc. (E&E) to perform a critical issues analysis (CIA (Appendix 2)). The scope of the CIA was to perform a detailed desktop review of the region to analyze potential project constraints that need to be factored into the siting and final development plan for the wind project. This CIA reviewed multiple issues including:

- Threatened and endangered species
- Bird and Bat Species
- Wetlands/Water Resources
- Geology/Soils
- Historic Sites/Cultural Resources
- Public Lands and Land Use
- Federal Aviation Administration (FAA) Airport Locations

The CIA also included a permitting matrix outlining required permits or approvals, the responsible agency, the requirements and the expected time frame. The most prominent environmental issue identified within the CIA was the potential impact to avian species. This includes species protected by the Endangered Species Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act. Although potential for impacts to avian species exists, no critical issues were identified that should prevent construction of a wind energy facility within the area reviewed in the CIA.

4 Lessons Learned

Since 2001 the Iowa Tribe has had a long term vision of energy self-sufficiency with a focus on economic development and resource development. This vision aligns with the Tribe's environmental philosophy of taking what you need from the Earth without impacting the ability of future generations to meet there needs. In other words, sustainability. Utilizing BJK Solutions, Inc., an Iowa Tribe company, to assist with their energy planning, the Tribal leadership has continued their commitment to the energy plan. As a small tribe, however, there are issues which occasionally impede the ability to perform assignments in a timely and effective manner.

There are strengths and opportunities for smaller tribes, however, the repetitive themes of lack of in-house technical knowledge and limited human and financial resources are formable challenges. Three areas which contributed to delays for the completion of tasks under the grant's objectives are identified below.

Tribal Capacity- Being able to maintain and grow capacity is a constant challenge, especially for knowledge retention. During the length of the grant, beginning in 2010, the Tribe has developed remarkable skills in executing contracts and project management. They have also made significant technological advancements for sharing information, storing data, and developing electronic files for access, which are essential tools for effective grant management.

The ongoing monitoring and oversight of grant activities with multiple consultants can be a significant task. The Tribe acknowledges that hiring the right employees with strong project management and business experience is key to working on complex and technical energy grants. There will always be unexpected circumstances that arise, but having a strong business plan that accounts for uncertainties that might impact a project is something the Tribal administration continues to put into place.

Technical and Operational

Lack of technical or operational experience put too much dependency on the consultants, in some cases leaving the Tribe one-step removed from the day-to-day operations of the project. Hiring an experienced energy manager midway through the project brought to the attention of the Tribe that this leadership role was imperative in addressing the Tribe's energy needs and future grant projects. Without technical oversight, equipment at the first site was compromised and vandalized impacting the data collection for wind speed analysis. Although the wind feasibility assessment and other analysis determined wind not economically feasible, the integrity of the completed work tasks strengthens the final conclusions with verification of the actual data sets that were completed despite the setbacks.

Not having a fundamental understanding of energy matters and relying on the assumptions of consultants was another issue that brought about change in how the Tribe moves forward. Tasks that might have been overlooked or issues left unresolved were not due to negligence but in many cases not knowing the right questions to ask. Staff is now encouraged to take advantage of the DOE's webinars, online database, and technical staff to help review reports. These are ways to increase industry and technical knowledge within the Tribe as they move toward a sustainable energy future.

Human Resources

Personnel issues impacted the grant on several levels. The project manager and other employees left their employment with the Tribe causing gaps in knowledge transfer and the overall understanding of assignments and expectations within the Tribal government. Add to this, working with multiple consultants. The lack of an integrated approach with multiple stakeholders caused unforeseen delays and project setbacks. For example, it was the Tribe's responsibility and not the consultants' to make sure the environmental assessment and procedures were compliant with the government agency's guidelines for installing and uninstalling the MET towers and SoDAR units on the Tribe's land. Without a project lead and internal team to address all aspects of the grant, tasks such as these were put at risk due to a lack of understanding of the job at hand. The hiring of energy consultant Michelle Holiday allowed the Tribe to move forward in a much more seamless effort.

It should be noted that Michelle Holiday has an extensive professional background in energy and is a strong advocate for Tribal economic development and energy sustainability. As an enrolled member of the Iowa Tribe of Oklahoma, she brings not only her expertise in energy to the Wind Resource on Tribal Land project but her inherent understanding of Tribal relations. Under her leadership the Tribe was able to fulfill the requirements of the grant and invest in a sustainable energy future.

5 Next Steps

Sustainability

The Wind Resource on Tribal Land project was an ambitious task in analyzing the Tribe's existing energy policies and determining how they can be improved. The project has also provided direct information that will make an immediate and lasting difference in the way the Tribe uses energy helping them to build a sustainable energy future.

Energy Sustainability is the concept that energy can be provided and consumed without impacting the ability of future generations to meet their needs. Renewable energy is one avenue to sustainability; however, energy efficiency is also an effective method and oftentimes faster and lower costs than implementing renewable energy. Integrating Tribal renewable energy generation is an exciting and interesting way to reduce the Tribe's carbon footprint and move toward sustainability from an electricity perspective and a cultural standpoint. Native American communities, and Native Peoples of the world, have relied upon continuous natural cycles throughout their history on the Earth. Shifting to renewable energy sources and energy efficiency has environmental, cultural, and economic motivations that the Tribe has and carries forward.

The first step on the ladder to energy sustainability is understanding the Tribe's energy usage and identifying areas of waste and opportunities for shedding load or cutting usage without impacting normal business, such as replacing light bulbs, aging appliances, windows, etc. with more energy efficient options, and applying load shifting where possible. When normal operations have been optimized, then alternatives need to be examined where small investments can create long term energy savings, such as looking at processes and systems, and re-designing systems toward sustainability.

6 Key Findings

- Given the existing renewable energy costs compared to the existing conventional power system, there are opportunities for renewable energy to provide net value to the Iowa Tribe of Oklahoma.
- Analysis of wind speed data concluded that wind resources in the proposed project sites were not likely to be sufficient for a utility-scale wind project.
- Small wind does not appear to be an attractive option at this time due to the inefficient load of the Tribal complex proposed for the small wind site.
- In discussions with the Iowa Tribe, it was indicated that the Tribe does not have the financial liquidity or the desire to act as the developer on this project or to front these funds for the development of the project.

- As a result of the project the Iowa Tribe of Oklahoma is motivated to analyze their existing energy polices and individual energy use to determine how they can be improved to help build a sustainable energy future.

7 Conclusions and Recommendations

7.1 Conclusions

The overall objective of the Wind Resource on Tribal land project was to conduct a wind resource assessment in order to quantify the wind resource potential available on the Iowa Tribe's land. Wind resource assessment data determined that there was insufficient wind speed for a utility-scale wind project on Tribal land.

Further wind speed assessments were conducted to determine the feasibility of small wind for the Tribal complex. The analysis shows that the load did not warrant the cost of self-generation when compared to the annual kWh use and dollars spent with the local utility provider.

There are still reasons to pursue renewable energy but the Tribe is determined at this time to focus its efforts on their long term vision of energy efficiency.

7.2 Recommendations

1. Develop an Energy policy that addresses energy conservation objectives, technology upgrades and initiatives.

2. Create an Energy Team consisting of an experienced energy manager to continue exploring alternative energy options and to deploy renewable energy technology where possible.

3. Develop comprehensive energy initiatives and disseminate information to Tribal members encouraging them to reduce their energy usage and help build a sustainable energy future for the Iowa Tribe of Oklahoma.

4. Meet with CREC representatives to review energy efficiency report's recommendations.

5. Consider applying for a U.S. Department of Energy grant for the implementation of renewable energy and energy efficiency technologies on tribal lands for the implementation of energy efficiency technologies to reduce energy provided by CREC.

Attachments and Appendices – List of Reports

Appendix 1. *Energy Production Summary*, AWS TruePower, March 2013
Energy and solar assessments and analysis for proposed wind and solar project

Appendix 2. *Energy Assessment and Energy Efficiency Reports*, Smart Energy Source, LLC

Appendix 3. *Final Narrative SF-425 Wind Study Report* (Submitted to Bureau of Indian Affairs), Solas Energy Consulting US Inc., June 2013
Includes Ecology and Environment (E&E) critical issues analysis

Appendix 4. *Commercial Energy Analysis*, Smart Energy Source LLC, August 2014
Information comparing economic viability of stand-alone and utility grade wind and solar power generation systems when compared to Iowa Tribe of Oklahoma’s connected meter loads as documented by local utility

Appendix 5. *DOE Iowa Tribe of Oklahoma Energy Program Review*, Michelle Holiday, Power Point Presentation, March 2014

To: Paul Egesdal, Johnson Controls

CC: Jesse Stowell, Mark Gramatico and Matthew Eberhard, AWS Truepower

From: Kate Morphis, Senior Project Manager

Date: 27 March 2013

Re: Iowa Tribe of Oklahoma Resource and Energy Production Reports

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Johnson Controls has been working with the Iowa Tribe of Oklahoma to coordinate the installation and data collection from a meteorological monitoring tower located in Lincoln County, Oklahoma. AWS Truepower has been retained to use the meteorological data collected through February 2013 to assess the wind and solar resource in the region and to estimate the energy production potential of a proposed wind project and a proposed solar project located in the vicinity of the meteorological monitoring tower. Due to the early stage of development for both scenarios, AWS Truepower proposed multiple turbine model/hub height and solar panel/inverter scenarios based on site characteristics, our understanding of the project goals and our industry experience to provide realistic energy production estimates for each project type given the information provided by both Johnson Controls and the Iowa Tribe of Oklahoma. As the projects progress, it is expected that further clarification of the design considerations for both wind and solar projects would be further evaluated and the energy estimates will be updated accordingly.

The two attached reports discuss the analysis completed for the solar and wind energy assessments including the following:

- validation of the collected data
- adjustment of the observed data to represent the expected long term conditions at the site
- extrapolation of the long term average to hub height (wind analysis only)
- estimation of energy production based on preliminary plant designs
- evaluation of expected energy losses
- evaluation of the uncertainty in the resource assessment and energy calculations

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ENERGY PRODUCTION SUMMARY

Calibrated Assessment of the Wind Resource and Energy Production Using the SiteWind System

MARCH 27, 2013

FOR THE IOWA TRIBE OF OKLAHOMA WIND PROJECT

LINCOLN AND PAYNE COUNTIES, OKLAHOMA

CLASSIFICATION
CONFIDENTIAL

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DOCUMENT CONTRIBUTORS

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DOCUMENT HISTORY

ISSUE	DATE	SUMMARY
A	27 March 2013	Initial Report

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1. INTRODUCTION

AWS Truepower, LLC, was retained by Johnson Controls to evaluate the long-term wind resource and energy production potential of the proposed Iowa Tribe of Oklahoma Wind Project, located in north-central Oklahoma, about 50 km to the northeast of Oklahoma City, and 110 km west-southwest of Tulsa. This report presents the results of our analysis and briefly describes the methods used to develop the wind resource and energy estimates.

2. WIND MEASUREMENTS

Wind monitoring at the Iowa Tribe of Oklahoma project began in November 2011 with the installation of a single monitoring mast, designated Mast 0149. The mast remains in operation. Table 1 presents basic information about the mast including its geographic coordinates, elevation, period of record, and sensor heights. It should be noted that the proposed project area is located approximately 20-25 km to the northeast of the Mast 0149 location. Johnson Controls provided the data to AWS Truepower in their raw binary format via email. Each data file contained 10-minute average wind speed, direction, and temperature records, along with their standard deviations.

The observed mean wind speed at Mast 0149 is 4.94 m/s (57.4 m). The annualized mean wind speed, which takes into account repeated months in the data record and weights each calendar month by its number of days, was 4.93 m/s. The observed wind shear exponent, which represents the rate of wind speed increase with height above ground according to the power law, was 0.503. The shear was calculated from the mean wind speeds at the highest and lowest monitoring levels based on concurrent valid records at both heights. Only wind speeds greater than 4 m/s, the range of interest for energy production, were used in the calculation.

The Weibull function is an analytical curve that describes the wind speed frequency distribution, or number of observations in specific wind speed ranges. Its two adjustable parameters allow a reasonably good fit to a wide range of actual distributions. *A* is a scale parameter related to the mean wind speed while *k* controls the width of the distribution. Values of *k* typically range from 1 to 3.5, the higher values indicating a narrower distribution. The observed *k* value was 2.09 (57.4 m) at Mast 0149, which is indicative of a somewhat variable wind resource with few high wind events. Figure 1 contains a chart showing the observed frequency distribution and the fitted Weibull curve for Mast 0149.

The directional distribution of the wind resource is an important factor to consider when designing the wind project to minimize the wake interference between turbines. An annual wind frequency and energy distribution by direction plot (wind rose) for the onsite mast is presented in Figure 2. The wind rose indicates that the prevailing wind direction is south.

3. ESTIMATION OF LONG-TERM MEAN WIND SPEED

We obtained historical wind speed data from several nearby potential reference stations operated by the National Weather Service (NWS) and assessed them for suitability as long-term references. In addition to these data sources, we also assessed data from our *windTrends*[1] database.

Linear regression equations were established using concurrent daily mean wind speeds at Mast 0149 and each potential reference source. Following reviews of the correlations and the time series of reference station annual mean speeds, we selected the Oklahoma City (Will Rogers Airport) surface station to estimate the long-term annual mean speed at Mast 0149. Substitution of the annualized mean wind speed at the reference station into the regression equation listed in Table 2 yields a 57.4-m long-term mean wind speed of 4.83 m/s at Mast 0149.

Extrapolation of this long-term mean wind speed using phased reductions to the observed wind shear exponent as a function of height yields a mean wind speed of 5.89 m/s at the 96-m hub height. It should be noted that significant uncertainty is present in this extrapolation process in recognition of the characteristics observed at this tower and the substantial elevation difference between mast top and hub height. A summary of the climate adjustments and extrapolation is included in Table 2.

4. ESTIMATION OF LONG-TERM ENERGY PRODUCTION

The energy production of the proposed Iowa Tribe of Oklahoma Wind Project was estimated using the openWind® software. openWind was developed by AWS Truepower as an aid for the design, optimization, and assessment of wind power projects.[2] The primary input is a wind resource grid generated by a numerical wind flow model, in this case the SiteWind® system. Other inputs include elements of the project design such as the turbine locations, hub height, power curve, and thrust coefficients, as well as the mast data. The SiteWind system and openWind software and their applications in this project are briefly described below.

The SiteWind System

Numerical wind flow models are used to calculate the wind resource variation across a project area due to changes in terrain and surface roughness. AWS Truepower has developed the SiteWind system to perform these calculations. SiteWind employs both mesoscale and microscale models to simulate the wind climate over a wide range of scales. The mesoscale model assesses regional climate conditions and simulates complex meteorological phenomena such as katabatic (downslope) mountain winds, channeling through mountain passes, lake and sea breezes, low-level jets, and temperature inversions. The microscale model accounts for the localized influences of topography and surface roughness changes and produces a detailed wind resource map and grid. As a final step, the predicted speed and direction are adjusted with on-site data from masts within the project area. This method has been found to be more accurate on the whole than microscale wind flow models on their own.[3]

1 windTrends a simulated hourly time series created by AWS Truepower using an atmospheric model. It is similar to reanalysis data, but is computed at a finer spatial resolution (20 km) and relies on a fixed set of rawinsonde observational data. The model output can be interpolated to the exact location of a meteorological mast. For this analysis, the model output was interpolated to the location of Mast 0149.

2 openWind – Theoretical Basis and Validation, Version 1.3, AWS Truewind, LLC, April 2010.

3 Beaucage, Philippe and Brower, Michael C, Wind Flow Model Performance – Do More Sophisticated Models Produce More Accurate Wind Resource Estimates?, 6 February 2012

The mesoscale model used for this analysis was the Mesoscale Atmospheric Simulation System (MASS[4]), a non-hydrostatic weather model used in commercial and research applications. MASS was run in a series of nested grids, with the innermost grid having a spatial resolution of 1.2 km. Using regional weather data, MASS simulated historical weather conditions for a representative sample of days. The MASS output was then coupled to WindMap – a mass-conserving model – which was run on a grid scale of 50 m.[5] Finally, the output of WindMap was adjusted to the wind speed and direction distribution at Mast 0149. This last step was performed within openWind, as described below. The resulting wind resource map is shown in Figure 3.

openWind

Once the wind resource model has been run, the resource grid file is imported into openWind to define the wind resource for the project area. The Weibull parameters in the file are converted to directional speed-up ratios relating the wind speed at each grid point to the speed at a reference mast. By associating the model data to a wind speed histogram file for the reference mast, the program is able to adjust the modeled speed distribution to the true speed distribution observed at a point. This method usually produces a more accurate estimate of the energy production than relying on the modeled distributions alone.

A number of reference masts can be used to reduce errors in the predicted spatial variation of the wind resource across the project area. Conventionally, the project area is broken up into sub-regions, each of which is associated with a different mast using the distance-weighted interpolation between masts, as previously described. This avoids discontinuities in wind speeds across the boundaries of areas assigned to different masts and produces a more realistic picture of the spatial variation of the wind resource. Within openWind, the adjusted wind resource grid is divided into sub-regions associated with different masts to capture variations in the observed speed frequency distribution, although the corresponding impact on energy production estimates is usually relatively small.

AWS Truepower uses the openWind Deep Array Wake Model (DAWM) to calculate wake losses. This model actually contains two separate wake models operating independently. The first is the Eddy Viscosity model, which is based on the thin-shear-layer approximation of the Navier-Stokes equations assuming axisymmetric wakes of Gaussian cross-sectional form, as originally postulated by Ainslie.[6] The model equations ensure that momentum and mass conservation are observed simultaneously. As inputs, the wake model requires the ambient turbulence intensity at hub height, which influences the initial wake deficit behind each turbine and the rate of wake dissipation; the speed and direction frequency distribution, based on a wind resource grid and associated mast files; the locations of the turbines; and the turbine thrust coefficient curves. Validation of the openWind Eddy Viscosity model is described elsewhere.2

In response to evidence that conventional wake models like the Eddy Viscosity model underestimate wake losses in deep (multi-row) arrays of wind turbines, especially offshore, AWS Truepower implemented a second model designed to handle such situations. This model is loosely based on a

4 Developed for NASA, the US Air Force, and commercial and research applications, MASS is similar to and has been verified against other mesoscale weather models such as MM5 and WRF. For further information, see http://www.meso.com/mass.html.

5 WindMap, developed by AWS Truepower, is a mass-conserving model that adjusts an initial wind field, here supplied by MASS, in response to local variations in topography and surface roughness. See, e.g., Michael Brower, "Validation of the WindMap Model," Proceedings of WindPower 1999, American Wind Energy Association, June 1999.

6 Ainslie, J.F., 1988, Calculating the flowfield in the wake of wind turbines." Journal of Wind Engineering and Industrial Aerodynamics, 27. Pages 213-224.

theory developed by Frandsen,[7] who postulated that the effect of a deep array of wind turbines on the atmosphere could be represented as a region of increased surface drag, represented by a surface roughness length. Where the wind first impinges on the array, an internal boundary layer (IBL) is created, within which the wind profile is determined by the array roughness rather than by the ambient roughness. This IBL grows with downwind distance, and once its height exceeds the turbine hub height, the hub-height speed impinging upon turbines farther downwind is progressively reduced. According to the Frandsen theory, the effective array roughness is in the range of 1 m to 3 m, or typical of a forest, for mid-range speeds and typical turbine spacings. AWS Truepower modified the Frandsen model to treat each turbine as an isolated island of roughness, a necessary change to permit rapid modifications to the turbine layout for array optimization. In addition, the IBL created by each turbine is assumed to be centered on the turbine's hub height.

In combining the two models, the DAWM implicitly defines "shallow" and "deep" zones within a turbine array. In the shallow zone, the direct wake effects of individual turbines dominate, and the unmodified Eddy Viscosity (EV) model is used to calculate wake deficits; in the deep zone, the deep-array effect is more prominent, and thus, the roughness model is employed. The DAWM has been validated at several offshore and onshore projects.[8]

Results

The energy production was simulated for two different turbine models: the GE 1.6-100 and Siemens SWT-2.3-113. For each proposed turbine model, we also produced two separate energy production simulations reflecting different plant sizes, referred to as Phases 1 and 2. Results for the GE 1.6-100 turbine model (Phase 1 layout) are presented in the body of this report, while the remaining energy production scenarios are presented in the Appendix.

The GE 1.6-100 turbine features a 100-m rotor diameter and a 96-m hub height. The Phase 1 turbine layout, which was developed by AWS Truepower based on information provided by the Iowa Tribe of Oklahoma through BKJ Solutions and standard assumptions, is shown on the wind resource map in Figure 3. Each turbine in the layout was associated with the wind speed and direction distribution file from Mast 0149.

The average air density was calculated from the wind speed and temperature data from Mast 0149 and adjusted to the mean elevation of the turbines using a standard atmospheric lapse rate. The result was 1.166 kg/m^3.

Plant losses aside from turbine wake losses were estimated from AWS Truepower's experience with other projects and an analysis of site-specific data.[9] The wake loss was estimated by the openWind program to be 1.7%. Including combined plant losses totaling 13.4%, the total loss is estimated to be 14.9%.

The gross and net annual energy production estimates for the project are 68.7 GWh and 58.4 GWh, respectively. The net capacity factor is predicted to be 37.4%, and the estimated array-average free-

7 Sten Tronæs Frandsen, Turbulence and turbulence-generated structural loading in wind turbine clusters, Risø-R-1188(EN), Risø National Laboratory (January 2007).

8 Brower, Michael C. and Robinson, Nicholas M., "The openWind Deep Array Wake Model – Development and Validation", May 2012.

9 Dan Bernadett, et al., 2012 Backcast Study: A Review and Calibration of AWS Truepower's Energy Estimation Methods, AWS Truepower May 2012.

stream wind speed at hub height is 6.42 m/s. A summary of the estimated average free-stream wind speed and gross and net energy production for each turbine is presented in Table 3.

5. UNCERTAINTY ESTIMATE

The values presented in this section apply to the GE 1.6-100 Phase 1 layout; it should be noted that small variances in these estimates occur for each of the remaining project scenarios. The uncertainty in the projected long-term hub height wind speed across the project is estimated to be 8.0%. This value incorporates the uncertainties associated with field verification, the onsite measurements, the wind shear extrapolation, the historical climate adjustment, the evaluation period, and the wind flow modeling. The sensitivity of the project output to changes in wind speed was determined to be approximately 14.2% for the given 8.0% uncertainty in mean wind speed. The uncertainties in wind speed frequency distribution and plant losses were combined with the previous total to yield an overall energy production uncertainty of 14.7%, or 8.6 GWh/yr. Table 4 presents the estimated net annual energy production and capacity factor at five confidence levels assuming a 9-year mature operation evaluation period and the same for the first year and for any single year thereafter. The same five confidence level values assuming a 20-year total (19-year mature operation) evaluation period are contained in Table 5. The same values are presented in the Appendix for the three additional energy production scenarios.

6. SUMMARY

The long-term wind resource at the proposed Iowa Tribe of Oklahoma Wind Project was estimated using data from a single monitoring mast and correlation with Oklahoma City (Will Rogers Airport). The energy production was simulated using a wind resource grid developed using the SiteWind system, the openWind software, a wind turbine layout which was developed by AWS Truepower, and the GE 1.6-100 turbine model with a 100-m rotor diameter turbine at a 96-m hub height and site average air density of 1.166 kg/m^3. The total wind plant loss is estimated to be 14.9%. The expected average annual net production and capacity factor for the project are 58.4 GWh and 37.4%, respectively, and the predicted array-average wind speed is 6.42 m/s. Results for three additional energy production scenarios are presented in the Appendix.

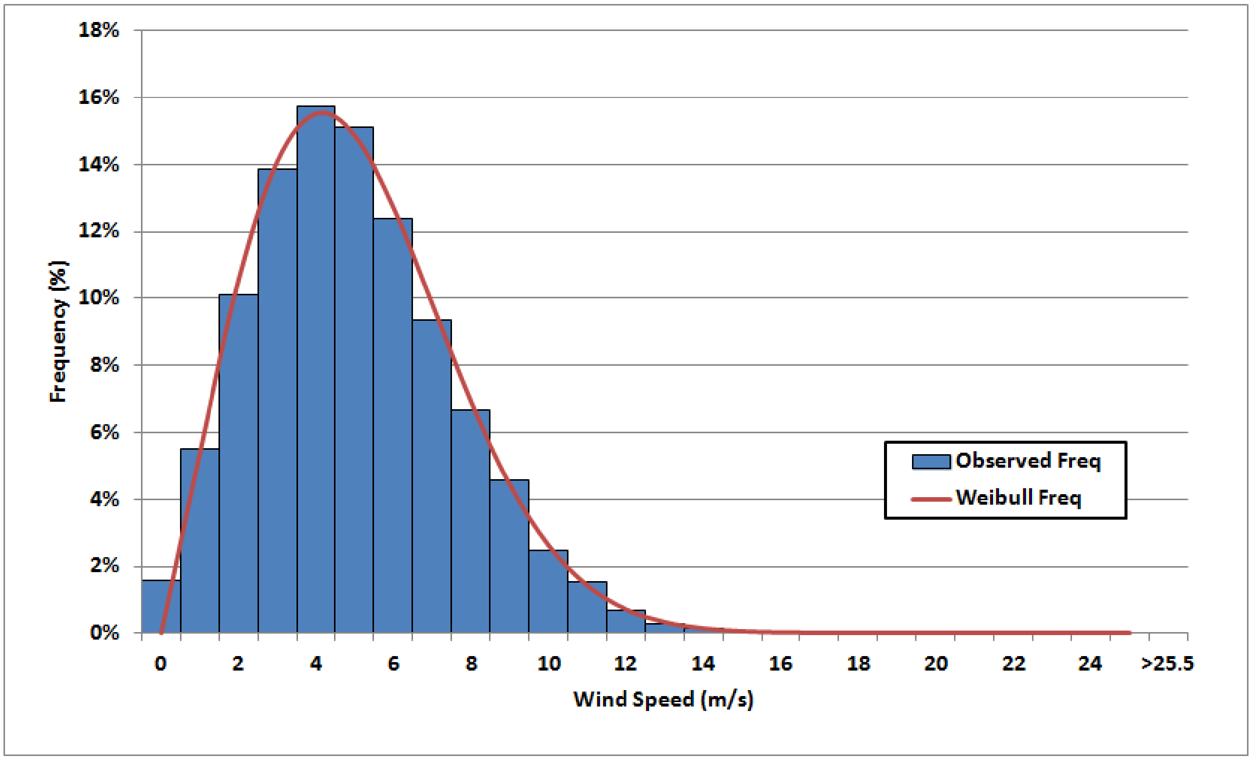

Figure 1. Mast 0149 Observed Wind Speed Frequency Distribution and Fitted Weibull Curve

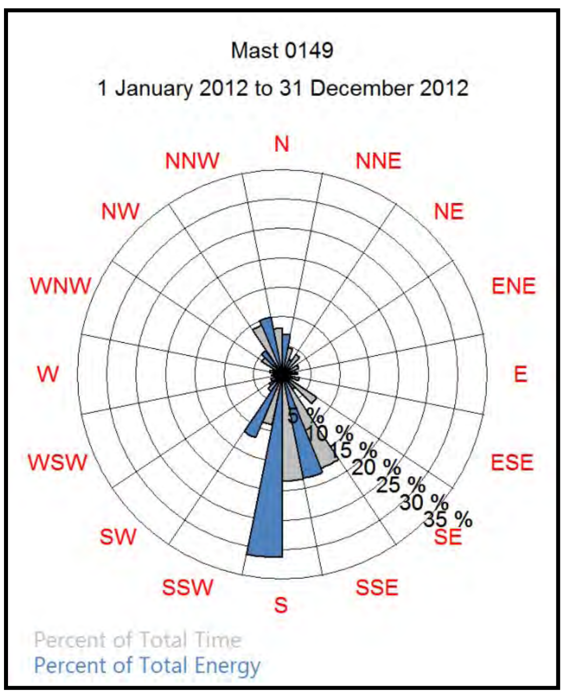

Figure 2. Mast 0149 Annual Wind Rose

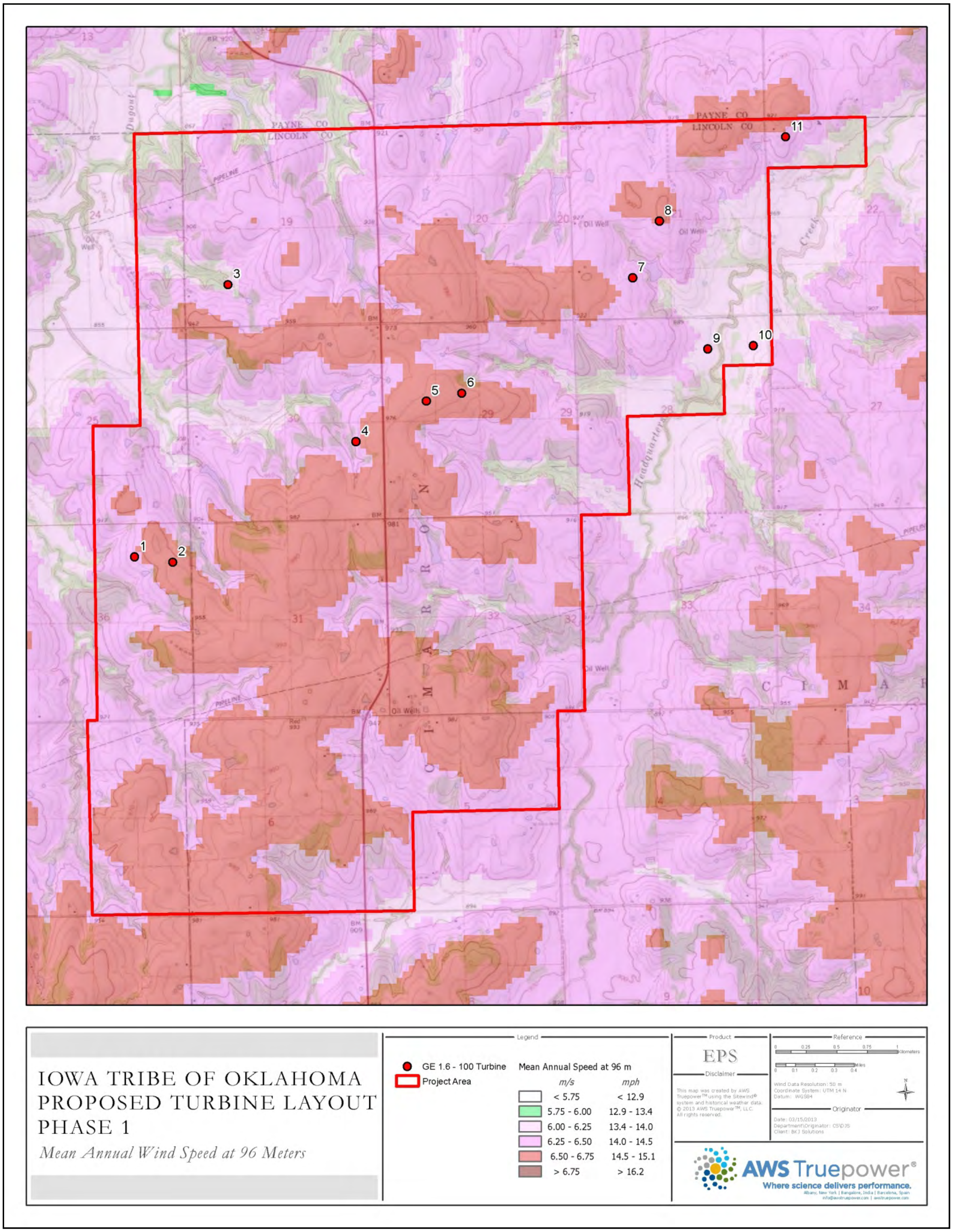

Figure 3. Proposed Iowa Tribe of Oklahoma Turbine Layout (GE 1.6-100 Phase 1 Layout)

Table 1. Mast Summary

Mast	Site UTM Coordinates (WGS84, Zone 14)		Elevation (m)	Period of Record	Monitoring Heights (m)		
	Easting	Northing			Wind Speed	Wind Direction	Temp
0149	669343	3958302	281	4 November 2011 – 3 February 2013	57.4, 47.6, 32	53.5, 43.5	2.7

Table 2. Monitoring Mast Long-term Wind Speed Projection Summary

Mast	Monitoring Height (m)	Reference	Regression Equation	r^2	Long-Term Wind Speed (m/s)	Effective Wind Shear	Projected 96-m Speed (m/s)
0149	57.4	Oklahoma City (Will Rogers Airport)	y = 0.870x + 0.564	0.91	4.83	0.359	5.89

Table 3. Iowa Tribe of Oklahoma Wind Speed and Energy Production Detail (GE 1.6-100 Phase 1 Layout)

Project:	BKJ Solutions - Iowa Tribe of Oklahoma	
Date:	15-Mar-13	
Comments:	Optimized Layout - Phase 1	
Turbine Manufacturer/Model:	GE 1.6 - 100	
Turbine Rated Power:	1.62	MW
Hub Height:	96	m
Number of Turbines:	11	
Plant Capacity:	17.82	MW
Site Air Density:	1.166	kg/m^3

Loss Accounting	
Wake Effect	1.7%
Availability	6.3%
Electrical	2.0%
Turbine Performance	3.5%
Environmental	2.3%
Curtailments	0.0%
Average Total Loss	14.9%

Overall Wind Plant Summary	
Average Free Wind Speed (m/s)	6.42
Gross Plant Production (MWh/yr)	68,673
Net Plant Production (MWh/yr)	58,426
Net Capacity Factor	37.4%

Per Turbine Summary

Turbine ID	Mast Association	Coordinates (WGS84 UTM14) Easting (m)	Northing (m)	Free Speed (m/s)	Gross MWh/yr	Array Eff. (%)	Array Loss (%)	Total Loss (%)	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Total TI at 15m/s (%)
1	149	676945	3975811	6.47	6,321	98.6	1.4	14.7	5,395	5	38.0	16.2
2	149	677257	3975766	6.56	6,457	98.8	1.2	14.4	5,527	3	38.9	15.9
3	149	677712	3978050	6.21	5,920	98.5	1.5	14.7	5,051	9	35.6	16.8
4	149	678764	3976758	6.47	6,333	99.1	0.9	14.1	5,438	4	38.3	16.1
5	149	679342	3977090	6.60	6,521	98.3	1.7	14.9	5,553	2	39.1	15.8
6	149	679635	3977157	6.60	6,508	98.8	1.2	14.4	5,568	1	39.2	15.9
7	149	681041	3978107	6.41	6,222	97.5	2.5	15.6	5,254	8	37.0	16.3
8	149	681259	3978572	6.51	6,390	95.5	4.5	17.3	5,283	7	37.2	16.1
9	149	681659	3977521	6.19	5,858	98.1	1.9	15.0	4,977	11	35.0	17.0
10	149	682035	3977548	6.17	5,851	98.5	1.5	14.7	4,993	10	35.2	17.0
11	149	682298	3979264	6.44	6,291	99.0	1.0	14.4	5,386	6	37.9	16.2

Table 4. Estimated Energy Production and Net Capacity Factor at Five Confidence Levels (Evaluation Period [Years 2-10], Annual, and First Year)

Probability of Exceedance	Evaluation Period Average Energy Production (GWh)	Evaluation Period Average Capacity Factor (%)	Annual Energy Production (GWh)	Annual Capacity Factor (%)	First Year Energy Production (GWh)	First Year Capacity Factor (%)
P50	58.4	37.4	58.4	37.4	56.4	36.1
P75	52.6	33.7	52.2	33.4	49.8	31.9
P90	47.4	30.4	46.5	29.8	44.0	28.1
P95	44.3	28.4	43.1	27.6	40.4	25.9
P99	38.5	24.6	36.8	23.6	33.8	21.7

Table 5. Estimated Energy Production and Net Capacity Factor at Five Confidence Levels 20-Year Evaluation Period [Years 2-20]

Probability of Exceedance	Evaluation Period Average Energy Production (GWh)	Evaluation Period Average Capacity Factor (%)
P50	58.4	37.4
P75	52.6	33.7
P90	47.4	30.4
P95	44.3	28.4
P99	38.5	24.6

APPENDIX – ALTERNATE ENERGY PRODUCTION SCENARIOS

Table A1. Iowa Tribe of Oklahoma Wind Speed and Energy Production Detail (GE 1.6-100 Phases 1 and 2 Layout)

Project:	BKJ Solutions - Iowa Tribe of Oklahoma
Date:	15-Mar-13
Comments:	Optimized Layout - Phases 1 and 2
Turbine Manufacturer/Model:	GE 1.6 - 100
Turbine Rated Power:	1.62 MW
Hub Height:	96 m
Number of Turbines:	32
Plant Capacity:	51.84 MW
Site Air Density:	1.165 kg/m^3

Loss Accounting	
Wake Effect	3.8%
Availability	6.2%
Electrical	2.0%
Turbine Performance	3.5%
Environmental	2.3%
Curtailments	0.0%
Average Total Loss	**16.6%**

Overall Wind Plant Summary	
Average Free Wind Speed (m/s)	6.53
Gross Plant Production (MWh/yr)	204,991
Net Plant Production (MWh/yr)	170,999
Net Capacity Factor	37.6%

Per Turbine Summary

Turbine ID	Mast Association	Coordinates (WGS84 UTM14) Easting (m)	Northing (m)	Free Speed (m/s)	Gross MWh/yr	Array Eff. (%)	Array Loss (%)	Total Loss (%)	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Total TI at 15m/s (%)
1	149	676945	3975811	6.47	6,321	96.3	3.7	16.5	5,276	24	37.2	16.3
2	149	677257	3975766	6.56	6,456	95.9	4.1	16.9	5,367	15	37.8	16.0
3	149	677712	3978050	6.21	5,920	96.6	3.4	16.3	4,956	31	34.9	16.9
4	149	678764	3976758	6.47	6,334	95.1	4.9	17.5	5,223	28	36.8	16.2
5	149	679342	3977090	6.60	6,521	93.8	6.2	18.7	5,302	21	37.3	16.0
6	149	679635	3977157	6.60	6,507	93.8	6.2	18.7	5,289	23	37.2	16.1
7	149	681041	3978107	6.41	6,222	96.6	3.4	16.2	5,212	29	36.7	16.4
8	149	681259	3978572	6.51	6,389	94.9	5.1	17.8	5,250	26	37.0	16.1
9	149	681659	3977521	6.19	5,858	97.4	2.6	15.6	4,943	32	34.8	17.1
10	149	682035	3977548	6.17	5,850	97.9	2.1	15.1	4,969	30	35.0	17.1
11	149	682298	3979264	6.44	6,290	98.5	1.5	14.7	5,364	16	37.8	16.2
12	149	676724	3973522	6.56	6,457	98.5	1.5	14.6	5,513	4	38.8	15.9
13	149	677126	3973446	6.61	6,510	98.3	1.7	14.7	5,550	2	39.1	15.8
14	149	677700	3973513	6.57	6,478	97.6	2.4	15.4	5,482	8	38.6	15.9
15	149	677802	3975752	6.56	6,457	95.3	4.7	17.4	5,334	19	37.6	16.0
16	149	678011	3973597	6.60	6,542	96.6	3.4	16.3	5,476	10	38.6	15.9
17	149	678116	3975829	6.67	6,609	94.2	5.8	18.3	5,400	13	38.0	15.8
18	149	678295	3973757	6.64	6,586	96.4	3.6	16.5	5,499	6	38.7	15.9
19	149	678396	3975963	6.69	6,649	95.1	4.9	17.6	5,481	9	38.6	15.7
20	149	678596	3973776	6.64	6,584	97.3	2.7	15.7	5,551	1	39.1	15.7
21	149	678679	3977887	6.52	6,388	94.6	5.4	17.9	5,243	27	36.9	16.2
22	149	679101	3974203	6.47	6,325	97.4	2.6	15.6	5,336	18	37.6	16.2
23	149	679290	3978307	6.52	6,389	94.9	5.1	17.7	5,257	25	37.0	16.2
24	149	679584	3974197	6.59	6,504	96.6	3.4	16.3	5,442	11	38.3	15.9
25	149	679599	3978303	6.57	6,461	95.0	5.0	17.6	5,320	20	37.5	16.2
26	149	679862	3974349	6.67	6,611	96.3	3.7	16.5	5,517	3	38.9	15.9
27	149	679915	3975815	6.55	6,438	95.0	5.0	17.7	5,299	22	37.3	16.1
28	149	679977	3977079	6.59	6,498	95.2	4.8	17.5	5,363	17	37.8	16.0
29	149	680161	3974383	6.51	6,372	97.8	2.2	15.3	5,400	12	38.0	16.1
30	149	680258	3977977	6.64	6,548	96.8	3.2	16.1	5,493	7	38.7	15.9
31	149	680477	3975522	6.52	6,399	97.1	2.9	15.9	5,381	14	37.9	16.0
32	149	681788	3979250	6.59	6,517	97.5	2.5	15.5	5,509	5	38.8	15.9

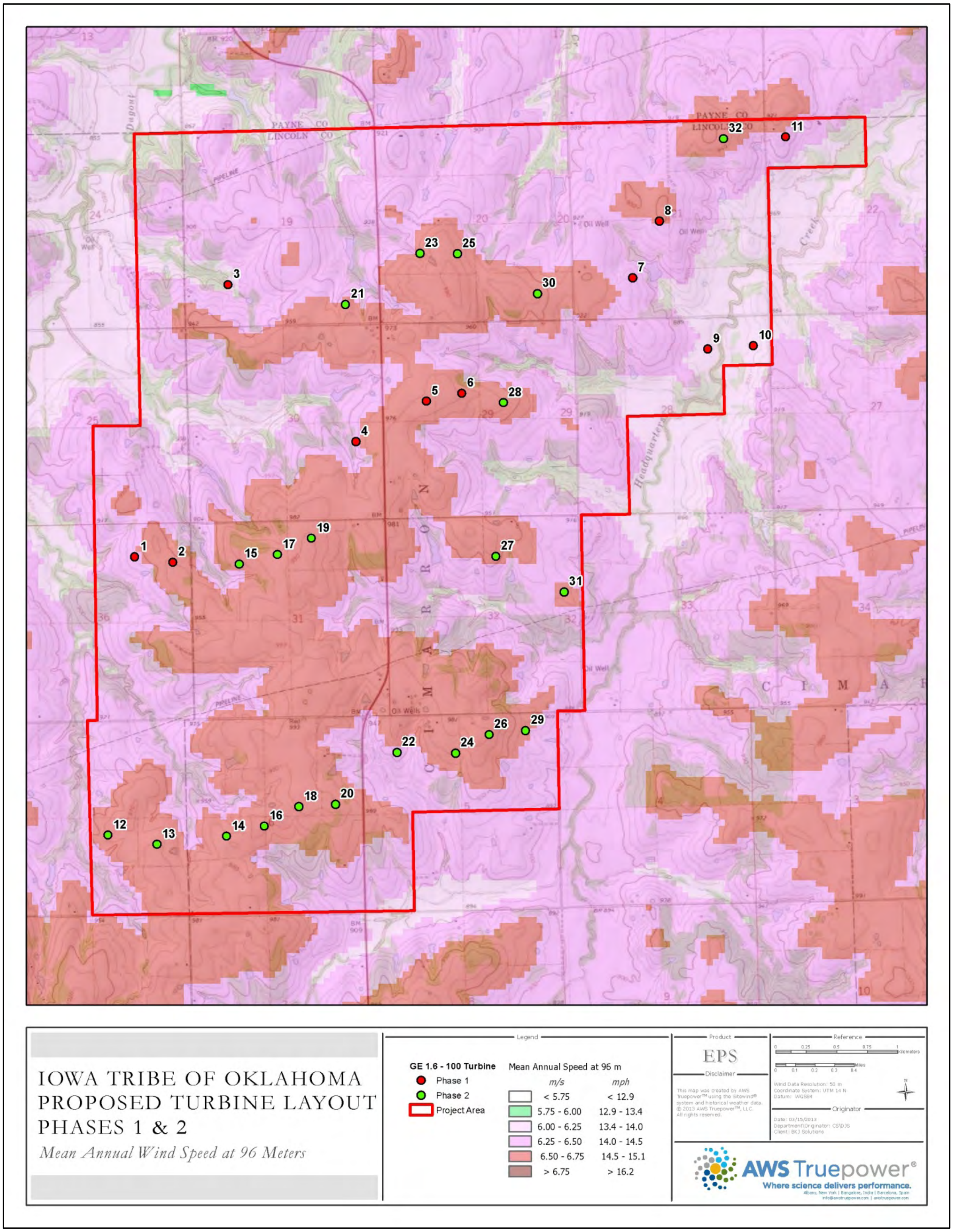

Figure A1. Proposed Iowa Tribe of Oklahoma Turbine Layout (GE 1.6-100 Phases 1 and 2 Layout)

Table A2. Estimated Energy Production and Net Capacity Factor at Five Confidence Levels (Evaluation Period [Years 2-10], Annual, and First Year) - GE 1.6-100 Phases 1 and 2 Layout

Probability of Exceedance	Evaluation Period Average Energy Production (GWh)	Evaluation Period Average Capacity Factor (%)	Annual Energy Production (GWh)	Annual Capacity Factor (%)	First Year Energy Production (GWh)	First Year Capacity Factor (%)
P50	171.0	37.6	171.0	37.6	165.0	36.3
P75	154.1	33.9	152.7	33.6	145.9	32.1
P90	138.9	30.6	136.2	30.0	128.7	28.3
P95	129.8	28.6	126.3	27.8	118.5	26.1
P99	112.7	24.8	107.8	23.7	99.2	21.8

Table A3. Estimated Energy Production and Net Capacity Factor at Five Confidence Levels 20-Year Evaluation Period [Years 2-20] -GE 1.6-100 Phases 1 and 2 Layout

Probability of Exceedance	Evaluation Period Average Energy Production (GWh)	Evaluation Period Average Capacity Factor (%)
P50	171.0	37.6
P75	154.1	33.9
P90	138.9	30.6
P95	129.7	28.6
P99	112.7	24.8

Table A4. Iowa Tribe of Oklahoma Wind Speed and Energy Production Detail (Siemens SWT-2.3-113 Phase 1 Layout)

Project:	BKJ Solutions - Iowa Tribe of Oklahoma	
Date:	15-Mar-13	
Comments:	Optimized Layout - Phase 1	
Turbine Manufacturer/Model:	Siemens SWT-2.3-113	
Turbine Rated Power:	2.30	MW
Hub Height:	96	m
Number of Turbines:	9	
Plant Capacity:	20.7	MW
Site Air Density:	1.166	kg/m³

Loss Accounting	
Wake Effect	2.2%
Availability	6.5%
Electrical	2.1%
Turbine Performance	3.5%
Environmental	2.8%
Curtailments	0.0%
Average Total Loss	**16.0%**

Overall Wind Plant Summary	
Average Free Wind Speed (m/s)	6.43
Gross Plant Production (MWh/yr)	73,705
Net Plant Production (MWh/yr)	61,885
Net Capacity Factor	34.1%

Per Turbine Summary

Turbine ID	Mast Association	Coordinates (WGS84 UTM14) Easting (m)	Northing (m)	Free Speed (m/s)	Gross MWh/yr	Array Eff. (%)	Array Loss (%)	Total Loss (%)	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Total TI at 15m/s (%)
1	149	676918	3975812	6.45	8,236	98.7	1.3	15.3	6,978	4	34.6	16.2
2	149	677257	3975766	6.56	8,463	98.9	1.1	15.0	7,191	3	35.7	15.9
3	149	679299	3977090	6.59	8,537	98.7	1.3	15.2	7,241	1	35.9	15.8
4	149	679635	3977157	6.60	8,532	98.8	1.2	15.1	7,241	2	35.9	15.9
5	149	681041	3978107	6.41	8,130	96.8	3.2	16.8	6,761	6	33.5	16.3
6	149	681259	3978572	6.51	8,362	93.6	6.4	19.7	6,717	7	33.3	16.2
7	149	681659	3977521	6.19	7,623	97.7	2.3	16.1	6,398	9	31.7	17.1
8	149	682035	3977548	6.17	7,601	98.1	1.9	15.7	6,408	8	31.8	17.0
9	149	682298	3979264	6.44	8,222	98.5	1.5	15.5	6,951	5	34.5	16.2

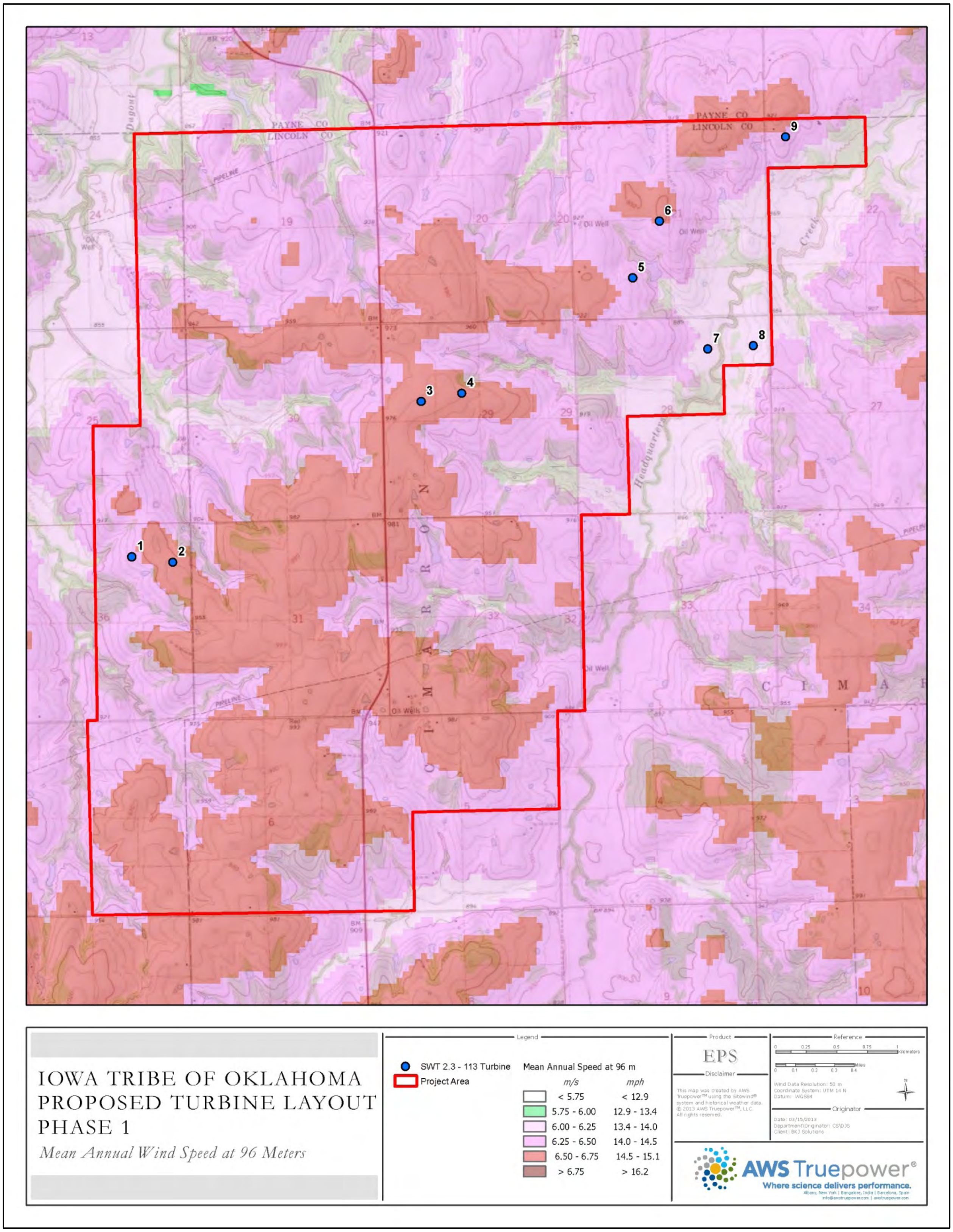

Figure A2. Proposed Iowa Tribe of Oklahoma Turbine Layout (Siemens SWT-2.3-113 Phase 1 Layout)

Table A5. Estimated Energy Production and Net Capacity Factor at Five Confidence Levels (Evaluation Period [Years 2-10], Annual, and First Year) – Siemens SWT-2.3-113 Phase 1 Layout

Probability of Exceedance	Evaluation Period Average Energy Production (GWh)	Evaluation Period Average Capacity Factor (%)	Annual Energy Production (GWh)	Annual Capacity Factor (%)	First Year Energy Production (GWh)	First Year Capacity Factor (%)
P50	61.9	34.1	61.9	34.1	59.7	32.9
P75	55.3	30.5	54.7	30.2	52.3	28.8
P90	49.3	27.2	48.3	26.6	45.7	25.2
P95	45.8	25.2	44.5	24.5	41.7	23.0
P99	39.1	21.6	37.2	20.5	34.3	18.9

Table A6. Estimated Energy Production and Net Capacity Factor at Five Confidence Levels 20-Year Evaluation Period [Years 2-20] –Siemens SWT-2.3-113 Phase 1 Layout

Probability of Exceedance	Evaluation Period Average Energy Production (GWh)	Evaluation Period Average Capacity Factor (%)
P50	61.9	34.1
P75	55.3	30.5
P90	49.3	27.2
P95	45.8	25.2
P99	39.1	21.5

Table A7. Iowa Tribe of Oklahoma Wind Speed and Energy Production Detail (Siemens SWT-2.3-113 Phases 1 and 2 Layout)

Project:	BKJ Solutions - Iowa Tribe of Oklahoma	
Date:	15-Mar-13	
Comments:	Optimized Layout - Phases 1 and 2	
Turbine Manufacturer/Model:	Siemens SWT-2.3-113	
Turbine Rated Power:	2.30	MW
Hub Height:	96	m
Number of Turbines:	22	
Plant Capacity:	50.6	MW
Site Air Density:	1.165	kg/m^3

Loss Accounting	
Wake Effect	3.5%
Availability	6.4%
Electrical	2.1%
Turbine Performance	3.5%
Environmental	2.3%
Curtailments	0.0%
Average Total Loss	**16.6%**

Overall Wind Plant Summary	
Average Free Wind Speed (m/s)	6.54
Gross Plant Production (MWh/yr)	185,221
Net Plant Production (MWh/yr)	154,494
Net Capacity Factor	34.8%

Per Turbine Summary

Turbine ID	Mast Association	Coordinates (WGS84 UTM14) Easting (m)	Northing (m)	Free Speed (m/s)	Gross MWh/yr	Array Eff. (%)	Array Loss (%)	Total Loss (%)	Net MWh/yr	Turbine Rank	Net Capacity Factor (%)	Total TI at 15m/s (%)
1	149	676918	3975812	6.45	8,235	96.2	3.8	16.9	6,846	18	34.0	16.3
2	149	677257	3975766	6.56	8,462	95.5	4.5	17.5	6,985	15	34.6	16.0
3	149	679299	3977090	6.59	8,536	96.7	3.3	16.4	7,137	10	35.4	15.9
4	149	679635	3977157	6.60	8,531	95.8	4.2	17.2	7,060	14	35.0	16.1
5	149	681041	3978107	6.41	8,130	96.1	3.9	17.0	6,748	19	33.5	16.4
6	149	681259	3978572	6.51	8,361	92.8	7.2	19.8	6,704	20	33.3	16.2
7	149	681659	3977521	6.19	7,622	96.9	3.1	16.2	6,384	22	31.7	17.1
8	149	682035	3977548	6.17	7,600	97.5	2.5	15.7	6,408	21	31.8	17.1
9	149	682298	3979264	6.44	8,221	97.9	2.1	15.5	6,951	17	34.5	16.2
10	149	677126	3973446	6.61	8,542	98.7	1.3	14.7	7,289	2	36.2	15.8
11	149	677617	3973477	6.55	8,456	97.3	2.7	15.9	7,113	12	35.3	16.0
12	149	677781	3975749	6.55	8,450	95.5	4.5	17.5	6,973	16	34.6	16.1
13	149	677950	3973566	6.60	8,568	96.6	3.4	16.6	7,150	8	35.5	15.9
14	149	678116	3975829	6.67	8,685	94.7	5.3	18.1	7,111	13	35.3	15.9
15	149	678261	3973716	6.62	8,611	96.5	3.5	16.7	7,176	6	35.6	15.9
16	149	678439	3975954	6.69	8,726	95.8	4.2	17.2	7,227	4	35.8	15.7
17	149	678596	3973776	6.64	8,634	97.6	2.4	15.7	7,278	3	36.1	15.8
18	149	679584	3974197	6.59	8,524	97.2	2.8	16.1	7,155	7	35.5	15.9
19	149	679889	3974351	6.66	8,657	97.8	2.2	15.5	7,319	1	36.3	15.8
20	149	679977	3977079	6.59	8,522	97.0	3.0	16.2	7,142	9	35.4	15.9
21	149	680258	3977977	6.64	8,603	96.9	3.1	16.3	7,204	5	35.7	15.9
22	149	681788	3979250	6.59	8,546	96.6	3.4	16.5	7,136	11	35.4	15.9

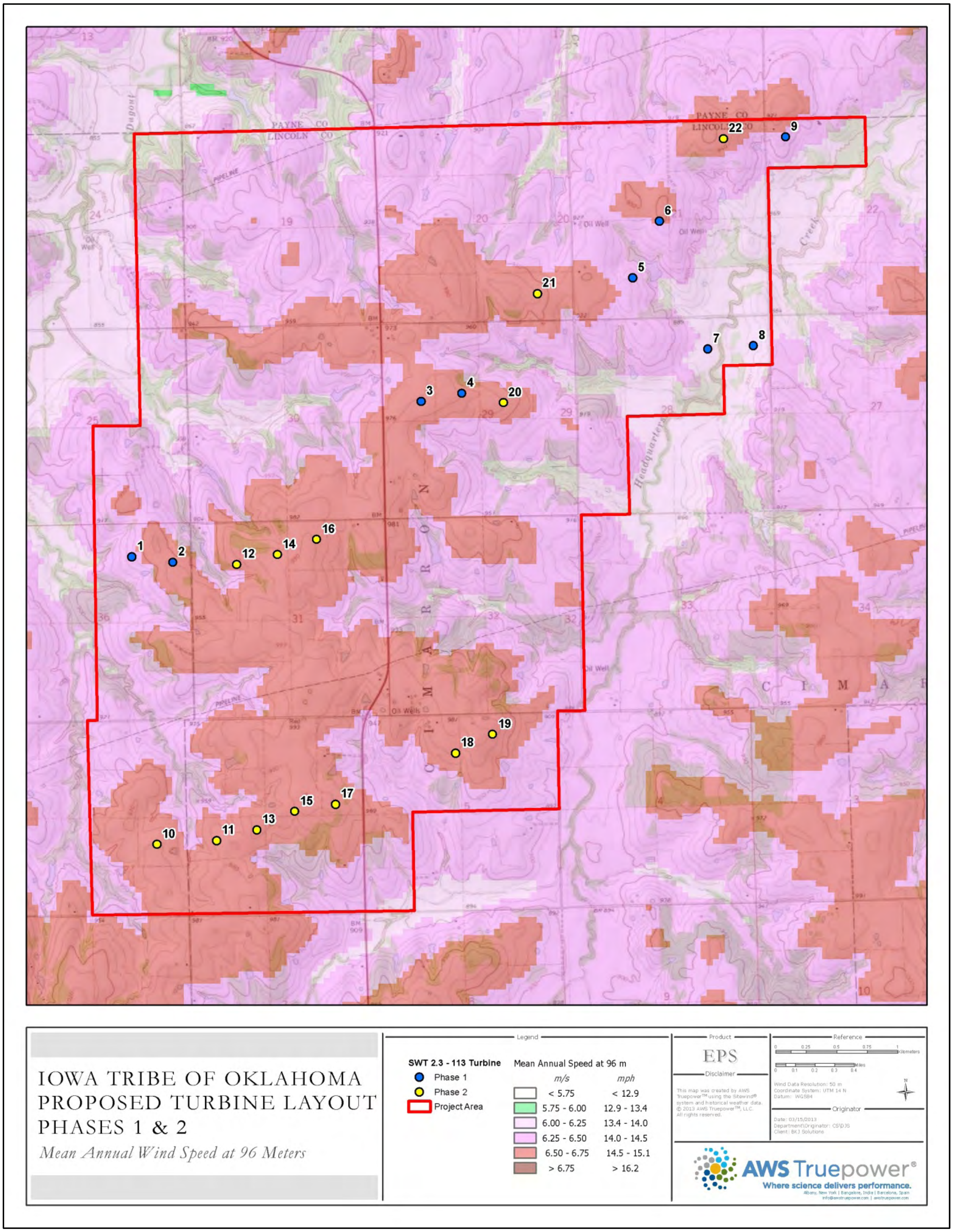

Figure A3. Proposed Iowa Tribe of Oklahoma Turbine Layout (Siemens SWT-2.3-113 Phases 1 and 2 Layout)

Table A8. Estimated Energy Production and Net Capacity Factor at Five Confidence Levels (Evaluation Period [Years 2-10], Annual, and First Year) – Siemens SWT-2.3-113 Phases 1 and 2 Layout

Probability of Exceedance	Evaluation Period Average Energy Production (GWh)	Evaluation Period Average Capacity Factor (%)	Annual Energy Production (GWh)	Annual Capacity Factor (%)	First Year Energy Production (GWh)	First Year Capacity Factor (%)
P50	154.5	34.8	154.5	34.8	149.1	33.6
P75	138.0	31.1	136.7	30.8	130.7	29.5
P90	123.1	27.8	120.6	27.2	114.1	25.7
P95	114.2	25.7	111.0	25.0	104.2	23.5
P99	97.5	22.0	93.0	21.0	85.6	19.3

Table A9. Estimated Energy Production and Net Capacity Factor at Five Confidence Levels 20-Year Evaluation Period [Years 2-20] –Siemens SWT-2.3-113 Phases 1 and 2 Layout

Probability of Exceedance	Evaluation Period Average Energy Production (GWh)	Evaluation Period Average Capacity Factor (%)
P50	154.5	34.8
P75	138.0	31.1
P90	123.1	27.8
P95	114.2	25.7
P99	97.5	22.0

PREPARED FOR
JOHNSON CONTROLS

PRELIMINARY SOLAR RESOURCE AND ENERGY ASSESSMENT

MARCH 27, 2013

FOR THE IOWA TRIBE OF OKLAHOMA SOLAR PROJECT
LINCOLN COUNTY, OKLAHOMA

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DOCUMENT HISTORY

Issue	Date	Summary
A	27 March 2013	Initial Report

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1. INTRODUCTION

AWS Truepower, LLC (AWS Truepower) was retained by Johnson Controls to estimate the long-term solar resource and preliminary energy production of the Iowa Tribe of Oklahoma photovoltaic (PV) project site, located in central Oklahoma. The project, which has a rated DC/AC capacity of 22.3/20 MW, was modeled using 79,662 Yingli YL280P-35b polycrystalline solar modules and 40 Advanced Energy Solaron 500 kW inverters. Using reliable nearby measured and modeled reference data sources, AWS Truepower estimated the long-term solar resource and developed a typical meteorological year (TMY) data set that represents the expected meteorological conditions at the project site. This data set was then used, along with standard plant specifications and losses assumed by AWS Truepower, and an energy simulation program, to estimate the long-term energy production potential of the plant. Through this process, several areas of uncertainty were identified and quantified in order to estimate the energy production at several confidence intervals.

For comparison purposes, estimated energy output considering Jinko JKM300M-72 and FirstSolar FS-380 modules is also provided.

2. SITE DESCRIPTION

The Iowa Tribe of Oklahoma solar project site is located approximately 110 km west-southwest of Tulsa, Oklahoma and approximately 50 km northeast of Oklahoma City, Oklahoma. Its location is indicated on the regional map in Figure 1. The project site, at a mean site elevation of approximately 281 m, is located amongst hilly terrain east of Highway 35 and north of Highway 44. Land cover immediately surrounding the project area consists of grass fields and scattered forest, with residential and agricultural development nearby. Basic information about the project site is provided in Table 1.

Table 1. Description of the Iowa Tribe of Oklahoma Solar Project Site

Site ID	Site Coordinates WGS84 Zone 14N		County	Elevation (m)	Nearby Town	Environmental
	Latitude	Longitude				
Iowa Tribe of Oklahoma Solar Project	35.75418	-97.12698	Lincoln	281	Chandler, Oklahoma	Grass fields and scattered forest, residential and agricultural development nearby

3. SOLAR AND METEOROLOGICAL MEASUREMENTS

Solar and wind monitoring at the project began in November 2011 with the installation of a single monitoring mast, designated Mast 0149. The mast remains in operation, and its location is indicated in Figure 1. TUV SUD America installed the mast, while Johnson Controls has been responsible for data collection. Since AWS Truepower did not perform a site visit, we relied on information about the mast provided in a detailed tower installation form provided by Johnson Controls.

The data at Mast 0149 were collected using an NRG Symphonie Plus3 data logger; data were provided to AWS Truepower in their raw binary format via ftp and email. Each data file contained 10-minute average wind speed, direction, temperature and solar radiation measurements, along with their standard deviations. The pyranometer used in the measurement program is assumed to be a LICOR LI-200 mounted off the side of the tower.

An experienced AWS Truepower meteorologist screened the data for completeness and quality, and examined any suspect values. The main considerations addressed by this validation process included identification of invalid measurements, ramp events produced by periods of cloud cover, and verification of missing data. After validation, the data recovery was 88.2% for the global horizontal irradiance (GHI) component.

4. SOLAR AND METEOROLOGICAL RESOURCE CHARACTERISTICS

Data from Mast 0149 was evaluated to obtain summary statistics for the period of data collection. Table 2 presents the observed monthly GHI and data recovery during its 15-month period of record. During this period, the total GHI was 1650 kWh/m^2. Figure 2 shows the observed monthly solar resource at Mast 0149 between November 2011 and January 2013, in addition to concurrent records from several reference data sources.

Table 2. Iowa Tribe of Oklahoma Solar Project Design

Month-Year	Irradiation (kWh/m^2/month)	Data Recovery (%)
Nov-11	73.8	86.5%
Dec-11	69.8	100.0%
Jan-12	101.3	100.0%
Feb-12	90.5	100.0%
Mar-12	142.3	100.0%
Apr-12	159.7	100.0%
May-12	206.9	100.0%
Jun-12	208.5	100.0%
Jul-12	15.9	6.5%
Aug-12	53.4	32.3%
Sep-12	150.7	100.0%
Oct-12	118.5	100.0%
Nov-12	105.6	100.0%
Dec-12	74.7	100.0%
Jan-13	78.4	100.0%
Total	**1650**	**88.2**

5. REFERENCE DATA SOURCES

AWS Truepower relied on the following sources of reference data to estimate the long-term solar resource at the project site:

- 10-km gridded solar and meteorological data sets produced by the State University of New York (SUNY)[1] as a part of the National Solar Radiation Database (NSRDB)
- 10-km gridded solar and meteorological data sets produced by Clean Power Research (CPR) as an extension of the SUNY model

[1] Perez, R., Ineichen, P., Moore, K., Kmiecikm, M., Chain, C., George, R., Vignola, F., "A New Operational Satellite-to-Irradiance Model", Solar Energy, 73 5, pp. 307-317.

- TMY3 data sets developed as part of the NSRDB
- Observations from several long-term solar reference stations located near the project site

The surface-based reference data source locations relative to the project site are shown on the regional map in Figure 1 and are summarized in Table 3. A detailed discussion of each reference data source can be found in Appendix A.

Table 3. Nearby Reference Data Sources

Reference Station	Network	Available Years	Distance from Project Site (km)	Elevation (m)
Stillwater	USCRN	9	40	152

6. ESTIMATION OF LONG-TERM SOLAR RESOURCE

Since the solar and meteorological resource can vary over timescales of months to years, it is important to adjust the data collected at a site to represent historical conditions as closely as possible. The method used to develop site-specific solar resource characteristics is known as measure-correlate-predict (MCP). In MCP, a linear regression or other relationship is established between a target site, spanning a relatively short period, and a reference site, spanning a much longer period. The complete record of the reference station is then used in this relationship to estimate the long-term historical climate at the target site.

Normally, the most important factor determining the success of MCP is the choice of reference station(s), particularly the quality of its relationship with the target site (which should ideally be linear with a high correlation coefficient) and the consistency and length of the reference data record. When less than a full year of data is available from the target site, the possibility of a seasonal bias in the relationship between the target site and reference site must be considered.

AWS Truepower evaluated several reference data sources within the vicinity of the project site and determined their relevance for estimating the long-term solar resource; including the CPR satellite model and Stillwater surface-based reference station. Linear regression equations were established between GHI data using concurrent daily records from Mast 0149 and each reference data source. Both Stillwater and the CPR satellite model were found to have strong correlations with the on-site data (r^2 = 0.97 and 0.98, respectively).

Although AWS Truepower often assigns greater weight to surface-based measurements of the solar resource, the regression results were similar enough for Stillwater and the CPR satellite model to give confidence in the model's use as a long-term reference data source for this analysis. The satellite model has a longer period of record, is representing the solar resource specific to the project site, includes all three solar components and has a high data recovery rate. Given this information and our confidence in the model for this region, AWS Truepower used the CPR satellite model as a reference to estimate the long-term solar resource at the project site.

The linear regression equation developed using concurrent daily values, and corresponding r^2 value between Mast 0149 and CPR is as follows:

Mast 0149 GHI = (CPR Satellite Model GHI * 1.052) – 0.168 kWh/m^2; (r^2 = 0.98)

The annual average GHI estimated by the model from 1998 through 2012 is 1695 kWh/m^2. Substitution of this value into the above equation with an annualized intercept[2] yields an estimated long-term solar GHI of 1722 kWh/m^2/year at the Iowa Tribe of Oklahoma project site. A scatterplot showing the regression results can be found in Figure 3. Long-term direct normal irradiance (DNI) and diffuse horizontal irradiance (DHI) were taken directly from the satellite model because they were not collected directly onsite.

7. DEVELOPMENT OF TYPICAL METEOROLOGICAL YEAR DATA SET

In order to accurately characterize the solar resource potential and to define its seasonal and diurnal distributions, a TMY data set was constructed. A TMY data set is defined as a long-term annualized hourly time series of insolation and meteorological parameters (GHI, DNI, DHI, ambient dry-bulb temperature and wind speed). When available, a historical data set with a long period of record is preferred. The primary historical database used in this analysis was the CPR satellite model. This data source was selected due to its consistent 15-year data record, representativeness of solar radiation specific to the project site and inclusion of all three solar components.

A TMY data set representing the site conditions was constructed using 15 years of satellite-modeled data (1998-2012). AWS Truepower has adopted a methodology similar to the Sandia Method for developing solar TMY data sets[3]. This approach identifies the most representative months from a long-term data set by examining the daily weighted cumulative distribution functions (CDF) of several solar and meteorological parameters and matching the long-term CDF with the most representative monthly CDF. The following atmospheric indices are considered:

- Mean GHI
- Mean DHI
- Dry bulb temperature: mean, maximum, and minimum
- Wind speed: mean, maximum, and minimum

When applying the Sandia Method to select the appropriate months for a TMY data set, the meteorological variables are weighted according to their defined importance. After removing months having inconsistent weather patterns, the twelve most representative months are then concatenated to form a complete year. The resulting data set has seasonal and annual averages comparable to the long-term average and represents typical conditions at the project site. Temperature and wind speed data for the concurrent months were obtained from the National Weather Service Automated Surface Observing System (ASOS) station at Oklahoma City. Given the similarities in elevation and general climate, the mean annual temperature and wind speed at the project site was taken from the Oklahoma City ASOS and is estimated to be approximately 16.2°C, while the mean annual wind speed is estimated to be 4.9 m/s.

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[2] Since daily measurements of energy (kWh/m2) are used to develop the regression equation for determining the total annual GHI (kWh/m2/year), the intercept must be annualized to ensure accurate representation of this measure of energy. The computation includes adjusting the intercept to account for the number of days in a year.
[3] Hall, I.; Prairie, R.; Anderson, H.; Boes, E. (1978). *Generation of Typical Meteorological Years for 26 SOLMET Stations*. SAND78-1601. Albuquerque, NM: Sandia National Laboratories.

The TMY data set was then scaled to the long-term solar radiation and meteorological components developed previously to produce a site-specific hourly time series. Estimated annual irradiation for the project area is shown in Table 4, including global horizontal, direct normal and diffuse horizontal components. Monthly solar irradiation is shown in Figure 4.

Table 4. Estimated Annual Irradiation (kWh/m^2/year) and Meteorological Components for the Project Site

Radiation Component	Estimated Annual Irradiation
Global Horizontal	1722
Direct Normal	1890
Diffuse Horizontal	581
Annual Average Temperature (°C)	16.2
Annual Average Wind Speed (m/s)	4.9

8. PRELIMINARY ENERGY ASSESSMENT

Based on the insolation and meteorological parameters defined previously and selected PV plant specifications, the electrical energy output of the project was modeled using AWS Truepower's energy simulation model. The simulation model includes the PV energy simulation program PVsyst v5.59 and additional post-processing of the output data. The inputs to the performance model were the project location, plant characteristics, estimated hourly solar and meteorological data, and loss factors derived by AWS Truepower.

SELECTED PV TECHNOLOGY AND CONFIGURATION

Annual energy production was estimated for the Iowa Tribe of Oklahoma solar project site using details outlined below and summarized in Table 5. Since the project is in the early stages of development, few design considerations have been finalized; therefore, most of the design considerations were assumed by AWS Truepower to represent a typical PV project based on industry experience.

- **Configuration**: Details regarding the main plant configuration were assumed by AWS Truepower. This configuration was simulated assuming a polycrystalline PV array using a ground-mounted fixed tilt of 35° and azimuth of 180° (south).

- **Panels**: The analysis was conducted using 79,662 Yingli YL280p-35b polycrystalline modules with a rated power of 280 W and efficiency up to 14.9% at Standard Test Conditions (STC)[4], resulting in a total rated power of approximately 22.3 MW_{DC}. The module operating temperature range is -40°C to 85°C, with a positive power tolerance of 0/+5 W. The 25-year transferrable power output warranty is rated at 10-year/91.2% and 25-year/80.7% to account for module degradation.
    - **Jinko Configuration** – a simulation was conducted using 76,912 Jinko JKM300M-72 monocrystalline modules with a rated power of 300 W and efficiency up to 15.5% at STC, resulting in a total rated power of 22.3 MW_{DC}.
    - **FirstSolar Configuration –** a simulation was conducted using 262,560 FirstSolar FS-380 thin-film modules with a rated power of 80 W, resulting in a total rated power of 21 MW_{DC}.

[4] Irradiance: 1000 W/m2; Spectrum: AM 1.5; and Cell Temperature: 25°C

- **Inverter**: The system design assumed 40 Advanced Energy Solaron 500 kW inverters, resulting in a total capacity of 20 MW_{AC}. The input operating voltage range for this inverter is ±330-600 V with a nominal power of 500 kW_{AC}.

- **Array**: To enable plant operation within the manufacturer-specified limits of the inverter, the project was modeled assuming 3,621 strings connected in parallel, each containing 22 modules connected in series. The resulting DC/AC ratio is 1.12.

- **Transformer**: The analysis includes standard losses for step-up transformers, including transformer efficiency.

Table 5. Iowa Tribe of Oklahoma Solar Project Design

Design Parameter	Yingli Simulation	Jinko Simulation	FirstSolar Simulation
Module	YL280P-35b	JKM300M-72	FS-380
Nominal $Power_{STC}$ (W)	280	300	80
Technology	Polycrystalline	Monocrystalline	Thin-Film
Array Orientation	Fixed 35° Tilt 0° Azimuth	Fixed 35° Tilt 0° Azimuth	Fixed 35° Tilt 0° Azimuth
Installed DC Capacity (MW)	22.3	22.3	21
Approx. Number of Modules	79,662	76,912	262,560
Inverter	AE Solaron 500	AE Solaron 500	AE Solaron 500
Number of inverters	40	40	40
Nominal $Power_{STC}$ (kW)	500	500	500
Installed AC Capacity (MW)	20	20	20
DC-AC Ratio	1.12	1.12	1.05

*Standard Testing Conditions

ENERGY SIMULATION AND LOSS ASSUMPTIONS

Annual net energy production was simulated for every hour of the calendar year using PVsyst. To determine the effective incident radiation, the horizontal solar components were translated to the plane of array (POA), which was estimated to be 1978 kWh/m^2/year. As part of the energy simulation, loss factors were also computed for each hour of a calendar year. Some loss factors were applied uniformly to all operating conditions. These were estimated based on the local environment and industry-standard values, then entered directly into the energy model. Other loss factors were calculated during the energy simulation process based on user-defined simulation settings and the hourly solar and meteorological input data. Plant losses are grouped into four main categories:

- **Effective irradiation** - Horizon shading, near shading, incident angle modifier factor, soiling

- **Photovoltaic conversion** - Initial light induced degradation, non-STC operation due to irradiance and temperature, panel quality, panel mismatch, performance degradation

- **Electrical** - DC wiring, inverter efficiency, inverter limitation, AC wiring, transformer

- **Operational** – System losses, including HVAC & auxiliary components, availability of system, availability of collection & substation, availability of utility grid, PPA curtailment

Although horizon and row-to-row shading (through plant layout design) should be considered, shading losses were not accounted for in the preliminary energy estimate. In order to account for horizon shading, horizon data should be obtained on-site using a Solar Pathfinder or other horizon viewing tool. Row-to-row shading losses are dependent on the final project design, including selected configuration, and are included in a more comprehensive energy assessment. The combined losses which are computed as efficiencies are 18.2% and are presented in Table 6.

Energy production is expected to decrease throughout the system lifetime due to annual performance degradation of the module. Therefore, the system performance is provided for the first year and for all subsequent years of the evaluation period. The annual degradation in module output of 0.5%/year is based on information provided by the manufacturer, typical industry values, the local climate and AWS Truepower's experience with similar projects.

Table 6. Estimated System Loss Factors

Loss Category	Yingli	Jinko	FirstSolar
Effective Irradiation	4.5%	4.5%	4.5%
Photovoltaic Conversion	9.8%	9.3%	7.0%
Electrical	4.3%	4.2%	4.1%
Operational	1.2%	1.2%	1.2%
Combined Loss*	**18.2%**	**18.3%**	**15.8%**

*Combined loss is computed as a total of efficiencies, not a sum.
Does not include annual performance degradation

ENERGY PRODUCTION ESTIMATE

Using the output from the PVsyst simulation, AWS Truepower post-processed the results to obtain the preliminary energy production estimate for the Iowa Tribe of Oklahoma solar project. The following performance parameters were computed to describe annual system performance:

- **Gross energy** is the production of an ideal system with no loss factors
- **Net energy** is the total energy produced after all losses have been applied
- **Performance ratio** is the ratio of the net energy to the gross energy, or 100% minus the total plant loss
- **Capacity factor** is the ratio of the net energy production to the production of the system if it were to operate at rated capacity for the entire year
- **Energy yield ratio** is the ratio of the net energy production divided by the DC nameplate capacity of the plant

The performance parameters for each plant design are summarized in Table 7. For the Yingli simulation, the long-term annual gross energy output is estimated to be 44.1 GWh. The first-year net energy production is estimated to be 36.0 GWh with a performance ratio of 81.6% and an AC capacity factor of 20.6%. Averaged over a 25-year evaluation period and including the estimated linear performance degradation rate of 0.5% per year, the average annual net energy production is estimated to be 34.0 GWh with a performance ratio of 77.0% and AC capacity of 19.4%. Monthly and diurnal 12x24 energy matrices are provided in Appendix B.

Average annual net energy production and AC capacity factor for the Jinko and FirstSolar modules is estimated to be approximately 33.8 GWh, 19.3%, 32.9 GWh and 18.8%, respectively. Total lifetime energy production is estimated to be 849.1 GWh, 846.1 GWh and 821.4 GWh for the Yingli, Junko and FirstSolar simulations respectively. Table 8 shows net energy output for each year during the project's lifetime, while Figure 5 shows the monthly estimated gross and net energy output and performance ratio.

Table 7. Estimated PV System Performance

Performance Metric	Yingli	Jinko	FirstSolar
Gross Energy (GWh)	44.1	44.1	41.5
First Year Net Energy (GWh)	36.0	36.0	34.9
First Year Performance Ratio (%)	81.6	81.5	84.0
First Year DC Capacity Factor (%)	18.4	18.4	19.0
First Year AC Capacity Factor (%)	20.6	20.5	19.9
First Year Energy Yield Ratio (kWh/kWDC)	1615	1612	1662
Life Avg. Net Energy (GWh)	34.0	33.8	32.9
Life Avg. Performance Ratio (%)	77.0	76.7	79.1
Life Avg. DC Capacity Factor (%)	17.4	17.3	17.9
Life Avg. AC Capacity Factor (%)	19.4	19.3	18.8
Life Avg. Energy Yield Ratio (kWh/kWDC)	1523	1517	1564
Total Lifetime (25 yrs) Energy Production (GWh)	849.1	846.1	821.4

Table 8. Estimated Evaluation Period PV System Performance

Net Energy Production (GWh)			
Year	**Yingli Modules**	**Jinko Modules**	**FirstSolar Modules**
1	36.0	36.0	34.9
2	35.8	35.8	34.7
3	35.7	35.6	34.6
4	35.5	35.4	34.4
5	35.3	35.3	34.2
6	35.2	35.1	34.1
7	35.0	34.9	33.9
8	34.8	34.7	33.7
9	34.6	34.5	33.5
10	34.5	34.4	33.4
11	34.3	34.2	33.2
12	34.1	34.0	33.0
13	34.0	33.8	32.9
14	33.8	33.7	32.7
15	33.6	33.5	32.5
16	33.5	33.3	32.3
17	33.3	33.1	32.2
18	33.1	33.0	32.0
19	32.9	32.8	31.8
20	32.8	32.6	31.7
21	32.6	32.4	31.5
22	32.4	32.3	31.3
23	32.3	32.1	31.1
24	32.1	31.9	31.0
25	31.9	31.7	30.8
Average	**34.0**	**33.8**	**32.9**
Total	**849.1**	**846.1**	**821.4**

9. UNCERTAINTY ANALYSIS

In order to quantify the uncertainty in the long-term energy estimate, an uncertainty analysis was conducted for the Yingli YL280P-35b module design scenario. The uncertainty analysis accounted for measurement accuracy, inter-annual variability in the solar resource, period of record, spatial variability in the solar resource, transposition to the POA, simulation and plant losses, and module degradation. For this analysis, the uncertainty was defined as the standard error for a normal probability distribution. While three energy scenarios have been simulated, the uncertainty analysis was performed assuming the Yingli scenario only.

Measurement Accuracy: This uncertainty addressed the accuracy of measured or modeled data used to estimate the solar resource at the project site. Factors considered include the sensor types and counts used for surface-based measurements, sensor non-stability, preventative site maintenance, sensor calibration, period of deployment, published model accuracies, extent of model validation and any corrections performed to account for model bias. Considering these factors, available measured and modeled data at the project site and experience with similar projects, a measurement uncertainty of 4.2% was assigned.

Inter-Annual Variability: This uncertainty addressed natural differences in the solar resource from year to year. Inter-annual variability is calculated from multiple years of high-quality reference data and varies by region. Local climates can cause this uncertainty to vary considerably over short distances. Based on nearby reference data sources, the climate of the project site and AWS Truepower's experience in the region, an inter-annual variability in irradiance of 4.0% for one year and 0.8% over the 25-year evaluation period were assigned for this analysis.

Representativeness of Monitoring Period: This uncertainty addressed how well the available period of record data may represent the long-term historical average. Considerations for this uncertainty include the measure of correlation between the on-site and reference data, their periods of record, data recovery of available reference data sources, and the inter-annual variability of the solar resource. The analysis assumed that the annual mean varied randomly according to the normal distribution, and thus the error margin varied inversely with the square root of the number of years. Given the 1.25-year period of record of the measurement tower at the project site, an uncertainty of 1.1% was assigned.

Spatial Variability: This uncertainty addressed the spatial variation in the solar resource across the approximate project area, which was calculated based on the selected technology, project size, the project layout assumed by AWS Truepower and an industry-average MW-density. Using a relationship derived from 1-km gridded, satellite-modeled data, an uncertainty of 0.1% was assigned.

Transposition to Plane of Array: This uncertainty addressed the accuracy of the transposition of the horizontal radiation components to the plane of array. Based on the expected accuracy of the transposition algorithms used in this analysis, an uncertainty of 1.6% was assigned.

Simulation & Plant Losses: This uncertainty addressed the performance simulation and derived plant loss factors and is estimated to be 20% of the total loss, or 3.6%.

Module Degradation: An additional uncertainty of 2.4% was applied to the evaluation period production to account for the annual performance degradation of the system. This is based on a comparison between the expected plant output and the output of the system following the most conservative scenario of the manufacturer-supplied limited power output warranty.

COMBINED UNCERTAINTY

The following steps were taken to determine the energy production at various desired confidence levels:

- The uncertainty percentages in the solar resource were combined as the square root of the sum of squares. This was then applied to the time series data set in order to quantify the uncertainty in the solar resource.
- The sensitivity of the project output to changes in annual irradiation was determined. This ratio was calculated by comparing the energy output of the system for the estimated long-term average annual irradiation to the predicted output of the system with the uncertainty-adjusted resource estimate (estimated long-term data set minus uncertainty).
- The sensitivity of the project output to changes in irradiation was multiplied by each irradiation uncertainty to estimate the corresponding uncertainty of the project energy output.

- The uncertainty in the simulation and plant losses were combined with the previous total using the square root of the sum of squares.
- Assuming a normal distribution of errors, the energy production levels that would be exceeded by the project with 75%, 90%, 95%, and 99% confidence were calculated.

The total and individual uncertainties of the energy estimates are shown for the first year and for the 25-year evaluation period in Table 9 and Table 10, respectively. The combined uncertainty margin in energy production is 9.0% for the first year of operation, or approximately 3.3 GWh. Energy production estimates at five confidence levels were generated for one and 25-year evaluation periods and are summarized in Table 11.

Table 9. First Year Uncertainty Summary

Uncertainty Source	POA Solar Resource		Energy Production	
	%	kWh/m^2	%	GWh/year
Measurement Accuracy	4.2	83	5.7	2.0
Inter-Annual Variability	4.0	79	5.4	2.0
Representativeness of Monitoring Period	1.1	23	1.5	0.6
Spatial Variability	0.1	1	0.1	0.0
Transposition to POA	1.6	31	2.1	0.8
Simulation & Plant Losses	-	-	3.6	1.3
Combined Uncertainty	**6.1**	**121**	**9.0**	3.3

Table 10. Evaluation Period Uncertainty Summary [25 years]

Uncertainty Source	POA Solar Resource		Energy Production	
	%	kWh/m^2	%	GWh/year
Measurement Accuracy	4.2	83	5.7	1.9
Inter-Annual Variability	0.8	16	1.1	0.4
Representativeness of Monitoring Period	1.1	23	1.5	0.5
Spatial Variability	0.1	1	0.1	0.0
Transposition to POA	1.6	31	2.1	0.7
Simulation & Loss Factors	-	-	3.6	1.2
Annual Degradation	**-**	-	2.4	0.8
Combined Uncertainty	**4.7**	**93**	**7.7**	2.6

Table 11. Energy Production and Capacity Factor at Five Confidence Levels: First Year and Evaluation Period [25 years]

Probability of Exceedance	First Year			25-Year Evaluation Period Average		
	Energy Production (GWh)	Performance Ratio (%)	DC/AC Capacity Factor (%)	Energy Production (GWh)	Performance Ratio (%)	DC/AC Capacity Factor (%)
P50	36.0	81.6	18.4/20.6	34.0	77.0	17.4/19.4
P75	33.8	79.6	17.3/19.3	32.2	74.7	16.5/18.4
P90	31.9	77.8	16.3/18.2	30.6	72.7	15.7/17.5
P95	30.7	76.7	15.7/17.5	29.7	71.4	15.2/16.9
P99	28.5	74.7	14.6/16.2	27.9	69.1	14.3/15.9

10. SUMMARY

The preliminary long-term energy production potential was estimated for the Iowa Tribe of Oklahoma Solar project site near Oklahoma City, Oklahoma. Solar and meteorological resource data from a 15-month on-site measurement program from November 2011 through January 2013 were evaluated to estimate the long-term solar resource and uncertainty at the Mast 0149 location. Using estimated irradiance from the CPR satellite model and a methodology to adjust data having a short period of record to the long-term, AWS Truepower estimated the long-term GHI to be 1722 kWh/m2/year. A TMY data set was then developed and scaled to the long-term solar radiation estimates. The mean annual temperature is expected to be approximately 16.2°C

Preliminary energy production potential was estimated for the plant using a primary design of Yingli YL280P-35b modules and two additional designs using Jinko JKM300M-72 and First Solar FS-380 module types. The first-year gross energy output of the Iowa Tribe of Oklahoma solar project using the Yingli YL280P-35b modules is estimated to be 44.1 GWh. The first-year net energy production is estimated to be 36.0 GWh with a performance ratio of 81.6% and an AC capacity factor and energy yield ratio of 20.6% and 1615 kWh/kW, respectively. Averaged over a 25-year evaluation period and including the estimated performance degradation, the average annual net energy production is estimated to be 34.0 GWh, with an average performance ratio of 77.0% and AC capacity of 19.4%. Over a 25-year evaluation period, the combined uncertainty of 7.7% in average annual production, or 2.6 GWh, results in a net plant output estimated to be at least 30.6 GWh/year with 90% confidence.

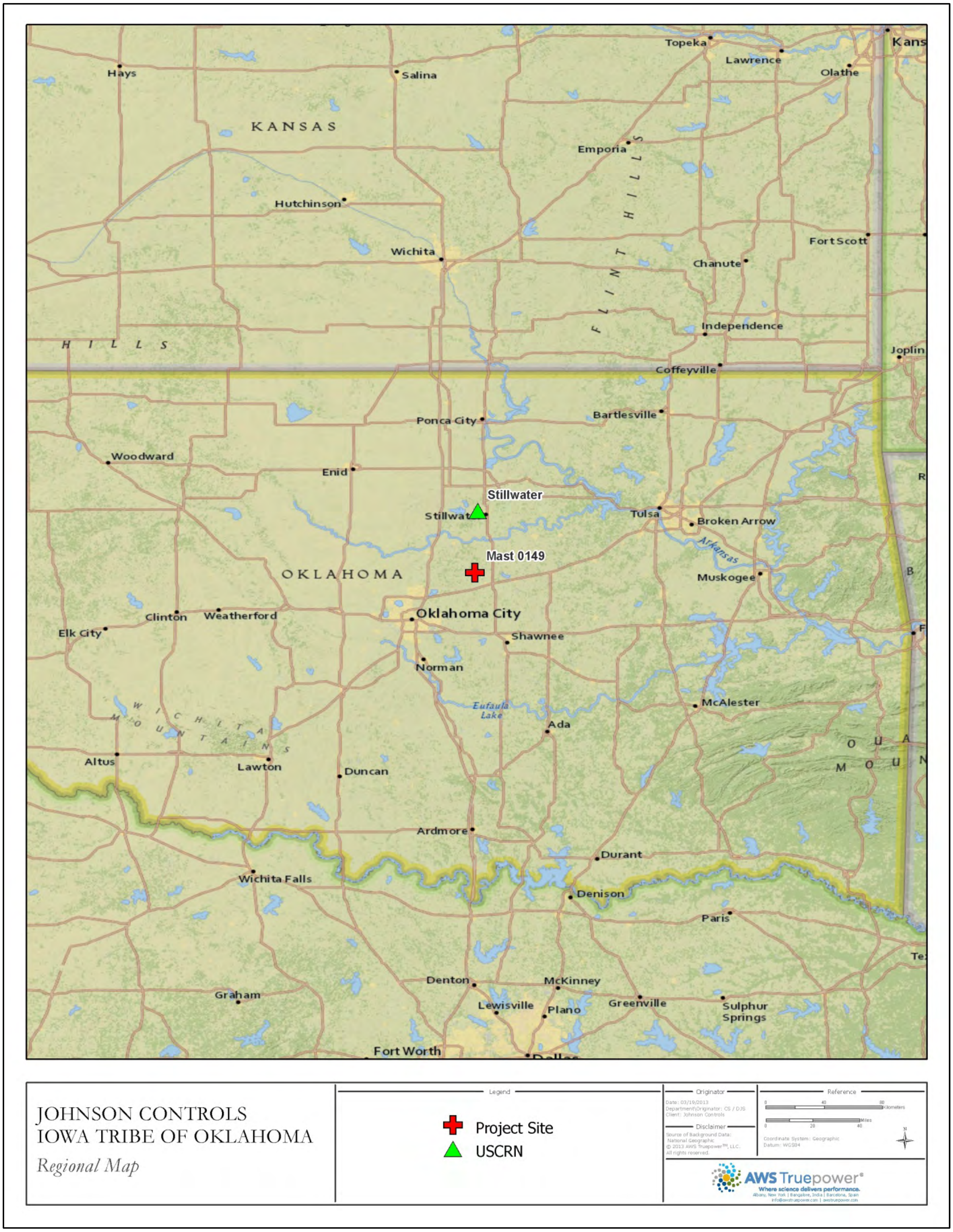

Figure 1. Location of the Iowa Tribe of Oklahoma Solar Project Site in central Oklahoma

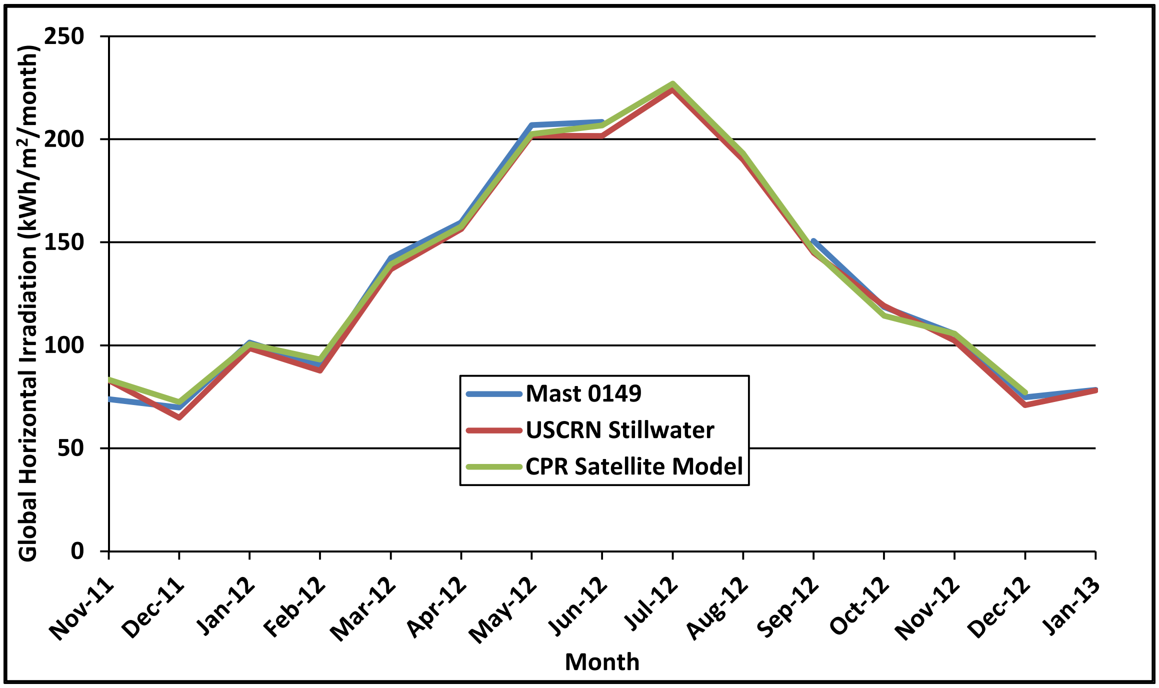

Figure 2. Observed Monthly Solar Resource Characteristics at Mast 0149

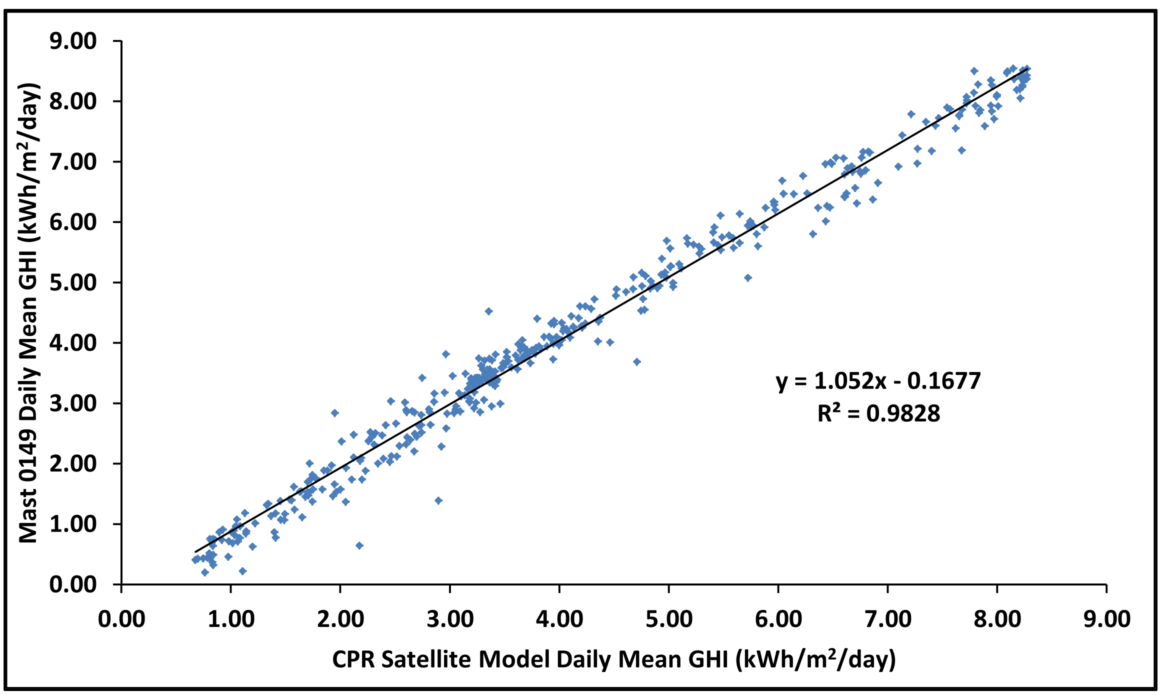

Figure 3. Scatterplot of Mast 0149 and CPR Satellite Daily Total GHI

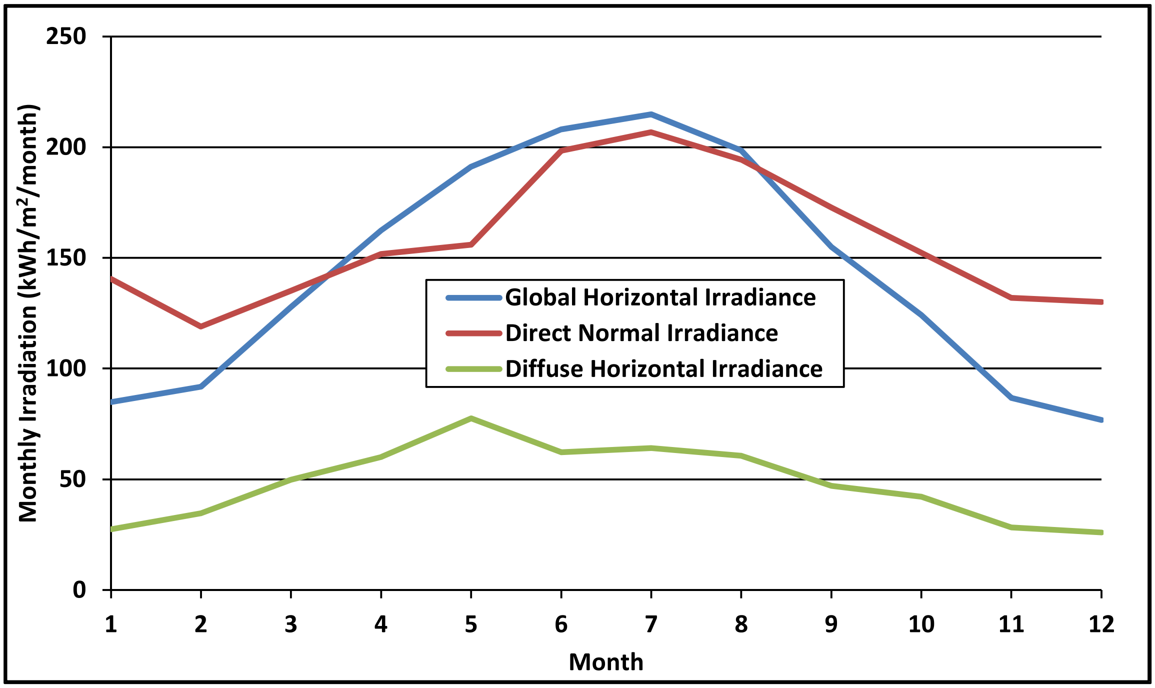

Figure 4. Monthly Solar Irradiation at the Iowa Tribe of Oklahoma Project Site

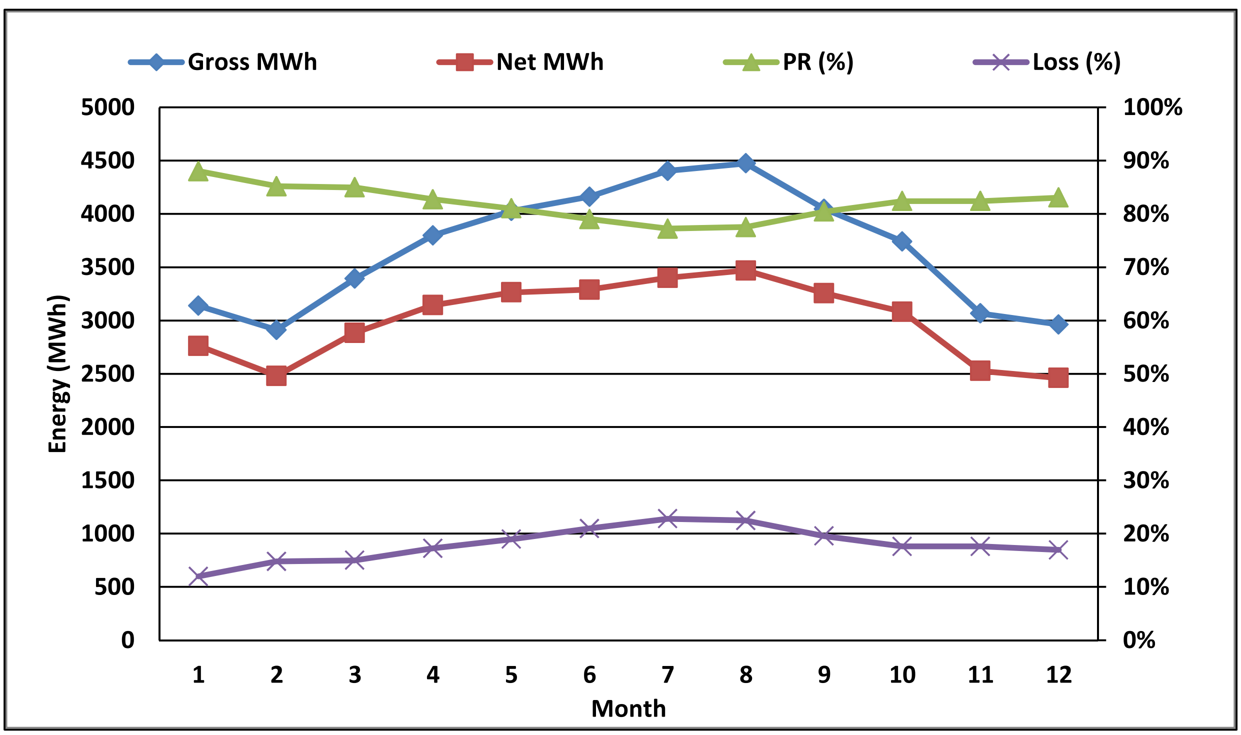

Figure 5. Estimated First-Year Monthly Plant Performance

APPENDIX A – REFERENCE DATA SOURCES

NSRDB – The NSRDB is a long-term hourly gridded data set consisting primarily of solar radiation data modeled at 10-km resolution, as well as various meteorological parameters. The global, direct normal and diffuse components of solar radiation are included in the data set. The original NSRDB, which spanned the period from 1961-1990, contained a complete data set of all sun-up hours for 239 stations and was produced using the Meteorological-Statistical (METSTAT) model[5]. The METSTAT model relied on NWS cloud cover observations and measured solar data from the NWS Solar Radiation SOLRAD[6] Network. An updated NSRDB was released which contains data from 1454 stations for the period from 1991 to 2005. In addition to the expanded station list, the update contains new or modified solar models, a gridded data product, and different meteorological fields. The METSTAT model was used during the period between 1991 and 1997, while a satellite-based model developed by SUNY was used starting in 1998. The SUNY model uses Geostationary Operational Environmental Satellite (GOES) visible-channel imagery to estimate solar radiation based on an inverse relationship between irradiance reflected by clouds and the atmosphere back to space and irradiance transmitted through the atmosphere to the earth's surface.

CPR Modeled Data – Clean Power Research previously developed a modeled solar radiation data set known as SolarAnywhere, a 10-km gridded data set spanning from January 2006 to the present, to complement the SUNY model provided by NREL. In the most recent version, CPR extended the period of record (1998-present) in order to provide a consistent 15-year modeled data set for all locations in the continental United States and parts of southern Canada, including southern Ontario. The model is derived using satellite imagery similar to the SUNY model, and outputs GHI, DNI, DHI, temperature and wind speed for the entire period.

NSRDB TMY3 Data Sets – NREL has used modeled data sets from the 1961-1990 and 1991-2005 NSRDB archives to create data files representing the typical meteorological year at 1,454 locations. These data files provide hourly solar and meteorological data for a complete 1-year period that represent typical, rather than extreme, conditions for a given site. The sites are broken into three classes, labeled Class I, Class II, and Class III. Class I sites have a complete period of record and the highest quality modeled data. Class II sites have a complete period of record, but have lower quality input data for the solar models. The periods of record for Class III sites span at least three years, but contain some data gaps. When using TMY3 data sets as part of a technical analysis, AWS Truepower prefers to use only Class I and II stations. For this analysis, TMY3 data were used as comparison data sets for the long-term estimate generated for the project site.

Long-term Measured Data – Several nationwide surface-based measurement networks have been collecting solar radiation data, some with periods of record extending back to 1975, including the National Oceanic and Atmospheric Administration's (NOAA) Integrated Surface Irradiance Study (ISIS) and Surface Radiation (SURFRAD) networks, NREL's Measurement and Instrumentation Data Center (MIDC), and several regional and state-wide meteorological networks. When attempting to estimate a project site's solar resource, AWS Truepower prefers to use these measurement stations because of their representativeness of regional climates, availability of hourly solar radiation data, proximity to specific project locations, extensive periods of record, and our confidence in high-quality measured solar radiation data. These stations typically represent the solar resource well at a given location and can be

[5] Maxwell, E.L. (1998), METSTAT – The Solar Radiation Model Used in the Production of the National Solar Radiation Database (NSRDB). Solar Energy 62(4), pp. 263-279.

[6] The SOLRAD network operated from 1951 to 19985 and consisted of up to 60 stations. Equipment and measurement strategies changed in the mid-1970's.

used to determine the long-term solar resource and to adjust modeled data to account for potential biases.

Data was examined from nearby United States Climate Reference Network (USCRN) station at Stillwater. The USCRN was established by NOAA in 2000 to help detect climate change in the United States. By meeting the requirements of the Global Climate Observing System (GCOS), the network's 122 stations are used continuously in operational climate monitoring activities and for understanding current and historical climate anomalies. Stations are purposely sited in stable environments that are unlikely to experience human activity. Solar radiation is measured on a 2-second sampling interval with a Kipp & Zonen SP Lite Pyranometer and translated into hour-averaged data records. Sensors undergo annual maintenance.

APPENDIX B – MONTHLY/DIURNAL ENERGY MATRICES

Gross Energy Monthly/Diurnal Matrix for Yingli YL280P-35b (First Year)

Hour	Month												Average (kWh)	Total (MWh)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	505	1294	1303	1227	684	82	0	0	0	427	156
7	0	36	2194	3655	4099	4811	4467	4161	3629	2708	428	0	2528	923
8	3469	3616	5672	7455	7805	8652	8758	8761	8552	7667	6787	4114	6785	2478
9	8885	6849	10135	10577	11585	12122	12238	12916	12661	11942	10778	8771	10805	3947
10	12286	9140	12112	14498	14125	15122	15520	16493	15528	14669	13294	12118	13761	5026
11	13909	13355	13631	16963	16837	17539	17627	18949	17802	17246	15977	14342	16184	5911
12	15882	14631	14698	17035	16989	17658	17997	19475	18247	17400	15172	15117	16694	6097
13	15630	15662	13971	16018	16400	17611	18207	18183	18129	16970	14066	14666	16285	5948
14	13466	16358	14011	14957	15278	15664	16760	17230	16204	14462	12391	13152	14975	5470
15	10871	13204	11444	12218	12360	13127	13488	13370	12720	10416	9089	8921	11749	4291
16	6378	8111	7738	8018	7856	8659	9307	8985	7979	6168	4222	4344	7303	2667
17	455	3005	3702	4067	4174	4892	4910	4293	3251	1018	1	0	2808	1026
18	0	0	142	664	1084	1363	1379	835	122	0	0	0	468	171
19	0	0	0	0	8	171	137	1	0	0	0	0	26	10
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Average (kWh)	4218	4332	4560	5276	5412	5779	5918	6014	5621	5028	4259	3981	5033	
Total (MWh)	3138	2911	3393	3799	4027	4161	4403	4474	4047	3741	3066	2962		44122

Net Energy Monthly/Diurnal Matrix for Yingli YL280P-35b (First Year)

Hour	Month												Average (kWh)	Total (MWh)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
0	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-8
1	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-8
2	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-8
3	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-8
4	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-8
5	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-8
6	-22	-22	-22	279	850	881	810	396	5	-22	-22	-22	259	95
7	-22	-15	1689	2896	3225	3663	3289	3085	2811	2112	275	-22	1925	703
8	3007	3013	4926	6340	6468	6977	6909	6972	7097	6499	5746	3393	5620	2053
9	8020	5941	8965	9038	9660	9864	9739	10323	10537	10129	9167	7440	9082	3317
10	11045	7895	10589	12300	11696	12230	12236	13014	12722	12219	11153	10176	11454	4183
11	12376	11512	11666	14087	13771	14019	13722	14752	14380	14251	13179	11957	13305	4860
12	13967	12475	12153	13954	13771	14022	14003	15080	14617	14273	12452	12585	13611	4971
13	13759	13399	11778	13255	13285	13971	14146	14078	14536	13957	11550	12221	13318	4865
14	11846	14074	12078	12493	12480	12484	13011	13445	13041	11993	10205	11000	12326	4502
15	9596	11366	9907	10255	10129	10464	10527	10479	10328	8660	7472	7423	9698	3542
16	5505	6880	6614	6637	6319	6800	7173	6983	6359	4994	3316	3482	5911	2159
17	286	2318	2920	3133	3142	3574	3534	3113	2324	622	-22	-22	2072	757
18	-22	-22	4	354	705	898	799	416	-3	-22	-22	-22	257	94
19	-22	-22	-22	-22	-22	-21	-21	-22	-22	-22	-22	-22	-22	-8
20	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-8
21	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-8
22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-8
23	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-22	-8
Average (kWh)	3713	3691	3876	4366	4386	4567	4569	4662	4522	4143	3509	3306	4108	
Total (MWh)	2762	2480	2884	3143	3263	3288	3399	3469	3255	3082	2526	2460		36013

Commercial Alternative Energy Analysis

PREPARED FOR THE

Iowa Tribe of Oklahoma

August 1, 2014

Prepared by

Jeff Pollard, PE, VP of Engineering
Ray Chambers, CEM, CEP, CEA, Commercial Energy Advisor
Randy Jarvis, VP of Corporate Development

1.0 Executive Summary

This report was compiled for the Iowa Tribe of Oklahoma by Smart Energy Source LLC (SES) certified energy professionals, Stillwater, Oklahoma. Information was provided to SES by the Iowa Tribe of Oklahoma in regard to the Iowa Tribe Wind Project Report prepared by AWS Truepower for Johnson Controls dated March 27, 2013 and the Wind Study Report for the Iowa Tribe of Oklahoma Wind Project provided to the Bureau of Indian Affairs by Solas Energy Consulting U.S. Inc. dated June 26, 2013. This information was used to compare the economic viability of stand-alone and utility grade wind and solar power generation systems when compared to the Iowa Tribe of Oklahoma connected meter loads as documented by Central Rural Electric Cooperative.

This report discusses the alternative energy systems as outlined in the scope of work. The information enclosed is intended to help the Iowa Tribe of Oklahoma achieve its energy efficiency objectives of reducing overall energy use and allow for a defined strategic energy plan going forward.

2.0 Scope of Work

The objective of this report is to define the viability of alternative energy systems in relationship to the Iowa Tribe of Oklahoma's historical electrical usage of individual meters and the aggregated load of all meters on the Central Rural Electric Cooperative's electrical distribution grid.

SES utilized the information in the referenced reports in addition to billing data provided by CREC and cost estimates associated with potential system impacts. These resources were used to develop assessments on wind and solar projects.

Facility Meter Data

The tables below show Iowa Tribe accounts with CREC. Annual kWh use and dollars spent are shown for each account.

Iowa Tribe of Oklahoma Accounts

Account	Account Number	Map Location	Electric Rate	Annual kWh Use	Annual $ Spent
Transitional Living	3142800	42 19 16	SMC 4	0	$354.96
Cemetery Water Well	2237100	42 14 08	SMC 4	63	$362.18
Chena Building	3192600	42 30 12	SMC 4	660	$414.07
Southwest Water Well	2194300	42 30 06	SMC 4	1,076	$442.55
Pow Wow Arena	2448900	42 30 09	SMC 4	1,355	$473.98
Pow Wow Area	1906500	42 30 04	SMC 4	2,227	$556.68
Gate at Eagle Aviary	3231100	42 19 18	SMC 4	2,444	$567.45
Sign-Hwy 177	2988600	42 30 10	SMC 4	2,632	$581.87
Community Building	1764000	42 22 06	SMC 4	4,107	$708.56
Fire Station	3217600	42 19 17	SMC 4	4,540	$733.64
The Farm	414207	42 19 03	SMC 4	8,934	$1,134.67
Northeast Water Well	2194100	42 30 05	SMC 4	13,837	$1,538.56
Baseball Field Site	3072600	42 30 11	SMC 4	22,960	$2,325.01
Vocational Rehab.	2202600	42 19 09	SMC 4	48,901	$4,586.49
Need Address	1368600	42 19 04	SMC 4	53,379	$4,891.46
Police/Fire Building	2281200	42 19 10	SMC 4	55,925	$5,224.13
Office Annex	2280800	42 19 11	SMC 4	62,566	$5,759.58
Multi-event Building	2222200	42 30 07	SMC 4	62,800	$5,773.77
Multipurpose Building	1623200	42 19 05	SMC 4	77,360	$7,088.79
Eagle Aviary	2617100	42 19 15	SMC 4	79,120	$7,085.02
Youth Shelter	1777000	42 19 06	SMC 4	86,564	$7,842.92
White Cloud	1912100	42 19 08	SMC 4	135,520	$12,148.90
Child Development Center	2427701	42 19 13	SMC 4	138,840	$12,267.97
			Totals	865,810	$82,863.21

Iowa Tribal Enterprises Accounts

Account	Account Number	Map Location	Electric Rate	Annual kWh Use	Annual $ Spent
607 E 116th St-Flea Market	2264103	41 01 11	SMC 4	476	$401.74
607 E 116th St-Gallery	740405	41 01 05	SMC 4	927	$435.70
Office Building RV Site	3048700	41 01 13	SMC 4	6,072	$868.34
607 E 116th St-RV Park	2373102	41 01 12	SMC 4	224,000	$19,504.47
			Totals	231,475	$21,210.25

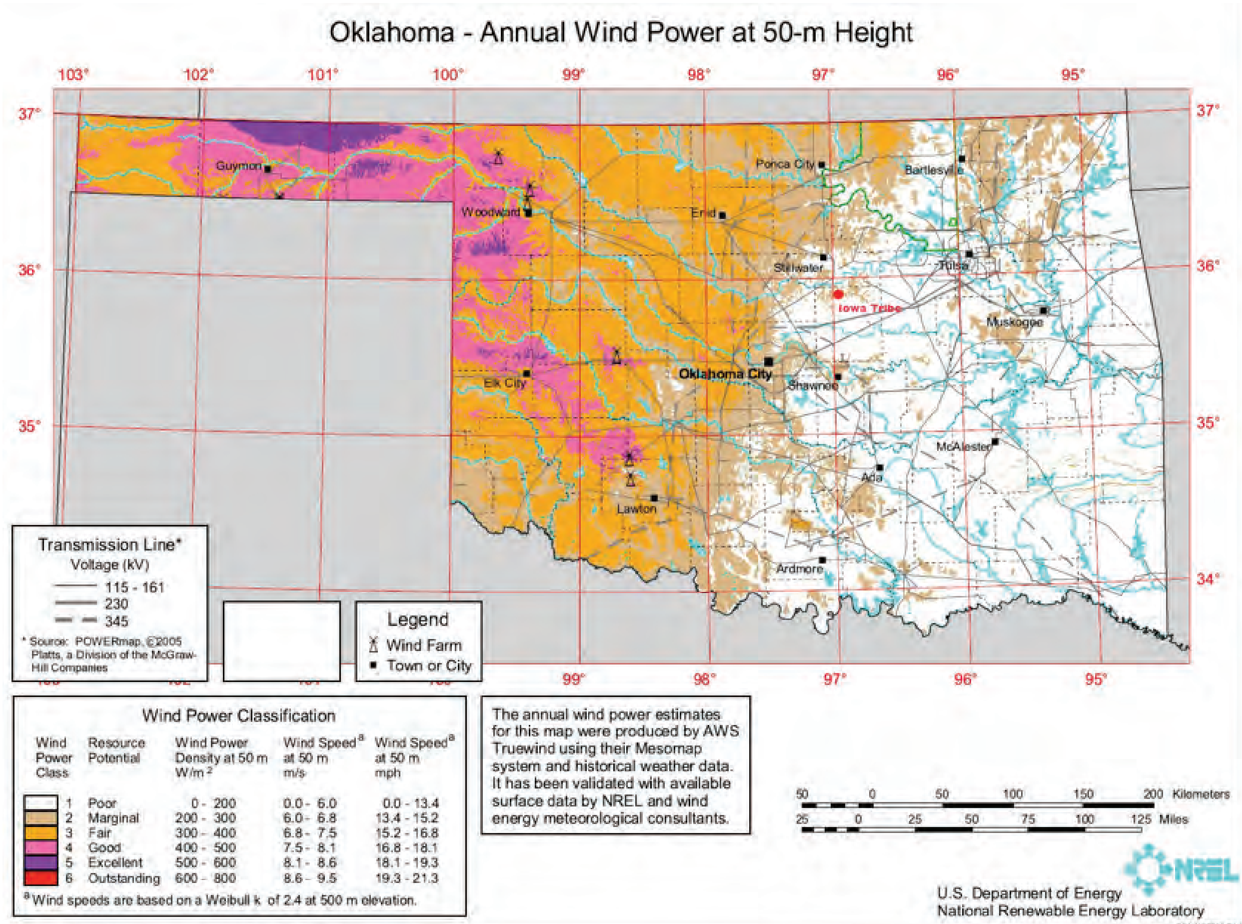

Figure 1 – *Courtesy the National Renewable Energy Laboratory for the Department of Energy*

Interpretation

In Figure 1, research from the National Renewable Energy Laboratory for the Department of Energy maps the Oklahoma annual wind power at 50-m height, which conclusively shows the Iowa Tribal Complex has poor to marginal wind resource potential.

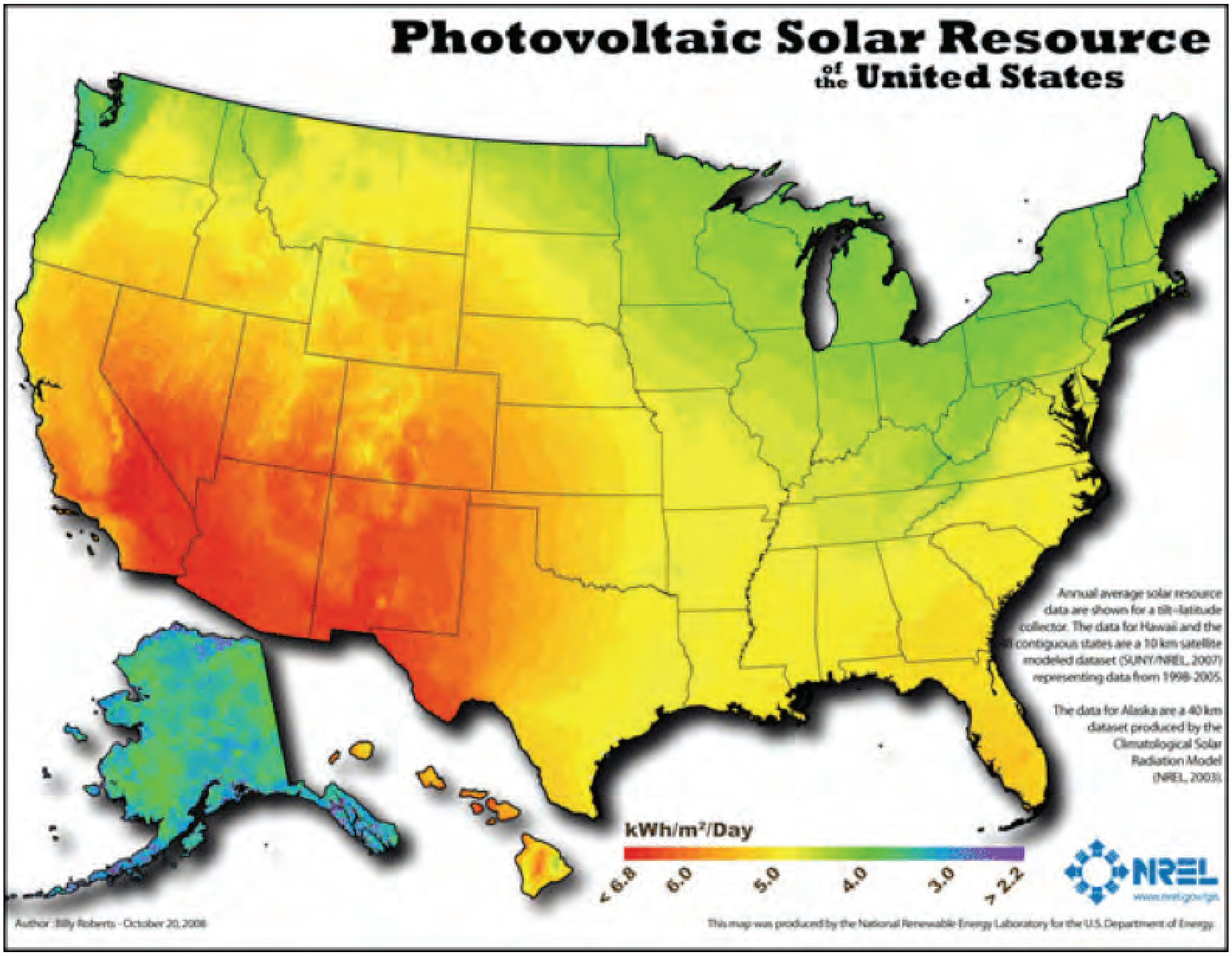

Figure 2 – *Courtesy the National Renewable Energy Laboratory for the Department of Energy*

Interpretation

In Figure 2, research from the National Renewable Energy Laboratory for the Department of Energy shows the Iowa Tribal Complex is located in an area where there is approximately 5 kWh/m2/day.

Assessment Resources

Facility and electric meter data was used to identify actual aggregated load for contiguous and non-contiguous electrical meters located on Central Rural Electric Cooperative's distribution grid to provide base load, peak and operational electrical use.

Wind and solar characteristics used in the report were supplied in the two alternative energy wind and solar data projects reports. The titles for each report only list wind; however, there is a section dedicated to solar (photovoltaic) projects in both. The reports are:

- Iowa Tribe Wind Project report prepared by AWS Truepower for Johnson Controls dated March 27, 2013
- Wind Study Report for the Iowa Tribe of Oklahoma Wind Project provided to the Bureau of Indian Affairs by Solas Energy Consulting US Inc. dated June 26, 2013

Green House Gas Emissions

- The web link, http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results provides the path to the Environmental Protection Agency calculator used to calculate carbon dioxide equivalent (CO2e) reductions in relationship to energy reduction projects.

Reference Reports

Project costs are estimates only using industrial averages and standards; however, SES always recommends bids from multiple contractors on any project to ensure a competitive and economical priced structure.

Assessment Constants

- Current load profiles for the metered locations served by Central Rural Electric Cooperative's distribution system, January 2013 through December 2013.
- Cost per watt for installed wind and solar systems are $3 per watt. The prices of solar systems are typically less expensive (per unit) for larger systems than smaller systems (economy of scale).
- Typical residential cost for electrical generation by wind is $4 per watt produced/installed – this cost is typically in the $5 to $6 range, based on research analysis of average cost across the United States.
- Typical, utility grade cost for electric generation by wind is $3 per watt. (large scale)
- Typical residential cost for electrical generation by solar is $4 per watt produced/installed – this cost is typically in the $7 to $9 range based on research analysis of the average cost across the United States.
- Typical utility grade cost for electrical generation by solar is $3 per watt. (large scale)
- Capacity factor for wind is 37.4 percent (capacity factor is the difference from time of actual use compared to full production) based on referenced report findings.
- Capacity factor for solar is 94 percent - First year (capacity factor is the difference from time of actual use compared to full production) based on referenced report findings.
- The estimated cost of interconnection engineering study (KAMO Power), $50,000.
- The estimated cost of interconnection substation (KAMO Power), $2,000,000.
- The estimated cost of distribution line per mile (CREC), $120,000.
- The estimated cost of transmission line per mile (KAMO Power), $350,000.

- Potentially, more costs could be associated with infrastructure upgrades depending on the results of the Interconnection Engineering Study.
- The estimated avoided cost of power is $0.02 per kWh.

Wind and Solar Assessments

The methodology of any assessment will provide a base line of information, or experimental control point, which can be used to gauge any study or assessment in the future to present conditions. The analytical process for current or future projects will be measured against this base line to validate project economics, processes and feasibilities that allow decision makers to realize estimated and or target savings potential.

SES has developed four alternative energy assessments from information included in the referenced reports. Additional historical energy use data and estimated distribution and transmission system impact costs were provided by Central Rural Electric Cooperative. This data was used in the wind and solar net metering assessments.

The assessments include:

- A. Wind – Utility Revenue Grade System
- B. Wind – Net Metering Contract
- C. Solar – Utility Revenue Grade System
- D. Solar – Net Metering Contract

Each assessment has an evaluation followed by a calculation worksheet. Each assessment includes an estimated cost for the generator plant, utility related system impact costs, the total project cost, revenue when applicable, payback in years and a return on investment.

A. Wind - Utility Revenue Grade System - Cost Avoidance Contract

This assessment is based on the installation of 11 1.62MW GE1.6-100 turbines as specified in the referenced reports. As a result of the local wind characteristics documented in the referenced reports, the system will operate at a 37.4 percent production factor, and based on the production factor the system will produce 57.6MWh per year. The system will have an estimated payback of 32 years with a ROI of 3.2 percent.

Evaluation

Project Description	Cost/Revenue
Generator Plant Cost (equipment only at $1.83 per watt installed)	$32,967,000
Transmission Line Cost ($350,000 per mile – 2.5 miles)	$875,000
Interconnection Study (Impact to system)	$50,000
Interconnect Substation	$2,000,000
Maintenance and Operations (average per year is 1.7% of capital for 25 years)	$560,439
Total Project Cost	**$36,452,439**
Revenue (Cost avoidance contract, estimated at $0.02 per kWh) per year	$ 1,151,657
Payback = 32 years	
ROI = 3.2%	

Calculation Worksheet

A. WIND	Count	MWh	kWh	# miles	$/mile		
Generator Plant $ @ $1.85/watt	11	17,820	6,771,600			$32,967,000	
37.4% of max kWh ->		6,665	6,664,680				
Overhead cost for Line (Transmission)				2.5	$350,000	$875,000	
Interconnection study						$50,000	
Plant substation						$2,000,000	
Maint. & Ops (per year avg - 25 yrs ops)						$560,439	
Production factor =	37.4%				Total	**$36,452,439**	
kW	2,493	MWh	GWh				
kWh/yr	57,582,835	57583	57.6		Yrs		
		ROI	**3.2%**	Payback	**32**	**$1,151,657**	@ $0.02/kWh
				GHG avoidance	15,466.7	Metric Tons of CO_2e	

B. Wind - Net Metering Contract

This analysis is based on the installation of one 1.62 MW GE1.6 turbine as specified in the referenced reports. As a result of the local wind characteristics documented in the referenced reports, the system will operate at a 37.4 percent production factor, and based on the production factor the system will produce 5.23 MWh per year. The system will have an estimated payback of 51.9 years with a ROI of 1.9 percent.

Evaluation

Project Description	Cost/Revenue
Generator Plant cost (equipment only at $1.85 per watt installed)	$ 2,997,000
Distribution Line Cost ($120,000 per mile – 2.5 miles)	$300,000
Interconnection Study (impact to system)	$50,000
Interconnection Substation	$2,000,000
Maintenance and Operations (average per year is 4.7% of capital for 25 years)	$50,949
Total Project Cost	**$5,397,949**
Net Metering cost reduction contract	
Payback = 51.9 years	
ROI = 1.9%	

Calculation Worksheet

B. WIND	Count	kWh		# miles	$/mile		
Generator Plant $ @ $1.85/watt	1	1,620				$2,997,000	
37.4% of max kWh ->		606					
Overhead cost for Line (Distribution)				2.5	$120,000	$300,000	
Interconnection study						$50,000	
Plant substation						$2,000,000	
Maint. & Ops (per year avg - 25 yrs ops)						$50,949	
Production factor =	37.4%	MWh	GWh		Total	**$5,397,949**	
kW	227	5,234.80	5.23				
kWh/Mo	436,234				Yrs		
kWh/Yr	5,234,803	ROI	**1.9%**	Payback	**51.9**		
				GHG avoidance	1,406.1	Metric Tons of CO_2e	

C. Solar - Utility Revenue Grade System - Cost Avoidance Contract

This assessment is based on the installation of 79,662 Yingli YL-280p solar modules. As a result of the local solar intensity characteristics documented in the referenced reports, the system will operate at a 94 percent production factor the first year, and based on the production factor the system will produce 20.9 MWh per year. The system modules will degrade over time. After 10 years, the systems will operate at an estimated production factor of 91.2 percent. Support system cost (frame/rack system) for solar panels are not known at this time. The system will have an estimated payback of 77.3 years with a ROI of 1.3 percent.

Evaluation

Project Description	Cost/Revenue
Generator Plant Cost (equipment only at $3 per watt installed)	$66,916,080
Transmission Line Cost ($350,000 per mile – 2.5miles)	$875,000
Interconnection Study (Impact to system)	$50,000
Interconnect Substation	$2,000,000
Maintenance and Operations (average per year is 1.7% of capital for 25 years)	$1,137,573
Total Project Cost	**$70,978,653**
Revenue (Cost Avoidance Contract, estimated at $0.02 per kWh) per year	$918,356
Payback = 77.3 years	
ROI = 1.3%	

Calculation Worksheet

C. SOLAR	Count	MWh	kWh	# miles	$/mile		
Generator Plant $ @ $3.00/watt	79,662	22.3	22,305			$66,916,080	
94% of max kWh -> (First Year)		21.0	20,967				
Overhead cost for Line (Transmission)				2.5	$350,000	$875,000	
Interconnection study						$50,000	
Plant substation						$2,000,000	
Maint. & Ops (per year avg - 25 yrs ops)						$1,137,573.36	
					Total	**$70,978,653**	
kW	20,967						
kWh/yr	45,917,814				Yrs		
		ROI	**1.3%**	Payback	**77.3**	$918,356	@ $0.02/kWh
				GHG avoidance	32,977.3	Metric Tons of CO_2e	

D. Solar Net Metering Contract

This assessment is based on the installation of 980 Yingli YL-280p solar modules. As a result of the local solar intensity characteristics documented in the referenced reports, the system will operate at a 94 percent production factor the first year, and based on the production factor the system will produce 1.1MWh per year. The system modules will degrade over time. After 10 years, the systems will operate at an estimated production factor of 91.2 percent. Support system cost (frame/rack system) for solar panels are not known at this time. The system will have an estimated payback of 31 years with a ROI of 3.2 percent.

Evaluation

Project Description	Cost/Revenue
Generator Plant Cost (equipment only at $3 per watt installed)	$823,200
Distribution Line Cost at $120,000 per mile – 2.5 miles)	$300,000
Interconnection Study (impact to system)	$50,000
Interconnection substation	$2,000,000
Maintenance and Operations (average per year is 4.7% of capital for 25 years)	$38,690
Total Project Cost	**$3,211,890**
Net Metering cost reduction contract	
Payback = 31 years	
ROI = 3.2%	

Calculation Worksheet

D. SOLAR	Count	kWh/day	ft^2	# miles	$/mile		
Generator Plant $	980	3,293	7,840			$823,200	@ $3.00/Watt
94% of max kWh -> (First Year)		3,095					
Overhead cost for Line (Distribution)				2.5	$120,000	$300,000	
Interconnection study						$50,000	
Plant substation						$2,000,000	
Maint. & Ops (per year avg - 25 yrs ops)						$38,690	
					Total	**$3,211,890**	
kW	258						
kWh/Mo	91,928				Yrs		
kWh/yr	1,103,141	ROI	**3.2%**	Payback	**31**		
				GHG avoidance	792.3	Metric Tons of CO_2e	

Considerations

The following items should be considered in determining the feasibility of alternative sources of power generation for the Iowa Tribe of Oklahoma.

- **Availablility of sustained wind at height of installation** – The observed mean wind speed provided by the AWS Truepower Report, Iowa Tribe of Oklahoma, Johnson Controls, March 27, 2013 at their measurement location (WGS84, Zone 14 – Easting 669343, Northing 3958302), page 1.
- **Cost of electric grid infrastructure upgrades** – Information and cost estimates provided by Jeff Pollard PE, System Engineer - Central Rural Electric Cooperative.
- **Initial cost of alternative energy projects** – The information provided for estimating the cost per watt for alternative energy is from the U.S. Energy Information Administration, "Levelized Cost of New Generation Resources in the Annual Energy Outlook 2013" published January 2013. http://www.eia.gov/forecasts/aeo/data.cfm

A key question must be answered by the collective body of the Iowa Tribe of Oklahoma before moving forward with any project. Does the development of a wind farm or solar park agree with the Iowa Tribe of Oklahoma's commitment to the environment?

Maps and Aerial Views

The following maps and aerial views show CREC infrastructure in comparison to Iowa Tribe facilities.

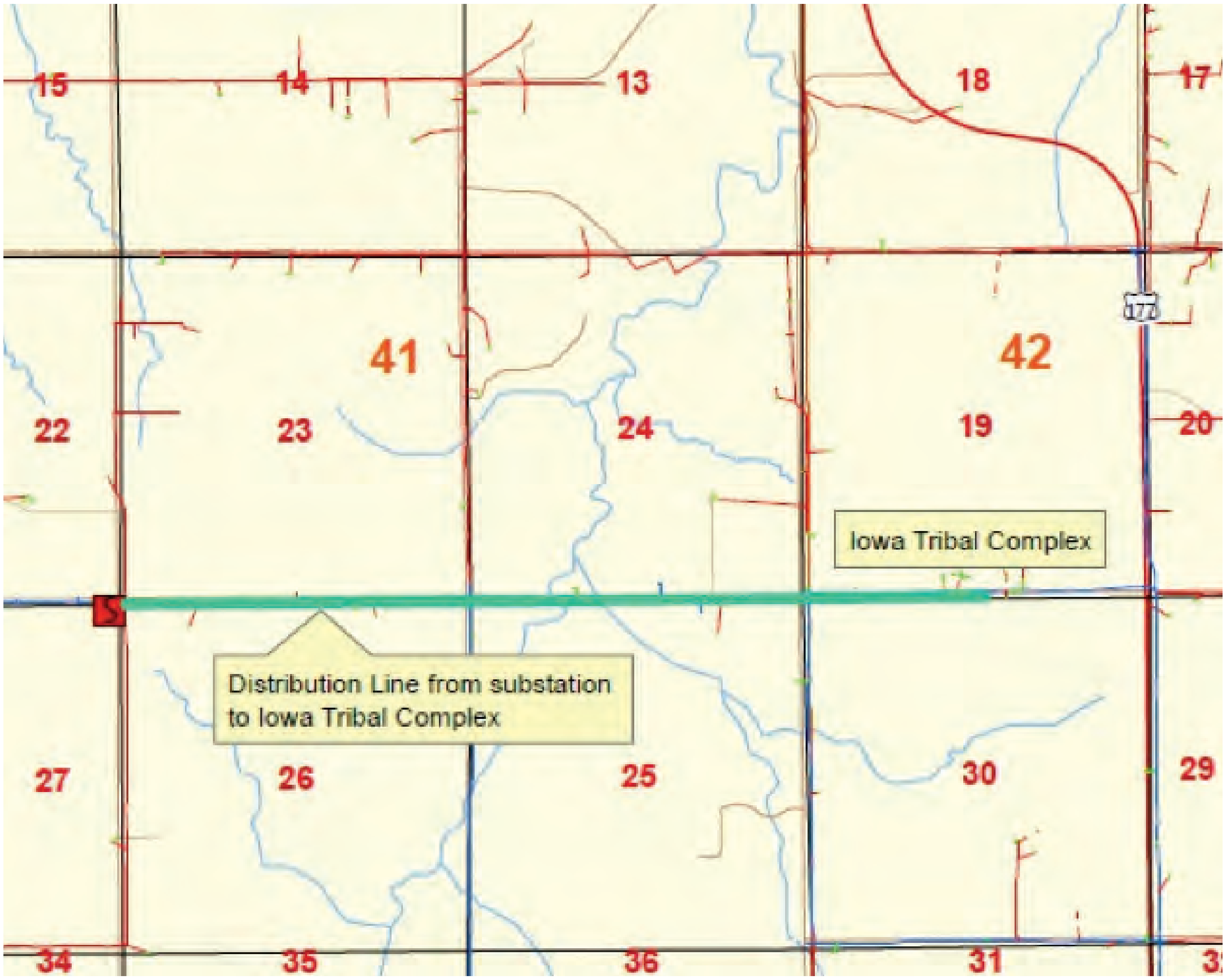

Figure 3 – Central Rural Electric Cooperative distribution line that serves the Iowa Tribal Complex

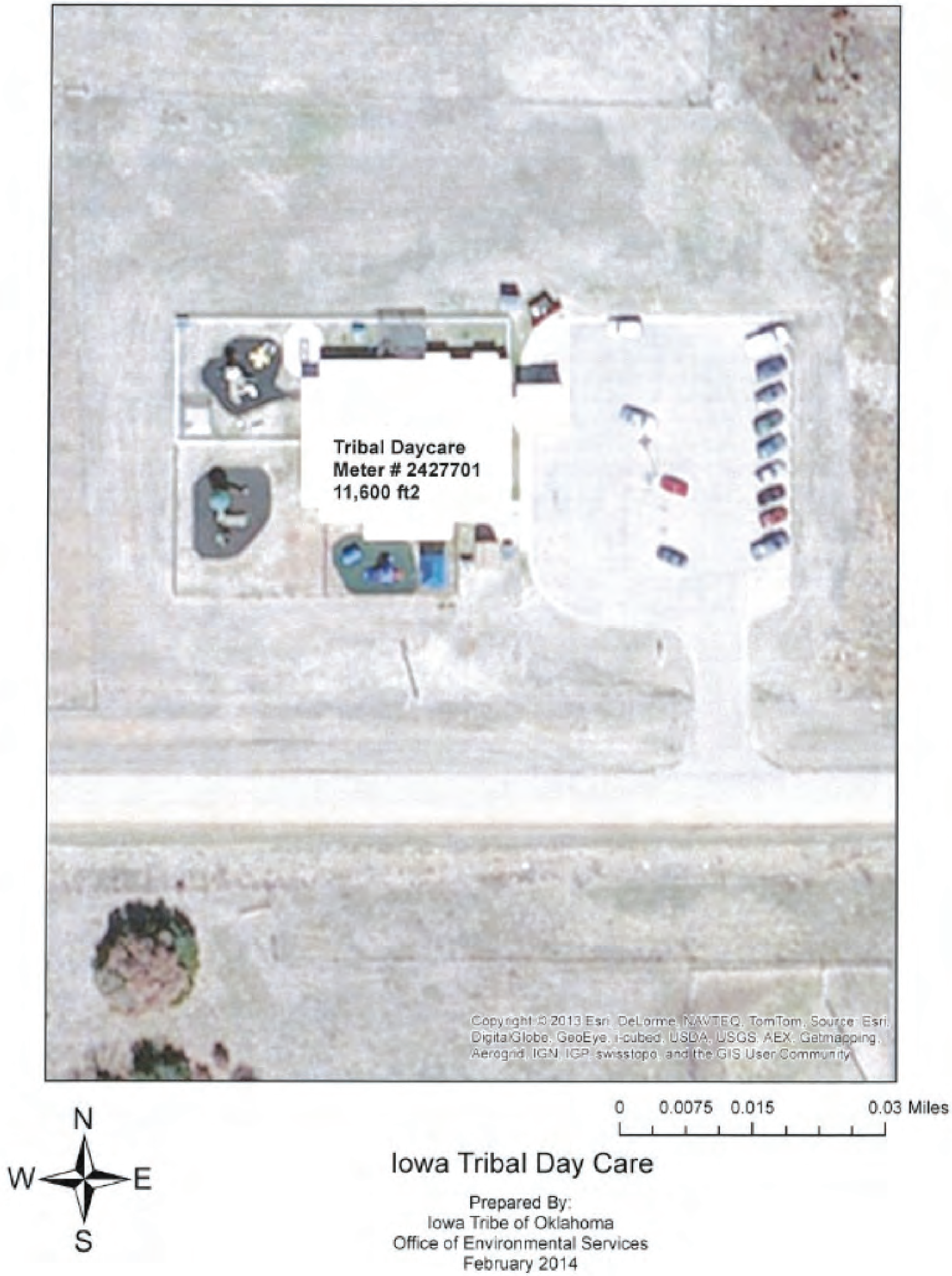

Figure 4 – Iowa Tribal Daycare Facility

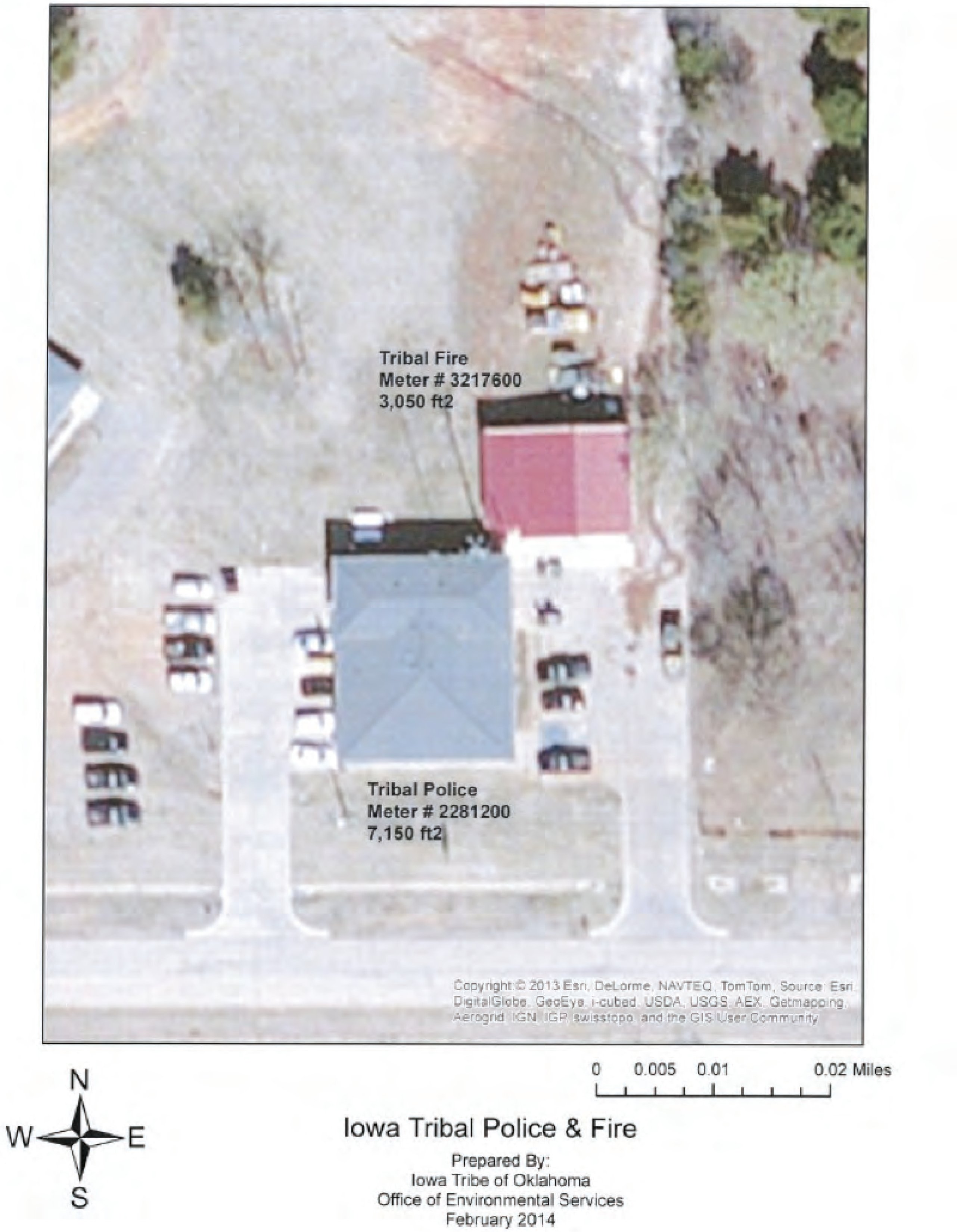

Figure 5 – Iowa Tribal Police and Fire

Figure 6 – Iowa Tribal Aviary

Figure 7 – Iowa Tribal Equine Barn

Figure 8 – Iowa Tribal Pow-wow & Chena

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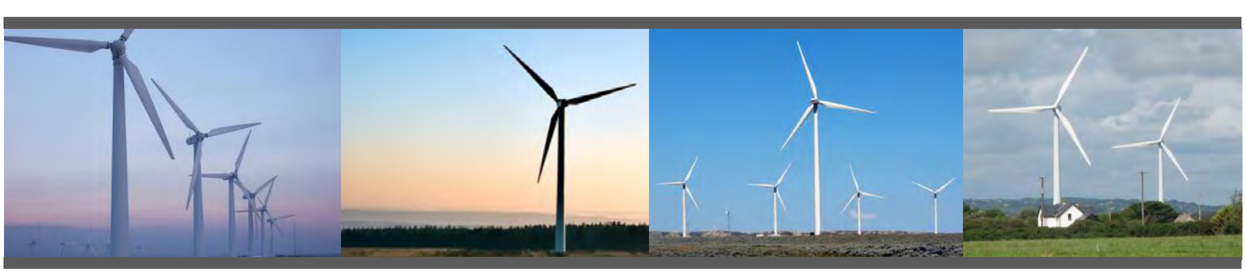
FINAL NARRATIVE SF-425
WIND STUDY REPORT

Iowa Tribe of Oklahoma Wind Project

June 30, 2013

Submitted to Bureau of Indian Affairs
Prepared by Solas Energy Consulting US Inc.
Issue date: June 26, 2013
Grant Number: GTB08T82218



CONTENTS

Special thanks to the following consultants who provided information and analysis utilized in the preparation of this report:

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- ***Comsearch***, 19700 Janelia Farm Blvd., Ashburn, VA 20147
- ***Doerner, Saunders, Daniel & Anderson, LLP,*** Two West 2nd Street, Suite 700, Tulsa, OK 74103
- ***Ecology and Environment**,* 9300 West 110th Street, Suite 645, Overland Park, KS 66210
- ***Renewable Choice Energy***, 4775 Walnut Street, Suite 230, Boulder CO 80301
- ***Renewable Resource Consultants***, 3801 Doris Lane, Round Rock, TX 78664
- ***Solas Energy Consulting US Inc***., 1136 E. Stuart Rd., Suite 4206, Fort Collins, CO 80525
- ***Summit Energy (a division of Schneider Electric*****),** 20830 N. Tatum Blvd., Suite 330, Phoenix, AZ 85050

1. EXECUTIVE SUMMARY

1.1. Project Overview

The Iowa Tribe of Oklahoma was awarded Grant GTB08T82218 from the Department of the Interior in December 2010. The original grant period was specified as December 7, 2010 to through December 31, 2012. The Iowa Tribe requested a 3-month extension in Fall of 2012 to complete a few additional studies to support the grant findings.

The scope of the grant was to determine the feasibility of a utility scale wind energy project on Tribal Lands. Pursuant to a separate DOE grant, wind resource data collection began in November 2011 at a single 60-meter measurement mast (designated Mast 0149) located near Fallis, Oklahoma. A sodar unit was also installed at the site which was being used to extrapolate the data collected from the met tower. After monitoring the wind at the met site for approximately 9 months and conducting correlations with long-term data, it was determined that the wind resource in the area near Fallis was not likely to be sufficient for a utility-scale wind project.

This early conclusion led to a re-evaluation of the proposed location for the project. A wind resource map was created to identify areas in the vicinity with higher wind speeds. This map was then graphically overlayed on land parcel information obtained from the respective counties so that land ownership in conjunction with wind resource could be analyzed. The areas of land that were associated with the Iowa Tribe were then identified to determine if the projected wind speeds at parcels associated with the tribal parcels could potentially support a utility scale wind project.

The area with the highest wind resource identified in the wind map corresponded well to the location of the tribal parcels. A new area for a proposed project site was identified using the parcel map which would maximize the use of tribal parcels while targeting areas with the highest wind speeds. The new area is located approximately 20 miles north-northeast of the met mast in Fallis.

After locating what was determined to be the best site from a wind resource and land ownership perspective, boundaries were drawn for both a 20 MW and a 50 MW project size. This project site area was then used as the boundary for additional studies and project feasibility, including environmental, land, wind setbacks, permitting, species, and other areas of concern. A site plan was then developed for proposed wind turbine locations taking into account these constraints.

The site plan was developed for each project size, and a Turbine Request for Proposal was conducted to determine pricing. Construction estimates were developed for both project sizes, and research was conducted on the potential project revenues. Finally, financial models were run for both project sizes.

1.1.1. Small Wind Overview

During the course of the feasibility study, the Tribe became increasingly interested in looking at their own electricity consumption patterns and determining if a small wind turbine for their own load would be feasible. As information was being collected and analyzed for the utility feasibility project, additional information was collected and analysis was performed to determine the feasibility of self-generation. This research included a detailed analysis of the Tribe’s electricity usage, the potential sizes for a wind turbine installation, the regulations and requirements through the utility, as well as siting information for a turbine. A supplemental analysis on small wind has been added in Section 8 of this report.

1.2. Conclusions

Several conclusions were drawn as a result of the study. They are as follows:

- A 50MW project had better economics than a 20 MW project.
- The power purchase price in the region is low in comparison to the rest of the country. The project economics are marginal at current rates. Either a 15% increase in power prices or a 15% decrease in project capital costs could provide the project with competitive returns.
- The REC market is not currently robust, and the cost associated with certifying the project for REC sales unbundled from the brown power is probably not justified at this time.
- Many of the financial incentives for utility scale wind energy projects are related to federal tax benefits, and since the tribe does not have taxable income, those benefits were not realized in the economics, which also hurt the economics. These benefits, however, could be realized by a private developer entity.
- The estimated initial development budget needed to bring the project to a stage where it could be financed is approximately $2 million for the 20 MW project and $3 million for the 50 MW project. The capital costs to procure the turbines and install the project were approximately $43 million for the 20 MW project and $93 million for the 50 MW project.
- The Tribe does not have the resources to proceed as the lead developer with the project, however Several avenues are available that the Tribe could take to participate in the project including the following:
  - The Tribe could look for a development partner to co-develop the project, and retain an ownership interest.
  - The Tribe could sell its existing interest in the project and become a landowner for the project.

1.2.1. Conclusions – Small Wind

The small wind analysis concluded the following:

- An opportunity exists for the Tribe to reduce its energy costs through energy efficiency, energy management and renewable energy.
- Small wind is not necessarily the ideal technology for the Tribe for self-generation due to the lack of suitable small wind technologies for the Tribe’s low wind resource. Solar photovoltaics (PV) may be a better choice for self-generation and should be considered further.
- The current local net metering provisions with the electricity providers dis-advantage wind generation with their policies for monthly energy generation true-ups, as well as limitations on size of small wind turbines allowed.

1.3. Next Steps

If the Tribe determines that it would like to proceed with the utility scale wind project, then the next steps should be taken:

- Establish a special purpose company (SPC) for the project development assets, and transfer this feasibility study and all existing work products into that company.
- Execute land lease agreements between the Tribe and the SPC which allow for the development and construction of a utility-scale wind generation project on Tribal Lands. During the course of this feasibility study, a land-lease agreement was developed in conjunction with the Tribal attorneys, which could be utilized for this purpose.
- Solicit interest from all Tribal members who hold land in fee simple in the area to execute leases with those members, and work with the BIA to secure parcels which are held either in Tribal Trust or are Federal parcels allocated to the Trust.
- Solicit interest from private developers, once the land is secure, and find a partner or purchaser for the project assets. From that point, a private developer would fund the development capital required to move the project forward.

1.3.1. Next Steps – Small Wind

Although the supplemental analysis for small wind did not provide out economically, the analysis strongly made a case that the Tribe can improve its energy usage, reduce costs and incorporate other renewable energy technologies into its operations. The following are the next steps for the Tribe:

- Within the supplemental analysis, several ideas were brought forward, such as appointing an energy manager, researching utility accounts which have no utilization, but are costing money every month, and focusing on energy efficiency measures.
- The analysis showed that solar PV would be economic if the tribe were to secure funding under a grant program such as DE-FOA-0000852: Community Scale Clean Energy Projects. This grant application is due at the end of June and it is strongly recommended that the Tribe pursue this grant application for its larger facilities.

2. TRANSMISSION AND INTERCONNECT STUDY

2.1. Overview of Scope

The purpose of the transmission and interconnect study was to identify potential points of interconnection for a utility scale wind project. The point of interconnection (POI) is where the project connects to the electric utility grid for the purpose of selling power from the generation project. The POI is an important aspect of the project because both the feasibility and the cost of the project will be dependent on the location of the point of interconnection. A couple factors influence feasibility and cost. The first is the physical distance to the nearest interconnection point. The second is the actual capacity of the interconnection point to receive the electricity generated by the project. If the nearest point of interconnection is constrained in capacity, it may be less expensive to construct longer new transmission line to a new point of interconnection than to upgrade a constrained resource.

For this reason, the selection of a transmission point of interconnection is an iterative process, which first involves the identification and location of the points of interconnection in the region of the project, and then a study of the potential capacity of those points of interconnection. Next, the potential capacity is determined by modeling several different future electric system build-out scenarios that include existing generation, future planned generation, and future planned transmission upgrades.

A detailed discussion of the site layout and design process is provided in Section 6 below. Early in the site layout and design process, the Perkins Substation was identified as being in reasonable proximity to the proposed project site. At the time of identification of that substation, it was unknown if that substation would qualify as a potential point of interconnection, however based on proximity, that was one of the early most likely candidates, and so that substation was included as an option for the analysis described below.

AWS Truepower, LLC (AWS Truepower) was hired to perform these detailed studies. First, the spatial relationship of the proposed interconnection circuits to the project was identified in a Geographic Information System (GIS). Alternative connection circuits and their approximate interconnection costs were identified. Next, energy projects within the Southwest Power Pool (SPP) which were likely to impact export capabilities from the proposed project were identified, as well as proposed network improvements. Power flow base cases were obtained from the North American Electric Reliability Corporation (NERC) and used to initialize system modeling. The queue base cases and proposed network improvements were then layered on the NERC conduct system modeling to determine the likely interconnection locations. These interconnection locations were then analyzed for system upgrade costs.

The results of this analysis by AWS Truepower is summarized below.

2.2. Thermal Screening[1]

AWS Truepower was retained for the project to conduct a thermal screening analysis of the proposed Iowa Tribe Wind Project, located in Lincoln County in northern Oklahoma. The purpose of the thermal screening was to identify the likely interconnection point for a potential 20 to 50MW wind project and assess capacity in the adjacent transmission system.

[1] This section summarizes the contents of the "Thermal Screening Report" dated November 19, 2012, prepared for BKJ Solutions, Inc. from AWS Truepower

2.2.1. Regional Generation and Transmission Queues

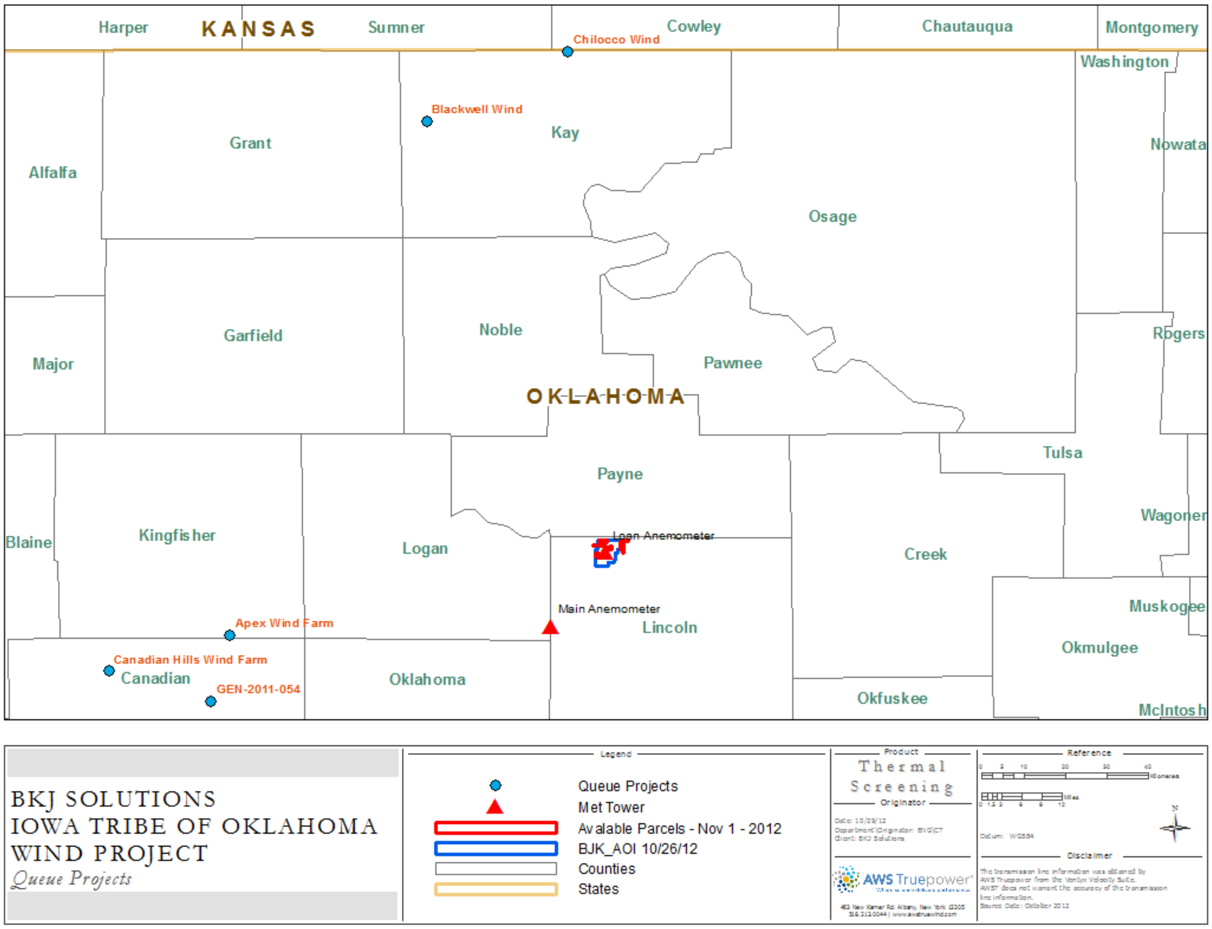
The generation interconnection queue from SPP was accessed on August 28, 2012. Queue projects that are located within any county 60 miles from the proposed project were identified as projects that could potentially impact the export capabilities of the Iowa Tribe project. During the review, 986 MW of queue projects (all of which were wind) were identified within the study area: 136 MW in Kay County, and 850 MW in Canadian County. The queue projects identified are as follows:

Table 1: Generation Queue Projects which May Impact the Project's Export Capability

Queue Map Number	Queue Number	Project	County	State	Proposed In-Service	Size (MW)	Fuel	Queue Status
Q1	GEN-2008-071	Chilocco Wind	Kay	OK	11/1/2010	76.8	Wind	IA FULLY EXECUTED/ON SUSPENSION
Q2	GEN-2009-025	Blackwell Wind	Kay	OK	12/31/2011	59.4	Wind	IA FULLY EXECUTED/ON SCHEDULE
Q3	GEN-2010-040	Canadian Hills Wind	Canadian	OK	11/30/2011	300	Wind	IA FULLY EXECUTED/ON SCHEDULE
Q4	GEN-2011-007	Apex Wind Farm	Canadian	OK	08/1/2013	250.1	Wind	IA PENDING
Q5	GEN-2011-054	NA	Canadian	OK	09/01/2013	300	Wind	IA PENDING

The projected in-service date and queue status were examined for each project. Some of the projects had a projected in-service date proceeding the date the queue was accessed, however according to SPP, they have not been withdrawn from the queue or been commissioned and so they were used in the study.

Figure 1: Location of Regional Queue Projects



The transmission interconnection queue for SPP was also reviewed. Due to the project size and interconnection level, none of the transmission queue projects were identified as having potentially large impacts on the export capabilities of the project, and so those projects were left out of the final study.

The figure below shows the regional large scale transmission plan overview. Within the proposed expansion plan, nine key projects make up the greater part of the portfolio:

- Lake Hawkins – Welsh 345 kV line with a 345/138 kV transformer at Lake Hawkins
- Elk City – Gracemont 345 kV line with a 345/230 kV transformer at Elk City
- Woodward – Tatonga – Cimarron 345 kV line, a second circuit
- Summit – Elm Creek 345 kV line with a 345/230 kV transformer at Elm Creek
- Neligh – Hoskins 345 kV line with a 345/115 kV transformer at Neligh
- Gentleman – Cherry Co. – Holt Co. 345 kV line with two substations
- Eastowne Transformer 345/161 kV
- Moundridge Transformer 138/115 kV
- Tuco – Amoco – Hobbs 345 kV with 345/230 kV transformers at Amoco and Hobbs

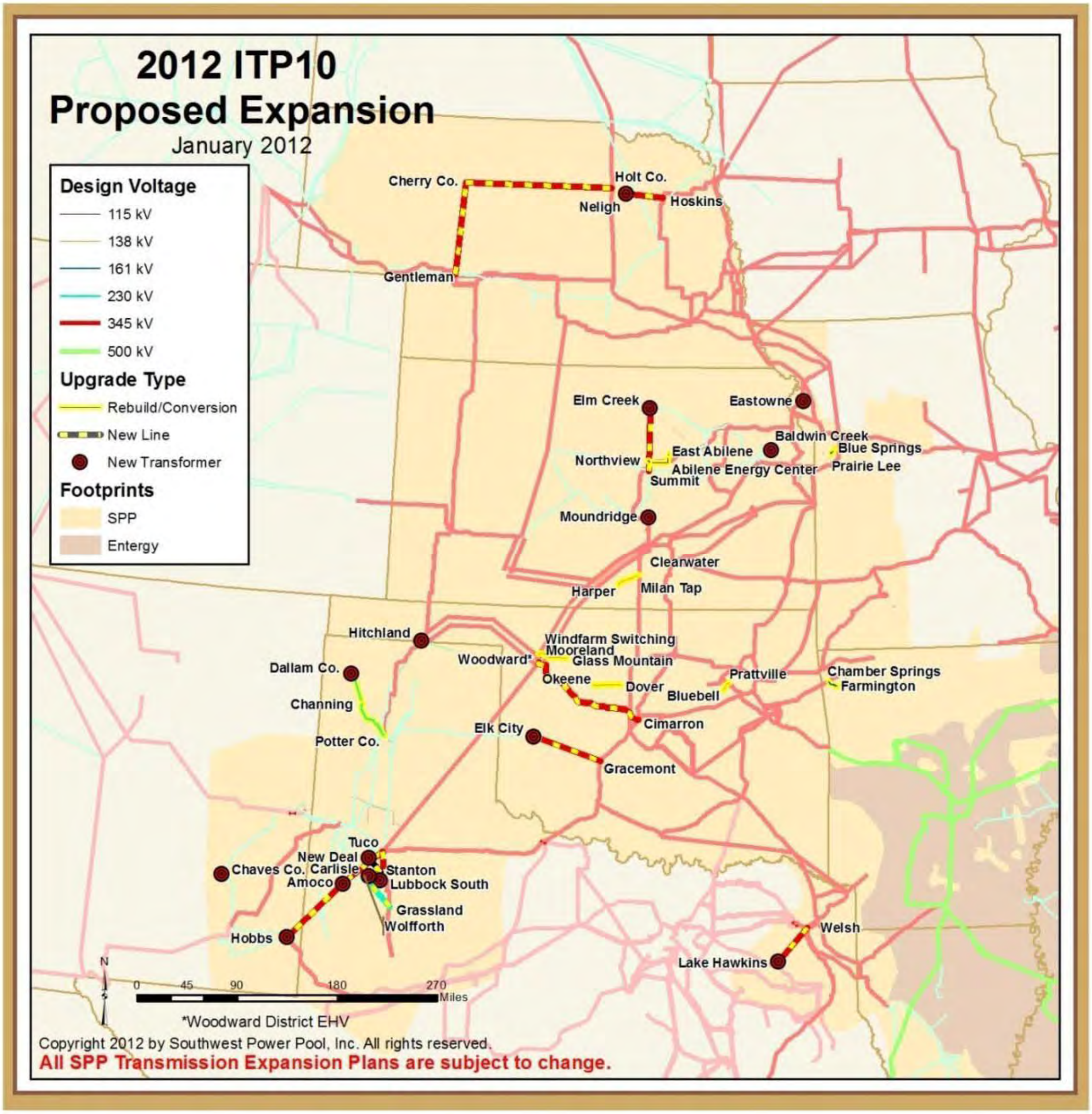


Figure 2: Regional Large Scale Transmission Plan Overview

2.2.2. Regional Existing Generation

A search was completed to identify projects commissioned in the region since the release of the most recent base cases. All projects with a name plate capacity greater than 20 MW, were identified. Any generation that is currently online, but not incorporated in the base case was added according to the voltage level, power level and POI provided. The search was conducted using the Ventyx Energy Velocity database (October 2012 data set). The projects, locations, fuel, voltage and additional information can be found in the full report from AWS Truepower. The information was deemed confidential and was therefore not provided herewith.

2.2.3. Thermal Screening Setup

The thermal screening was conducted using base cases compiled by the NERC for 2011. The power flows were solved using Commonwealth Associate's Transmission 2000® software. Cases used for the base case analysis were Summer 2011, Winter 2011, Summer 2016, Winter 2016, and Summer 2021. To provide conservative results, all generation projects were added to the queue at listed capacity.

During the base case analysis, generation from the Iowa Tribe project was ramped up until a system violation (voltage or thermal violation) occurred, which determined the amount of new generation the local system could accommodate. The most constrained base case was then selected for further study, in which the queue projects were added, as well as the existing regional wind projects at full capacity, to represent regional high wind events.

For the analysis, generation in the Oklahoma Gas & Electric (OGE) and American Electric Power West (AEPW) control areas was re-dispatched to accommodate the identified existing generation added to the control area. When adding a small amount of generation, this redispatch method is generally representative of the economic dispatch methods used by system operators, in which output from typically more costly fossil plants is minimized to accommodate typically cheaper wind generation. Nuclear and coal generators, often with a cost of energy similar or less than wind, were slightly underutilized due to the de-ratings but this should not significantly impact system results.

To evaluate the impact of queue projects on the Iowa Tribe project's export capability at the Perkins Substation, the project was added to the Perkins Substation along with the queue and existing projects. The project's output level was then ramped up until a system violation occurred, thus determining the thermal capacity of the POI substation.

All modifications to the base case were done within the OGE, AEPW, and Associated Electric Cooperative, Inc. (AECI) control areas, and all queue projects and wind plants were modeled with a +/- 0.95 power factor.

2.2.4. Outline of Scenarios

The Iowa Tribe project was modeled using three scenarios, which are outlined in Table 2: Scenario Overview and Descriptions. The scenarios encompass the modeling of 0%, 50%, and 100% of the queue projects[2]. For the 50% scenario, both Blackwell Wind (Q2) and Canadian Hills Wind (Q3) were included, as both projects were under construction at the time of the modeling. The Blackwell Wind project was developed by Own Energy and Sold to NextEra. Both Blackwell Wind and Canadian Hills Wind projects reached commercial operation prior to the end of 2012. The remaining three projects have more uncertainty surrounding their development; thus, they were not selected for inclusion in the 50% scenario. The initial development of Chilocco Wind (Q1) was funded under the US Department of Energy (DOE) Tribal Energy Program. Movement in the development of this project over the last year appears to have halted and the future of the project looks doubtful. Therefore, the project was not considered for the 50% scenario. Both the Apex Wind Farm (Q4), and GEN-2011-054 (Q5) appear to be either alternative project locations for the Canadian Hills Wind (Apex Wind Farm) project or potential

[2] The queue projects as listed in Table 1: Generation Queue Projects which May Impact the Project's Export Capability

additional phases to the Canadian Hills Wind (GEN-2011- 054). At this time, no strong indication that these projects will be built exists; thus, neither of the projects was considered for the 50% scenario.

Table 2: Scenario Overview and Descriptions

Scenario	Description	Existing Gen	Queue (%)	Maximum Project Size (MW)
1	0% of the Queue, POI was Perkins 69kV. Project Size 90 MW.	Yes	0%	90
2	50% of the Queue, POI was Perkins 69kV. Project Size 88 MW.	Yes	50%	88
3	100% of the Queue. POI was Perkins 69kV. Project Size 88MW.	Yes	100%	88

2.2.5. Results

Within the limitations of the thermal screening, it was found that the Perkins 69 kV substation will accommodate a plant size of 88MW. For both the 20 MW and 50 MW scenarios proposed by BKJ, the Perkins 69 kV line should be able to accommodate the Iowa Tribe project with minimal to no upgrades. With the assumptions above, the low voltage 24.9kV kV side of Perkins Substation should be able to accommodate the 20 MW scenario without overloading the transformer.

Actual system flows when the project and queue projects are online and generating significant energy could vary considerably due to differences in dispatch methods, queue project build out, actual generator output, and load. The non-linear, time-varying nature of the system undermines the assumption that the results, generated for four moments over a 6 year period, are representative of the actual conditions during production periods. Due to the temporally varying nature of the system not captured in this study, if the proposed plant is sized using the results of the thermal screening; significant curtailment or underutilization of the line could result.

System operators are required to meet N-2 reliability standards, meaning that the system must remain secure if any two facilities (generator, transmission line, transformer, etc) go out of service. While few systems meet N-2 reliability standards, this study did not consider N-2 contingencies and export capabilities typically drop when N-2 is imposed.

2.2.6. Key Findings

Table 3: Thermal Screening Findings

	Key Findings	Recommended Follow-up Action
1	Regional proposed projects and transmission projects modeled; Perkins substation identified as key point of interconnection	
2	Perkins Substation expected to be able to handle both a 20MW or 50MW project size with minimal upgrades	Complete the N-1 feasibility study to determine required network upgrades

2.3. Interconnection Feasibility Process

The original grant application contemplated that a feasibility study would be completed by the utility, OGE. The SPP, the electric reliability organization that services Oklahoma, has a defined interconnection process for each of its major utilities where staged studies are conducted for interconnection. The studies include: a) A Feasibility Study b) An Interconnection System Impact Study c) an Interconnection Facilities Study, and finally, d) execution of an Large Generator Interconnection Agreement. The feasibility study is the first stage in the process and the cost is approximately $10,000 to $15,000. When the thermal screening study was completed, it was determined that the desired point of interconnection was in the system of Central Rural Electric Cooperative (CREC), not OGE. CREC is a rural electric cooperative and does not have the same requirements as major utilities within the SPP. CREC does not conduct feasibility studies within their territory and an interested proponent must move directly to the interconnection system impact study. The cost and timing to perform a system impact study was prohibitive for the scope of this grant, and additionally, the project was too early in the process to move to this step.

Alternatives were considered, and it was determined that AWS Truepower could perform a study similar to the feasibility study in order to confirm feasibility of the interconnection. The scope of the study was to conduct a single contingency (N-1) analysis of the proposed Iowa Tribe Wind Project. The contingency study determined that during single contingency conditions, either 20 MW or 50 MW of wind could be connected to the 69 kV Perkins substation. Three queue scenarios were run to represent possible future build out scenarios that may impact project export capability. This conservative study models the regional existing wind plants at full capacity, thereby assuming a regional high-wind event, on top of a base case representing heavy system loading.

These estimates will be verified during the interconnection application process and are subject to significant change. Significant changes to these estimates may be the result of existing or new overload mitigation plans by the grid owner or operator or the result of other studies, such as a short-circuit analyses, stability analyses, or reliability and system impact analyses, which were outside of the scope of this analysis and which may further limit the amount of wind generation that can be injected into the grid.

2.3.1. N-1 Single Contingency Analysis

In order to interconnect to the existing electrical system, generation facilities are required to safely and reliably deliver energy under at least N-1 conditions. This means that a generation facility is expected to operate safely and reliably when any individual element is taken offline for reasons such as scheduled maintenance or an unscheduled outage. An N-1 contingency study simulates the conditions of the electrical system to verify that N-1 conditions will not affect the injection capabilities of the facility or will not require significant system upgrades to maintain the desired output levels.

AWS Truepower completed a contingency study to determine the amount of wind generation that can be injected into the 69 kV Perkins substation without violating or significantly exacerbating system reliability requirements during N-1 conditions. The contingency study builds upon the results of the Thermal Screening study performed by AWS Truepower, which analyzed the base case conditions (N-0), of the system for the proposed project[3].

The Thermal Screening analyzed two different project sizes (20 MW and 50 MW), interconnecting into the 69 kV bus at the Perkins substation, for three different generation queue scenarios: assuming 0%, 50% and 100% of the queue. These scenarios, identified and modeled during the Thermal Screening study, are described in Table 4. All regional wind plants were modeled at full capacity for all three scenarios. Both the Thermal Screening and Contingency Analysis used the NERC 2011 Summer power flow case, as the 2011 Summer case was identified as the most constrained case. These case files were the most updated files available at the time of the Thermal Screening study. The power flows were solved using Commonwealth Associate's Transmission 2000® software.

Table 4: Generation Queue Scenarios.

Scenario	Queue Number	Project	County	State	Proposed In-Service	Size (MW)	Fuel
100%	GEN-2008-071	Chilocco Wind	Kay	OK	11/1/2010	76.8	Wind
50%, 100%	GEN-2009-025	Blackwell Wind	Kay	OK	12/31/2011	59.4	Wind
50%, 100%	GEN-2010-040	Canadian Hills Wind	Canadian	OK	11/30/2011	300	Wind
100%	GEN-2011-007	Apex Wind Farm	Canadian	OK	8/1/2013	250.1	Wind
100%	GEN-2011-054	NA	Canadian	OK	9/1/2013	300	Wind

[3] AWS Truepower, AWST_BKJSolutions_ThermalScreeningReport_19Nov2012.pdf, November 19, 2012.

In agreement with the Thermal Screening results, none of the transmission interconnection queue projects were included in the contingency analysis study. This is a conservative approach.

For the contingency study, a number of simulations were run, each with one nearby transmission component (line, transformer, or generator) temporarily designated as being out-of-service. For each simulation, the remaining system components that did not operate within pre-selected thermal loading and voltage limits were flagged. To improve system performance, system upgrades, generation curtailment, or load curtailment may be necessary. Please note that some overload conditions can be alleviated by switching procedures and generator redispatch that are either automatically or manually performed by the grid owner or operator. These types of procedures were not accounted for in this study.

2.3.2. Key Findings

The overloads that were identified in the contingency study, for all three scenarios, are only slightly exacerbated by the connection of either 20 MW or 50 MW of wind generation to the 69 kV Perkins substation. The most significantly impacted circuit is the 2PERKINS to 2ECOYLE circuit, rising from outage of the 2PERKINS to 2VALLEY line for the 50 MW wind project. If an outage were to occur on this circuit, the farm would have to be taken off line or curtailed. The voltage performance of the transmission system is not significantly affected by the connection of either 20 MW or 50 MW of wind generation at the 69 kV Perkins substation. The majority of the overvoltage and undervoltage violations are due to the pre-existing conditions of the system and lack of available reactive power (VAR) compensation on the lower voltage transmission system. This is most likely due to the exclusion of capacitor banks and tap changing transformers from the model of the lower voltage (24.9 kV) system.

The pre-existing overloads and voltage performance issues on the transmission system may be corrected before the project is constructed, especially if upgrades are required for interconnection of a large share of the queue projects. It is possible that the project would be required to pay for a share of the cost of transmission system improvements to the extent that the project benefits from the improvements.

Table 5: Key Findings

Item	**Description**	**Approximate Cost**
1	The system will require small upgrades to accommodate the project; VAR compensation or capacitor banks may be required by the project	Cannot be quantified at this time; will depend on the turbine selected and project design
2	Under scenario 2 or 3 there would be some curtailment of the project, but only if 50% of the projected projects are constructed, and one of the main regional transmission lines is taken out of service.	

2.3.3. Methodology

Contingency Study

The Summer 2011 Case was solved under contingency conditions (N-1) for all three queue scenarios with 0 MW, 20 MW, and 50 MW project sizes interconnected to the 69 kV Perkins substation. The 0 MW project size represents the system without the proposed generation in-service and the 20 MW and 50 MW projects, represent the two different proposed generation sizes. A comparison is made, for each scenario, between contingency study results without the proposed generation and with the interconnection of the 20 MW and 50 MW projects. System performance issues are identified which may include thermal overload, undervoltages, or overvoltages on different lines and buses within the local system area.

For all three contingency scenarios, the study was completed on the local region, as defined in the Thermal Screening study.

Scenario 1: 0% Queue, Contingency Study

The results of this scenario study indicate that the interconnection of the 20 MW project does not produce any additional overloading conditions and even leads to decreased loading and elimination of overloading on several lines. The interconnection of the 50 MW project produces an additional overloading condition on the 2CARNEY to 2PERKINS line. This overloading condition occurs when either the 2PERKINS to 2ECOYLE line or 2VALLEY to 2ECOYLE line are taken out of service. The capacity of the 69 kV line from 2PERKINS to 2ECOLYLE cannot handle the full 50 MW and some of the capacity must evacuated through 2ECOYLE to the 2VALLEY substation. If an outage were to occur between 2PERKINS and 2VALLEY, the 50 MW project would have to be curtailed.

Scenario 2: 50% Queue, Contingency Study

The results of scenario 2 indicated that the interconnection of the 20 MW project does not produce any additional overloading conditions and even leads to decreased overloading and elimination of overloading on several lines. As with Queue Scenario 1, the interconnection of the 50 MW project in Queue Scenario 2 produces an additional overloading condition on the 2CARNEY to 2PERKINS line. This overloading condition occurs when either the 2PERKINS to 2ECOYLE line or 2VALLEY to 2ECOYLE line are taken out of service. The capacity of the 69 kV line from 2PERKINS to 2ECOLYLE cannot handle the full 50 MW and some of the capacity must evacuated through 2ECOYLE to the 2VALLEY substation. If an outage were to occur between 2PERKINS and 2VALLEY, the 50 MW project would have to be curtailed.

Scenario 3: 100% Queue, Contingency Study

The results of scenario 3 indicate that the interconnection of the 20 MW project does not produce any additional overloading conditions and even leads to decreased loading and elimination of overloading on several lines. As with both previous queue scenarios, the interconnection of the 50 MW project, in Queue Scenario 3 produces an additional overloading condition on the 2CARNEY to 2PERKINS line. This overloading condition occurs when either the 2PERKINS to 2ECOYLE line or 2VALLEY to 2ECOYLE line are taken out of service. The capacity of the 69 kV line from 2PERKINS to 2ECOLYLE cannot handle the full 50

MW and some of the capacity must evacuated through 2ECOYLE to the 2VALLEY substation. If an outage were to occur between 2PERKINS and 2VALLEY, the 50 MW project would have to be curtailed.

2.4. Financial Model Inputs

At this time, no capital cost assumptions were put in the model for any system upgrades. The scope of this study did not provide sufficient information to determine system upgrade costs, if any. The costs for conducting the system impact study, facilities study, and the interconnection agreement were included in the development costs of the project.

Table 6: Interconnection Financial Modeling Inputs- Project Development

Interconnection Task	50MW	20MW
Feasibility Study Fees	$ 10,000	$ 10,000
System Impact Study Fees	$ 75,000	$ 75,000
Facility Study Fees	$ 125,000	$ 125,000
Engineering/Consulting	$ 50,000	$ 50,000
Total	**$ 260,000**	**$ 260,000**

Table 7: Project Substation and Interconnection Costs - Project Construction

Construction Task	50MW	20MW
Project Substation Construction and Equipment Supply (total)	$2,855,000	$2,144,000
System Upgrades past point of interconnection	Not included	Not included

2.4.1. Summary of Interconnection Model Inputs

The costs provided in Table 6 are for the final development of the project and are modeled in the financial model as development costs. Those costs were estimated by Solas Energy Consulting based on research conducted on the costs for interconnection within the SPP. The interconnection process is identical at either the 20MW or 50MW project size and therefore the cost assumptions between the two projects are identical.

The costs provided in Table 7 were estimated by AWS Truepower[4]. AWS Truepower conducted a detailed construction estimate for the project based on the expected cost of a substation transformer, equipment and facilities that would need to be constructed for the project. Their cost estimates name the 20MW project as "Phase 1" and the 50 MW project as "Phase 1 and 2". For the Phase 1 & 2 estimates, it was deemed that both would be constructed at the same time without a break and demobilization for Phase 2.

[4] Gross, Richard C. *"BKJ Solutions Iowa Nation of Oklahoma Wind Farm; Phase 1 Only, 69kV – 24.9kV substation construction cost estimate"* and *"BKJ Solutions Iowa Nation of Oklahoma Wind Farm; Phase 1 and 2, 69kV – 24.9kV substation construction cost estimate"* dated May 2013 (US Dollars)

It should be noted that no costs were included in the financial model for any system upgrades external to the project infrastructure. The N-1 contingency did identify that it is possible that system upgrades will be required, however estimating the costs of those upgrades was outside the scope of this feasibility study. A rough estimation of those costs normally is conducted by the utility during the system impact study, with refined estimates during the facility study. At that time, the utility would determine the cost and schedule for conducting any required system upgrades, and those costs would be allocated to the generator. The cost allocation must be accepted prior to signing the finalized interconnection agreement.

3. MARKET RESEARCH FOR UNBUNDLING GREEN TAGS[5]

3.1. Summary of Scope

Any generation source, such as coal, gas, wind, solar or hydropower produces electricity, measured in mega-watt hours (MWh), and that electricity is sold in the market-place for a specific price. The electricity market consists of both multiple bi-lateral contracts (power purchase agreements) between buyers and sellers, and generation which is placed into the grid by generators and utilized by consumers without direct bi-lateral contracts (the spot market). An electric utility generating power and selling to retail consumers, as an example, is generating power at a known cost and providing into the retail market according to a tariff, which may change based on season, time of day, demand and supply.

When electricity is generated by a renewable source, such as wind power or solar power, the electricity has a price premium in the market place because no associated carbon emission is generated. Electricity generated by a renewable energy source can be sold as green power (bundled power) or can be 'unbundled' into two components – the actual electrons, also called 'brown power' and the value of the renewable price premium – the renewable energy credit (REC), which is also called a 'green-tag' in some markets. When developing an independent power project, the developer is always seeking to maximize the revenue from a power project. With renewable energy projects, the maximum revenue may be gained from either selling the green power in one bundle (brown power + RECs), or from breaking apart the green power into two commodities – the brown power and the RECs, and selling them separately. The contract value the project developer is able to acquire for RECs is dependent on the current appetite of market participants for the green tags. Some regions that have Renewable Portfolio Standard (RPS) requirements, but have limited renewable resources or are a larger distance from the generation source, may be willing to pay a premium for the unbundled RECs to meet the RPS requirements. The market appetite for RECs is one of the keys to potential project profitability for a green energy project because this provides some additional project revenue.

The purpose of this section of analysis is to consider whether unbundling the green power into two commodities might garner a larger price in the market then selling the power as 'green', which is bundled. This section is specific to the value for that green tag or REC. A discussion of the value of bundled energy and pure brown power is considered in Section 5.

Initially, research was conducted on the voluntary and compulsory green tag and REC market. An emphasis was placed on the SPP and Oklahoma REC market, although the national market was also reviewed for potential opportunities. The carbon value of the RECs was determined including both the EPC E-Grid rules and the REC vs. Carbon Offsets pricing and indicative REC value was also determined.

A REC value enhancement strategy was analyzed, which included research on a "Tribal REC" branding strategy to determine if a REC premium could be obtained from the sale of RECs to the Federal or State

[5] This section is primarily drawn from "BKJ Solutions, Iowa Tribe of OK REC Consulting" dated November 2, 2012 prepared for BKJ Solutions, Inc. from Renewable Choice Energy, with some edits, modifications, and conclusions by Solas Energy Consulting US Inc.

governments. Additionally, research was conducted on adding value through offering naming rights or providing flexible term contract options.

The results of the analysis were utilized to provide sensitivities for REC value in the project economic model.

3.2. Overview of the Renewable Energy Credit (REC) Market

Renewable energy credits, or RECs, are how green power is tracked and traded in North America. RECs verify that one megawatt-hour (MWh) of green power has been generated and embody the environmental attributes of that clean energy including the associated greenhouse gas reductions. RECs are certified by third parties, and purchased by the U.S. EPA, Air Force, Fortune 500 companies as well as many major universities and non-governmental organizations (NGOs). RECs may be generated by the following energy producing technology types: wind farms, biomass facilities, qualifying hydroelectric projects, geothermal projects and photovoltaic/solar projects.

When a renewable facility produces one MWh of electricity and adds it to the power grid, they also generate one corresponding REC (one-for-one). Once the electricity is on the power grid, there is no way to accurately track where it ends up - it mixes with the electricity generated from coal, nuclear and all other sources. One can think of the national power grid a big pool of energy. Unless you are fully off-grid, there is no way to tell where the electrons running through your computer right now actually originated. However, if you have ownership of RECs corresponding to the amount of power you take out of the pool, you know that at least that much power was generated at a renewable facility and added back to the power grid somewhere.

All renewable energy tracking is based on RECs - in both compliance and voluntary markets. As of November 2012, twenty nine U.S. states and the District of Columbia have established Renewable Portfolio Standards (RPS) or renewable electricity standards. These standards essentially mandate that utilities in those states have a certain percentage green power in their power mix (e.g. 20% by 2020). The way that these utilities prove that they have this green power in the mix is through ownership of the associated RECs. These markets with compliance obligations are termed compliance markets, and the driving force behind the market is the government legislation where utilities are required to purchase RECs.

The voluntary market works the same way. If you hear a company is “wind powered” or “buying green power” it probably means they are buying enough RECs to match their electricity usage. A common misunderstanding is that when green power is purchased through a utility it is somehow different than buying RECs. When green power is bought through a utility, it simply means that both delivered power and RECs are being purchased together. This is often referred to as “bundled” power or “power plus,” where the REC or power alone is referred to as an “unbundled” product. The main point for the consumer to understand here is that the electrons from the wind farm aren’t all going directly to the site of the end user either way; the consumer is simply ensuring that its usage is replaced in the pool with clean energy. For both the compliance and voluntary buyer, RECs are the only way to track and trade grid-sourced, as opposed to on-site, green power.

3.3. Purchasers of RECs

Buying green power is becoming more popular as we have seen an increase in both compliance and voluntary buyers over the past ten years – voluntary buyers have actually purchased a higher volume of RECs over the past several years than the utilities that are mandated to buy because of an RPS. On the voluntary side, buying RECs is a way for many organizations to show that they are green powered or using 100% renewable energy – an environmental commitment that can help them connect to customers, partners and important stakeholders through marketing and branding efforts. Since the REC embodies the environmental benefits of producing clean energy, the buyer can also reduce their greenhouse gas emissions through REC purchases. From businesses trying to be good corporate citizens and universities supporting student interests to government agencies looking to support domestic industry, REC purchasers come in all sizes and types of organizations.

3.3.1. Project Developer Value

The value of the REC system goes beyond value to the buyer. For renewable energy developers, RECs provide an additional income stream that can help make a project more viable or more competitive with conventional fossil fuel generators. It allows them to capture the added value in producing energy in a sustainable way. Further, the robust voluntary and compliance REC markets demonstrate broad support and demand for renewable energy. On the support side, corporate advertising dollars can help spread the word and garner public support. On the demand side, increased green power demand helps drive up REC prices, providing further incentive for new development. At its essence, the REC market can provide an important revenue source that many projects rely on as a core element of their project's financial performance.

3.3.2. REC Certification

Not all renewable energy credits are certified. In compliance markets, RECs are generally delivered from seller to buyer via regional tracking systems and must meet state guidelines. Regional tracking systems include the Midwest Regional Energy Tracking System (MRETS) and the Generation Attribute Tracking System (GATS) in the PJM region, among others. These tracking systems are used to trace the chain-of-custody of the REC and ensure that no double-counting occurs. To show that the project meets state guidelines, each individual green power facility must go through an application process with the state in order to qualify to sell RECs to compliance constrained entities (large utilities). Every state RPS has slightly different criteria.

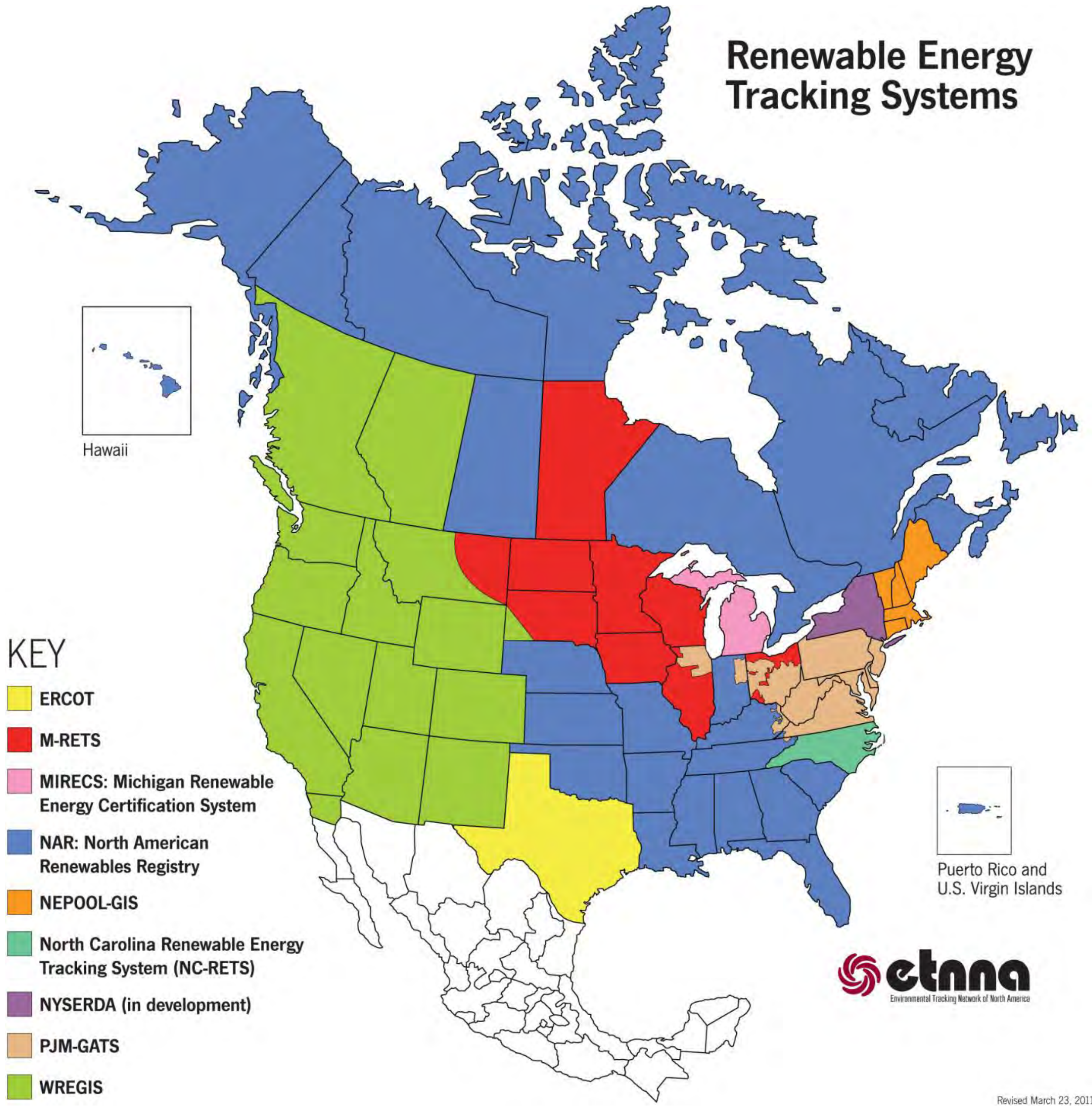


Figure 3: REC Registeries in the United States

3.4. Oklahoma REC Market[6]

Eight states do not have mandatory requirements for renewable energy, but rather voluntary goals. These programs operate similarly to a mandatory RPS, but typically no penalty is assessed for non-compliance. Oklahoma has such a goal.

Oklahoma's renewable energy goal was established in May 2010 by the Oklahoma Energy Security Act. The goal is related to generation capacity rather than actual generation. It aims for 15% of total installed generation capacity to come from renewables by 2015. Eligible resources are wind, solar, hydropower, hydrogen, geothermal, biomass, and distributed generation smaller than 5 MW capacity. Energy efficiency and demand side management (DSM) can be used to meet 25% of the overall 15% goal.

Because this goal is related to generation capacity and not actual generation, RECs are not traded to comply with the goal. Instead, every electricity generating entity or company operating electricity generation facilities in Oklahoma must file a report with the Oklahoma Corporation Commission (OCC) by March 1 of each year disclosing total installed capacity of the entity's facilities, generation from each facility, and the resource for each facility. The annual renewable energy percentage is then simply calculated by dividing total renewable energy generation capacity in the state plus any savings from DSM measures by the total electricity generation in the state.

For 2011, the OCC determined that 14.54% of Oklahoma's total generation capacity came from renewable resources and DSM. This percentage was achieved by 2,754.85 MW of installed renewable capacity as well as 165 MW of DSM measures. This was an increase from 12.85% in 2010 and demonstrates that Oklahoma is well on its way to achieving the voluntary goal. It is important to note that not every electrical generation producer provides this data, and therefore the OCC uses its best estimates to track achievement of this goal. It is unlikely that this goal will provide any additional value to new wind projects developed in Oklahoma in the near term.

The vast majority of the renewable energy capacity in the state comes from wind power development, and Oklahoma ranks 8th best in the nation for both existing and potential capacity for wind power. Additionally, a substantial hydropower base of 805 MW and a single biomass facility are installed. No geothermal or large scale solar plants were identified in the state.

Many Oklahoma utilities are selling RECs to their local customers with prices ranging from $0.35 to $1.72 per 100 kWh[7]. Although specific accurate numbers are not disclosed, it is estimated that only a few thousand Oklahomans are purchasing RECs to offset their carbon footprint. In these cases, it is possible that off takers such as OG&E are willing to pay above National REC prices (historically, $1.00-

[6] This section is a combination of information from Renewable Choice Energy and Schneider Electric. All information is from Renewable Choice Energy unless otherwise noted.
[7] Report "Electricity Price Modeling & Incentive Opportunity Assessment" dated May 30, 2013 by Schneider Electric.

1.50/MWh), however, these purchases are infrequent and short term. Below are the links to the programs:

- OG&E's Program[8]
- Public Service Company of Oklahoma's (PSO) Program[9]
- Western Farmers Electric Cooperative's (WFEC) Program[10]
- Oklahoma Electric Cooperative's (OEC) Program[11]
- Edmond Electric's Program[12]

3.5. Compliance Markets in Surrounding States

Oklahoma lacks a tradable market for RECs for compliance purposes, so the next step in finding a market for Oklahoma RECs is to look at other compliance markets in the region to determine whether Oklahoma RECs would be eligible for use in those states' RPS's. Five of the six states that border Oklahoma have a mandatory RPS—Arkansas is the only one that does not. However, of those five states with an RPS, three of them— Kansas, New Mexico, and Texas—allow only in-state generation for use in RPS compliance, so they do not provide compliance market opportunities for Oklahoma RECs. Missouri has an RPS with a goal of 15% of retail electric sales by 2021. The goal is currently at 2% through 2013 and will ramp up to 5% in 2014, 10% in 2018, and 15% in 2021. The RPS applies only to investor-owned utilities (IOUs), of which there are four: Ameren Missouri, Empire District Electric Company, Kansas City Power and Light Company (KCP&L), and KCP&L Greater Missouri Operations Company. These utilities currently have enough supply to last them through the next few years, but it is uncertain how they will procure their supply as the RPS ramps up. One utility in particular will have a shortfall of ~4 million RECs by 2021 given their current contracted assets and PPAs, so there is the potential that they would look for a long-term PPA to lock in supply. At present, Missouri-located wind RECs trade equivalent with Oklahoma as roughly the lowest-cost US wind RECs.

Colorado has an aggressive RPS of 30% by 2020, and it allows REC trading to help meet the goal. Colorado's RPS does not explicitly require in-state generation, but a few factors limit the opportunities to sell into that market. The first is that Xcel Energy is the major investor-owned utility in the state and has the majority of the compliance obligation in the state. Xcel has a massive wind power portfolio in Colorado and in other states, and they have far more RECs than needed to fulfill their obligations, so they are not active buyers in the compliance market. Colorado's RPS also gives 125% credit for in-state generation, which further supports use of in-state RECs. Colorado has its own viable wind resource, and planned upgrades in the four corners transmission region will relieve some of the regional transmission constraints, allowing for the development of additional wind power in Colorado. In May 2013, senate

[8] http://www.oge.com/environment/WindPower/Pages/WindPower.aspx
[9] https://www.psoklahoma.com/account/bills/manage/WindChoice.aspx
[10] http://www.wfec.com/generation/renewable
[11] https://www.okcoop.org/services/windworks.aspx
[12] http://edmondok.com/index.aspx?NID=269

bill 252 was moving through the legislature[13]; the bill would require rural electric cooperatives and municipal utilities to comply with a 15% REC obligation by 2020, which would increase the demand in the Colorado market. As such, Colorado probably does not currently represent a viable compliance market for Oklahoma RECs; however, this market should be watched.

Moving beyond adjacent states, a few options are available for sales of Oklahoma RECs into other compliance markets. Most of the remaining RPS's require generation to come from within a state, from adjacent states, or from a regional power pool. As discussed above, Oklahoma is adjacent to only two states with an open RPS, and the opportunities are limited. The other potential compliance market for Oklahoma RECs in the U.S. is in North Carolina. North Carolina's RPS calls for IOUs to supply 12.5% of their sales from renewable energy by 2021, and electric cooperatives and municipal utilities must supply 10% of their sales from renewables by 2021. RECs may be used to meet these requirements, and they must be traded and retired in the North Carolina Renewable Energy Tracking System (NC-RETS) electronic registry. RECs registered in other registries, including the North American Renewables (NAR) registry which covers Oklahoma, can be transferred into the NC-RETS system. The RPS does allow the use of out-of-state RECs to be used to meet up to 25% of a utility's obligation unless the utility has fewer than 150,000 customers, in which case no limit exists to the number of out-of-state RECs that may be used. In order for a facility not located in North Carolina to be eligible for the RPS, it must have come online after January 1, 2007 and be registered with the North Carolina Utilities Commission (NCUC). As of September 26, 188 out-of-state facilities are registered with the NCUC, with a total nameplate capacity of 936.8 MW. Of these, eight are wind facilities, with a combined capacity of 780.2 MW. This is a new market that has not been heavily traded. The limitation on the use of out-of-state RECs suggests that it will not be a huge market, but recent spot trades were done at or below the $1/MWh mark.

3.6. REC Voluntary Market

Demand for RECs is driven by the combination of the voluntary and compliance markets. The limitations on supply eligible for each state's RPS results in regional- and state-specific demand, which overlaps in many cases. For instance, Pennsylvania, New Jersey, and Maryland can all source top-tier RECs from the PJM Interconnection; North Dakota RECs are eligible in Minnesota, Illinois, and in some cases North Carolina. Cross-RPS eligibility increases competition for those RECs, and as RPS targets ramp up over time, the competition will increase proportionally to project development. These RECs may also be sold to voluntary buyers, but they will generally command similar prices to the compliance markets for which they are eligible. Other RECs are generated in a non-RPS state or in a state whose RPS demand is less than the available supply. In these cases, the excess RECs may also be sold in the voluntary market, but their prices will be determined by the voluntary market.

The compliance market is a significant source of REC demand and has driven much of the capacity growth in the U.S. The Lawrence Berkeley National Laboratory and the Union of Concerned Scientists

[13] "Bill to Expand Renewables in Rural Colorado Awaits Governor's Signature" Renewable Energy World.com, May 7, 2013

have projected that state RPSs will require over 300 million MWh of renewable generation by 2020. RPSs are dynamic insofar as they are legislation open to amendment. California and Colorado, for example, increased their goals in the past few years, while Ohio has recently seen proposed legislation to repeal the RPS. Nonetheless, the compliance market will continue to be a large source of demand, and this could impact pricing in the voluntary market.

Voluntary REC demand has increased steadily over the past ten years. The National Renewable Energy Laboratory (NREL) estimates that the total voluntary market exceeds 35 million MWh. This is comprised of sales through utility green pricing programs, competitive electricity sales, and REC sales (i.e. Green-e Energy-certified sales). The Center for Resource Solutions, which runs the Greene Energy program, reported 28 million MWh in total Green-e-certified sales in 2011, a 21 percent increase over 2010. Green pricing programs are now offered by over 850 utilities nationwide, and competitive electricity suppliers continue to expand their green power offerings in an effort to attract customers. These programs continue to grow in popularity and are often sources of state-specific demand for RECs. Recent low prices, among other factors, have resulted in voluntary buyers purchasing a larger volume of RECs, and the purchase of renewable energy has become increasingly normal for businesses— Green-e Energy retail sales have grown at an annual compounded rate of 44% from 2006-2011. Even factoring in this growth in demand, the combination of increasing supply and the economic downturn has resulted in the market falling to the lowest prices in its history. As we emerge from this period, we would hope to see increasing demand from business and individuals as well as the growth of existing federal, state and municipal-level initiatives utilizing the REC markets to support renewable development, driving prices back toward previous levels. Unfortunately, it is difficult to predict the timing of this market growth and developers remain cautious when evaluating voluntary market pricing over the next 3 to 5 years.

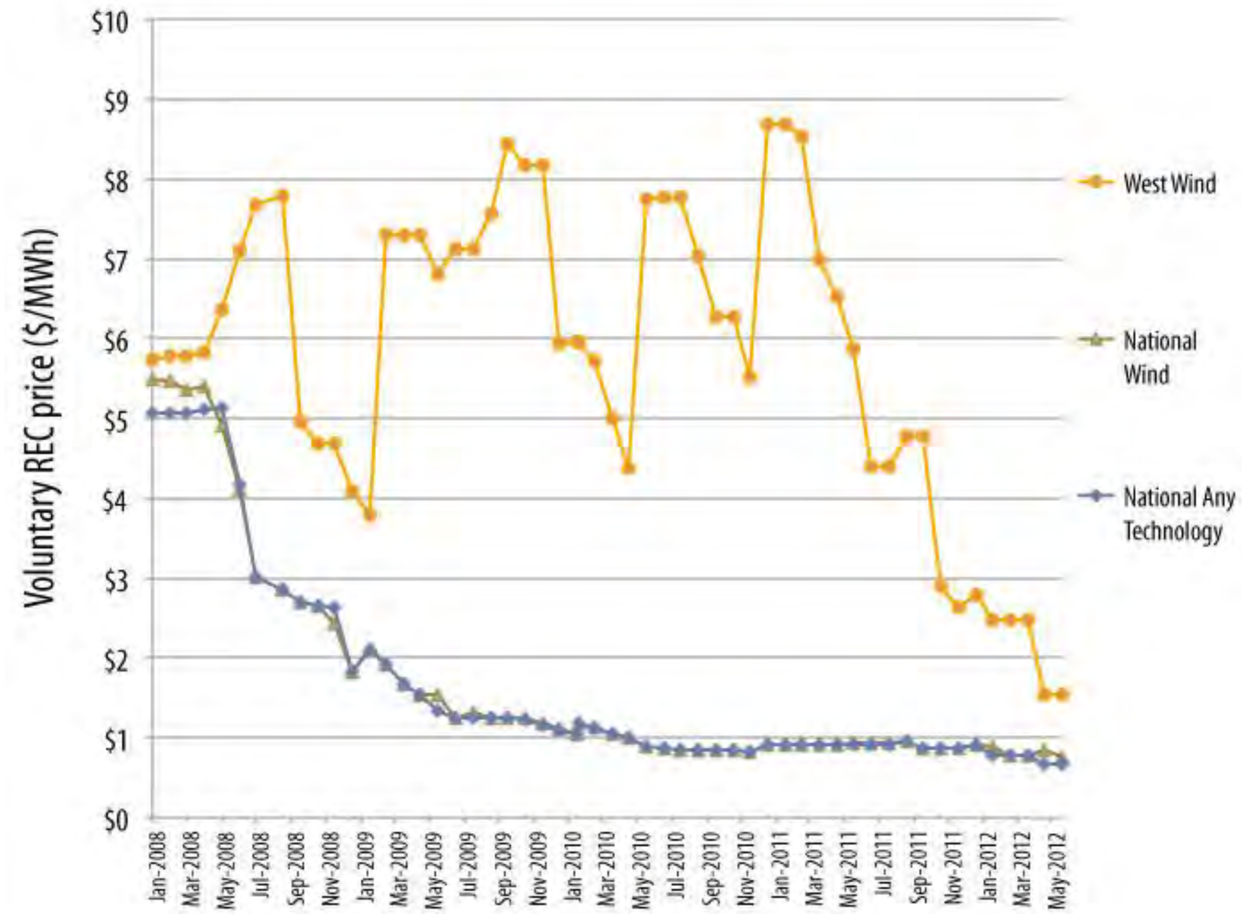


Figure 4: Voluntary REC Pricing (Renewable Choice Energy, referenced report)

3.7. Green Power on Federal Lands

In 2005, the Environmental Protection Agency (EPA) ruled that all federal government agencies must use at least 5% renewable energy if feasible by 2012. The percentage goes up to 7.5% renewable energy (if feasible) from 2013 on. This Act has led to consistent green power purchasing from most federal agencies, including the armed services, EPA, national laboratories, etc. A provision within the Act increases the value toward the required offset percentage to double for green power that is located on federal or Native American land.

http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US01R

http://www1.eere.energy.gov/femp/technologies/renewable_requirements.html

The 2012 estimated US federal government electricity consumption is around 60 million MWh/year (per the U.S. Department of Energy, Energy Efficiency and Renewable Energy Division (EERE)); so, 7.5% would be 4.5 million MWh/year, which is more than enough demand to take the full output of the project in question. Price-wise, the large, government RFPs generally command the lowest REC prices in the market due to their public nature and competition. Two recent such RFPs were run by Western Area Power Authority and the Defense Logistics Agency (July-October 2012), resulting in REC prices in the $0.60-$0.65/MWh range for 2012, somewhat higher for 2013-2016 (perhaps a 4-year blended cost of around $0.75-0.80/MWh). With Native American REC values worth double to this constituency, we could expect prices in this market just under **$1.50/MWh** for the near-term. Looking longer-term, the continuation, cancellation or expansion of this federal EPA Act is highly dependent on politics. It is conceivable that the program is expanded, creating more demand and higher prices (perhaps up to $5-8/MWh in out years). It is also conceivable that the program is abandoned altogether by the next administration. A reasonable 10-year number to put to the EPACT 2005 REC opportunity may be $1.50-3.00/MWh.

3.8. Adding Value to RECs

3.8.1. Long term REC contracts

The strongest likely market for RECs from the Iowa Tribe of Oklahoma project appears to be the voluntary market. Voluntary RECs are sold either by full calendar year generation or half-year generation. Half years are sold due to the overlap in generation periods of eligibility under the Green-e Energy program. Green-e allows retail sales made in a given year to be filled with RECs generated in the same calendar year, the last six months of the preceding year, or the first three months of the subsequent year. The most common REC contract is for a spot transaction of RECs that have already been generated. This gives the generator the ability to offer a firm, rather than a contingent contract, and the pricing for the RECs of that particular vintage is often relatively established in the market, which gives both the seller and the buyer confidence that the pricing is appropriate. These contracts are easy to execute and to settle.

"Long Term" in the voluntary REC market typically means two to three year contracts, and these are relatively uncommon. Since 2007, voluntary REC prices have dropped significantly. Buyers who made long term commitments prior to the price dropping have ended up paying for legacy contracts at a higher price than if they had just bought in the spot market. For this reason, the market place has been hesitant to engage in long-term REC contracts; however, the current low pricing is starting to entice more buyers into the marketplace in the form of long-term contracts as the risk of further price drops is fairly low.

3.8.2. Naming Rights/Value Add

Outside of the traditional REC trading model of marketers and utilities aggregating large volumes of supply from many facilities, examples of partnership or sole off-taker purchasers exist as well. In this model, a sophisticated buyer with a moderate to large appetite for renewable energy seeks to identify a project in development which is looking for a long term REC or Power and REC purchase agreement to help clear the financial hurdles it faces. This buyer assumes that a premium will be associated with such an agreement, but also anticipates a variety of benefits beyond a traditional REC contract. These benefits may include naming rights to the facility, communication support from the developer/owner, increased media coverage, as well as other marketing and branding benefits.

An example of this type of agreement was facilitated by Renewable Choice Energy in 2008 between the developer, John Deere Renewables and the US furniture manufacturer Steelcase. This was the first time that one company made a long-term commitment to purchase all the renewable energy credits and the associated naming and branding rights from a facility. Since that transaction, several large companies have been utilizing the same model, including Walmart and Google.

It should be noted that while some good examples of this model exist, from PPA plus RECs to the sole off-taker REC only model presented here, this is not yet a common contract in the renewables industry. Firms like Renewable Choice and others are always looking to identify buyers and developers who would be a good fit for this type of agreement and even the EPA has begun to try to encourage this type of partnership, but it would be unwise for a project developer to expect that this is a likely scenario at present.

3.9. Compliance Obligations and Reporting[14]

As discussed in Section 3.3.2 above, the entity generating the RECs must be registered and in some cases conduct compliance auditing of the RECs generated. The ongoing REC monitoring, reporting and compliance obligations are a real project cost that must be accounted for in the long term operating costs of a facility. Additionally, when the RECs and brown power are unbundled, the facility must now contract with two different entities for the sale of the power and the RECs. For a facility which is likely to be project financed, this introduces an additional level of complexity to the valuation because power purchase agreements are long term, while REC agreements are typically less than 5 years, and so estimating the forward pricing of those REC contracts after 5 years becomes an uncertainty in the financial model.

With the value of RECs currently so low, it is difficult to recommend that the RECs be unbundled from the green power as a separate revenue stream. The additional administrative costs introduced into the project by the compliance obligations for RECs alone might off-set the bulk of any additional revenue gained by unbundling. Likely, more purchasers exist for a green energy product and this would also provide the lowest operating expense structure for the project, which is important based on the existing project economics.

3.9.1. Key Findings

Table 8: REC Market Findings

Key Findings	
1	The prices for both voluntary and compulsory REC purchases are low. Unbundling the power and RECs may not lead to any price premium for the RECS and may lead to additional administrative costs.

[14] This section provided by Solas Energy Consulting US Inc.

2	The Iowa Tribe of Oklahoma's project presents a unique opportunity for a purchaser who would see additional value in a Native American Branding opportunity; however, a purchaser should be sought who can also take the power.
3	REC sales to US government entities would garner a price premium over the traditional REC market. Research should be conducted on these potential off-takers specifically.

3.10. Financial Model Inputs

After research on the REC pricing and the administrative costs associated with unbundling green tags or RECs from the green power, it was determined that the best course of action would be to sell a bundled product. This strategy eliminates additional long-term project operating costs and allows for a larger pool of potential purchasers who might be interested in both the power and the associated environmental attributes.

No cases were run in the financial model for an unbundled scenario because the associated cost was deemed to be higher and the associated revenue was deemed to be lower than with a bundled product.

4. NEPA, FAA, BIOLOGICAL AND ENVIRONMENTAL STUDIES

4.1. Overview of Scope

In order to determine the feasibility of a wind project at the proposed location, the Iowa Tribe commissioned environmental consultant Ecology and Environment, Inc. (E&E) to perform a critical issues analysis (CIA)[15]. The scope of the CIA was to perform a detailed desktop review of the region to analyze potential project constraints that need to be factored into the siting and final development plan for the wind project. This CIA reviewed multiple issues including:

- Threatened and endangered species
- Bird and Bat Species
- Wetlands/Water Resources
- Geology/Soils
- Historic Sites/Cultural Resources
- Public Lands and Land Use
- Federal Aviation Administration (FAA) Airport Locations

The CIA also included a permitting matrix outlining required permits or approvals, the responsible agency, the requirements and the expected time frame.

The CIA assumptions initially included a much larger project area than what was ultimately selected. The reason for this is that initial indications from the project met tower were unfavorable for the project, and a new area needed to be determined[16]. The study area for the CIA encompassed over 82,000 acres. The proposed tribal lands available for wind development for this Project were a small subset of this at approximately 6,400 acres. The Project study area boundary was developed in conversation between BKJ Solutions and E & E to encompass all potential locations and buffer zones for development of the proposed wind project. Part of the ultimate project boundary lies outside of the eastern boundary of the CIA assessment area.

4.1.1. CIA Early Stage Environmental Studies

Following the completion of the CIA, research was conducted by Solas Energy Consulting that more clearly identified tribally owned parcels which then enabled additional site specific field-based environmental and cultural studies to be performed. BKJ commissioned Atwell, LLC for these studies, which included:

- Agency Meetings and Consultation
- Biological and Cultural Resource Site Reconnaissance
- Biological Resources
- Archaeological Resources and Historic Structures

[15] Hrabe, Ryan "Critical Issues Analysis for the Proposed Iowa Tribe Wind Project, Lincoln and Logan Counties, Oklahoma" Ecology and Environment, Inc. August 31, 2012.

[16] Reference discussion on site selection in Section 6.

- Land Use Relative to Existing Easements and Sound Receptors
- Constraints Mapping
- Permits, Licenses, and Regulatory Approvals

Upon completion of the early stage environmental field studies Atwell created an Environmental Work Plan to outline the scope, cost range and timeline of anticipated environmental field studies required to achieve a construction ready project.

4.1.2. Aviation Constraints

BKJ commissioned Aviation Systems (ASI) to evaluate project feasibility from an airspace point of view. The ASI Study[17] reviewed the project against the aviation and airspace criteria set forth in Federal Aviation regulation (FAR) Part 77 (14 CFR 77) *Safe, Efficient Use and Preservation of the Navigable Airspace*, the *United States Standard for Terminal Instrument Procedures* (TERPS) and FAA Order JO 7400.2J *Procedures for Handling Airspace Matters,* which are the criteria used by the FAA to evaluate aeronautical compatibility if or when the project is submitted to the FAA for official regulatory review.

4.1.3. Microwave Beam Path Constraints

Wind turbines can interfere with certain microwave bands, especially sensitive first-responder networks, and so the location of the proposed project needs to be mapped against regional microwave beam paths. BKJ commissioned Comsearch to determine potential microwave pathway impacts. See Comsearch report[18] and summary in 4.2.9.

4.2. Detailed Study Results

4.2.1. Summary of CIA Results

E&E's methodology for the analysis focused on obtaining publicly available geographic information system (GIS) shapefiles from a variety of federal, state, and local agencies. E&E also reviewed literature and conducted queries of on-line databases to obtain relevant information for analysis. The review was conducted by a multi-disciplinary team of resource professionals, including wetland scientists, botanists, avian/bat biologists, and GIS technicians, all of whom have previous wind permitting experience in Oklahoma.

The most prominent environmental issue identified within the CIA was the potential impact to avian species. This includes species protected by the Endangered Species Act, Migratory Bird Treaty Act, and Bald and Golden Eagle Protection Act. Although potential for impacts to avian species exists, no critical issues were identified that should prevent construction of a wind energy facility within the area reviewed in the CIA.

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[17] Allen, Gary M. "Iowa Tribe of Oklahoma Wind Power Project, 12-N-0728.001" Aviation Systems Inc. February 27, 2013

[18] Comsearch"Wind Power GeoPlanner Microwave Study" March 8, 2013

The analysis identified several potential issues that will need to be considered during Project development and, particularly, when siting project infrastructure. These issues, which may require additional surveys and/or resource agency consultation, are summarized as follows:

Table 9: Critical Issues Assessment Findings

Key Findings		Recommended Follow-up Action
1	Wetlands/Water Resources	Conduct an on-site wetland delineation survey prior to final siting of infrastructure. Results of the survey would allow Project engineers to avoid significant impacts, allowing the Project to proceed with minimal Section 404 permitting requirements.
2	Proximity to Whooping Crane Migratory Corridor	Investigate the potential stopover habitat associated with the Cimarron River and wetland/open water resources within the Project area, and USFWS concerns regarding potential risks to the Whooping Crane
3	Raptors	Conduct migratory and nesting raptor surveys to estimate migration rates and breeding activity in the Project area.
4	Sensitive Watersheds	Evaluate proposed construction activities within the designated protected watershed boundary of the Cimarron River.

4.2.2. Threatened and Endangered Species

E&E queried on-line databases for federal and/or state listed threatened or endangered (T/E) species for Lincoln and Logan Counties. Federally Endangered species documented to occur include Whooping Crane and Least Tern, and Federally Threatened species include the Piping Plover and the Arkansas River Shiner. No state-listed T/E species are listed for these Counties.

Whooping Cranes migrate through the central region of Oklahoma and use marshes, shallow ponds, prairie wetlands, and salt flats for stopover habitat. The United States Fish and Wildlife Services (USFWS) developed a map of the Whooping Crane migration corridor through the central U.S. based on confirmed sightings from 1975-2010. The project area lies to the east and outside of this whooping crane migratory corridor; however, the northern part of the project area is near to the Cimarron River that contains sandy shores and sandbars that could be attractive stopover and roosting habitat, which creates some potential for Whooping Cranes to occur in the Project area during spring and fall migration.

Least Terns prefer habitat that include low vegetation on gravel beaches, sand bars and small islands within rivers or reservoirs for nesting, and migrating birds tend to follow major rivers, so the proximity to the Cimarron creates some potential for habitat.

The Piping Plover prefers open beaches and sandbars within streams with little vegetation, and generally avoid heavily vegetated upland areas. They may be attracted to sandbar habitat associated with the Cimarron River. The species does not nest in central Oklahoma and is considered to be rare even during migration.

The Arkansas River Shiner is a small fish that can be found in the Arkansas River main stem and its right bank (descending) tributaries, and small, sandy prairie channels.

4.2.3. Bird and Bat Species

The project is located in the Central Migratory Flyway. The State of Oklahoma classifies a variety of avian species as Species of Special Concern including the following which could be brought up as a concern by the Oklahoma Department of Wildlife Conservation (ODWC).

Table 10: Species of Special Concern by ODWC

Species of Special Concern	*Species Name*
Long-billed Curlew	*Numenius americanus*
Ferruginous Hawk	*Buteo regalis*
Prairie Falcon	*Falco mexicanus*
Barn Owl	*Tyto alba*
Bell’s Vireo	*Vireo bellii*
Burrowing Owl	*Athene cunicularia*
Snowy Plover	*Charadrius alexandrines*
Swainson’s Hawk	*Buteo swainsoni*

The Long-billed Curlew, Burrowing Owl, and Snowy Plover are considered rare in central Oklahoma. Ferruginous Hawk and Prairie Falcon occur in central Oklahoma during the winter. The Barn Owl is a year-long resident in central Oklahoma. Swainson’s Hawk and Bell’s Vireo breed in Lincoln and Logan Counties, and possible breeding records for Swainson’s Hawks and confirmed breeding records for Bell’s Vireo exist in the Project area.

Raptors may be impacted by the project. No prominent topographic features to attract or concentrate migrating raptors in large number are located in the project area; however, the Iowa Tribe has an Eagle Aviary just north of the proposed project area. This facility is dedicated to the rehabilitation and re-introduction of injured eagles and does attract visiting eagles to the area. Discussions were held with Tribal members as to the appropriate setbacks and consideration due to this special facility, and more conversations are needed to determine the potential impact of this facility on the layout of the project. The Bald Eagle occurs in central Oklahoma during the winters. Raptor migration surveys and Bald Eagle occurrence should be evaluated in the avian survey efforts.

The Oklahoma Biological Survey (OBS) has no records of occurrence for any federal or state listed T/E bat species in Lincoln or Logan Counties, Oklahoma. A review of cave location data within Oklahoma provided no hibernacula records of any T/E bat species within proximity of the project area. The project area is not known to be within a migratory corridor for any listed bat species

4.2.4. Wetlands/Water Resources

A variety of unnamed bodies of water are present within the project area which flow into the Cimarron River which abuts the northern boundary of the project. In general, wind projects have the potential to impact wetland or stream resources at discrete crossing locations required for temporary crossings or permanent access roads. Such impacts can usually be accommodated by a nationwide permit (NWP). A new nationwide permit (NWP 51 – Land-Based Renewable Energy Generation Facilities) is available for application to wind energy development projects requiring a Section 404 permit. Methods for avoiding impacts to wetlands or stream resources include a thorough on-site mapping of surface water features within the project area, resulting in GIS shapefiles of locations of such features. Project engineers may then incorporate this information into the siting layout and make planning decisions as appropriate.

Atwell developed a Wetland and Stream Constraints Map[19] on May 9, 2013 depicting watercourses, water bodies, National Wetland Inventory Wetlands, Potential Wetlands based on fieldwork, and FEMA Zone A areas (those inundated by 100-year flooding). The map includes a 1 mile buffer around each project boundary. Data collected for this map was then used to assist in micro-siting the proposed turbine locations. No stream crossings were determined to be needed as a part of the initial project micro-siting, and it is anticipated that a nationwide permit can be avoided.

4.2.5. Geology/Soils

The project area lies within the Central Redbed Plains geomorphic province with soils containing high amounts of iron. According to Natural Resources Conservation Service (NRCS) Soil Survey data, the Project area is described as flat to gently rolling plains. Weathered sandstone provides the fundamental components of local soils. Dominant soil types within the Project area include the Darsil-Stephenville complex and the Renthin-Grainola complex.

Untilled soil and ‘prime farmland’ soils are present in the project area. The conversion of ‘prime farmland’ to commercial or industrial use requires consultation with the NRCS according to review standards of the National Environmental Policy Act.

A relatively small amount of hydric soil is in the Project area, which means the expected acreage of naturally occurring wetlands is considered low. A more comprehensive geophysical investigation was conducted for the project by Renewable Resources Consultants. A discussion of that investigation can be found in Section 6.4 below.

[19] Atwell, “Iowa Tribe of Oklahoma Wind Study Wetland and Stream Constraints Map”, May 9, 2013

4.2.6. Historic Sites/Cultural Resources

Atwell performed a Cultural Resource Sensitivity Study[20] for the proposed project area and for a one-mile buffer external to the proposed project area. This enlarged area is referred to as the Area of Potential Effect (APE). The APE for the 50 MW boundary encompasses approximately 19,356 acres. Based on review of existing cultural resources information, previously documented cultural resources are not present within the project area, but are present in the APE. Thus, direct impacts to cultural resources are not anticipated at this time. However, indirect (visual) impacts are a potential concern for historic properties located within the APE. Examination of the viewshed for historic properties located within the APE indicated that indirect (visual) impacts are not anticipated to occur due to the proposed project being screened from historic properties by intervening topography and/or vegetation.

The APE was not assessed to determine the presence of previously-undocumented archaeological sites that may be present within the APE. Therefore, additional archaeological investigations may be necessary to determine impacts to previously undocumented archaeological sites which may occur from ground disturbance associated with the proposed project. The Iowa Tribe's Office of Cultural Preservation is expected to provide substantial input and direction with respect to any additional Tribal cultural resources to be considered during final project design.

4.2.7. Public Lands

No protected public lands or recreational areas lie within the project area, and so this was deemed not to be an area of concern.

4.2.8. Aviation

Eleven airports and three heliports are located within a 20-mile radius of the center point of the area studied in the CIA. FAA Notifications are required for structures exceeding 200 feet in height or those that are within a distance-to-height ratio of 100:1 to an FAA-recognized runway. The FAA should be consulted to ensure proper lighting and micro-siting of turbines to avoid impacts to public or private airports in proximity to the project area.

In February 2013, BKJ commissioned ASI to evaluate project airspace feasibility in further detail once the project area was further defined. Results were as follows:

- The study identified the nearest public airport (Cushing Municipal Airport) at 11.52 NM east of the project center-point, and concluded that the project would not impact its operations.
- The project would not impact Low Altitude Enroute Airways or Minimum Vectoring Altitudes (MVA) on any regional Airport Surveillance Radars
- The project would be located outside the boundaries of all Military Special Use Airspace
- Impact to Long Range Radars (LRRs) is likely. Further LRR impact study on this issue is advised by ASI. This would be conducted pursuant to any final project site design.

[20] Banks, Benjamin (Atwell), "Cultural Resources Sensitivity Study for the Iowa Tribe of Oklahoma Wind Energy Project Lincoln County, Oklahoma", May 15, 2013

- Minimal to no impact is expected to NEXRAD weather radar operations.
- The project area does not exceed the permit requirements of the Oklahoma Aircraft Pilot and Passenger Protection Act
- If a turbine were to exceed 600 feet, then it could impact the approach airspace associated with the Stillwater Regional Airport. Also any structures over 499 feet would initially be considered a presumed Hazard and a possible VFR Flyway (HW 177) would have to be evaluated as part of a State permit requirement.

ASI recommends refreshing this study prior to filing for a formal FAA determination due to common policy and procedural revisions that could render the study's conclusion obsolete.

4.2.9. Microwave Beam Path Constraints

The Comsearch report[21] commissioned by BKJ identifies a single microwave path bisecting the northeastern corner of the project area (figure 1). This pathway, known as a Freznel Zone was calculated and mapped, and GIS shapefiles were provided to BKJ. The Freznel Zone shapefiles were subsequently loaded into the project constraints map to ensure that the area was avoided in layout design. A site visit conducted by Solas Energy Consulting in May 2013 identified an additional potential beam path, which is utilized by the Tribe for their first responder activities. This path was identified too late within the study time period to provide the information to Comsearch to re-do their analysis; however, it should be noted that the potential impact of this beam path is considered minor to the project. It is likely that the only potential impact to the project would be careful planning and siting of wind turbines to prevent interference with the existing tower.

[21] Comsearch"Wind Power GeoPlanner Microwave Study" March 8, 2013

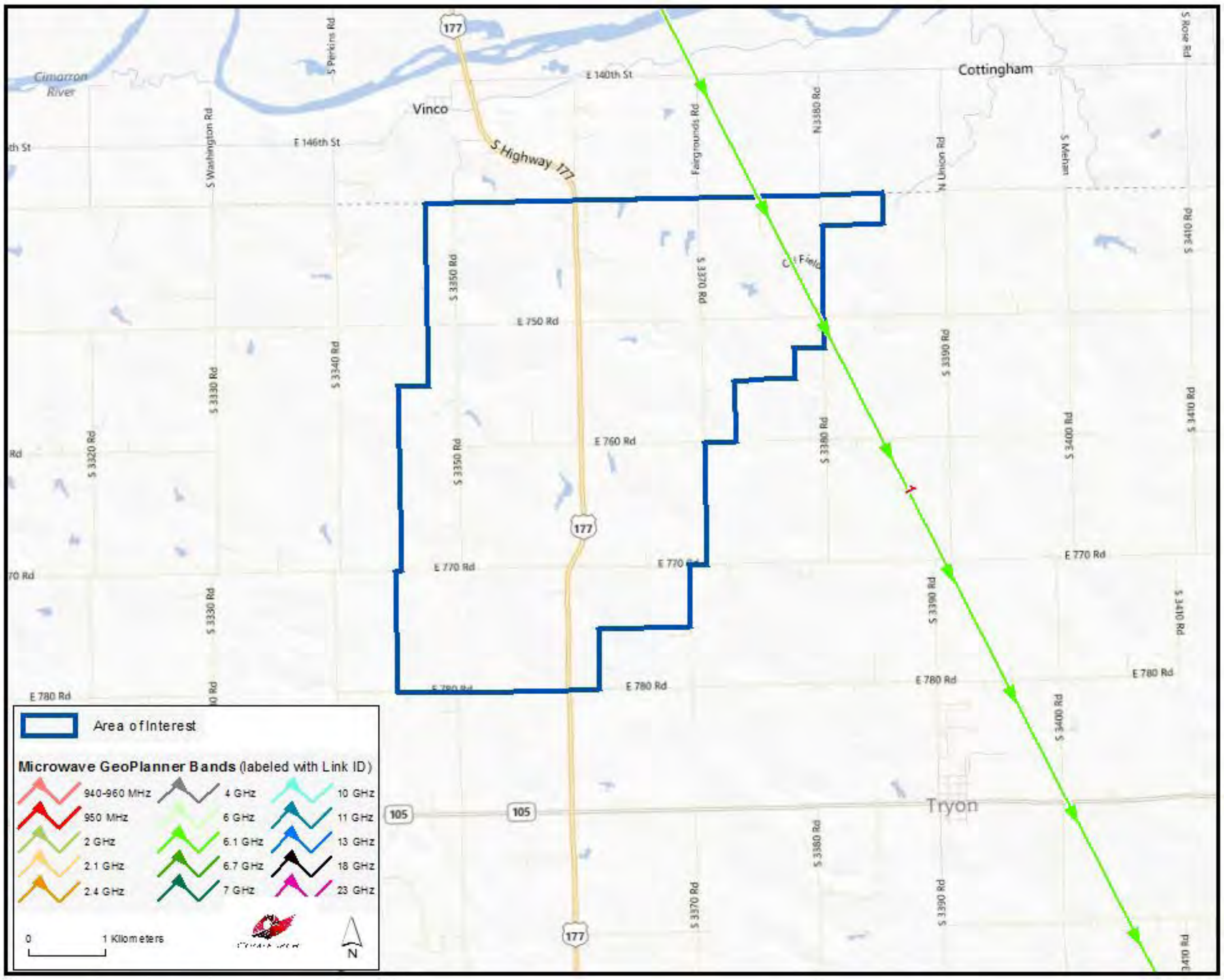

Figure 5:Microwave Beam Path in Project Area

4.2.10. Agency Meetings and Consultation

Atwell conducted a Tier I and Tier II Preliminary Evaluation and Screening Report[22] for the project. The purpose of the report was to summarize the results of the Tiers I and II of the tiered approach identified in the USFWS Land-Based Wind Energy Guidelines (WEG). These voluntary guidelines provide a structured, scientific process for addressing wildlife concerns at all stages of land based wind energy development.

This report documents the preliminary development/project planning process of the Iowa Tribe of Oklahoma Wind Energy Center relative to questions posed within the first two tiers of the WEG and serves as the initial steps in documenting the process that the Iowa Tribe is taking to provide evidence that they have complied with state and federal regulations regulating impacts to birds and bats and has reviewed potential impacts to sensitive bird and bat species, and, for future analyses, 1) developed a project to avoid and minimize those impacts and 2) identified measures to address those impacts.

[22] Atwell, "U.S. Fish and Wildlife Service Tier I and Tier II Preliminary Evaluation and Screening Report for the Iowa Tribe of Oklahoma Wind Energy Project", May 15, 2013

Specifically, Tier I of the WEG is a preliminary site evaluation on a broad geographical scale to understand which species of concern may be present, what critical habitat might exist, and whether areas of wildlife concentration are present. Tier II consists of the same review but on a project-level scale. The project site is more specifically evaluated relative to the potential for sensitive species to occupy the site and potential impacts to those species are assessed.

At the conclusion of each tiered analysis, a series of decision points are evaluated prior to moving to the next tier. Decisions are based on the information obtained from adequately answering the questions in each tier. Part of the decision process for each tier is an evaluation of risk; estimates of risk will typically be qualitative, but are often based on quantitative information. No adverse responses were presented to any of the Tier I or II questions.

In addition the tiered USFWS study, letters requesting preliminary face to face meetings with the Bureau of Indian Affairs (BIA)[23], Oklahoma Archaeological Survey (OAS)[24], Oklahoma Department of Wildlife Conservation (ODWC)[25], State Historic Preservation Office (SHPO)[26] and U.S. Fish and Wildlife Service[27] to present the project and discuss potential concerns were drafted by Atwell. However, at the direction of the Tribe, these letters would not be formally sent until more formal decisions on the project status were made.

4.2.11. Habitat Assessment

Atwell performed a Habitat Assessment[28] on May 10, 2013 that involved background wetlands, topographic, flood, land use, land cover, critical habitat, and threatened and endangered species research, combined with a windshield site reconnaissance and the generation of a habitat map[29] for the project area.

According to their assessment the project area contains relatively intact riparian and wooded areas when compared to the surrounding region. However these habitats do not constituted optimal habitat for the protected species - least tern, piping plover or whooping crane. These species may pass within or adjacent to the study area as part of migration events, however their presence is unlikely due to the limited wetland and other aquatic habitats located within the study area. The potential presence of least terns on the nearby Cimarron River may pose a potential, albeit low, risk due to their documented presence along the riverine corridor; however, documented occurrences in this location are rare and would be associated with the preferable riverine habitat of the Cimarron River. Therefore, it is unlikely that the proposed project will have an increased adverse impact of the least tern, piping plover, or whooping crane.

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[23] Haas, Chris (Atwell), "BIA Agency Meeting Request Letter", May 1, 2013
[24] Haas, Chris (Atwell), "OAS Agency Meeting Request Letter", May 1, 2013

[25] Hass, Chris (Atwell), "ODWD Agency Meeting Request Letter", May 1, 2013
[26] Hass, Chris (Atwell), "SHPO Agency Meeting Request Letter", May 1, 2013

[27] Haas, Chris (Atwell) "USFWS Agency Meeting Request Letter", May 1, 2013.
[28] Haas, Chris (Atwell) "Habitat Assessment for the Iowa Tribe of Oklahoma Wind Energy Project", May 10, 2013.
[29] Atwell, "Iowa Tribe of Oklahoma Wind Study Habitat Map" May 9, 2013

Suitable habitat for the Texas horned lizard is available and their preferred prey item, harvester ant mounds, was observed in the project area. Additional coordination with the ODWC may be recommended to reduce potential adverse impacts to this species. Also, the use of BMPs during construction and operations is recommended to further reduce potential concerns for the above mentioned species.

4.2.12. Sound Receptor Analysis

Atwell performed a Sound Receptor Analysis[30] covering the larger 50 MW project boundary including a one mile buffer surrounding the project area which covered approximately 19,356 acres. GIS and aerial photography was used to identify potential receptors, which were verified in the field to the extent practicable based on public access points.

A total of 625 potential sound receptors (a sound receptor is a residence or structure that may be occupied) were identified within the study area through desktop and field observations. Of the receptors, the majority were assessed to be barns (381) and residences (233), with limited industrial (8) and municipal (3) receptors also present. A total of 392 receptors were assessed to be vacant. Of the vacant receptors, the majority (381) consisted of barns, and the remaining 11 vacant receptors consisted of 10 residential receptors and 1 industrial receptor. The remaining 233 receptors were assessed to be occupied and consisted of 223 residential, 7 industrial, and 3 municipal receptors.

Identified potential sound receptors were generally scattered across the study area with some areas of somewhat concentrated occurrences of sound receptors, such as in the vicinity of the Iowa Tribe of Oklahoma Headquarters and in the vicinity of the community of Vinco in the northwestern portion of the study area. A table[31] detailing the identified receptors and associated maps is contained in the referenced document. On the enclosed maps[32], receptors assessed to be vacant are not labeled with a receptor ID.

In addition to identifying potential sound receptors within the study area, state and local regulations were reviewed to assess potential noise and sound regulations that may be applicable to the proposed project. State of Oklahoma regulations were reviewed, and state level ordinances and/or regulations were not identified that would directly govern noise associated with wind energy facilities. Similarly, officials from Lincoln County indicated that the County does not currently have noise regulations. Nevertheless, although specific regulations or ordinances governing noise levels for the proposed facility were not identified, it is recommended that the proposed project adopt best management practices relative to reducing impacts resulting from noise (e.g. setbacks from residences and other sensitive noise receptors).

Based on historical research, levels beyond 50 decibels at a property/boundary line (depending on average wind speed) appear to be a common threshold for evaluating noise emissions from wind facilities; with levels above this threshold requiring additional micro-siting efforts to minimize impacts to sensitive receptors, or mitigation efforts than can assist in reducing potential impacts to surrounding

[30] Haas, Chris (Atwell) “Sound Receptor Analysis Report”, May 10, 2013
[31] Haas, Chris (Atwell) “Sound Receptor Analysis Table”, May 10, 2013
[32] Atwell, “Sound Receptor Analysis Map”, May 10, 2013

areas. The City of Perkins, located north of the study area, has noise regulations applicable to industrially zoned districts which state that "no noise, either continuous or intermittent, from any operation conducted on the premises, other than that emanating from vehicular traffic, shall be detectable at any boundary line of the…district." As the study area is not located within the City of Perkins, this regulation is not anticipated to be applicable to the proposed project, but provides an example of noise regulations established within the region. Atwell recommends that the client conduct a noise assessment for the project in order to minimize potential impacts to sensitive sound receptors located within the study area.

4.3. Constraints Map

Atwell developed four constraints maps[33] based on the two different layouts overlaid onto aerial and topographic base maps. Constraints included setbacks from public roads, sound receptors, occupied and unoccupied structures, non-participating property owners, transmission line easements, cultural resources, oil and gas infrastructure, and sensitive biological areas (e.g. heron rookery, eagle apiary). Data acquired from field studies, as well as industry standard offsets were loaded into the map to assist with turbine siting.

4.4. Permitting Matrix

E & E developed the following Preliminary Permit Matrix as part of the CIA in August 2012:

Table 11: Permitting Matrix

Permit or Approval	Responsible Agency	Regulated Activity	Requirements	Expected Agency Review Time
Federal				
Section 10/404 Individual Construction Permit and/or Nationwide Permit (NWP) 12 and 14	U.S. Army Corps of Engineers (USACE), Tulsa District	Projects involving impacts to navigable waterways, including wetlands connected by surface water.	Conduct wetland delineation to USACE standards and prepare Wetland Delineation Report. Report would be submit to the USACE Tulsa District.	120+ days for Individual Permits 30+ days for NWP
Section 7 Federal Endangered Species Consultation	U.S. Fish and Wildlife Service – Oklahoma Ecological Services Field Office	Projects requiring Federal 404 permit or with the potential to adversely affect federally listed species or their habitat	Project may be cleared with informal USFWS consultation. However, if not, must conduct biological surveys and prepare a Biological	Varies

[33] Atwell "IowaTribeWind_ConstraintsMap_GE_Aerial_20130524.pdf" May 25, 2013;
Atwell "IowaTribeWind_ConstraintsMap_GE_Topo_20130524.pdf" May 25, 2013;
Atwell "IowaTribeWind_ConstraintsMap_Siemens_Aerial_20130524.pdf" May 25, 2013;
Atwell "IowaTribeWind_ConstraintsMap_Siemens_Topo_20130524.pdf" May 25, 2013.

Permit or Approval	Responsible Agency	Regulated Activity	Requirements	Expected Agency Review Time
			Assessment.	
Federal Aviation Administration Notification	Federal Aviation Administration – Southwest Region Office	Construction of structures greater than 200 feet or within a 100:1 (distance: height) ratio of a runway.	Submit Form 7460-1 to Regional FAA office	Must be submitted at least 45 days prior to applying for any type of construction permit
Section 401 Water Quality Certification (WQC)	Environmental Protection Agency (EPA)	Federally permitted activities (Section 404 Individual or Nationwide Permit) that result in dis-charges to waters of the U.S. that may violate water quality standards	Certification from EPA required prior to obtaining a federal 404 Individual or Nationwide permit	Varies
Stormwater – General Permit for Construction Activities	EPA	Construction activities disturbing greater than 1.0 acre of land.	Submittal of necessary paperwork to the EPA office and the development and implementation of a storm water pollution prevention plan.	Varies
Section 106 Consultation	Oklahoma State Historic Preservation Office (SHPO) and/or Tribal Historic Preservation Office(s) (THPO)	Any federally funded or permitted project with the potential to impact cultural resources.	Must provide adequate documentation, including project location and a description of the proposed project. Information about buildings, structures, sites, districts, objects, and/or landscapes that may be present in the project area may also be required.	Dependent upon nature of request and significance of any findings.
Local				
Zoning or building	Individual township within the counties		Townships do have jurisdiction to enforce zoning regulations if construction is within the township.	Varies

Atwell developed a detailed permit matrix for the project on March 10, 2013. This detailed document[34] outlines the Regulator Agency, Statute/Permit, Status/Reason, Probability of Requirement, Fees,

[34] Atwell, "Permit Matrix", March 10, 2013

Application Review Timeframe, Public Process and Additional information. Key Requirement drawn from both the E&E and Atwell matrices are summarized in Table 12: Key Permitting Requirements.

4.4.1. Key Findings

Table 12: Key Permitting Requirements

Critical Permits or Compliance Items	
1	National Environmental Policy Act (NEPA)
2	Endangered Species Act (USFWS Section 7 Consultation)
3	ASTM Phase I ESA
4	Determination of No Hazard to Air Navigation
5	Aeronautical Study
6	Oklahoma Wind Energy Development Act
7	Threatened and Endangered Species Consultation Review
8	National Historic Preservation Act (Sec 106 Review Consultation)

4.4.2. Oklahoma Wind Energy and Mineral Rights

The constraints map identifies numerous oil and gas wells and related infrastructure within the project area. Understanding how the Mineral Rights holders interact with the project as it is sited and developed is crucial for a successful project. Doerner, Saunders, Daniel & Anderson, L.L.P provided a legal memorandum[35] giving an overview of the Oklahoma Wind Energy Development Act, The Exploration Rights Act of 2011, and Pertinent Case Law as they related to the impacts that mineral rights holders can have on wind energy development.

Summary of Oklahoma Wind Energy Development Act (The "Act")

The legislature acknowledges that wind energy resources and their promotion are important to the economic growth the Oklahoma, and further recognizes the need to reconcile the relative rights of mineral interest owners and parties leasing land to wind energy developers, specifically with regard to decommissioning of wind energy sites and hazards that may be associated with such sites.

The Act addressed decommissioning of wind energy facilities and provides a procedure and practices for removing and remediating the land where such facilities are located upon abandonment or the end of their useful life.

The Act requires the owner file a financial evidence of security with the Oklahoma Corporation Commission in the form of a surety bond, collateral bond, parent guaranty or letter of credit following the fifteenth year of operation. The owner shall provide the estimate of cost of decommissioning upon which the financial security shall be determined.

The Act also requires the owner or operator of the facility to describe how any compensation made relative the amount of energy produced is determined. Any landowner with lease payment based on energy produced shall have the right to inspect the records of owner or operator for the past 24

[35] Anderson, Matthew, "Oklahoma Statutes and Case Law Relating to Wind Energy Development", Doerner, Saunders, Daniel & Anderson, L.L.P, May 22, 2013.

months. Each year the owner or operator shall report to the Commission the power generated from the facility.

Owners and operators must also carry insurance customarily acceptable in the industry naming the landowner an additional insured, and must provide the landowner the certificate and at least a 30 day notice of any material modification, cancellation or termination of the insurance.

Summary of the Exploration Rights Act of 2011 (The "ERA")

Under Oklahoma law the surface estate is servient to the dominant mineral estate. The ERA provides that "the lessee of a wind or solar energy agreement or the wind energy developer shall not unreasonably interfere with the mineral owner's right to make reasonable use of the surface estate, including the right of ingress and egress therefor, for the purpose of exploring, severing, capturing and producing the minerals." The ERA also states ""[i]t is the intent of this act to confirm the mineral owner's historical right to make reasonable use of the surface estate, including the right of ingress and egress therefor, for the purpose of exploring, severing, capturing and producing the minerals, and nothing in this act is intended to expand or diminish those historical rights. Further, nothing in this act shall amend or modify the surface damages statutes or be interpreted to grant, expand or diminish any person's rights therein"

Notwithstanding the fact that the mineral estate is dominant to the surface estate, the mineral owner must limit its use of the surface to what is reasonably necessary for the operation and development of the mineral lease. Furthermore, the mineral interest holder's use of the surface "must be exercised with due regard to the right of the owner of the surface."

The ERA also details a 30 day notice requirement required for the developer prior to the beginning construction.

Pertinent Case Law

In a recent case, the United States District Court for the Northern District of Oklahoma addressed the application of the ERA relative to the rights of a mineral interest holder and the holder of a lease for wind energy purposes in an unreported decision, *Osage Nation v. Wind Capital Group, LLC*, 2011 WL 6371384. The Court found that the use of the surface by the wind energy developer did not unreasonably interfere with the mineral interest owner's rights to explore, capture or produce oil and gas. *See Osage Nation*, at 9.

The Court cited an Oklahoma Supreme Court Case wherein the mineral interest owner had sought to force a party with surface rights to buy out its lease. *See Gulf Pipeline Co. v. Pawnee Tulsa Petroleum Co.*, 127 P. 252 (Okla. 1912). The surface rights holder refused to buy out the mineral interest owner's rights at the exorbitant amount demanded and preceded to construct improvements on the land. The mineral interest holder responded by beginning to drill a well dangerously near the surface owner's improvements. The surface owner sought and ultimately obtained a permanent injunction restricting the mineral interest holder from placing its well near the improvements. The court found that there were other locations where the well could be drilled within the area comprising the mineral interest owner's property. The court reasoned as follows:

> *Having the right to drill anywhere, and the right to occupy the surface not being conveyed to them, but reserved to the owners, it follows that they must exercise their right to drill with due regard to the rights of the owners of the surface, and that where they can fully enjoy their own rights without injury to others they should not be allowed out of the spirit of wantonness or of blackmail, to jeopardize the property and the lives of others exercising an equal right. See Gulf Pipeline Co., 127 P. at 253-54.*

Thus, the mineral interest owner's rights to use the surface are limited in nature, limited to what is reasonably necessary to access the minerals. *See Liverly v. Tidewater Petroleum Co*., 139 P.3d 897, 903 (Okla. 2006).

4.4.3. Construction Permitting[36]

No statewide construction permit requirements exist other than the stormwater and zero-emission facility permits from the Oklahoma Department of Environmental Quality as discussed above. The Department of Environmental Quality handles storm water drainage permits for areas that disturb more than one acre cumulative. Jennifer Wright at the Oklahoma Department of Environmental Quality (405.702.1077) is the contact to help with stormwater/sewage permitting. The website for the DEQ is www.deq.state.ok.us.

Frequently transportation permits are required to bring in the heavy equipment, including turbines, substation transformers, and other over-sized loads. The Oklahoma Department of Public Safety (http://www.dps.state.ok.us/swp) is the entity that handles transportation permits. Typically, the responsibility for transportation of the components to the site is done by the manufacturers of the turbines and components; thus, these permits would be the responsibility of the manufacturers. The cost for the permitting would be considered in the turbine and/or transformer pricing.

Wind energy siting and permitting requirements vary in Oklahoma from county to county, and local building codes and ordinances may also apply.

4.4.4. Logan and Lincoln Counties – Construction Permitting

In Logan and Lincoln counties, after conversations with local officials, it appears that no restrictions to construction are enforced, unless the project falls within city limits, then it must follow the town enforcement codes. The Chamber of Commerce asks the developer to work with local officials to ensure they remain aware of all activities. The contact information for the Lincoln County Clerk's Office is (405)258-0080, and the commissioners are Don Sporleder (chairman), Ricky Taylor and Lee Doolen. The contact information for the Logan County Clerk's office is (405)282-0267, and the commissioners are Mark Sharpton, Michael Pearson and Monty Piearcy.

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[36] This section provided by Solas Energy Consulting US Inc.

4.5. Permitting Financial Model Inputs

In order to determine a budget for the final development of the project, the permitting costs going forward were estimated. The costs below represent the expected costs required to get the project to the point of construction. These costs are utilized in the project financial modeling as the basis for permitting the project.

4.5.1. Environmental and Permitting Model Inputs

Table 13: Environmental and Permitting Financial Model Inputs

Permitting Task	50MW	20MW
NEPA Permitting	$150,000	$100,000
Wildlife Studies	$260,000	$180,000
USFWS (HCP) Permits	$35,000	$35,000
FAA/NTIA (airspace, radar)	$10,000	$10,000
Cultural Resources Surveys	$100,000 - $150,000	$60,000 - $75,000
Wetlands, Stormwater Delineation and permitting	$15,000 - $20,000	$10,000 - $15,000
Phase I ESA (haz mat)	$15,000	$10,000
Construction Permits	$15,000	$15,000

4.5.2. Summary of Environmental and Permitting Model Inputs

These inputs are based in part on costs developed by Atwell in the Environmental Work Plan[37], as well as a Proposal for Environmental Consulting Services[38] submitted by E&E and general industry permitting knowledge provided by Solas Energy Consulting. The cost estimates provided were scaled to each respective project size.

- The NEPA process includes the cost and process management required to scope and draft an Environmental Assessment (EA) or Environmental Impact Statement (EIS) document and acquire an approval decision either via a Finding of No Significant Impact (FONSI) for and EA or Record of Decision (ROD) for an EIS.
- Environmental Studies include all baseline field studies required for wildlife, habitat, wetlands and vegetation based tribal, state and federal consultations for project siting to avoid impacts and to satisfy regulatory requirements. Some studies would be required for several seasons.
- A USFWS Habitat Conservation Plan (HCP) or conservation strategy could be required if baseline studies reveal potential impacts to federally protected species and their habitats.
- An FAA Aeronautical Study, in addition to a DOD Radar Study and clearance, would be required to ensure no conflicts with designated airspace or defense radar.
- A field based cultural resource inventory would be required for the facility's footprint to ensure no conflicts with archaeological or historical resources.

[37] Haas, Chris (Atwell) "Environmental Work Plan" May 30, 2013
[38] Lawlor, Denis (E&E) "Proposal to Provide Environmental Consulting Services for the Proposed Iowa tribe Wind Project in Lincoln, County Oklahoma" January 18, 2013

- Wetlands delineations and surveys would be required for wetland areas and waters of the U.S. that may be impacted by civil infrastructure.
- A NPDES stormwater permit and management plan would need to be designed to minimize stormwater runoff.
- A Phase I ESA would be required to ensure that no facilities are sited on an area contaminated with hazardous Materials
- Construction related permits include road and bridge use, grading plans, and similar administrative permits that would be acquired by the construction contractor closer to construction.

5. POWER PURCHASE RESEARCH AND NEGOTIATIONS

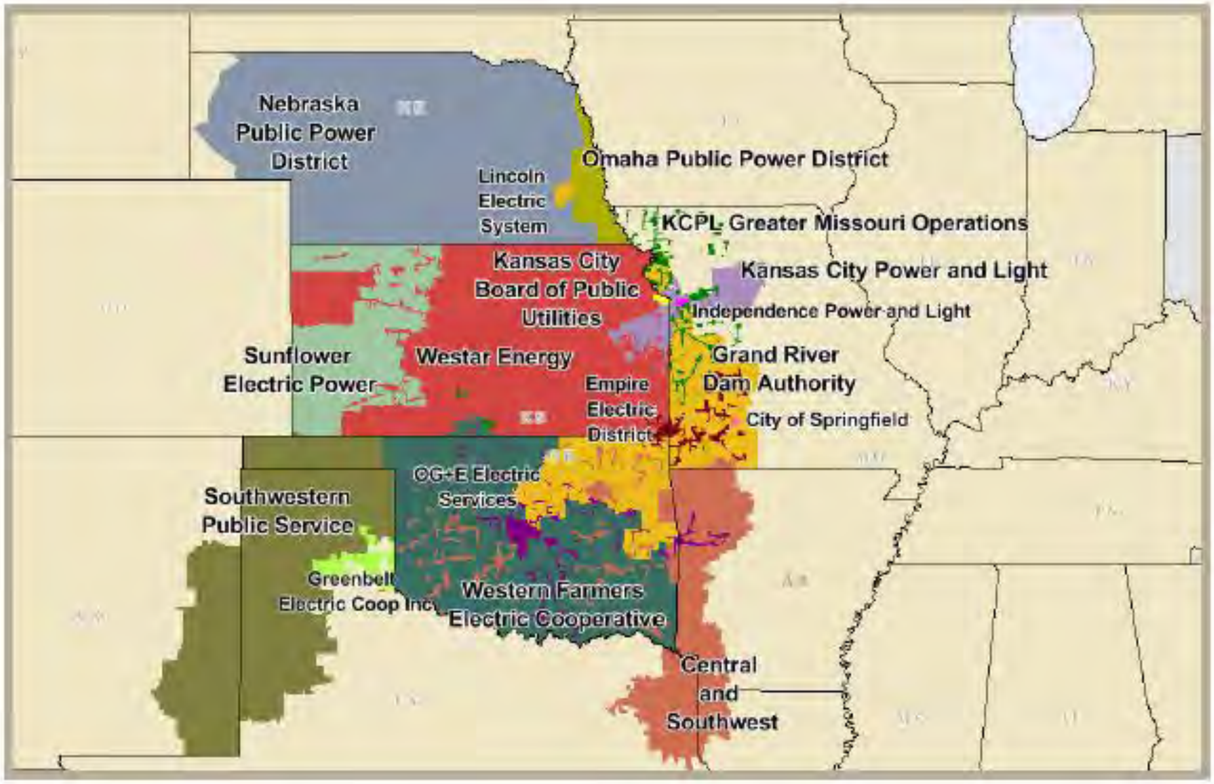
5.1. Overview of Scope

Section 3 of this report discusses REC pricing and the concept of bundled vs. unbundled green power. Section 3 also discusses the price for RECs in an unbundled scenario. The value of RECs, however, is just a small portion of the total overall value of green energy; thus, the most important factor to understand for a power project is the value at which the energy itself can be sold. This section serves to analyze the value of the unbundled brown power pricing, as well as the bundled green power.

Summit Energy, a subsidiary of Schneider Electric, was hired by the Iowa Tribe of Oklahoma to research brown power pricing and bundled green power pricing, as well as analyze the potential structures for the sale of the electricity. Schneider Electric conducted research on potential power purchasers and pricing in the Southwest Power Pool (SPP) market. Several criteria were researched including:

- Common power purchase agreement terms and conditions
- Expectations on power price for both brown and bundled contracts including ancillary services and wheeling charges, if applicable
- Bundled power sales vs. Unbundled REC/Brown Power sales strategies
- Potential Off-takers and specific opportunities including power RFQs
- Oklahoma Gas and Electric (OGE) (brown) price market fundamentals – current state and projected future rates (conservative and aggressive forecast)
- OGE (green – RECs bundled with electricity) price market fundamentals – current state and projected future rates (conservative and aggressive forecast)
- Research into any public renewable energy project structures with generation in SPP, including evaluation and analysis of commercial structures (term and rates, etc)
- List of potential off-take in market area (those who have bought third party renewables within the SPP.
- Types of models (sell project to buyer, PPA, hybrid, etc)
- Evaluation of how modeling changes for different project size scenarios
    1. 20MW
    2. 50MW
    3. 50+ MW
- Research any existing or proposed federal, state or local incentives associated with wind energy development

Figure 6: Southwest Power Pool Electricity Market[39]



Schneider Electric produced a report on their findings titled *"Electricity Price Modeling & Incentive Opportunity Assessment"* dated May 30, 2013. The contents of the following sections are primarily drawn from that report, with additional commentary and analysis by Solas Energy Consulting. The full report is deemed commercially sensitive and therefore is not included herewith. The findings, however, are summarized below.

5.2. Brown Market Price Fundamentals

The Iowa Tribe engaged Schneider Electric to develop a forecast of brown power prices for their financial feasibility analysis. Originally, the focus for the analysis was on OGE electricity rates. However, after analyzing the utilities situation and the broader market for electricity, Schneider Electric determined that SPP's Locational Imbalance Prices would be the most appropriate proxy for representative pricing.

OGE serves approximately 798,000 (6,800 MW) in Oklahoma and West Arkansas,[40] whereas SPP includes OGE and many other utilities in Arkansas, Kansas, Louisiana, Mississippi, Missouri, Nebraska, New Mexico, Oklahoma, and Texas.[41] See Figure 6 for a map of SPP's service territories.

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[39] http://www.ferc.gov/market-oversight/mkt-electric/spp/elec-spp-reg-des.pdf

- SPP provides access to 5 years of historical hourly data. OGE has many different rate classes for customers and the components in the rate classes are not always directly related to electricity prices. OGE will perform multiple upgrades over the next 5 years and they are issuing long term debt to accomplish this.[42]
- OGE's rates do not correlate well with Natural Gas futures, whereas SPP average spot prices have historically tracked the NYMEX prompt month natural gas contract closely. On a quarterly basis since 2007, the aforementioned gas contract has been able to explain over **90%** of the variation in the SPP spot market average price.

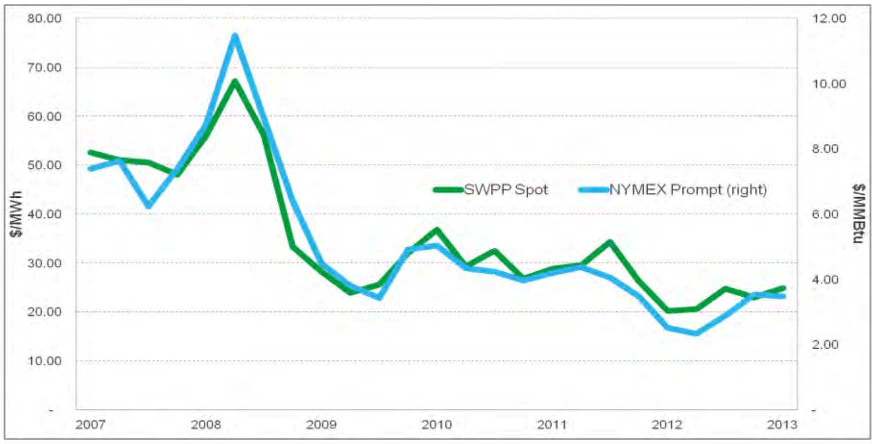

Figure 7: SPP Spot Prices versus NYMEX Prompt

At the moment, SPP does not have futures data available. SPP only has an Energy Imbalance Service Market, but is in the process of implementing the SPP Integrated Marketplace, which will include both Day-Ahead and Real-Time markets (March 2014).[43]

In order to find an appropriate proxy, Schneider Electric looked at the fuel mix in Oklahoma and found that Natural Gas dominated.**[44]** Since the R^2 for NYMEX and SPP is 90%, other fuels were not used for the forecast. Additionally, other fuels follow the natural gas market as they are substitutes. They expect natural gas to continue to be a price-setting fuel in most North American power markets, including SPP.

[40] http://media.corporate-ir.net/media_files/irol/10/106374/OGE_2012AR.pdf P2
[41] http://www.spp.org/section.asp?pageID=1
[42] http://media.corporate-ir.net/media_files/irol/10/106374/OGE_2012AR.pdf P29
[43] http://www.spp.org/section.asp?pageid=143
[44] http://www.eia.gov/state/?sid=OK

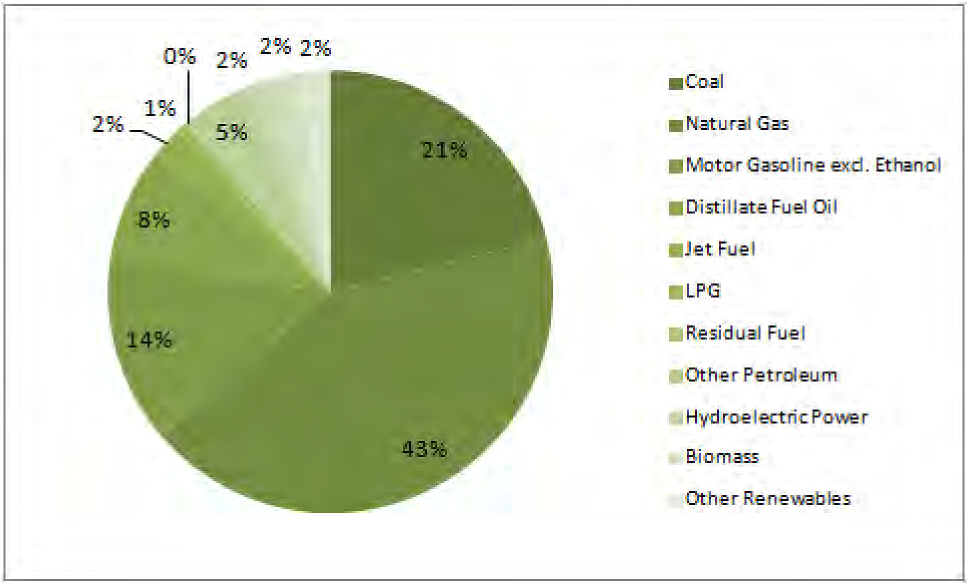

Figure 8: Oklahoma Electricity Fuel Mix (2010)

Using Schneider Electric's proprietary natural gas model, Schneider extrapolated a 20-year forecast for the base, high, and low cases for brown power pricing (no renewable energy attributes). In the base report, 20-year forecast spot pricing is provided for SPP from the year 2014 to 2033. A base, high, and low case were developed. This graphic, provided in the full report, provides information from which some pricing assumptions were developed for the project financial models. The table was deemed commercially sensitive and therefore was not included in this summary report; however, the pricing assumptions utilized for the financial model assumed a 20-year fixed price PPA, escalating at GDP, starting in 2016, and examines the low, mid, and high level cases. A long term fixed PPA would be expected to come in slightly higher than base spot price, and a green power PPA would be near the mid- to high- PPA range. The Schneider report provided several potential upside and downside price risks. Those are discussed in detail below.

5.2.1. Upside Price Risks

- Future Liquefied Natural Gas (LNG) exports made by the US could drive up gas prices in the sector, depending on how much the government allows to be exported. This could lend upward support to power prices.
- Gradual increases in demand for power generation could lead to upticks in demand.
- Potential green energy initiatives involving emissions caps would cause a general shift from coal toward natural gas, driving up power prices.

5.2.2. Downside Price Risks

- Future increases in production of shale oil could alleviate any upward pressure on natural gas prices.
- The continued potential for "coal-switching" could keep prices low.
- Natural Gas storage production capacity is increasing, which could likely cause prices to fall.

- Gradual increases in NGL (Natural Gas Liquids) production could help to keep the overall supply of energy options constant.

5.3. Types of Models for Power Sales

After research on the potential models for power sales from the project, it was determined that the most likely off-take scenario was to sell the entire output (all the energy generated) of the facility under a long-term PPA. Sometimes, a project developer will provide one or more PPAs to different off-takers, however at either the 20 MW or 50 MW in size, there would be power purchasers interested in the entire output. Another sales option would include a full merchant facility, or a shorter-term PPA followed by merchant operations after expiration of the PPA. An explanation of a PPA vs. a merchant facility is discussed below.

5.3.1. Power Purchase Agreements[45]

Power Purchase Agreements (PPAs) are financial agreements for delivery of power in which a third-party developer such as the Iowa Tribe owns, operates, and maintains the generating asset and delivers that power via a purchase contract to an end-user or other off-taker, such as an investor owned utility, power retailer, or municipality. If the PPA includes the corresponding environmental attributes then the power is delivered under a 'green power PPA'. If the environmental attributes are stripped away and sold separately as RECs, then the power delivered under a PPA would be a 'brown power PPA'. PPAs are typically offered in term lengths of 10 years or more, often 15- or 20-year deals. A green power PPA will always be at an equal or higher rate than a brown power PPA. If the off-taker places no value on the environmental attributes, then a green or brown power PPA would be identically priced. It is, however, probable that a green power PPA would have a higher price and more interested counterparties as compared to a straight brown power PPA offering.

For end-users of electricity, PPAs are generally priced on a $/MWh purchased basis and may include an initial cost of energy figure that is escalated by a fixed percent in each subsequent year. PPAs are very common and the long-term commitment of the agreement structure would allow the project to be financed for the Iowa Tribe without the end-user or utility incurring up-front capital costs.

PPAs are one of the most common means by which renewable energy projects are financed, as the off-take arrangements allow for stable, predictable revenue to the project's investors and ensure that there are counterparties in place through the payback period on the initial investment. For end-users, a PPA can be seen as a 3rd party supplier of power, similar to a retail energy provider in deregulated markets, that provides the commodity portion of the power, but in most cases still relies on the prevailing utility for delivery to the facility. In a PPA arrangement, the pricing is often inclusive of all transmission, distribution, congestion, and other ancillary fees so that the price being evaluated is "as delivered to the site." In the event that the Iowa Tribe is offering power "from the bus bar" (which means from the substation) or from the point of origin at the generator, the end use purchaser is responsible for transmission or "wheeling" the energy to its distribution network and ensuring reliable scheduling and

[45] This section primarily drawn from the Schneider Electric report, with some additional editing and content provided by Solas Energy Consulting.

delivery to its facilities. It is incumbent that any PPA is crystal clear on the point of delivery and who is responsible for non-generation charges.

Transmission and wheeling charges (charges to 'move' the power to the end user) within the SPP region can be identified and calculated once the destination for the electricity is known. Those wheeling charges can be quite high, and any consideration of who could purchase the power must factor in those wheeling charges. Selling the power to an entity that must be wheeled long distances could make the project cost-prohibitive and so the strategy will be to identify an off-taker within a reasonable wheeling market if a long term PPA vehicle is utilized for the sale of the power.

Benefits of Utilizing a Power Purchase Agreement

- Provides relatively known, stable energy price to both the Iowa Tribe and end user for 10-,15-, or 20-year type terms – effectively hedging against future increases in grid power costs
- If all environmental attributes are included with the sale of power, PPAs provide the most direct and tangible link to a generating asset, short of on-site generation or a direct equity investment in an asset
- The Iowa Tribe could negotiate performance incentives in to the PPA for availability factor and can benefit from control and operation of its own facility management
- If the Iowa Tribe were to maintain control over the project, the tribe could create jobs, a source of revenue, and develop technical skills within the tribal members.
- PPAs are fairly common and generally understood in the energy and financial community where typical contracting and delivery terms are established
- Very financeable provided financial underwriting standards (price, counterparty creditworthiness) are met

Considerations

- PPAs are generally structured as long term contracts with predictable revenue streams, which effectively limits the Iowa Tribe's upside potential in event power prices rise over fixed price power structure sold over life of PPA
- PPAs may not be as cost effective as brown power + RECs when stipulations are made that RECs are to be bundled with power purchased
- Caution should be exercised in negotiating a direct purchase / PPA contract to ensure that all costs associated with "wheeling" the power into an end-user's site have been accounted for in pricing as the SPP wheeling costs can be expensive.
- The signatory party to a PPA in most every case requires the developer to provide some form of financial security to secure the power sale obligations to the buyer. This is a significant hurdle for small developers and can drive smaller developers into partnerships with larger entities that can put up multi-million dollar letters of credit for the offtake. This requirement alone may drive the Iowa Tribe to consider a development partner for this project.

Direct purchase / PPAs are often positioned to off-take purchasers as a hedge against future rise in energy costs and may in some cases be provided at a discount to grid-sourced electricity over the course of the agreement. Green power PPAs are attractive to utility off-takers because the cost of fuel (wind or solar irradiation) are free, and therefore provide a good hedge for other fuels such as coal and gas. Caution should be exercised in order to ensure that the environmental attributes associated with the renewable power, including RECs and all carbon reduction effects, are expressly either being retained or sold by the Iowa Tribe, as retention may strip the agreement of any claims to being "renewable power" for the off-take purchaser.

5.3.2. Power Sales – Merchant Market

The merchant power market is another avenue for the sale of electricity, and some wind power facilities, especially in particular markets such as ERCOT, can be financeable in a merchant power sales model. A merchant facility is built to service the 'spot' electricity market and is constructed with little or no prior commitment of its output to a contractual off-taker in the form of a PPA. Instead, the electricity from the facility is sold into the competitive wholesale power market. Spot pricing in the wholesale electricity power market can vary dramatically due to supply and demand constraints, and therefore the project revenue is much more uncertain than under a long-term PPA. Over the life of a facility, sales into this market make result in much higher long-term project revenues, however the uncertainty of that is so high that this model is difficult to finance and is not an ideal strategy for a first-time developer such as the Iowa Tribe. Wind power projects within the SPP, however, have been built both merchant and with PPAs.

5.4. Existing Projects in SPP and their Structures

Research on wind power projects within the SPP region was conducted using publically available information to determine the most common structure of those projects. It was found that most projects have been constructed with long term PPAs in the range of 20 years, which is the most likely model for this project. Additionally, among the 1,127 MW installed in Oklahoma during 2012, 73% of that was contracted under long-term PPAs[46]. The buyers under this PPA scenario are largely utilities – 85% of the new wind installed in 2012 was under PPAs from utilities.

Table 14: Wind Projects in the SPP and their Structure

State	Project Name	Capacity (MW)	Turbine Rating	Project Developer	Project Owner	Power Purchaser	Structure
OK	Crossroads (2012)	32.00	2.3+3.0	RES Americas	Oklahoma Gas & Electric	Oklahoma Gas & Electric	Company Owned
OK	Big Smile Wind Farm at Dempsey Ridge	132.00	2.00	Acciona Energy	Acciona Energy	Merchant (SPP)	Merchant
OK[47]	KODE Novus I	80.00	2.00	DeWind; Novus Windpower	KODE	Xcel Energy	PPA (contined every year with exceptions, rate

[46] "Electricity Price Modeling & Incentive Opportunity Assessment" May 30, 2013, Schneider Electric
[47] http://interchange.puc.state.tx.us/WebApp/Interchange/Documents/40824_2_742766.PDF

							unknown)
OK[48]	Rocky Ridge I	148.80	1.60	TradeWind Energy	Enel Green Power North America (51%); TradeWind Energy (49%)	Western Farmers Electric Cooperative	PPA (duration undisclosed, rate unknown)
OK[49]	Blackwell	59.80	2.30	NextEra Energy Resources	NextEra Energy Resources	Oklahoma State University via Oklahoma Gas & Electric	PPA (20 years, rate unknown)
OK[50]	Canadian Hills	298.00	2.4+2.05	APEX Wind Energy	Atlantic Power Corp (99%); APEX Wind Energy (1%)	Google via Grand River Dam Authority (48 MW); Oklahoma Municipal Power Authority (49 MW); SWEPCO (201 MW)	PPA (Grand River Dam Authority 20 years, SWEPCO 20 years, Oklahoma Municipal Power Authority 25 years)
OK[51]	Chisolm View	235.20	1.68	TradeWind Energy	GE Energy Financial Services (51%); Enel Green Power North America (49%)	Alabama Power Company	PPA (20 years, rate unknown)
OK[52]	KODE Novus II	40.00	2.00	DeWind	DeWind	Xcel Energy	Merchant
OK	Minco III	100.80	1.60	NextEra Energy Resources	NextEra Energy Resources	Golden Spread Electric Cooperative	
TX	Frisco	20.00	2.00	DeWind	DeWind	Xcel Energy	
TX	Cirrus 1	61.20	3.60	Cirrus Wind 1	Cirrus Wind Energy	Merchant	
TX	Mozart	30.00	2.50	WKN USA, LLC	WKN USA, LLC	Merchant (ERCOT)	
KS	Flat Ridge 2	419.20	1.60	BP Wind Energy	BP Wind Energy (50%); Sempra Energy (50%)	Associated Electric Cooperative Inc. (310.4 MW); SWEPCO (108.8 MW)	PPA (SWEPCO 77.8/108.8, 20 years)
NE	Broken Bow I	80.00	1.60	Midwest Wind Energy; Edison Mission Group	Edison Mission Group	NPPD (47 MW); Omaha Public Power District (18 MW); Lincoln Electric System (10 MW); Municipal Energy Agency of Nebraska (4 MW); City of Grand Island (1 MW)	NE

48 http://www.nawindpower.com/e107_plugins/content/content.php?content.10081
49 http://www.ownenergy.net/sites/default/files/Blackwell_Wind_Farm.pdf
50 http://www.atlanticpower.com/assets/existing-projects/canadian-hills.aspx
51 http://www.enelgreenpower.com/en-GB/ena/power_plants/ongoing_projects/Chisholm_View/
52 http://microsoft-lync-solution-news.tmcnet.com/news/2012/10/26/6679981.htm

NE	Crofton Bluffs	42.00	1.8+3.0	Edison Mission Group	Edison Mission Group	NPPD (20 MW); OPPD (13 MW); Municipal Energy Agency of Nebraska (4 MW); Lincoln Electric System (3 MW)	

5.4.1. Key Findings

Table 15: Brown Power Purchase Key Findings

Key Findings	
1	Most wind projects developed in the SPP market receive long-term power purchase agreements on the order of 15-20 years.
2	A merchant project scenario for the Iowa Tribe Project would be difficult to finance and is considered not feasible.
3	Pricing analysis completed by Schneider Electric provided indications that brown power sold under a long-term PPA could be expected to start at $49 to $70/MWh, escalating over the life of the project.

5.5. Bundled vs. Unbundled Power

The analysis above addresses the brown power resulting from unbundling the RECs from the electricity. Section 3 provided information regarding the REC sales and expected pricing. The other potential methodology to sell the power is as a bundled product, or ‘green power’ which ties the electricity to the RECs and is sold to one off-taker. Ultimately, the project will need to be structured such that the maximum revenue is obtained. This feasibility study was conducted utilizing historical information and market knowledge, and recommendations were developed based on that research. It should be noted, however, that the power market is dynamic and green power especially is driven not just by supply and demand, but also by environmental legislation related to climate change, politics, and social awareness of the benefits of green power. All of these elements introduce a certain degree of volatility to any projections for pricing of green energy.

5.5.1. Results

Based on the analysis in this section and the REC section, it was determined that the most advantageous structure for the project economic modeling was a bundled product. This is for several reasons. First, the likelihood of securing a PPA was higher for a bundled product, and this would not necessarily preclude the project from providing naming rights to the right buyer. Additionally, the long term administrative costs would be lower, and the project would be more financeable. The US Government could be an interesting purchaser as they put a 100% premium on green power generated on Native lands.

5.5.2. Key Findings

Table 16: Bundled vs. Unbundled Power Sales Findings

	Key Findings	Caveats & Limitations
1	A bundled 'green power' product would likely have the most interested purchasers.	The power market is dynamic, and the bundled vs. unbundled strategy will require continuous review and evaluation as the market changes.
2	A bundled 'green power' product may garner a higher sale price than a REC plus brown power sales strategy	This strategy has the highest probability of success if a REC buyer with a strong appetite for Native American RECS is not located.
3	If a buyer is found who is willing to pay a significant premium for the Native American branding, then unbundling may be the best option	The assumed market for this type of buyer is small, which is why this is deemed to be a less likely scenario.

5.6. Potential Off-Takers

5.6.1. Results

Schneider Electric conducted a survey of the market to determine who potential power purchasers might be within the SPP region, as well as non-traditional power purchasers. They noted a trend that non-traditional power purchasers were entering the market and either executing PPAs or stating their intent to purchase RECs. These participants tended to be large organizations who were interested in mitigating power costs, as well as incorporating green branding and sustainability practices into their corporations. The listing of potential off-takers was deemed to be commercially sensitive and therefore was not included within this summary report. The full listing can be found in the base report from Schneider Electric.

5.7. Power Purchase Financial Model Inputs

5.7.1. Power Purchase Inputs

Table 17: Power Purchase Financial Model Inputs

Scenario	20MW and 50MW Case	Comments
Low Case – Brown Power Price, 20 Year PPA	\$29/MWh	This scenario was not utilized. With a green product it is expected that the mid- to high- case are more likely.
Mid Case – Brown Power Price, 20 year PPA	\$33/MWh	This is the model base case.
High Case – Brown Power Price, 20 year	\$39/MWh	This is the model high case.

PPA		
15% Additional Premium on power price	$45/MWh	This case was also examined to determine the impact on the internal rate of return (IRR).

5.7.2. Summary of Power Purchase Model Inputs

The year 2016 was assumed for commercial operation of the project and Schneider's price projections starting in that year were utilized for the financial model. The power pricing was escalated over the 20 year period. REC pricing was added to the brown power price, and the base assumption was $1/MWh for RECs.

The SPP region is an unusually low market for power pricing. It is not uncommon in other regions of the country, such as the Western Electricity Coordinating Council (WECC), or ISO-New England, for PPAs to be signed at $70-85/MWh. This low power price makes it difficult to reach favorable project economics (reference section 7).

6. WIND FARM DESIGN & PRELIMINARY TURBINE SELECTION

6.1. Wind Farm Design

6.1.1. Overview of Scope

Pursuant to a separate DOE grant, wind resource data collection began in November 2011 at a single 60 meter measurement mast (designated Mast 0149) located near Fallis, Oklahoma. A sodar unit was also installed at the site which was being used to extrapolate the data collected from the met tower. After monitoring the wind at the met site for approximately 9 months and conducting correlations with long-term data, it was determined that the wind resource in the area near Fallis was not likely to be sufficient for a utility-scale wind project.

AWS Truepower was then commissioned to generate a wind resource map[53] of the counties of Lincoln, Logan and southern Payne utilizing coupled mesoscale and microscale mapping technology and data from the met mast. The purpose of this wind resource map was to determine the most likely areas for the best regional wind resource that might support a project.

The wind resource map was then graphically overlayed on land parcel information obtained from the respective counties so that land ownership in conjunction with wind resource could be analyzed. The areas of land that were associated with the Iowa Tribe were identified to determine if the projected wind speeds at parcels associated with the tribal parcels could potentially support a utility scale wind project. The Iowa Tribe land identified was either owned in fee simple, held in trust, or deeded to the Tribe.

The area with the highest wind resource identified in the wind map corresponded well to the location of the tribal parcels. A new area for a proposed project site was identified using the parcel map, which would maximize the use of tribal parcels while targeting areas with the highest wind speeds. The new area is located approximately 20 miles north-northeast of the met mast in Fallis. The ground elevation at the location where the met mast is installed is notably lower than the project site, and additionally the met mast is located within a draw, which would have lower wind speeds.

The combined wind and land map was then analyzed for specific parcels and landowners. A boundary was drawn for both a 20MW and a 50MW project size, and then these boundaries were studied in further detail for project constraints and feasibility, including environmental, land, wind setbacks, permitting, species, and other areas of concern. A site plan was then developed for proposed wind turbine locations taking into account these constraints.

The site plan for both the 20MW and 50MW case was then used as the basis for turbine estimates, energy production estimates, capital construction and operating budgets, and financial modeling of the wind projects.

In order to finalize the energy estimates, several different turbine model options were modeled to determine which turbine had the most favorable power curve for the particular wind resource. Multiple turbines were evaluated, and the top [3] units were selected for a detailed energy output analysis. Indicative pricing was sought from those turbine suppliers to develop the budget for the project capital

[53] "*Wind Resource of the Iowa Tribe of Oklahoma Wind Project – Mean Annual Wind Speed at 80 Meters*", produced by AWS Truepower, dated 9/20/12 (client confidential, map not provided in this report).

expenditures. This cost information was input into the financial model along with the energy projections to complete the modeling cases.

6.1.2. Wind Resource Mapping

AWS Truepower utilized their SiteWind® system over the proposed project area to develop a wind speed map of the region. The SiteWind system is a proprietary coupled mesoscale-microscale model, which is discussed in more detail later in this section. AWS Truepower utilized a mesoscale grid spacing of 1.2 km and the final deliverable was a 50 m high resolution wind map. Topographic data was obtained from the National Elevation Database (NED), and the land cover data was derived from the USGS 30m and gridded Landsat databases. Pursuant to this work, AWS Truepower delivered a CD ROM to the Iowa Tribe containing the ESRI ArcReader and the map showing the estimated mean wind speed for several heights above ground. The map included thematic overlays such as roads, transmission lines, parks, towns, cities, and other items. This map was used as a coordination tool between the subcontractors working on the study, and constraints data was layered into this file as it became available. This work product was deemed commercially sensitive and is not included herewith.

6.1.3. Project Site Layout Design

A layout for the project was developed based on an iterative process between the various contractors working on the project. AWS Truepower provided a preliminary wind turbine layout based on the wind speed, additional climate conditions, and standard setbacks. Ecology and Environment performed a desk-top constraints analysis as discussed in section 4.2.1, which was then integrated with the wind data. That information was then utilized by Solas Energy Consulting to identify the underlying landowners. Title records were pulled for the potential landowners and analyzed in greater detail. Parcels were located which were associated with the Tribe, and another iteration of the site layout was developed for further study. At this point, the microwave path analysis and FAA studies as discussed in Section 4 were conducted for a high level fatal flaw analysis of the selected parcels. Solas conducted additional land research and consultation with the Tribal attorneys to develop a land acquisition strategy, which is discussed in further detail in Section 6.3 below. Additionally, Atwell Engineering was contracted to do an on-site environmental screening, and geophysical studies were conducted by Renewable Resource Consultants. The results of the geophysical studies are discussed in Section 6.4 below.

Based on the inputs available from all subcontractors at the time of the energy production estimates, minor alterations were made to the preliminary layout to create an updated layout. This updated layout was utilized as the basis for energy estimates, cost estimating, turbine selection, and development of a financial model to determine economic project feasibility. It should be noted that some inputs received after completion of the energy estimates were not considered in the updated layout; these considerations should be made during continued development of the project layout.

6.1.4. Energy Estimates[54]

AWS Truepower was retained by BKJ Solutions Inc. to evaluate the long-term wind resource and energy production potential of the proposed Iowa Tribe of Oklahoma Wind Project, located in north-central Oklahoma, about 50 km to the northeast of Oklahoma City, and 110 km west-southwest of Tulsa. This section presents the results of AWS Truepower's analysis and briefly describes the methods used to develop the wind resource and energy estimates.

Wind Measurements

Wind monitoring at the Iowa Tribe project began in November 2011 with the installation of a single monitoring mast, designated Mast 0149. The mast remains in operation. Table 18 presents basic information about the mast including its geographic coordinates, elevation, period of record, and sensor heights. It should be noted that the proposed project area is located approximately 20-25 km to the northeast of the Mast 0149 location. The Iowa Tribe provided the data to AWS Truepower in their raw binary format via email. Each data file contained 10-minute average wind speed, direction, and temperature records, along with their standard deviations.

Table 18: Mast Summary

Mast	Site UTM Coordinates (WGS84, Zone 14)		Elevation (m)	Period of Record	Monitoring Heights (m)		
	Easting	Northing			Wind Speed	Wind Direction	Temp
0149	669343	3958302	281	4 November 2011 – 3 February 2013	57.4, 47.6, 32	53.5, 43.5	2.7

The observed mean wind speed at Mast 0149 is 4.94 m/s (57.4 m). The annualized mean wind speed, which takes into account repeated months in the data record and weights each calendar month by its number of days, was 4.93 m/s. The observed wind shear exponent, which represents the rate of wind speed increase with height above ground according to the power law, was 0.503. The shear was calculated from the mean wind speeds at the highest and lowest monitoring levels based on concurrent valid records at both heights. Only wind speeds greater than 4 m/s, the range of interest for energy production, were used in the calculation.

The Weibull function is an analytical curve that describes the wind speed frequency distribution, or number of observations in specific wind speed ranges. Its two adjustable parameters allow a reasonably good fit to a wide range of actual distributions. A is a scale parameter related to the mean wind speed while k controls the width of the distribution. Values of k typically range from 1 to 3.5, the higher values indicating a narrower distribution. The observed k value was 2.09 (57.4 m) at Mast 0149, which is indicative of a somewhat variable wind resource with few high wind events. The full report contains a chart showing the observed frequency distribution and the fitted Weibull curve for Iowa Tribe of Oklahoma Wind Project. This information was deemed commercially sensitive and not included

[54] This section taken from "*Energy Production Summary, Calibrated Assessment of the Wind Resource and Energy Production Using the SiteWind System*", by AWS Truepower, dated March 27, 2013

herewith, however can be found in the AWS Truepower report "Energy Production Summary, Calibrated Assessment of the Wind Resource and Energy Production using the SiteWind System" dated March 27, 2013, (the "Energy Production Report").

The directional distribution of the wind resource is an important factor to consider when designing the wind project to minimize the wake interference between turbines. An annual wind frequency and energy distribution by direction plot (wind rose) for the onsite mast is presented in the Energy Production Report. This information was deemed commercially sensitive and is not included herewith.

Estimation of Long-Term Mean Wind Speed

AWS Truepower obtained historical wind speed data from several nearby potential reference stations operated by the National Weather Service (NWS) and assessed them for suitability as long-term references. In addition to these data sources, they also assessed data from the AWS Truepower *windTrends*[55] database.

Linear regression equations were established using concurrent daily mean wind speeds at Iowa Tribe of Oklahoma Wind Project and each potential reference source. Following reviews of the correlations and the time series of reference station annual mean speeds, AWS Truepower selected the Oklahoma City (Will Rogers Airport) surface station to estimate the long-term annual mean speed at Iowa Tribe of Oklahoma Wind Project. Substitution of the annualized mean wind speed at the reference station into the regression equation yields a 57.4-m long-term mean wind speed of 4.83 m/s at Iowa Tribe of Oklahoma Wind Project.

Extrapolation of this long-term mean wind speed using phased reductions to the observed wind shear exponent as a function of height yields a mean wind speed of 5.89 m/s at the 80m hub height. It should be noted that significant uncertainty is present in this extrapolation process in recognition of the characteristics observed at this tower and the substantial elevation difference between mast top and hub height. A summary of the climate adjustments and extrapolation is included in the Energy Production Report.

Estimation of Long-Term Energy Production

The energy production of the proposed Iowa Tribe Wind Project was estimated using the openWind® software. openWind was developed by AWS Truepower as an aid for the design, optimization, and assessment of wind power projects.[56] The primary input is a wind resource grid generated by a numerical wind flow model, in this case the SiteWind® system. Other inputs include elements of the project design such as the turbine locations, hub height, power curve, and thrust coefficients, as well as the mast data. The SiteWind system and openWind software and their applications in this project are briefly described below.

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[55] windTrends a simulated hourly time series created by AWS Truepower using an atmospheric model. It is similar to reanalysis data, but is computed at a finer spatial resolution (20 km) and relies on a fixed set of rawinsonde observational data. The model output can be interpolated to the exact location of a meteorological mast. For this analysis, the model output was interpolated to the location of Iowa Tribe of Oklahoma Wind Project.

[56] openWind – Theoretical Basis and Validation, Version 1.3, AWS Truewind, LLC, April 2010.

The SiteWind System

Numerical wind flow models are used to calculate the wind resource variation across a project area due to changes in terrain and surface roughness. AWS Truepower has developed the SiteWind system to perform these calculations. SiteWind employs both mesoscale and microscale models to simulate the wind climate over a wide range of scales. The mesoscale model assesses regional climate conditions and simulates complex meteorological phenomena such as katabatic (downslope) mountain winds, channeling through mountain passes, lake and sea breezes, low-level jets, and temperature inversions. The microscale model accounts for the localized influences of topography and surface roughness changes and produces a detailed wind resource map and grid. As a final step, the predicted speed and direction are adjusted with on-site data from masts within the project area. This method has been found to be more accurate on the whole than microscale wind flow models alone.[57]

The mesoscale model used for this analysis was the Mesoscale Atmospheric Simulation System (MASS[58]), a non-hydrostatic weather model used in commercial and research applications. MASS was run in a series of nested grids, with the innermost grid having a spatial resolution of 1.2 km. Using regional weather data, MASS simulated historical weather conditions for a representative sample of days. The MASS output was then coupled to WindMap – a mass-conserving model – which was run on a grid scale of 50 m.[59] Finally, the output of WindMap was adjusted to the wind speed and direction distribution at Mast 0149. This last step was performed within openWind, as described below. The resulting wind resource map is shown in the Energy Production Report.

openWind

Once the wind resource model has been run, the resource grid file is imported into openWind to define the wind resource for the project area. The Weibull parameters in the file are converted to directional speed-up ratios relating the wind speed at each grid point to the speed at a reference mast. By associating the model data to a wind speed histogram file for the reference mast, the program is able to adjust the modeled speed distribution to the true speed distribution observed at a point. This method usually produces a more accurate estimate of the energy production than relying on the modeled distributions alone.

A number of reference masts can be used to reduce errors in the predicted spatial variation of the wind resource across the project area. Conventionally, the project area is broken up into sub-regions, each of which is associated with a different mast using the distance-weighted interpolation between masts, as previously described. This avoids discontinuities in wind speeds across the boundaries of areas assigned to different masts and produces a more realistic picture of the spatial variation of the wind resource. Within openWind, the adjusted wind resource grid is divided into sub-regions associated with different

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57 Beaucage, Philippe and Brower, Michael C, Wind Flow Model Performance – Do More Sophisticated Models Produce More Accurate Wind Resource Estimates?, 6 February 2012

58 Developed for NASA, the US Air Force, and commercial and research applications, MASS is similar to and has been verified against other mesoscale weather models such as MM5 and WRF. For further information, see http://www.meso.com/mass.html.

59 WindMap, developed by AWS Truepower, is a mass-conserving model that adjusts an initial wind field, here supplied by MASS, in response to local variations in topography and surface roughness. See, e.g., Michael Brower, "Validation of the WindMap Model," Proceedings of WindPower 1999, American Wind Energy Association, June 1999.

masts to capture variations in the observed speed frequency distribution, although the corresponding impact on energy production estimates is usually relatively small.

AWS Truepower uses the openWind Deep Array Wake Model (DAWM) to calculate wake losses. This model actually contains two separate wake models operating independently. The first is the Eddy Viscosity model, which is based on the thin-shear-layer approximation of the Navier-Stokes equations assuming axisymmetric wakes of Gaussian cross-sectional form, as originally postulated by Ainslie.[60] The model equations ensure that momentum and mass conservation are observed simultaneously. As inputs, the wake model requires the ambient turbulence intensity at hub height, which influences the initial wake deficit behind each turbine and the rate of wake dissipation; the speed and direction frequency distribution, based on a wind resource grid and associated mast files; the locations of the turbines; and the turbine thrust coefficient curves. Validation of the openWind Eddy Viscosity model is described elsewhere.

In response to evidence that conventional wake models like the Eddy Viscosity model underestimate wake losses in deep (multi-row) arrays of wind turbines, especially offshore, AWS Truepower implemented a second model designed to handle such situations. This model is loosely based on a theory developed by Frandsen,[61] who postulated that the effect of a deep array of wind turbines on the atmosphere could be represented as a region of increased surface drag, represented by a surface roughness length. Where the wind first impinges on the array, an internal boundary layer (IBL) is created, within which the wind profile is determined by the array roughness rather than by the ambient roughness. This IBL grows with downwind distance, and once its height exceeds the turbine hub height, the hub-height speed impinging upon turbines farther downwind is progressively reduced. According to the Frandsen theory, the effective array roughness is in the range of 1 m to 3 m, or typical of a forest, for mid-range speeds and typical turbine spacing. AWS Truepower modified the Frandsen model to treat each turbine as an isolated island of roughness, a necessary change to permit rapid modifications to the turbine layout for array optimization. In addition, the IBL created by each turbine is assumed to be centered on the turbine's hub height.

In combining the two models, the DAWM implicitly defines "shallow" and "deep" zones within a turbine array. In the shallow zone, the direct wake effects of individual turbines dominate, and the unmodified Eddy Viscosity (EV) model is used to calculate wake deficits; in the deep zone, the deep-array effect is more prominent, and thus, the roughness model is employed. The DAWM has been validated at several offshore and onshore projects.[62]

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[60] Ainslie, J.F., 1988, Calculating the flowfield in the wake of wind turbines." Journal of Wind Engineering and Industrial Aerodynamics, 27. Pages 213-224.

[61] Sten Tronæs Frandsen, Turbulence and turbulence-generated structural loading in wind turbine clusters, Risø-R-1188(EN), Risø National Laboratory (January 2007).

[62] Brower, Michael C. and Robinson, Nicholas M., "The openWind Deep Array Wake Model – Development and Validation", May 2012.

6.1.5. Results

The energy production was simulated for two different turbine models: the GE 1.6-100 and Siemens SWT-2.3-113. This work was completed prior to the turbine request for proposals detailed below in section 6.2. For each proposed turbine model, AWS Truepower also produced two separate energy production simulations reflecting different plant sizes, referred to as Phases 1 and 2. Results for the GE 1.6-100 turbine model (Phase 1 layout) are presented in the Energy Production Report.

The GE 1.6-100 turbine features a 100-m rotor diameter and a 80-m hub height. The Phase 1 turbine layout, which was developed by AWS Truepower based on information provided by BKJ Solutions and standard assumptions, is shown on the wind resource map in the Energy Production Report. Each turbine in the layout was associated with the wind speed and direction distribution file from Mast 0149.

The average air density was calculated from the wind speed and temperature data from Iowa Tribe of Oklahoma Wind Project and adjusted to the mean elevation of the turbines using a standard atmospheric lapse rate. The result was 1.166 kg/m^3.

Plant losses aside from turbine wake losses were estimated from AWS Truepower's experience with other projects and an analysis of site-specific data.[63] The wake loss was estimated by the openWind program to be 1.7%. Including combined plant losses totaling 13.4%, the total loss is estimated to be 14.9%.

The gross and net annual energy production estimates for the project are 68.7 GWh and 58.4 GWh, respectively. The net capacity factor is predicted to be 37.4%, and the estimated array-average free-stream wind speed at hub height is 6.42 m/s. A summary of the estimated average free-stream wind speed and gross and net energy production for each turbine is presented in the Energy Production Report.

Uncertainty Estimate

The values presented in this section apply to the GE 1.6-100 turbine in the 20MW project layout; it should be noted that small variances in these estimates occur for each of the remaining project scenarios. The uncertainty in the projected long-term hub height wind speed across the project is estimated to be 8.0%. This value incorporates the uncertainties associated with field verification, the onsite measurements, the wind shear extrapolation, the historical climate adjustment, the evaluation period, and the wind flow modeling. The sensitivity of the project output to changes in wind speed was determined to be approximately 14.2% for the given 8.0% uncertainty in mean wind speed. The uncertainties in wind speed frequency distribution and plant losses were combined with the previous total to yield an overall energy production uncertainty of 14.7%, or 8.6 GWh/yr. Table 4 in the Energy Production Report presents the estimated net annual energy production and capacity factor at five confidence levels assuming a 9-year mature operation evaluation period and the same for the first year and for any single year thereafter. The same five confidence level values assuming a 20-year total (19-

[63] Dan Bernadett, et al., 2012 Backcast Study: A Review and Calibration of AWS Truepower's Energy Estimation Methods, AWS Truepower May 2012.

year mature operation) evaluation period are contained in Table 5 of the Energy Production Report. The same values are presented in the Appendix for the three additional energy production scenarios.

Key Findings

Table 19: Energy Assessment Findings

Key Findings	
1	The wind resource in the vicinity of the installed met mast near Fallis is not rigorous enough to support a project.
2	The wind resource in the new proposed project area is a class III, low wind resource. The wind resource is in the outer bounds of feasibility and the economics will be driven largely by the achievable power price for the project.
3	A high degree of uncertainty regarding the wind resource exists at the proposed site and additional on-site information should be obtained to verify the projections in the report.

6.2. Wind Turbine Selection[64]

A request for quotation for wind turbine pricing for the Iowa Tribe of Oklahoma Project was conducted so that indicative pricing could be obtained for the project feasibility. Many different criterion need to be considered for the selection of an appropriate technology, including price, technical characteristics, installed turbine base, service packages, turbine performance, and warranties, among others. More than a dozen wind turbine manufacturers supply utility-scale technology to the US market, although the largest installed base is by approximately 9 manufacturers. All of the major manufacturers were reviewed prior to issuance of the RFP.

As of December 31, 2012, the American Wind Energy Association reported[65] that Oklahoma had a total installed wind energy capacity of 3,134 MW, the sixth highest state for installed capacity in the United States. This capacity consists of approximately 1,718 individual units, representing 9 turbine manufacturers. The listing of the manufacturers, the total installed capacity by megawatts (MW), and the quantity of units per manufacturer is as follows:

Table 20: Installed Capacity in Oklahoma by Manufacturer

Turbine Manufacturer	Total Installed (MW)[66]	Total Number of Units
GE	1252.4	802
Siemens	639.4	278
Vestas	321.9	187
Mitsubishi	278.4	116

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[64] This section is primarily drawn from "Indicative RFQ Results for Wind Energy Turbines" dated May 21, 2013 by Solas Energy Consulting US Inc.
[65] AWEA U.S. Wind Industry Fourth Quarter 2012 Market Report, AWEA Data Services; January 30, 2013
[66] The research conducted was not able to identify the manufacturer of approximately 4 MW of turbines installed.

REpower	149.7	73
Gamesa	132.0	66
Acciona	123.0	82
DeWind	120.0	60
Suzlon	113.4	54
Totals	**3130.15**	**1718**

The existing installed capacity base is important for the reason that the proximity of existing wind farms increases the likelihood of availability of spare parts and qualified service technicians in the event of outages during the operation of the wind farm. In general, smaller wind farms tend to have higher costs on a $/MWh basis than larger wind farms, because fixed costs must be amortized over a lower production rate. The availability of the smaller wind farms (hours per year when the turbines are available to generate electricity) tends to also be lower because fewer spare-parts are kept on-site and turbine manufacturers are reluctant to provide rigorous guarantees on smaller wind farms. Parts sourcing and supply chain is an important consideration, especially as wind farms age, so that wind farm availability, and therefore production, are maximized. If a large number of turbines are in close proximity with the same technology, the likelihood is higher that spares would be available regionally in a shorter amount of time, contributing to a higher overall plant availability.

6.2.1. Purpose

The purpose of this Turbine RFQ was to gather information for a financial model and to survey the market to determine current market conditions and pricing. Each turbine has a specific production profile for the wind resource and different operational and initial costs. The most relevant metric for making a decision on the turbine is the lowest $/MWh cost over the lifetime of the project. AWS Truepower provided energy calculations for the GE and Siemens turbines (Siemens did not respond to the RFQ) and so a $/MWh lifecycle cost was factored into the financial model.

During the RFQ process, feedback was received that turbine manufacturers tend to be less interested in small scale, one-time projects with a customer who does not have plans to develop additional projects. Project efficiencies are generally gained starting with the sale of a quantity of 20 turbines. Smaller quantities of turbines result in a loss of efficiency in manufacturing and transportation and therefore the pricing may be higher or it may be difficult to get a manufacturer to respond or negotiate commercial terms. Negotiating power can be achieved by purchasing large quantities of turbines over several years, which puts the Tribe at a disadvantage relative to some of the large independent power producer customers or utility customers of the turbine suppliers. For purposes of this project, it is realistic to expect that the Tribe will not have much leeway to negotiate special provisions or pricing considerations from turbine manufacturers. That being said, turbine manufactures vary in their willingness to negotiate and market dynamics change quickly.

These negotiated terms and conditions during the initial turbine supply agreement and the long-term service agreement are just as important as understanding the technical advantages of the various turbine models, and so a discussion of some of those commercial terms is included below.

Consolidation of turbine manufactures in the US market has been put under increasing pressure due to public policy uncertainty and marked swings in demand. This has caused reductions in wind turbine prices, but also in turbine manufacturer's profitability and some turbine manufactures have exited the market as a result. Reviewing long-term debt and profitability for a turbine manufacture to ensure sustainability is recommended before making a final procurement decision.

6.2.2. Request for Quotation and Selection of Vendors

The list of turbines installed in Oklahoma was analyzed and six of the nine listed manufacturers, as well as two new market entrants, Nordex and Goldwind, were sent an initial expression of interest and request for a non-disclosure agreement. Of the eight manufacturers contacted, non-disclosure agreements were successfully executed with six companies. After execution of a non-disclosure with the six participants, a Request for Quotation (RFQ) was issued to the respondents on March 12, 2013 requesting indicative pricing for the Iowa Tribe of Oklahoma Wind Power Project. Pricing was requested by March 22, 2013. A general project description was given, including topography, temperature, wind characteristics and expected changes in the wind monitoring program.

Base variations requested to propose in the RFQ included: 1) Two wind farm sizes at both 20 MW (megawatts) and 50 MW 2) COD (commercial operation date) – Q4 2015 and Q4 2016 and 3) hub height – 80 meters and 100 meters.

Options requested in the RFQ included turbine erection/installation, cold weather package, pre-commissioning, SCADA and grid integration options. Per the RFQ instructions, indicative pricing for base or extended warranties, warranty options, and long-term service agreements were to be included. Transport to Perkins, Oklahoma and commissioning were requested as part of the base price as well as standard warranties including power curve, sound power, availability and serial defect provisions.

Commercial information requested in the RFQ included a base price plus options for a class IIIA turbine model, transport costs and duration, payment schedule, warranties and long-term service. Technical information requested in the RFQ included turbine characteristics (e.g. power curve) electrical characteristics, applicable type certificates and installed/operational experience.

Proposals were received from five (5) companies: Goldwind, Nordex, REpower, Suzlon and GE. A quotation was not received from Vestas. Nordex and GE provided pricing for 20-MW and 50-MW scenarios, whereas REpower and Suzlon provided pricing only for the 50-MW scenario. Goldwind provided pricing for only the 20-MW scenario.

Delivery year and length of validity for budgetary turbine proposals is not necessarily important at this stage, because prices for commodity goods used in manufacturing wind turbines frequently change. Ideally, turbine supply negotiations should be completed within three months of an RFQ to secure a firm price. The purpose of this solicitation was to collect information for a capital cost estimate for the project and so escalation estimates to account for alternative time-lines will be provided in the final feasibility study report.

The turbine manufacturers recommended the models that would be best suited for the site based on the wind data provided. The models that were proposed by the turbine manufacturers included the following:

Table 21: Wind Turbine Models Proposed

Manufacturer and Model	Quantity	Size (MW)	Rotor Diameter (m)	Hub Height (m)
GE 1.7 – 100	12 or 29	1.7	100	80
GE 2.5 – 120	8 or 20	2.5	120	110
Goldwind GW 87-1.5	13	1.5	87	85
Nordex N117/2400	8	2.4	117	91
REpower MM100	28	1.8	100	80
Suzlon S111-2.1MW	24	2.1	111	90

6.2.3. Summary of Results

Each of these turbines were analyzed for the energy production specific to that turbine, and the cost per kWh for production of those units was examined. The lowest overall cost on a $/kWh basis (ranked lowest to highest) is as follows:

Table 22: Turbine Models Ranked by $/kWh[67]

Ranked Listing of Turbines		Comments
1	Suzlon S111 – 2.1MW	The cost on a $/kWh basis was slight between the first and second choices, and due to the relatively small number of Suzlon units installed in Oklahoma, it was decided to utilize the GE 1.7 in the economic analysis.
2	GE 1.7-100 (quantity 29)	GE pricing had differences between quantities. This turbine would be the first choice only for the 50 MW project size.

[67] The turbine pricing and energy estimates upon which this analysis is based is strictly confidential between the Iowa Tribe and the turbine manufactures. The full detail can be found in the Solas Energy Consulting Turbine RFP report.

3	GE 2.5-120 (quantity 29)	The 2.5MW machine may be a good choice in a year or two as pricing changes. The site capacity factor with the 2.5MW was the highest of the group.
4	REpower MM100	This analysis was based on an 80 m hub height. The economics would be improved with a higher tower.
5	Nordex N117/2400	The combination of pricing and energy production dropped this machine to mid-pack.
6	GE 1.7 – 100 (quantity 12)	The pricing for smaller quantities makes this uneconomic.
7	GE 2.5 – 120 (quantity 12)	The pricing for smaller quantities makes this uneconomic.
8	Goldwind GW 87-1.5	This analysis was based on an 85 m hub height and 87 meter rotor, the smallest of the group. The economics would be improved with a higher tower and/or larger rotor.

6.2.4. Detailed Analysis

As noted in Section 6.1.4 above on wind resource assessment, the current measured wind data may not be best representative of the proposed site. The initial siting of the met tower is a far distance from the proposed project area. The expected mean wind speed at the proposed site, utilizing the SiteWind system modeling based wind map provided by AWS Truepower, is between 6.25 to 6.50 m/s at an 80-m hub height. Using this estimated wind speed, turbine vendors were requested to propose a turbine class IEC IIIA technology.

According to the International Electrotechnical Commission (IEC) 61400-1 standards, wind classes are designed around conditions measured at a project site – wind speed, turbulence intensity and extreme 50-year, 3-second wind gust. Measured turbulence intensity with an A rating indicates the wind turbine is able to operate at higher turbulence conditions and the B rating indicates the wind turbine is designed to operate at lower turbulence conditions. Wind speeds lower than 7.5 meters per second (m/s) is considered to be a class III turbine and should experience a 50-year gust less than 52.5 meters per second.

Table 23: Standard Wind Classifications for Turbine Types

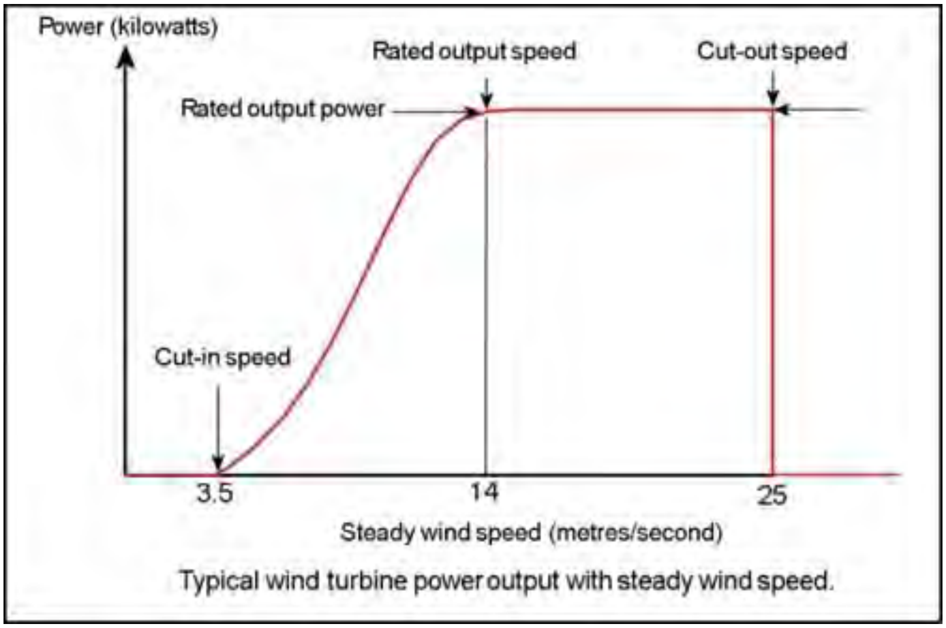
Wind Class	Wind Speed		Turbulence Intensity			Extreme 50-Year Wind	Wind Speed

						(3 second gust)	
I	10 m/s		A	18%		I	70 m/s
II	8.5 m/s					II	59.5 m/s
III	7.5 m/s		B	16%		III	52.5 m/s
IV	5 m/s					IV	42.0 m/s

6.2.3.1 Energy Production for the Turbines

Wind turbines convert the mechanical energy of the wind into electrical energy through the use of a generator and other equipment housed within the turbine. Each wind turbine has a specific production profile that works best in a particular wind profile. The measurement of a wind turbine's ability to produce power over a specific wind regime is the turbine's power curve, and as such, each of the 5 wind turbines being evaluated has a unique power curve. A power curve is the graph of the power output of a wind turbine at a particular wind speed. Typical wind turbines begin generating at about 3.5 m/s and cut out at around 25 m/s. Figure 9 shows a generic power curve for a wind turbine.

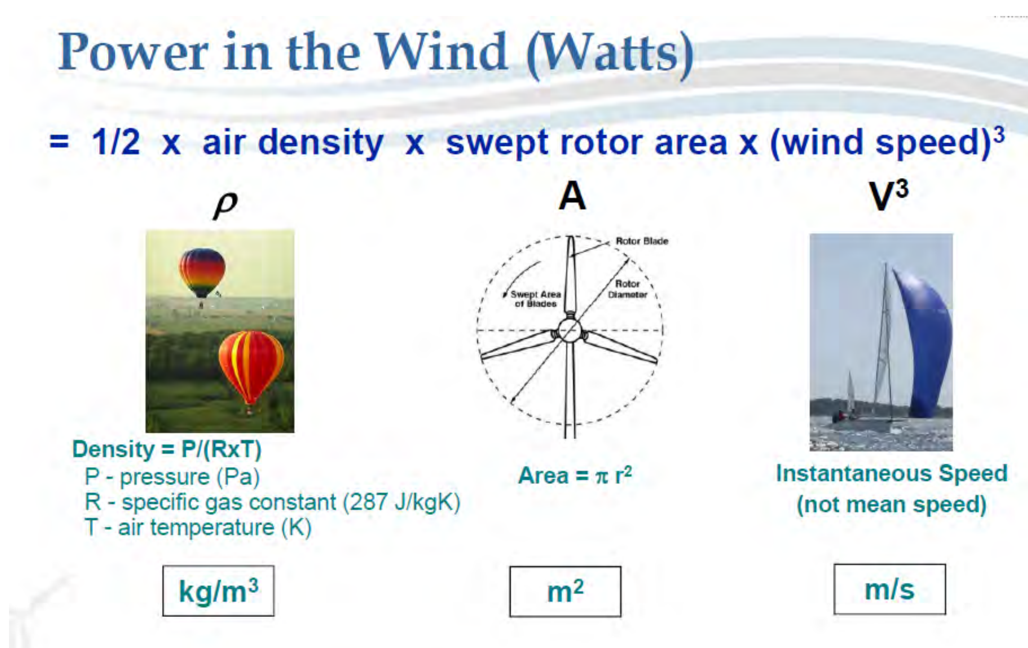
Figure 9: Typical Wind Turbine Power Curve



[68]

Energy production and ultimately the power curve varies due to the turbine rotor diameter and project site characteristics, namely wind speed and air density. As seen in the figure below, the power from the turbine is a function of the cube of the wind speed. The energy captured by a wind turbine is related to the swept area of the rotor, and so larger diameter rotors capture greater amounts of energy.

Figure 10: Power in the Wind[69]

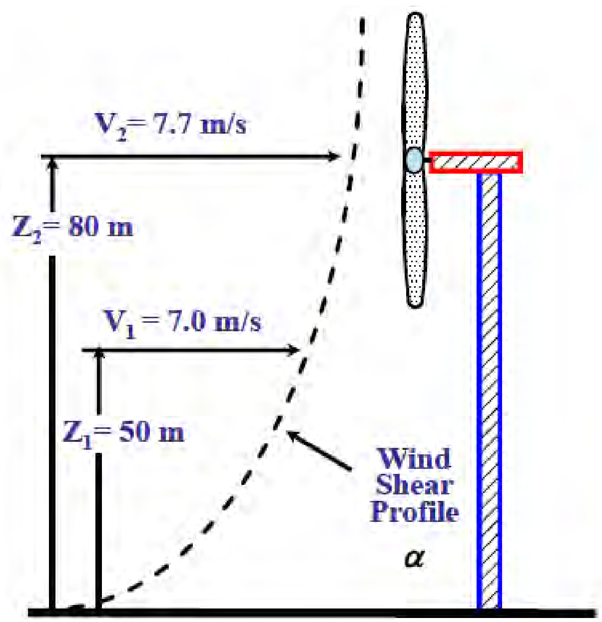


[68] Graphic courtesy of http://www.wind-power-program.com/turbine_characteristics.htm accessed 5/21/2013
[69] Graphics from White Eric, "Essentials for a Successful Wind Project." AWS Truewind September 2009.

In a low wind resource, such as the wind resource for the Iowa Tribe Project, larger rotor diameters are used to capture more of the wind's energy. Generally, rotor diameters for IEC class III turbines (lower resource) will be larger than IEC class I and II rotor diameters - capturing more kinetic energy from the slower wind. Generally, a higher ratio of rotor diameter to rated power will also produce higher energy production at lower wind speed sites.

Another phenomenon related to wind speed is the increase of wind speed with an increase in height above the ground; this is known as wind shear (see figure for example). It is common practice when designing a wind project to evaluate whether an increase in the hub height of a turbine (ie. higher tower), to take advantage of the wind shear effect, will produce a more economical project than a shorter turbine, which would be subjected to lower wind speeds. A higher hub height requires more steel, resulting in a higher turbine cost; however, this higher cost may be off-set by the increase in production due to the wind shear effect, and so this is the reason why two different tower heights were evaluated. The additional cost of the higher hub height must be weighed against the additional revenue from power generation to determine if the cost outweighs the benefits. Ideally, this calculation is done using an internal rate of return (IRR) model to capture performance over the life of the project.

Figure 11: Example of Wind Shear[69]



More recent turbines installed in the United States typically have an 80-m hub height, but 100-m hub heights are becoming more common, and quotations were received for hub heights up to 120 meters. Although the Federal Aviation Administration (FAA) has not set a specific limit on the height of a turbine, a limit of 500 feet (152.4 meters) has been used as a benchmark for structure height (hub height plus half the rotor diameter). This is based on the current definition of navigable airspace[70,71]. The FAA

70 http://www.faa.gov/air_traffic/publications/atpubs/AIR/air0603.html

71 http://www.masscec.com/index.cfm/pk/download/pid/11163/id/11645

considers navigable airspace to be the flight accent and decent paths, as well as all airspace that is more than 500 ft above ground level (AGL). In general, a greater chance of a turbine being classified as an aviation hazard exists if the overall structure height exceeds 500 ft, due to a Visible Flight Rule (VFR) routes. A VFR route are typically land features or rivers that can be used by pilots to navigate. The Cimarron River may be ruled a VFR. While this does not necessarily preclude turbines from being installed above 500 ft, it may make the project more sensitive to FAA regulations or more costly to permit. VFR routes are most commonly along easily distinguishable land features or water ways. It is likely that the Cimarron River would be considered a primary VFR route, which could have an impact on the ability of the Iowa Nation project to utilize taller towers and/or much larger rotor diameters.

Energy production estimates can be calculated using a number of software programs. Characteristics of the wind (e.g. speed, intensity, duration) recorded at the site are matched up with the turbine power curve to calculate estimated annual energy production. AWS Truepower performed this analysis for the turbines proposed under the RFQ.

A common term used to compare turbine performance at a particular project site is capacity factor. The capacity factor (CF) is defined as the percentage of power produced by the plant in relation to the potential power of the generation facility (installed capacity). Given the low wind speeds at the Iowa Tribe site, the capacity factor for the turbines was expected to be in the mid to low 30% range. Accurate wind measurement is the number one factor in determining accurate wind energy production forecasts, and it should be noted that no actual on-site data for the proposed project area was available, as the installed met mast is located more than 20 km from site, and so the uncertainty in AWS Truepower's projections is high. Installation of a met mast within the project boundary can increase the confidence in the estimations.

6.2.3.2 Technical Characteristics

The wind turbine selected for the project needs to be technically compliant with the project requirements. Electrical characteristics are not identical for all turbine manufacturers and models. Although all the electrical requirements for this project are not yet known from the utility/transmission provider, general electrical requirements for all projects include fault ride through (zero voltage ride through) and extended frequency ranges. These features keep the turbine on-line during a minor system or utility fault or frequency variation. Each utility has specific grid requirements and those requirements can change; thus, the actual electrical characteristics of the units need to be considered and evaluated by the utility pursuant to a facilities study and interconnection agreement. The evaluation of the electrical compatibility of the turbines to the grid is outside of the scope of this evaluation. Once the system impact study (SIS) has been completed, electrical characteristics required by the Federal Energy Regulatory Commission (FERC) should be clearer.

An international standard exists which applies to the design and certification of wind turbines. This standard, International Electrotechnical Commission (IEC) 61400-1, specifies the design life, loads, and requirements for wind turbines and their components. Multiple different organizations conduct the testing of the wind turbines to this standard, and issue a certification of the type of turbine to the particular wind class as specified by the IEC. Some of the organizations that provide design and manufacturing certifications include: Germanischer Lloyd (GL), Bureau Veritas, TÜV Nord, and DNV KEMA. Technical certifications are important because debt and equity lenders require this information in order to loan money to the project. This certification is specific with respect to origin/design of components. During the development process, the wind turbine manufacturer will review the site specific loads on the turbine estimate by the climatologic data collected, and provide a mechanical loads review or suitability review to ensure that those loads are within the design envelope of the wind turbine certification.

Another consideration in addition to the certifications of the turbine is the turbine Supervisory Control And Data Acquisition system (SCADA). The SCADA system provides the monitoring of the performance of the wind turbines and the information needed to operate and maintain the turbines. The SCADA system allows the Owner to remotely reset turbines for a majority of the types of turbine faults that are encountered during standard operations, as well as provides valuable information about the output and performance of the units. Choosing the right SCADA system should be carefully considered because it will impact your interface with the turbine manufacture during the warranty period (and/or long-term service), the asset management procedures followed and your interface with the utility. An evaluation should be made for various factors including the structure of 24/7 monitoring of the operations of the turbines, data backup and hardware/software design. For a stand-alone wind farm such as is proposed for the Iowa Tribe of Oklahoma Wind Project, the hardware/software design should not be overly complex, as it may be for an Independent Power Producer (IPP) that has a number of wind farms that are monitored as an aggregate.

6.2.3.3 Contractual Agreements

Aside from technical characteristics of the wind turbine that is used to calculate revenue, a number of other factors should be taken into consideration when selecting a turbine manufacture. Contractual agreements during the construction/erection period and long-term agreements during the operational life of the wind farm directly impact the revenue and profitability of the wind farm.

Typically, turbine manufacturers include a two year Performance Warranty in the base price of the turbine, as long as the Purchaser contracts the manufacture as the Service provider. The Performance Warranty includes provisions for i) Power Curve Guarantee (how much energy will be generated); ii) Sound Power (how noisy the turbine is); and iii) Availability (how many hours per year the turbine is available to run, excluding any planned maintenance or other external factors such as a grid shut-down). Provisions for the Power Curve and Sound Power Guarantees are typically found in the Turbine Supply Agreement (TSA) and the Availability Guarantee is typically found in the long-term Service Agreement. This is noteworthy because the objective of the wind project is to generate the maximum amount of electricity possible over the life of the facility and the power and availability are the key factors to maximizing production. Wind power projects have a larger up-front capital cost and reduced operating costs, primarily because the cost of the fuel (the wind) is free. Therefore, once the equipment is installed, you want to get the maximum value out of it – the most mega-watt hours (MWh) generated over the life of the equipment possible. The majority of the operating costs are focused on this aspect, with many projects electing to pay a slightly less reduced operations fee to have quality parts and technicians, improving the overall productivity of the turbines (availability).

Because the Iowa Tribe does not own and operate other wind power facilities, is it is recommended that the Tribe consider purchasing an extended equipment warranty from the manufacturer which will most likely be bundled with a long-term Service Agreement. One advantage of this Service/Warranty bundle is that the turbine manufacture should include an Availability Guarantee for the duration of the long-term Service Agreement rather than just the initial two-year Warranty. The Availability Guarantee is designed to motivate the wind farm technicians (turbine manufacture in this case) to operate the wind farm at the highest possible energy production (i.e. revenue!). Exclusions to the Availability Guarantee will include periods when the wind turbines are not "available" such scheduled maintenance, utility/grid outages, Owner requested shut-downs and force majeure. If the wind turbine experiences down time at fault of the Service provider, this will count against the availability calculation. If the Availability Guarantee is not met, the Service provider will be required to pay the wind farm owner liquidated damages (LDs) for energy production losses. If the operating hours are above the Availability Guarantee, there may be a provision for the Service provider to receive a bonus payment. These types of provisions are common with service agreements and are expected by project lenders and equity participants.

With respect to the Power Curve and Sound Power Guarantees, it is important to understand both what the guarantee is and what the manufacture's liability is if the guarantee is not filled. Sound restrictions are generally imposed by the county and zoning provisions. No sound restrictions were identified in the location proposed for the Iowa Tribe's project based on conversations with local permitting authorities; so, Sound Power may not be a critical guarantee to negotiate with manufacturers. However, due to the close proximity of many residents and the Tribe's own facilities, the Tribe should definitely consider the sound power of the respective manufacturers in the context of being a good neighbor in the community. The guaranteed limit by manufacturers is expressed as a decibel A-weighted (dBA) level. Some manufactures express the guarantee as a percent (i.e. 95%), so this should also be noted. The Power Curve Guarantee is critical because losses over a 20-year period can reach millions of dollars for a project of this size if a project is required to implement a noise reduction strategy.

The calculation for LDs for not meeting the power curve guarantee may be for one or more turbines and one or more years. If the calculation for losses is generous, it may multiply production losses by all turbines in the wind farm and twenty years, which is the typical design life of a turbine. However, the limit of liability for the Power Curve Guarantee will most likely be reached before the result of that calculation. The power curve guarantee generally requires the completion of a power performance test, including installation of permanent meteorological towers, which is typically completed at the cost of the developer. Preparing a wind farm for a power performance test should take place during turbine negotiations, because one or more turbines should be selected for the measurement prior to completion of the final wind farm layout.

In addition to limits of liability associated with the Performance Warranty, limits of liability are given for performance of supply, delivery and commissioning in the TSA. If the Purchaser experiences delay due to the fault of the manufacture, the project schedule will suffer and financial damages will incur. LDs are meant to cover these financial losses, but they may not cover all losses associated with delay. LDs are typically assessed on a per-turbine per-day rate for delivery, turbine completion and commissioning (or any other performance-related activities associated with the turbine manufacture). The LDs will have a maximum upper allowable limit of liability in the contract because the turbine manufacture also needs to protect their losses in the event of a delay. In addition to limits of liability for LDs and the Performance Warranty, an Overall Limit of Liability is assessed for the TSA, which covers all other contractual liabilities. This is typically set at 100% of the contract price, but can vary depending on the manufacturer.

6.2.3.4 Project Execution and Experience

Project management during the construction phase of the wind project is critical to bringing the wind farm online, within budget. Once the TSA has been signed, the turbine manufacturer will assign a project manager responsible to communicate delivery of components, status of turbine completion after erection and commissioning. If any delays occur during this process, the entire project schedule will suffer, impacting third party contractors performing civil works at the site.

6.2.3.5 Long Term Operations

As mentioned above, procuring turbines for a wind energy project has significant up-front capital costs. Although the long-term operating costs are lower due to the free cost of the fuel, the long-term operating performance is also crucial for a project's profitability. The lowest price turbine model is not always the logical choice for turbine procurement, because the project is designed to operate a minimum of 20 years, not just one year. The Service team will need a minimum of two service technicians regardless of the number of turbines at the site. A general rule of thumb is two service technicians for twenty turbines, but a third technician is most likely required for rotation. If the wind farm comprises ten turbines, Service costs may be higher on a per-turbine basis so working with a turbine manufacture or independent contractor with other projects nearby can help manage costs.

6.3. Land Strategy and Development Work[72]

6.3.1. Description of Project Area

The 50 MW project area boundary covers approximately 7,860 acres and is comprised of parcels owned by the Iowa Tribe, the State of Oklahoma, and private owners. The 20 MW project area lies within the 50 MW boundary and is approximately 2,875 acres. Both project boundaries are considered to be conceptual and subject to modification based on landowner participation.

Tribal parcels are not contiguous, necessitating the acquisition of private and possibly State parcels to enable the project footprints.

[72] This section provided by Solas Energy Consulting US Inc.

The 50 MW boundary will be the focus of the land strategy effort since the 20 MW project area can be carved out of the larger effort once contiguous landowner participation is better understood. Of the approximate 7,860 acres approximately 1,328 acres (17%) of the land is tribal trust, restricted or fee land; approximately 6,492 acres (83%) is private, and roughly 40 acres (0.01%) is owned by the State of Oklahoma.

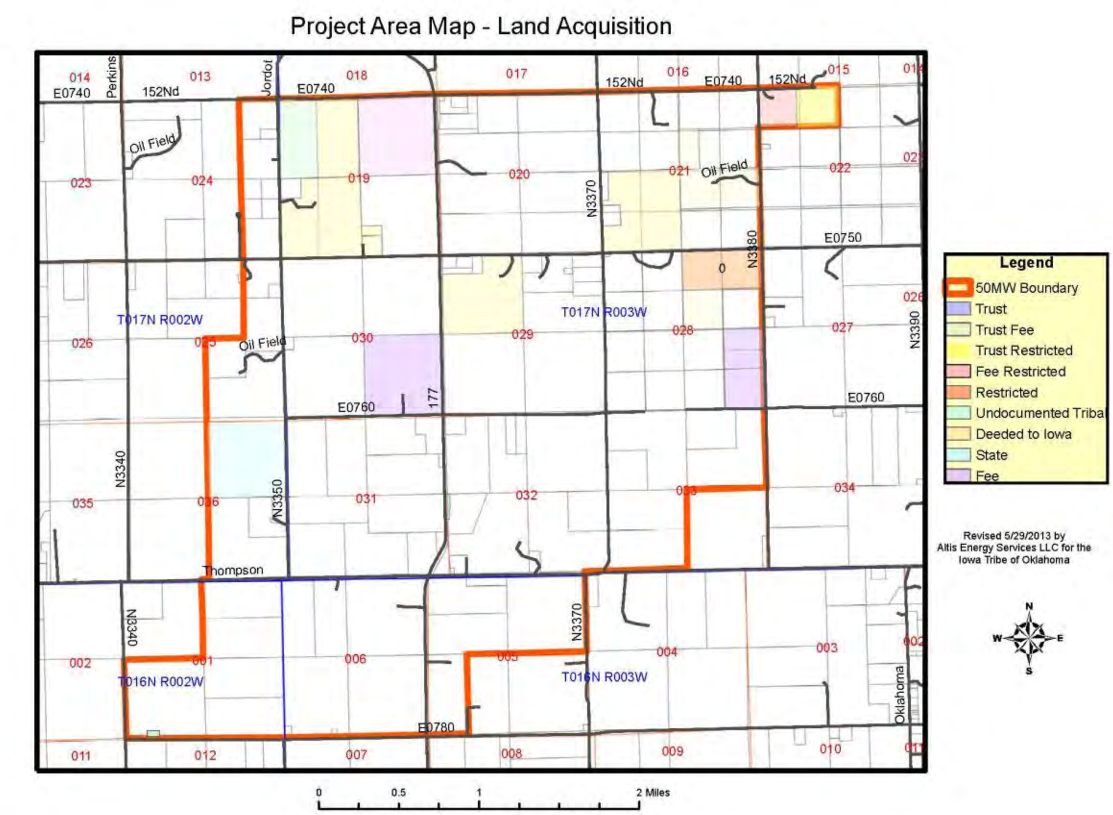


Figure 12: Land Map of Proposed Project Area

6.3.2. Leasing Processes for Various Land Types (Tribal, Private and State)

Tribal Land (Under Bureau of Indian Affairs (BIA) jurisdiction)

The following section is based on a legal memo[73] prepared by Doerner, Saunders, Daniel & Anderson, L.L.P for this feasibility study summarizing the land acquisition procedure for land under BIA jurisdiction.

Several different types of Iowa tribal parcels exist within the project area including trust property, restricted Indian land, and land that the Iowa Tribe owns in fee. The trust and restricted property lies under the jurisdiction of the Bureau of Indian Affairs (BIA), which is part of the U.S. Department of

[73] Christensen, Matthew L. "Procedure for Acquiring Lease on Real Estate Subject to the Bureau of Indian Affairs Jurisdiction" Doerner, Saunders, Daniel & Anderson, L.L.P, May 21, 2013.

Interior (DOI). Land owned by the Iowa Tribe in fee is treated the same as a private parcel owned in fee and is discussed in the subsequent section.

On January 4, 2013 the BIA revised its non-agricultural surface leasing of Indian land, adding new regulations to address wind energy evaluation leases and wind and solar development leases on Indian land (25 CFR Part 162).

Fractional Ownership

BIA regulations (25 CFR 162.001) require a potential lessee to negotiate directly with the individual landowners, and individual landowners must ultimately consent to the terms of a proposed lease. If a tract has fractionated ownership, then only a proportion of the owners are required to consent. The percentages requirements are as follows per (25 CFR 162.012):

Table 24: Fractionated Ownership Requirements

Number of owners of undivided interest (restricted or trust status)	Required percentage of undivided trust or restricted interest that must consent
1-5	90%
6-10	80%
11-19	60%
20 or more	50%

Leasing Procedure

The BIA offers two site control instruments in Indian land having Trust or Restricted status, a Wind Energy Evaluation Lease (WEEL), and a Wind and Solar Resource Lease (WSR). WEELs are "short-term leases that authorize possession of Indian land for the purpose of installing, operating, and maintaining instrumentation, and associated infrastructure, such as meteorological towers, to evaluate wind resources for electricity generation." *See* 25 CFR § 162.501(a)(1). WSRs "are leases that authorize possession of Indian land for the purpose of installing, operating and maintaining instrumentation, facilities, and associated infrastructure, such as wind turbines . . . to harness wind . . . energy to generate and supply electricity for resale on a for profit or non-profit basis, to a utility grid serving the public generally, or to users within a local community." *See* 25 CFR § 162.001(a)(2).

WEELs

WEELs are for a three year period with the option to extend an additional three years. The WEEL must address how much compensation will be paid, the date on which such compensation is due, that the WEEL may be canceled upon failure to make timely payments. *See* 25 CFR § 162.523. No valuation is required by a WEEL. *See* 25 CFR § 162.524.

WEEL Lease Provisions:

1. The obligations of the lessee and its sureties to the Indian landowners are also enforceable by the United States, so long as the land remains in trust or restricted status;

2. There must be no unlawful conduct, creation of nuisance, illegal activity, or negligent use or waste of the leased premises;
3. The lessee must comply with all applicable laws, ordinances, rules, regulations and other legal requirements under 25 CFR § 162.014.
4. If historic properties, archeological resources, human remains, or other cultural items, not previously reported are encountered during the course of any activity associated with this lease, all activity in the immediate vicinity of the properties, resources, remains, or items will cease, and the lessee will contact the BIA and the tribe with jurisdiction to determine how to proceed and appropriate disposition.
5. BIA has the right, at any reasonable time during the term of the lease, and upon reasonable notice, in accordance with 25 CFR § 162.589, to enter the leased premises for inspection; and
6. BIA may, at its discretion, treat as a lease violation any failure by the lessee to cooperate with a BIA request to make appropriate records, reports, or information available for BIA inspection and duplication.

Unless otherwise prohibited by law, the lease must also contain the following provisions:

1. The lessee holds the United States and the Indian landowners harmless from any loss, liability, or damages resulting from the lessee's use or occupation of the leased premises.
2. The lessee indemnifies the United States and the Indian landowners against all liabilities or cost relating to the use, handling, treatment, removal, storage, transportation, or disposal of hazardous materials, or the release or discharge of any hazardous material from the leased premises that occurs during the lease term, regardless of fault, with the exception that the lessee is not required to indemnify the Indian landowners for liability or cost arising from the Indian Landowners' negligence or willful misconduct.

WSRs

WSRs require a valuation, proof of insurance, performance bond or other security, statement of conformance with tribal law and Federal and tribal environmental and land use requirements. A resource development plan describing improvements and a schedule are also required along with a restoration plan, documentation of technical ability, legal land description, and organizational documentation of the legal entity of the lessee.

WSR Lease Provisions

A WSR must set a definite lease term. The maximum term of a WSR is twenty-five years (25) with an option to renew the lease for an additional twenty five (25) year term. *See* 25 CFR § 162.540. The required provisions of a WSR Lease are mandated in 25 CFR § 162.542 and are substantially similar to the required provisions discussed above regarding WEEL Provisions.

1. A WSR must address the (i) the nature of permanent improvements 25 CFR § 162.544 and (ii) removal requirements of permanent improvements 25 CFR § 162.545.
2. A WSR must require the lessee to comply with the following "due diligence requirements":
    a) Commence installation of energy facilities within 2 years after the effective date of the lease or consistent with a timeframe in the resource development plan;

b) If installation does not occur, or is not expected to be completed, within the required time period, provide the Indian landowners and BIA with an explanation of good cause as to the nature of any delay, the anticipated date of installation of facilities, and evidence of progress toward commencement of installation;

c) Maintain all on-site electrical generation equipment and facilities and related infrastructure in accordance with the design standards in the resource development plan; and

d) Repair, place into service, or remove from the site within a time period specified in the lease any idle, improperly functioning, or abandoned equipment or facilities that have been inoperative for a continuous period specified in the lease (unless the equipment or facilities were idle as a result of planned suspension of operations, for example, for grid operations or during bird migration season).

3. The WSR must address the performance bonding requirements and provide under what condition the BIA may adjust the requirements to reflect changing conditions. 25 CFR §§ 162.559©.

WSR Compensation

25 CFR §§ 162.549-162.558 address compensation issues related to WSR Leases.

1) The BIA will defer to a tribes determination of compensation for a WSR Lease of tribal land, if the tribe provides a tribal authorization stating that the tribe has negotiated compensation satisfactory to the tribe, the tribe waives valuation, and the tribe has determined that the compensation provided for is in the tribe's best interests. 25 CFR §§ 162.549(a).
2) A WSR Lease of individually owned Indian land must be for "fair market value." 25 CFR §§ 162.550(a). The compensation must be based on (i) a fixed amount, (ii) a percentage of the projected gross income, (iii) megawatt capacity fee, or (iv) some other method. Upon waiver of an individual Indian landowner, amounts less than fair market value are permissible in certain circumstances. *See* 25 CFR §§ 162.550(b) and (c).
3) If required, in the case of individually owned land or upon the request of the tribe, fair market value shall be determined by market analysis, appraisal, or other appropriate valuation method, which the BIA will either have prepared or, if approved, an existing valuation using one of the referenced methodologies. 25 CFR §§ 162.551. A WSR may also provide for non-monetary compensation. *See* 25 CFR §§ 162.555.
4) As long as a WSR provides for automatic adjustments to the compensation (ie. escalators), no periodic reviews or adjustments by the BIA of the compensation due under a WSR are necessary. 25 CFR §§ 162.557. Otherwise, the BIA may be required to review the adequacy of the compensation every five years of the lease term. 25 CFR §§ 162.555(c).

WSR Security

A WSR must provide a performance bond or an alternative form of security, unless the WSR is for a public purpose or the individual landowners waive the requirement. 25 CFR §§ 162.559. The amount of the bond must be sufficient to secure the following contractual obligations: the highest annual rental specified or another amount determined by the BIA; installation of the improvements; operation and maintenance charges for land within an irrigation project; and cost of the reclamation and restoration of the leased premises. 25 CFR §§ 162.559(a)

> The following forms of security are acceptable: (i) certificates of deposit; (ii) irrevocable letters of credit; (iii) negotiable treasury securities; (iv) surety bonds. 25 CFR §§ 162.560.

Parcels Owned in Fee by Private and Tribal Entities

Parcels owned in fee are private parcels owned by individuals or entities and are not subject to BIA or State of Oklahoma jurisdiction. This includes parcels owned by the Iowa Tribe that are not held in Trust or Restricted status. This is the most straightforward of the three discussed leasing process. It involves the project company offering a lease contract directly to the landowner and entering into bilateral negotiations between the two parties in an effort to come to terms on a contractual agreement in the form of a lease.

Lease terms typically vary from lease to lease depending on the outcomes of the lease negotiations. The form of lease for the fee parcels are discussed in further detail in the "Lease Forms" section below. They include up to a seven year development term, and a thirty year operations term. The initial term would be based on a dollar per acre rate, and the operations term would be rate based on a percentage of the gross revenue generated by the project with a floor minimum payment based on a dollar per Megawatt rate.

Provisions also addressed in the form include taxes, owner and lessee's representation, warranties and covenants, assignment, Subleasing and cure, access and transmission easements, mortgagee protection; default and termination, as well as miscellaneous provisions like *force majeure* and confidentiality.

Iowa tribal parcels owned in fee are considered to be the easiest tribal parcels to lease from a process standpoint given the lack of BIA jurisdiction, which enables a more streamlined decision making process between the landowner and the project proponent.

Parcels owned by the State of Oklahoma

Land owned by the Oklahoma Commissioners' of Land Office, also known as the School Land Commission (SLC) lies within the 50MW project area. The parcel of interest is approximately 160 acres and is currently leased for grazing and timber.

A Doerner, Saunders, Daniel & Anderson, L.L.P memo[74] provides a description of the lease form and procedure. The lease process as described in the Memo is outlined below.

> The SLC lease form contemplates two phases. Phase I is a three year term for inspection and determination for feasibility for wind energy purposes intended for research and analysis. It may be extended an additional two years due to unforeseen delays. Phase II is intended to last 25 years. The maximum term of any lease is 55 years, but the SLC's preferred term for wind is between 25 and 30 years.
>
> The terms of each lease must be approved by the SLC, which includes five positions within the Oklahoma Government: the Governor, Lieutenant Governor, State Auditor and Inspector, Superintendent of Public Instruction, and the President of the Board of Agriculture. The Governor executed the final lease.

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[74] Christensen, Matthew L."Procedure For Acquiring Lease From Oklahoma Commissioner's of the Land Office of the State of Oklahoma." Doerner, Saunders, Daniel & Anderson, L.L.P, May 17, 2013

SLC property must be appraised based on its fair market value by the appraiser of the SLC.

The lease must also be submitted to a public bidding process, with bids that must exceed the minimum fair market value established by the appraiser. The successful high bidder shall pay one-half of the annual rental at the time of auction.

The negotiation, approval and bidding process can take between two and six months.

6.3.3. Acquisition Strategy

The land acquisition strategy is based on the larger 50 MW project area and includes the use of tribal, private and state lands. While a conceptual boundary exists for the 20 MW site, the successful acquisition of the parcels within that specific boundary is currently unknown without landowner feedback, and strategic negotiation flexibility would be gained from having the optionality of nearby parcels within the 50 MW boundary, so the initial 20 MW contiguous area would be identified after landowner contacts had been made for the larger area.

Parcel Breakdown

Based on the conceptual layout and all ancillary facilities within the 50 MW project boundary, approximately 75 individual parcels would need to be acquired. To prioritize the effort, parcels are grouped into three tiers. Tier 1 tracts are those parcels where turbines and infrastructure improvements (interconnection, service roads) would be installed. Tier 2 tracts are smaller tracts needed solely for access and transmission. Tier 3 tracts are those required for non-disturbance, setback and/or upwind or downwind buffer areas for the turbines. Forty-five (45) parcels are Tier 1, eight (8) are Tier 2 parcels, and twenty-two (22) are Tier 3 parcels. The locations of these parcels are depicted on the Land Acquisition Strategy Map[75].

The majority of the project infrastructure lies on tribal parcels owned in fee, which for the purpose of leasing is an identical process to other privately owned land. Under the current layout, only two parcels have trust or restricted status, which fall under the jurisdiction of the BIA. Only one of those two parcels has a fractional ownership requiring the consent of multiple owners (see *Fractional Ownership*).

Implementation

Private Lease Tracts:

The projected acquisition time frame is twelve (12) months to negotiate and acquire the leasehold interests. The acquisition team is recommended to include the following professionals: (1) field agent (2) attorney, (3) title agent, and (3) project manager. The field agent will be responsible for field activities including direct negotiations with the landowners, execution of the contracts and facilitating payment to the landowners. The attorney will draft the lease documents to support the field agent's activities. The title agent should be one of the earliest team entrants to facilitate issuance of the title abstracts for drafting of the lease contracts with the proper parties, legal descriptions, etc. Project

[75] Bergen, Christopher W. "Land Acquisition Strategy Tiers" (map) Altis Energy Services LLC, May 10, 2013

management oversight is key for purposes of directing strategy, negotiations, priorities and budgeting compliance.

Tribal Lease Tracts:

A potential Lessee is required to negotiate directly with individual landowners and individual landowners must ultimately consent to the terms of a proposed lease. If a tract has fractionated ownership, then only a proportion of the landowners are required to consent in the percentages as is provided in Table 24: Fractionated Ownership Requirements.

Upon receipt of a WSR lease proposal, the BIA will notify the Lessee if it is complete or not. If the package is complete, within sixty (60) days of receipt, the BIA will either approve or disapprove the lease, return for revision, or inform the Lessee that more time is needed to review the lease. If the BIA requests additional information, , then the Lessee has fifteen (15) days to respond to the concerns raised by the BIA. The BIA will have thirty (30) days from sending the letter requesting additional time to either approve or disapprove the proposed lease.

SLC Lease Tracts:

Land owned and managed by the SLC is leased for agricultural and commercial purposes subject to Oklahoma State Land Commission regulations and laws. The lease terms, which likely will be negotiated with SLC staff, will need to be approved by the SLC at one of the regularly scheduled meetings and ultimately the lease be executed by the Governor. The fair market value of the property will need to be determined by an SLC appraiser. The property must also be submitted to the public bidding process and bid on at a public auction. The process will take between two (2) and six (6) months.

6.3.4. Lease Forms

Private Lease Form[76]:

A form of lease agreement for use with the private parcels was developed by Solas Energy Consulting. This Lease form (the "Private Lease') is in a format that has been reviewed extensively by debt and equity financing counsel for use in several hundred megawatts of wind energy projects developed across the United States. The general terms and provisions have been determined to be reasonable and acceptable in typical third-party commercial financing transactions including landowner, debt and equity counsel. The form of agreement has been provided to the Tribe under separate cover, however was deemed commercially sensitive and not provided herewith.

General Terms and Provisions:

The lease includes a broad right to develop all components of the wind energy project including transmission, substations, operations and maintenance buildings, access and other critical project improvements. In addition, the lease includes appropriate references to pertinent legislation as set forth in the State of Oklahoma Wind Energy Development Act effective as of January 1, 2011 which addresses the state policies relative to wind energy development.

[76] Centera, Kim "Private Lease Form" May 2013

The lease consists of two terms: (i) an initial period generally consisting of up to five (5) years during which the Lessee has the right to determine feasibility of the project and commence pre-construction and construction activities associated with the project and (ii) the operations date of the project defined as when the project first begins to deliver electrical energy in commercial quantities. During the initial period, Lessee pays only annual rent commencing with the execution date of the lease and continuing through the operations date of the project.

Following commencement of the operations period, Lessee pays Owner a percentage of the gross revenues as offset by minimum rent on an installed Megawatt basis on a quarterly basis, or if no turbines are installed on the property, minimum rent is paid annually solely based upon the number of acres leased for purposes of buffer or wind non-interference. The actual economic terms are not provided in this report as the information is deemed to be commercially sensitive; however, those terms are in the form of lease provided to the Tribe.

Percentage rent is adjusted every ten (10) years commencing with the operations date of the project.

The Private Lease includes a right to terminate by Lessee upon thirty (30) days' notice to Owner without payment or penalty. Owner is restricted from interfering with the Lessee's use of the property in its entirety.

The Private Lease does not include a provision for bonding for removal of the improvements because such requirement must be satisfied separately in accordance with the Oklahoma Corporation Commission statute.

The Private Lease includes typical cure rights for assignees and commercial lenders (mortgagees) together with a right to assign the lease for benefit of a lender without a right of Owner consent or approval.

Lastly, the Private Lease includes a covenant by the Owner to grant access, transmission and facility easements (substations and operations & maintenance building) upon request by Lessee for both present and future projects with no additional payments to Owner, provided that Lessee has installed wind turbines on the leased property.

Tribal Lease Form[77]:

As previously discussed, the BIA procedures allow for two (2) different general types of lease formats – (i) short-term evaluation lease for the purpose of installing and maintaining meteorological towers, or Wind Energy Evaluation Leases ("WEELS"), and (ii) Wind and Solar Resource Leases or ("WSR's") which are intended as longer-term and more permanent use of the property for purposes of installation of a wind energy project. For purposes of this discussion, we have focused on the requirements of the WSR lease because we believe it to be more applicable to the present acquisition strategy based upon our understanding of the intended use of the property.

[77] Centera, Kim "BIA Tribal Lease Form" May 2013

The BIA procedures do not specifically set forth a model lease to allow for flexibility in negotiating and drafting of the leases. That being said, certain requirements of the WSR lease form must be adhered to prior to the lease being submitted to the BIA for approval. A review of the WSR lease requirements indicates that they are generally consistent with those found in the Private Lease form.

Since no specific lease model is required for the BIA, and the Private Lease form has previously been deemed to be acceptable in other third party arms-length commercial wind project transactions, it is recommended that the Private Lease form be utilized for purposes of securing the land subject to BIA jurisdiction, including trust property and restricted Indian land in the interests of consistency and conformity.

Specific Tribal Lease Terms and Provisions:

A WSR must set a definite lease term which cannot exceed twenty-five years (25) with an option to renew the lease for an additional twenty five (25) year term. In contrast to the Private Lease, which allows for an initial five (5) year term, the WSR Lease provides for installation of energy facilities within two (2) years after the effective date of the lease; subject to a request for extension upon good cause and depending upon the nature of the delay.

The rent structure is similar to that set forth in the Private Lease, provided that the tribe provides authorization confirming that the compensation is satisfactory and the compensation was negotiated in the best interests of the tribe. A WSR Lease of individually owned Indian land must be for “fair market value” based on (i) a fixed amount, (ii) a percentage of the projected gross income, (iii) Megawatt capacity fee, or (iv) some other method. Upon waiver of an individual Indian landowner, amounts less than fair market value are permissible in certain circumstances. In some cases, fair market value must be determined by market appraisal or other appropriate valuation method, which the BIA will either have prepared or, if approved, an existing valuation using one of the referenced methodologies.

The procedure for BIA’s approval of the WSR Lease is provided in the regulations, including the fact that the BIA must respond to an initial inquiry within 60 days of receiving the required information.

State Lease Form[78]:

A portion of the proposed project area is situated on School Land Commission (SLC) property owned by the Oklahoma Commissioners of the Land. The SLC requires that the Lessor enter into a Wind Turbine Power Production Lease. While this lease form is consistent with the Private Lease form in many respects, it has several very important and significant differences.

Specific State Lease Terms and Provisions:

An SLC lease is approved by the SLC Board of Commissioners and is ultimately signed by the Governor. The maximum term of any SLC lease is fifty-five (55) years, however, verbal discussions with SLC staff indicate that the preferred term is between twenty-five (25) to thirty (30) years for wind energy leases.

[78] State of Oklahoma Commissioners of Land Office, “Wind Turbine Power Production Lease”, Undated

The lease is divided into two phases for development, similar to that provided for in the Private Lease, and the economic payment structure is also equally similar in that a provision exists for an annual payment in the initial period of the lease with a conversion to a percentage of gross revenues upon commercial operation of the project (defined in similar fashion to that set forth in the Private Lease).

All property proposed to be the subject of an SLC lease must be appraised and leased for its fair market rental value as set forth by the appraisers of the SLC. The SLC appraisers consider several variables in determining the fair market value, including, (A) Present land use; (B) Acres of land in cultivation, pasture, timber and nonproductive; (C) Soil types and productivity; (D) Availability of water; (E) Climatic conditions prevailing in the area for the last ten to twenty years; (F) Cash rental price of comparable agricultural land; and (G) Effective cash return on landlord's share of crop rent from comparable agricultural land for the five (5) year period preceding the appraisal.

After the fair market value is determined, the lease must then be submitted to a public bidding process where all of the central economic terms and provisions are subject to public review and open bidding.

In addition to the foregoing, the SLC lease has a restriction on assignment requiring written consent of the Board of Commissioners and there is an express provision stating that no amendments of the SLC lease are permitted, with the SLC reserving the express right to approve any subsequent requests for amendments. This requirement in particular will not be well-received by lenders, which will make financing the project difficult if state lands are included in the project area.

The SLC lease form also requires Lessor to provide a copy of an agreement for the purchase and sale of the electricity negotiated for the project along with all subsequent amendments.

6.3.5. Title Curative

Title Curative for the project in its entirety will involve resolution of anticipated lender and title insurance issues in order to prepare the project for lender due diligence and scrutiny. Such issues include, but are not limited to, subordination of prior deeds of trust or mortgages affecting the land, together with non-disturbance agreements for tenants that have contracted for use of the land, including grazing and crop production.

Owners may also be asked to complete affidavits to clear matters showing of record, including oil and gas leases affecting the property, and transfer of unresolved interests pertaining to probate of deceased relatives and/or unresolved fractional interests.

In the specific case of the Oklahoma Land Commission property, while the SLC lease requires that the property be leased "as is" the property is currently the subject of a grazing and timber lease. Since the SLC lease procedure requires consent of any prior contractual holders, this tenant will need to sign a non-disturbance agreement or some other agreement whereby consent to the granting of the SLC lease is given.

6.3.6. Financial Model Inputs for Land Acquisition

Table 25: Financial Model Inputs for Land Acquisition (Development Costs)

Task	20 MW	50MW

Lease agreements, installation fees, other land payments	$ 127,000	$ 274,000
Landman – acquisition agent	$ 25,000	$ 60,000
ALTA Survey	$ 30,000	$ 60,000
Legal, title, misc.	$ 78,000	$ 178,000
Total	**$ 260,000**	**$ 572,000**

6.3.7. Financial Model Input Assumptions

The table above lists the assumed costs for securing option agreements on the land. This includes consulting fees, title work, surveys, legal costs, and payments to landowners for initial options, as well as disturbance or installation fees which are typically paid to landowners during construction of the project. This table does not include assumptions for on-going revenue payments to landowners over the life of the project. Those cost are contained in the operating cost budget in the Financial Model section below.

6.4. Geotechnical Investigation[79]

Renewable Resource Consultants, LLC (RRC) was retained to complete completed geophysical surveys and geotechnical engineering evaluation for the proposed Iowa Tribe Wind Project. The purpose of this investigation and report was to:

• Explore subsurface conditions utilizing non-destructive geophysical surveys using the Multi-Channel Analysis of Surface Waves (MASW) method and review of available groundwater records in the nearby area; and

• Provide preliminary foundation and construction recommendations.

MASW surveys were performed at 8 locations (MASW-1 through 5 and MASW 7 through MASW-9) as shown on Figure 13, MASW Surveys Test Location Map. RRC provided preliminary recommendations based upon results of MASW surveys, their evaluation and interpretation of MASW results, and their understanding of the proposed project. Additional site-specific geotechnical studies must be performed at all turbine sites to verify and/or to modify recommendations presented in this report, or to provide necessary mitigation measures should unfavorable subsurface conditions exist. The additional site-specific studies should consist of subsurface exploration, laboratory-testing programs and geotechnical engineering evaluation.

6.4.1. Geology

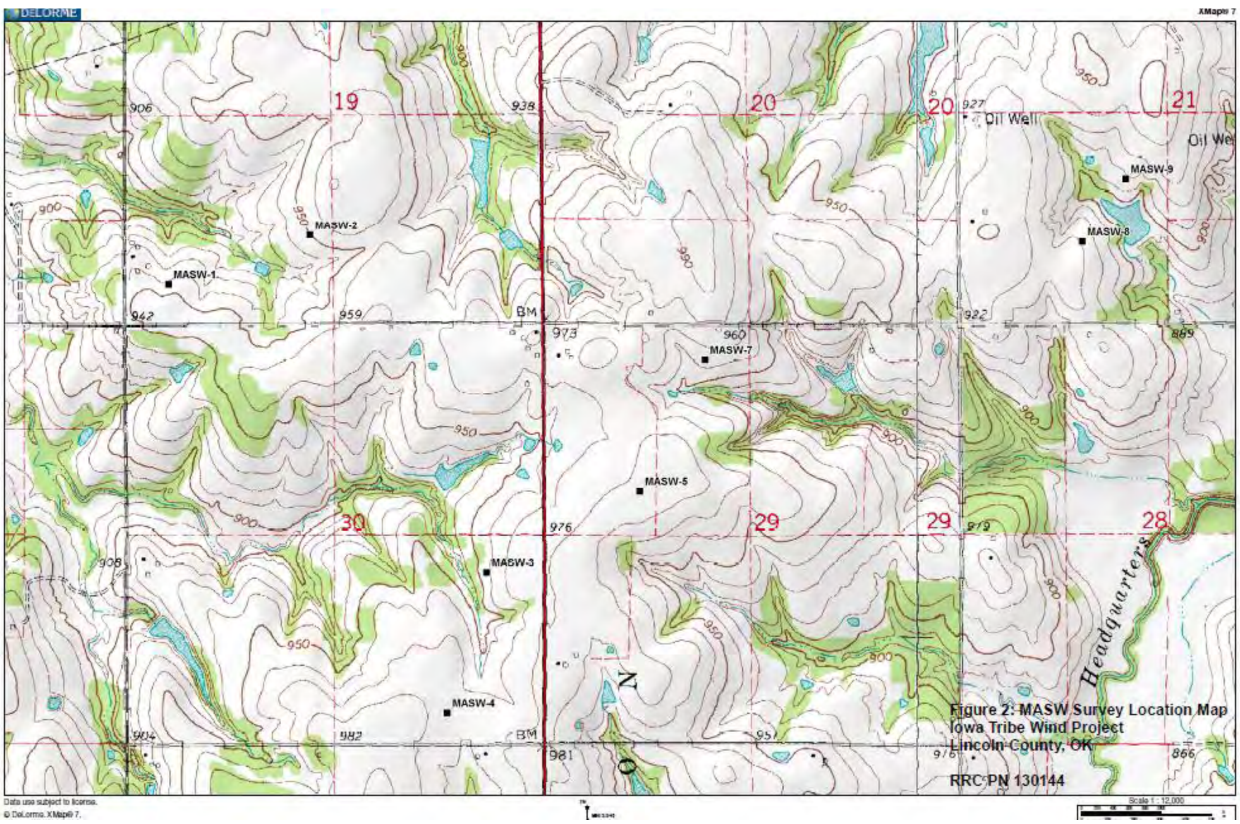
The surface geology is described by the following statement, *"Shale, sandstone and limestones of upper Pennsylvanian age (Neva to Pawhuska) compose the rocks cropping out in the eastern part of the*

[79] This section primarily drawn from "*Preliminary Geotechnical Report, Iowa Tribe Wind Project, Lincoln County, Oklahoma*" by Renewable Resource Consultants, dated June 7, 2013

county, and shale and sandstones of basal Permian age (Stillwater Group) compose the surface rocks in the western part." The Geologic Map of Oklahoma[80] indicates that the Garber sandstone is comprised of the following formations or groups:

- Wellington Formation – Fallis sandstone member;
- Chase Group – Herington limestone;
- Council Grove Group – Cottonwood limestone; and
- Admire Group.

Figure 13- MASW Surveys Test Location Map



6.4.2. Subsurface Stratigraphy

Stratigraphy refers to geological and archaeological layers that make up the soil subsurface. Exploratory borings were not included in the scope of RRC due to the fact that final turbine locations were not known and this was primarily a feasibility study. As such subsurface stratigraphy for the site was estimated based on well logs obtained from the Oklahoma Water Resources Board website. The references for this information can be found in the base report from which this content was derived. Based on the well logs, top soil or surface soil ranges from about 1 to 3 feet overlying a red clay or sandy

[80] Geologic Map of Oklahoma (1954). Miser, H.D., 1954. United State Geological Survey and Oklahoma Geological Survey.

clay layer ranging from 0 to 13 feet in thickness. Bedrock consists of sandstone and shale with estimated depths ranging from about 1 to 15 feet below the ground surface.

6.4.3. Groundwater Conditions

Groundwater conditions are most accurately determined when exploratory borings are performed for the project. Since exploratory borings were not in the scope of this geotechnical study, RRC estimate the groundwater conditions based on well logs obtained from the Oklahoma Water Resources Board website. Based upon review of selected well logs, groundwater levels (first water zone indicated in the well log) varies significantly from about 18 feet to greater than 300 feet below ground surface.

This is a wide variation in depth, however none of the water logs indicated surface water and so it is not expected that buoyant foundations will be required for the site.

6.4.4. Geophysical Surveys

An (MASW) survey was performed by RRC at 8 selected turbine locations. MASW is a method of testing the consistency and rigidity of soil matrices and rock masses. Data is collected using an active seismic source, such as a sledgehammer impact, and a linear receiver array consisting of roll-along 24-channel receivers to collect the surface wave arrival times. Surface waves, which propagate at the same velocity as the shear waves, are recorded. The dispersion of the surface waves can then be inverted to a layer model of shear wave velocity versus depth. The data is processed using the SurfSeis 3.0 computer program.

6.4.5. Geotechnical Recommendations

Based on the MASW survey results and literature reviews of geology at and near the vicinity of the site, RRC concluded that the proposed site appears suitable for the proposed construction of wind turbine facilities, and that the use of spread foundation systems for support of the turbines was considered acceptable. The turbine foundations will bear at a depth of about 7 to 10 feet below existing site grade. RRC found several geotechnical conditions that will require special consideration in the design and construction of the project.

- The presence of shale and sandstone bedrocks at shallow depths at the site may require particular attention in the design and construction. The use of heavy-duty excavation equipment will most likely be required in most areas. Blasting may be required in areas where hard to very hard and strongly cemented sandstone bedrock is encountered at shallow depths.
- Areas where soft or loose soils may be encountered below foundation bearing elevation that may require remedial measures prior to foundation construction. Remedial measures may consist of partial over-excavation to suitable depths, moisture conditioning, and recompaction of the subgrade soils, or replacement with structural fill materials. Subgrade soils generally can be moisture conditioned with -3% to +2% of optimum moisture content and compacted to 97% of the maximum dry density as determined by ASTM D 698.

- Areas where moderately to highly expansive clay soils and shale bedrock are encountered at or near foundation bearing elevation may require particular attention in the design and construction. Expansive potential of subgrade soils and shale bedrock should be evaluated in conjunction with the final geotechnical engineering study to properly formulate mitigation measures.
- In areas where soil and bedrock are exposed at foundation bearing elevation at turbine pad, consideration should be given to placement of the proposed foundation either entirely on engineered fill, or deepening the foundation to bear entirely on native bedrock materials in order to reduce potential differential bearing conditions.

6.4.6. FOUNDATION CONSTRUCTION CRITERIA[81]

Site Preparations

RRC recommended that prior to starting any work at the site, adequate positive drainage should be established to maintain a relatively dry condition. Ponding of water, although not anticipated at the site, should be avoided. Site preparation should begin by removing any surface vegetation, soil, and major root systems within the foundation areas. Such organic soils should be placed in non-structural areas. Excavated materials, which are free of organic debris, may be stockpiled and reused as backfill where necessary. During excavation of the turbine foundations, every effort should be made to avoid disturbing the subgrade materials at the planned excavation base. The geotechnical engineer or their representative should observe the base of each foundation excavation prior to foundation installation. When granular subgrade is disturbed, the resulting surface should be recompacted to achieve a minimum compaction of 95% and at moisture within 2% of optimum in accordance with ASTM D 1557. In areas where densification of the subgrade materials is required, the excavated slopes should be built in accordance with all applicable federal OSHA, and state requirements for the protection of construction personnel.

On-Site Excavated Materials as Overburden Backfill

The use of on-site materials is considered acceptable as backfill materials against foundations. Excavated soil may be stockpiled for later use as overburden backfill or structural backfill. Foundation backfill materials should be free of organics, expansive clays (if encountered), and roots before the stockpile is allowed for reuse. Each overburden material lift should be compacted and moisture conditioned properly in order to provide the minimum and maximum dry and wet unit weight values used in the structural design. In areas where structural elements such as transformer pads or crane pads are located within the backfill zone, the backfill materials should be compacted to a minimum of 95 percent of the maximum dry density as outlined by ASTM D1557 (or 97% of the maximum dry density as determined by ASTM D 698) and moisture conditioned to within 2% of optimum moisture. A qualified representative of the geotechnical engineer must be on-site on a full-time basis during backfill placement to observe and verify the condition of the backfill materials and that proper density is achieved. It is imperative that

[81] This section summarizes the recommendations made by RRC in the Geophysical Report.

proper drainage is maintained around the foundation structures to reduce the potential for water infiltration and fine migration, and the potential for “nested” voids.

Structural Fill Specifications

On-site sands may be used beneath foundations where over-excavation and replacement of unsuitable materials is performed. If gapping is a concern, the use of well graded granular materials or structural fill meeting the specifications contained in the original report will be required. Structural fill material beneath foundations, where required, should consist of a non-expansive, well-graded material with sufficient binder for compaction purposes and must meet the Oklahoma Department of Transportation Grading “B” or better.

Structural fill should be placed in lifts having a maximum loose lift thickness of 12 inches and should be compacted to a minimum of 95% of ASTM D 1557. The structural fill should be moisture conditioned with 2% of optimum moisture content.

On-Site Excavated Materials as Foundation Fill Specifications

On-site lean clay and sand soils could be reused beneath foundations where over-excavation and replacement of unsuitable materials is performed. These reused materials should have a maximum Plasticity Index of 25 and a maximum Liquid Limit of 40. If gapping is a concern, the use of well graded granular materials or structural fill meeting the specifications outlined in RRC’s report will be required.

Shallow Foundation Construction

The following construction criteria and general guidance should be observed during foundation construction:

- All foundation construction should be observed by the Geotechnical Engineer or a qualified representative to verify that the anticipated bearing material has been reached in accordance with the recommendations given herein. The Geotechnical Engineer should also assess the need for densification of any soft or disturbed subgrade materials.
- Special care should be taken to protect the exposed soils and shale bedrock from being disturbed, freezing or drying out prior to placement of the structural fill pad.
- Foundation excavation should be accomplished with conventional excavation equipment to a depth of about 12 inches below foundation bearing elevation. The foundation excavation should be sloped sufficiently to create internal sumps for runoff collection and removal. Foundation excavations subject to rainfall and possible deterioration from accumulated water should be protected using a protective “mud-slab” (concrete) of not less than 2 inches in thickness. If surface runoff water or groundwater seepage accumulates at the bottom of the foundation excavation, it should be collected and removed and not allowed to adversely affect the quality of the bearing surface.
- Foundation should be founded on uniform material. If inclined bedrock is encountered at foundation excavation bottom, the excavation bottom should be over-excavated to generate a uniform and competent bedding surface. The over-excavation can be filled with lean concrete to top of mud mat grade, or compacted structural fill. To reduce the risk of differential foundation settlement, the structural fill thickness below turbine foundation should be kept as uniform as

possible (with no abrupt thickness change), with a total thickness difference of 24 inches or less across the turbine foundation width.

- The foundation excavations should be checked for size and cleaned of loose material and debris prior to the placement of reinforcing steel. Precautions should be taken during the placement of reinforcement and concrete to prevent loose excavated material from falling into the excavation.
- Prior to the placement of concrete, any free water must be removed from the foundation excavation.
- Prompt placement of concrete in the excavation as it is completed, cleaned, and observed is strongly recommended.

Open Excavations

Temporary construction slopes and/or permanent embankment slopes should be protected from surface runoff water. Site grading should be designed to allow drainage at planned areas where erosion protection is provided, instead of allowing surface water to flow down unprotected slopes. Surcharge loads, either static or dynamic, should not be applied to an excavation slope. Construction equipment should be prevented from traveling along or near the top of the excavation slope. Monitoring of temporary slopes, trenches, and dewatering during construction should be undertaken by the contractor to detect early signs of movement within slopes, structures, pavements, etc.

In all cases of excavations, sloped excavations and trench shields are recommended for excavations greater than 4 feet in depth. OSHA and applicable state and local standards should be observed and followed. Site safety is the responsibility of the contractor.

Drainage and Dewatering

Proper drainage should be provided away from the foundation elements during all phases of construction and post-construction grading. Proper drainage is essential to the long-term stability of the structure. Ponding of water near the foundation elements from improper drainage should not be permitted.

Preliminary Access Roadways Design and Construction

Access roadways will be built for both construction and maintenance purposes. The final location of those access roads will be determined when the final turbine locations are selected. At this time, the recommendations in this section are generic for roads expected to be constructed for both construction and long term project access. Traffic volume during construction is anticipated to be frequent with heavy equipment utilizing the access roadways. Following the construction period, the traffic volumes will be light and vehicles accessing the roadways will generally consist of pickup trucks and occasional single and multi-unit truck traffic. The actual thickness and material characteristics of the gravel roadways should be determined by the design/build contractor, keeping in mind the frequency, duration and requirements of the turbine manufacturer. Aggregate base course materials used for surfacing of the access roadways should be compacted to a minimum of 95% of the maximum dry density and within 2% of optimum moisture content as determined in accordance with ASTM D 1557. Prior to the placement of the aggregate base course materials, stripping and removal of existing vegetation and other deleterious materials from the proposed access roadway alignment should be performed. Topsoil and organics could be up to about 4 to 6 inches or more in thickness in some areas and should not be allowed for use in structural areas or along the access roadway alignment.

The exposed subgrade should then be proof-rolled prior to the placement of the aggregate base course materials to assess the presence of soft areas and the need for any remedial measures. The proof-roll operations should be conducted with a fully loaded 4,800-gallon water truck or similar equipment (gross weight of 50,000 pounds is required). In areas where excessive “pumping” of the subgrade is encountered, partial removal of subgrade soils in these areas and re-compaction and/or replacement with granular soils will be required. These subgrade areas should be scarified to a minimum depth of about 6 to 12 inches, moisture conditioned within 2% of optimum moisture content and re-compacted to a minimum of 95% of the maximum dry density as determined in accordance with ASTM D 1557.

It is imperative that proper drainage of the subgrade be provided in the construction of the roadways and crane pads to enhance their performance. Post-construction proof-rolling of the subgrade materials should be performed prior to re-opening the roadways for traffic after periods of heavy rainfall/snow melt to assess stability of the roadway and the need for remedial measures. The proof-roll should be accomplished with a fully loaded water truck or similar heavy equipment. Areas where remedial measures are required should be re-worked and corrected prior to acceptance. It is also imperative that periodic inspection of the access roadways be performed following periods of rainfall or snow-melt to assess the condition of the roads and the need for remedial measures.

6.4.7. Limitations

The RRC report contained standard limitations including their field observations and limited testing. This report was sufficient to determine that the proposed wind project, from a geotechnical perspective, was feasible, and furthermore that spread foundations would be considered suitable for the site. It provided recommendations for roadways and foundations. It provided information that buoyant foundations would not be required.

6.5. Layout and Turbine Selection Financial Model Inputs

A detailed construction budget was developed for the project which includes all the proposed capital expenditures for the project. A detailed development budget was also developed, which includes the development costs for the project. That information is contained in the economic feasibility section of the report in Section 7 below.

7. ECONOMIC FEASIBILITY ANALYSIS

7.1. Overview of Scope

Solas Energy Consulting was retained by BKJ Solutions, a subcontractor to the Iowa Tribe of Oklahoma, to provide project management services and oversee the project feasibility study for the Iowa Tribe Wind Project. The technical project feasibility was conducted by a variety of consultants coordinated by Solas Energy Consulting. Each of those consultants was tasked with a specific technical area, and Solas worked with those consultants to develop cost assumptions for the project.

Those cost assumptions were utilized to develop a project financial model using various assumptions. In order to best understand the assumptions for that modeling, some background is required of how traditional wind power projects are developed, owned, and financed.

7.2. Wind Project Ownership Structure

Most wind projects are developed by private companies who either retain the asset or sell off all or part of the asset and take a development fee for their services. Utilities will sometimes develop projects for their own, or they will hold a competitive request for power under which they will offer a PPA and contract with a private developer. It is established practice for a project developer to create a project company (most typically a Limited Liability Company or LLC) that is owned by the developer and then capitalized with equity from the developer themselves, project equity (i.e., equity contributed exclusively for the project company itself) and debt provided by a lending institution such as a bank, pension fund or other financing institution. All of the project assets are held by that LLC, including all the contracts for land, permits, the PPA, any REC agreements, purchase agreements for turbines, the construction agreement with the balance-of-plant (BOP) contractor, and the long term turbine service and maintenance agreements, among others.

The establishment of the project company or LLC to hold all the project assets has several benefits including the flexibility to create different financing arrangements for the particular project and potentially being able to access non-recourse debt financing (i.e., lenders and project equity participants are limited to looking at cash flows from project itself and not the developer). This allows the developer to limit its capital risk to direct sums contributed to the project company itself.

This approach, while most common in the industry, does have some limitations. First, any lenders and project equity contributors are likely to demand a greater risk premium (in the form of a rate of return) to the extent such project debt is considered non-recourse. Second, any lender or project equity contributor will demand greater assurances from the purchaser of the project itself to ensure its interests are protected.

7.2.1. Project Development

The cost for the full development of this project, in either the 20 MW or the 50 MW scenario, is expected to be high. The typical project developer is willing to take a risk on the development capital for the project if the project looks fairly feasible. The development costs are considered 'at-risk' capital, and the developer takes a project fee during the sale of the project from a third party to take a satisfactory rate of return on that development risk capital.

A development budget was developed for this project in both the 20 MW and the 50 MW scenarios. The development budget includes the costs likely to be required to get the project ready for sale, and includes additional wind monitoring, land acquisition, interconnection queue studies, project permitting, preliminary engineering, legal, and consulting fees. The development budget was estimated to be as follows:

Table 26: Project Development Budget

Task	20 MW	50MW
Land Work[82]	$ 260,000	$ 572,000
Meteorology[83]	$ 286,000	$ 416,000
Interconnection[84]	$ 175,000	$ 175,000
Permitting[85]	$ 440,000	$ 625,000
Engineering[86]	$ 240,000	$ 240,000
Legal Fees[87]	$ 500,000	$ 750,000
Consulting[88]	$ 120,000	$ 120,000
Total	**$2,021,000**	**$2,989,000**

In discussions with the Iowa Tribe, it was indicated that the Tribe does not have the financial liquidity or the desire to act as the developer on this project to front these funds for the development of the project. An alternative to self-financing the development costs would be for the Iowa Tribe to seek a developer partner for the project who would provide the development capital, or sell the project assets in whole to a developer and just participate as a landowner. Under either scenario, the Iowa Tribe would need to allow ownership of the project by the third party, however in the first scenario, the Tribe would maintain a small portion of ownership.

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[82] Additional detail on the estimated land costs can be found in Table 25.

[83] 20 MW case assumes 2 met towers and 50 MW case assumes 4 met towers installed for additional wind speed verification. Includes finance level reports.

[84] Additional detail on the estimated interconnection costs can be found in Table 6.

[85] Additional detail on the estimated permitting costs can be found in Table 13.

[86] Engineering costs assumes engineering support for developing specifications, plans and materials to bid the project to a design-build contractor. It also includes the cost for a full independent engineering review of the project, which is required under a project financing scenario. This cost is largely project size independent.

[87] Legal fees are estimated based on a non-recourse project finance scenario. This would include the cost for support for the contracts and a project finance transaction.

[88] This is the cost for additional consulting services to support the project.

7.2.2. Co-Developer/Partner

An interesting method to use for development of this project would be for the Iowa Tribe to create a project company LLC and then execute lease agreements between the tribal parcels held in fee simple and also any private parcels owned by tribal members. The tribe could then assign all of the feasibility work created pursuant to this report to that project company, and then do a competitive RFP for wind power developers for the project assets. Combining lease agreements with the work performed to date on the project provides some value to a developer as the initial high-risk activities have been completed. The Tribe could set the development terms and conditions for the project, and find a developer best suited to work with the tribe from both a commercial and compatibility perspective.

In this scenario, the tribe could serve as a co-developer with small capital obligations, and have an expectation that a small portion (less than 10%) of the project ownership could be held by the tribe. In addition to receiving rent from the use of the land, the Tribe could take a modest development fee (at least the cost of this feasibility study, and perhaps greater), and also a modest income off of the long-term operations of the project. It should be noted that the Tribe would have a minority interest and little control over the development of the project. The tribe would also need to be realistic about the value that it brings because the economics of the project are modest and onerous financial terms as a co-developer could make the economics unfavorable.

7.2.3. Full Project Sale plus Project Landowner

Another avenue for the tribe which might be more attractive to project developers is if the tribe conducted the same RFP process to find the best developer for the project, but did not retain any interest in the project other than being a landowner with option payments and long-term revenues off of the project. The initial stages would still be the same and the tribe would establish an LLC and execute leases, but would sell the project and the development assets to a third party developer. This would require no development capital from tribe, would provide a small payment for the sale of the project company, and would provide the tribe with back-end revenue over the life of the project as a landowner. This structure is expected to be more interesting to private developers and may ultimately result in the greatest financial benefit to the Tribe.

In this scenario, the Tribe could still require non-tangible benefits to accrue to the tribe, such as job creation, training of tribal members, utilization of tribal resources for avian studies and cultural studies, and other benefits.

Ultimately the best structure for the project will be the one that is most financeable, whether the tribe is a development partner or simple landowner, the developer who comes into the project will be seeking financing for the project.

Several vehicles could be utilized for financing of the project by a developer/partner. Those financing vehicles are discussed below.

7.3. Financing Vehicles

7.3.1. Debt Financing

Debt financing consists of traditional loan structures, but due to size of project can be structured in various manners including:

- **Syndicated/Club Loans** – Commercial loans spread amongst various financial institutions to minimize risk
- **Private Placements** – Bond issuance to qualified institutional investors that avoid SEC registration

Different types of debt structures have various pros and cons. Commercial loans tend to be more traditional and easier to process, as well as having more flexible terms as there are more entities that compete to provide such financing. However, bond issuance can have less restrictive covenants, offer a longer repayment term option and be issued at tax-exempt rates (for qualified projects) leading to a lower effective borrowing cost.

7.3.2. Equity Financing

Equity financing differs from debt financing in that the investing entity expects a negotiated return on capital that will be based upon success of project and typically is well in excess of any debt financing costs. This is because the debt financing has higher priority to revenue streams and is paid first in the event of a default, so the subordinated equity position will require a premium for its risk capital.

Besides the equity contributed by the Iowa Tribe, equity financing can be obtained by soliciting investors who wish to have a stake in the project. Such terms again would be bilaterally negotiated and can be structured in any manner as long as done with full transparency and with recognition of the preferred standing of any debt financing.

Below is one of the most common ways to obtain financing in large scale renewable projects.

7.3.3. Tax Equity Financing / Investment-Grade Sourcing

Tax equity financing is one of the most common investment structures for renewable energy projects in the United States. The US federal government has been offering a renewable production tax credit (PTC) whereby the generator receives a one-for-one tax reduction benefit at a pre-determined rate for the project, based on the generated MWh of the project. These tax incentives are valuable and useful for a party who has a long-term known tax liability. The Iowa Tribe, however, does not pay federal taxes and so this tax credit is not of value to the Tribe. This tax credit, if in effect at the time of the project commissioning, could be sold to an equity investor.

The continuation of that particular tax incentive, however, is in question. The likely or actual expiration of certain tax incentives (such as the production tax credit (PTC) and the 1603 cash grant program) have created a financing void for many large scale developments. Tax equity financing presents the opportunity for private investors – in this case corporations – to inject capital into the development of renewable energy projects, while transferring remaining tax incentives from the project developers, who usually do not have enough profits to take advantage of them, to corporate investors with a larger tax exposure to offset. The corporations investing in the project are also attributed a share of the future revenues or equity stake in the asset.

Traditionally, financial corporations and banks have filled this investment pool, but corporations with cash on hand and an appetite for tax incentives, such as Google, have stepped in to provide financing for projects in exchange for tax abatement and for future revenues. In most cases, these transactions are purely financial, with no green power attributes or physical delivery of renewable power flowing back to the investor. However, the Iowa Tribe may want to consider investment that includes potential off take of power or environmental attributes on an equity basis, once a project is operational.

7.3.4. Benefits

- Investing corporations engage in the renewable energy marketplace in a manner that provides liquidity and results in an ownership stake in a developed asset
- Investors earn a return on their investment as projects come online and begin to generate revenues from the sale of energy and/or environmental attributes
- If structured to include off take of power and/or RECs once the project is operational, these investments can provide for a single, flagship project of sufficient size to offset an entire corporation's grid-sourced power footprint.

7.3.5. Considerations

- Tax equity financing requires significant outlay of capital for investors to buy into a project – for example a 100 MW wind farm would require an investment of $25MM to $75MM from a single investor to participate

Tax equity projects are typically structured as purely financial investments, and the additional requirement of off take of power and renewable attributes would impact the anticipated ROI of such a project (vs. monetizing those attributes and selling the power to the open market)

7.4. Incentive Analysis[89]

Incentives exist within the United States and the State of Oklahoma for investing in green energy, and those incentives have in the past contributed substantial value to wind projects. The following is a list of relevant government organizations that have funded wind development in the past:

- US Department of Agriculture[90]
- Department of Energy[91]
- Oklahoma Department of Environmental Quality [92]

[89] This section drawn from the Schneider Electric Report.
[90] http://www.rurdev.usda.gov/energy.html
[91] http://www1.eere.energy.gov/financing/funding_award_process.html
[92] http://www.deq.state.ok.us/

- Oklahoma Department of Commerce[93]

The government uses several tax-based policy incentives to stimulate the deployment of wind power.

- Renewable Electricity Production Tax Credit (PTC)[94]
    - PTC is a per KWh tax credit for electricity generated by qualified energy resources.
    - The PTC was originally enacted in 1992 and has been extended several times. Most recently it was extended as part of the American Taxpayer Relief Act in January 2013.
    - Deadline for start of construction for PTC eligibility: December 31, 2013
    - Credit amount: $0.023/kWh
    - American Wind Energy Association is currently fighting for extension.[95] The outlook is not optimistic that it will be extended further.

- Business Energy Investment Tax Credit (ITC) [96]
    - The American Recovery and Reinvestment Act of 2009 allows taxpayers eligible for the federal renewable electricity production tax credit (PTC) to take the federal business energy investment tax credit (ITC) instead of taking the PTC for new installations
    - Equal to 30% of expenditures, with no maximum credit for small wind turbines placed in service after December 31, 2008.
    - Eligible small wind property includes wind turbines up to 100 kW in capacity.
- Oklahoma Zero-Emission Facilities Production Tax Credit [97]
    - Facilities placed in operation on or after January 1, 2007 and before January 1, 2016
    - $0.0025/kWh - $0.0075/kWh for 10 years; amount varies depending on when the facility is placed in operation and when electricity is generated.
    - Tax years beginning on or after January 1, 2003, a state income tax credit is available to producers of electric power using renewable energy resources from a zero-emission facility located in Oklahoma.
    - Rated production capacity of one megawatt (1 MW) or greater
    - The facility must be placed in operation after June 4, 2001, and the electricity must be sold to an unrelated party.
    - The construction and operation of the zero-emission facility must result in no pollution or emissions that are or may be harmful to the environment, as determined by the Department of Environmental Quality.
- Oklahoma's business incentive program [98]

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[93] http://okcommerce.gov/workforce-development/green-grant/
[94] http://dsireusa.org/incentives/incentive.cfm?Incentive_Code=US13F
[95] http://www.awea.org/issues/federal_policy/
[96] http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=US02F&State=federal%C2%A4tpageid=1&ee=1&re=1
[97] http://dev3.okcommerce.gov/v2/Businesses-And-Employers/Reduce-Operating-Costs/Streamline-Operations/rc/Oklahoma-Is-Wind-Energy-Incentives
[98] http://dev3.okcommerce.gov/v2/Libraries/Documents/2010-Oklahoma-Business-Incenti_170.pdf

  - Offers up to 5% cash back quarterly of new taxable payroll (Quality Jobs)
  - Tax credit on investment or new jobs (Investment/New Jobs Tax Credit).
  - 5-Year Ad Valorem Property Tax Exemption is available for qualifying manufacturing companies.
- Oklahoma Freeport Inventory Benefits Law [99]
  - Exempts from taxation goods, wares, and merchandise that come from outside the state
  - Goods, wares and merchandise must leave the state within nine months
  - Goods, wares, and merchandise must be held for assembly, storage, manufacturing, processing, or fabricating purposes within the state.
- Property Tax Exemption for Wind Generators[100]
  - The state of Oklahoma offers a five year ad valorem property tax exemption for certain wind power generators.
  - An initial investment of $250,000 and an addition of $250,000 in annual payroll in counties with a population of 75,000 or less are required. If the company is located in a larger county, an additional annualized payroll of $1 million is required to file for the exemption. Wind power generators are exempt from the Oklahoma payroll requirement if there is an increase of $2 million or more in capital improvements while maintaining or increasing payroll.
  - Property eligible to be exempt from tax may include land, buildings, improvements, machinery, fixtures, and equipment used directly and exclusively in the process of wind power generation on the facility site. Companies must apply for the exemption by March 15th for each year.
- Qualifying Advanced Energy Manufacturing Investment Tax Credit [101]
  - Maximum Incentive: $30 million, 30% of qualified investment
  - The American Recovery and Reinvestment Act of 2009 established an investment tax credit to encourage the development of a U.S.-based renewable energy manufacturing sector
  - Equipment and/or technologies used to produce energy from the sun, wind, geothermal or "other" renewable resources

It should be noted that federal renewable production incentives are starting to wind down, most notably the PTC, which had previously provided substantial economic benefits to projects. A shift has occurred at the federal level from production incentives into research and development incentives. Programs that are expiring are not likely to be renewed. The uncertainty of these incentives is high, and the majority of the incentives are tax-based, which is not beneficial to the Tribe. None of these incentives were considered in the financial modeling for the project because it was deemed that they would provide optimistic projections.

[99] http://dev3.okcommerce.gov/v2/Businesses-And-Employers/Reduce-Operating-Costs/Streamline-Operations/rc/Oklahoma-Is-Wind-Energy-Incentives
[100] http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=OK38F
[101] http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US52F

7.5. Native American Incentives

- Oklahoma Department of Commerce American Indian Lands Tax Credit[102]
    - Provides an accelerated federal property depreciation schedule (up to 40%)
    - Federal employment tax credits of up to $4,000 per qualifying employee per year
- Tribal Energy Program Grant [103]
    - Managed by the United States Department of Energy
    - Program provides financial assistance, technical assistance, education and training to tribes for the evaluation and development of renewable energy resources
    - U.S. federal government sources of tribal energy project loans and loan guarantees.
        - Rural Energy for America Program Guaranteed Loans[104]
        - Rural Development Loan Assistance[105]
        - Electric Program Loans[106]
        - Business and Industry Guaranteed Loans[107]
        - Indian Affairs Division of Capital Investments[108]
        - Indian Home Loan Guarantee Program[109]
        - Tribal Housing Activities Loan Guarantee Program[110]
- IRS Clean Renewable Energy Bonds (CREBs)[111]
    - Bonds to fund clean renewable production.
    - Primarily for public sector production. Tribal Government would qualify.
    - Program expired but may be renewed in the future. Program ran from 2005-2010.

The tribal energy program grant is potentially an interesting incentive for the small wind project. An application for this grant is being developed for submittal in June, 2013. That incentive is not as applicable in the large wind scenario.

7.6. Economic Modeling Results

The project economics were developed and put into a financial model to determine what rates of return one could expect with the project. Multiple cases were run on various revenue scenarios including pricing for both brown and RECs, different capital project costs, operating costs, and the development costs as detailed in Table 26. The economics were not found to be very favorable.

102 http://okcommerce.gov/location-or-expansion/incentives/american-indian-lands-tax-credit/
103 http://apps1.eere.energy.gov/tribalenergy
104 http://www.rurdev.usda.gov/rbs/busp/9006loan.htm
105 http://www.rurdev.usda.gov/RD_Loans.html
106 http://www.rurdev.usda.gov/UEP_Loans_Grants.html
107 http://www.rurdev.usda.gov/rbs/busp/b&i_gar.htm
108 http://www.bia.gov/WhoWeAre/AS-IA/IEED/DCI/index.htm
109 http://portal.hud.gov/hudportal/HUD?src=/program_offices/public_indian_housing/ih/homeownership/184
110 http://portal.hud.gov/hudportal/HUD?src=/program_offices/public_indian_housing/ih/homeownership/titlev
111 http://www.irs.gov/pub/irs-tege/tc_and_stcb_q-a._09-07-10_1.5.pdf

7.6.1. Project Conclusions

The forecast for power prices in SPP is not supportive of wind development at its current level. As indicated above, the projected power rates in the SPP are much lower than in other markets, and this is the primary reason why the project economics are not more robust. In other markets with slightly higher pricing, the project would have favorable rates of return. A future increase in power prices, plus the potential to reduce capital costs through advantageous turbine pricing could easily result in an economically viable project.

It should also be noted that a 50 MW project is more easily justified economically then a 20 MW project. Certain costs are fixed regardless of project size, including project financing transaction costs, which can be substantial. Also, many construction costs are fixed, such as mobilization, making a larger project with larger revenues helps to offset those costs.

7.6.2. Key Findings

Table 27: Financial Modeling Findings

Case	Key Findings	Recommended Follow-up Action
1	50 MW project could be economic at reduced turbine costs and increased revenues.	Investigate options for more favorable turbine pricing and seek opportunities for increased revenue.
2	Smaller projects are not likely to be economic.	Pursue 50 MW project unless SPP power prices increase.

7.7. Analysis

7.7.1. Summary

The analysis investigated the economics of a wind farm under two scenarios:

1) 29 turbines of 1.7 MW capacity each, for a total wind farm capacity of 49.3 MW.
2) 12 turbines of 1.7 MW capacity each, for a total wind farm capacity of 20.4 MW.

   In each of these scenarios, several cases were analyzed for different revenue expectations and capital costs.

7.7.2. Key Findings

Table 28: Key Findings for both the 20 MW and 50 MW case

	Key Findings	Recommended Follow-up Action
1	Base Case economics are not favorable	

2	Transmission costs are excessive	Investigate for reduced transmission costs
3	Lower capital and operating costs and higher revenues could make the project economic	Investigate options for more favorable turbine pricing and seek opportunities for increased revenue.

7.7.3. Detailed Analysis

Capital and operating costs were prepared by Solas Energy Consulting. Power prices and transmission charges were provided by Schneider Electric in their report. Resource assessment was performed by AWS Truepower and taken from BKJ_Energy_Estimates_Various_Turbine_Models_03Jun13.xls Turbine RFQ energy results.

7.7.4. Assumptions

The 50 MW scenario assumed 29 GE 1.7-100 turbines with a capacity of 1.7 MW each. The 20 MW scenario assumed 12 of the same turbine model. Economics were performed on a before tax basis with no debt. The Net Capacity Factor (NCF) was 33.8% for the 50 MW case and 33.6% for the 20 MW case. Land royalties were included at a level of 4%, escalating to 5% over the life of the project. The capital and operating cost assumptions used were as follows:

Table 29: Project Capital Cost Estimate

Item	20 MW	50 MW
Project Management (BOP Contractor and Developer)	$ 1,420,300	$ 1,580,300
Sitework/Civil	$ 1,476,700	$ 3,859,000
Foundations	$ 2,090,900	$ 5,034,600
Turbines purchase, Turbine Erection, FAA lights	$ 29,546,400	$70,352,000
Collection system, padmount transformers, SCADA	$ 5,624,600	$12,178,000
Electrical Substation	$ 2,143,900	$ 2,855,000
Permanent Met Tower	$ 200,000	$ 200,000
Operations and Maintenance building	$ 500,000	$ 500,000
Total	**$43,003,000**	**$96,579,000**

Table 30: Project Operational Cost Estimate, per year, escalating

Item	20 MW	50 MW
Management, Operations, Maintenance Administration Fee (project operations)	$ 173,850	$ 189,300
Turbine Service/Warranty/Maintenance Fees	$ 720,000	$1,566,000
Balance of Plant Repairs	$ 65,000	$ 80,000
Electricity Usage	$ 14,400	$ 34,800
Insurance	$ 90,000	$ 217,500
Transmission/Wheeling charges through SPP	$612,000	$1,479,000
Total without the transmission charges	**$1,063,250**	**$2,087,600**
Total with the transmission charges	**$1,675,250**	**$3,566,600**

7.7.5. Notes and Details

The estimate of transmission charges is quite sizeable and further investigation is required to verify the actual transmission charges. Those charges were provided by Schneider Electric and are the transmission charges through the SPP to wheel power to another off-taker. Those charges vary based on origination and destination of the power. For the purpose of this estimate, an average charge through the SPP region was utilized because the location to deliver the power is currently unknown. This cost will vary dramatically based on the off-take and will require detailed evaluation when the source and destination are known.

7.8. Modeling

7.8.1. Summary

In total, five cases were modeled for each project size (20 MW and 50 MW):

1) The Base Case: The mid-range estimates for revenue (includes both RECS and brown power) and transmission cost as provided by Schneider Electric.
2) High Revenue Case: The high revenue forecast was used with all other assumptions the same as the base case.
3) High Revenue, Low Transmission: The high revenue forecast and low transmission cost estimate were used.
4) High Revenue, No Transmission: The high revenue forecast plus transmission costs set equal to zero $/MWh.
5) 15% Improvement Case: Case 4 plus a 15% increase in revenue and a 15% reduction in capital and operating costs.

In each of the first 4 cases, the capital costs were held constant. The capital costs as modeled included both the costs from Table 26 and Table 29 (Development Costs and Capital Costs, respectively). The scenarios were run to determine what the most favorable case would be. Generally, a 15% increase in the power purchase and REC price and a 15% decrease in the capital costs, with the project bearing none of the SPP transmission costs, would be required to make the project feasible. This case, case 5, is the only case run that returned a positive NPV with an IRR above 8%.

7.8.2. Results: 50 MW Scenario

Table 31: 50 MW Case, Scenario 1 through 5

Scenario	Production /year (MWh)	Capacity (MW)	Capital Cost (k$)	Avg O&M Cost ($/MWh)	NPV @8%	IRR	2016 SPP Price ($/MWh)	2020 SPP Price ($/MWh)
Base Case	145,971	49.3	$ 98,105	$ 26.11	($54,305,601)	-0.3%	$ 33.00	$ 47.00
High Revenue	145,971	49.3	$ 98,105	$ 26.11	($38,502,998)	2.7%	$ 39.00	$ 57.00
High Rev, Low Trans	145,971	49.3	$ 98,105	$ 25.84	($36,889,740)	3.0%	$ 39.00	$ 57.00
High Rev, No Trans	145,971	49.3	$ 98,105	$ 15.99	($21,792,976)	5.2%	$ 39.00	$ 57.00
15% Improvement	145,971	49.3	$ 83,389	$ 13.95	$6,270,090	8.9%	$ 44.85	$ 65.55

The base case has a negative IRR; therefore, no further downside cases were examined.

Moving to the High SPP Power Price and REC price forecast, which is a plausible case, increases the IRR to 2.7%. Lowering the transmission cost to the low forecast only increases the IRR to 3.0%; however removing transmission costs completely increases the IRR to 5.2%.

Finally, power and REC prices were increased by a further 15% and capital and operating expenses were lowered by 15%. The result is an IRR of 8.9% and an NPV of $6.2 Million. Economics in this case could be looked on favorable by an investor. It should be noted that the capital cost estimates were done on a +/- 15% basis and the actual project construction could come it at a lower cost based on a competitive bid. Additionally, a 15% increase in the base power and REC pricing is not a drastic assumption. Furthermore, no incentives were modeled within the scenarios, and a tax incentive available to a private developer could swing this project into positive, more viable territory.

7.8.3. Results: 20 MW Scenario

Table 32: 20 MW Case, Scenario 1 - 5

Scenario	Production /year (MWh)	Capacity (MW)	Capital Cost (k$)	Avg O&M Cost ($/MWh)	NPV @8%	IRR	2016 SPP Price ($/MWh)	2020 SPP Price ($/MWh)
Base Case	60,045	20.4	$ 45,921	$ 29.59	($29,028,172)	-2.1%	$ 33.00	$ 47.00
High Revenue	60,045	20.4	$ 45,921	$ 29.59	($22,527,001)	1.0%	$ 39.00	$ 57.00
High Rev, Low Trans	60,045	20.4	$ 45,921	$ 29.32	($21,859,446)	1.3%	$ 39.00	$ 57.00
High Rev, No Trans	60,045	20.4	$ 45,921	$ 19.41	($15,612,509)	3.5%	$ 39.00	$ 57.00
15% Improvement	60,045	20.4	$ 39,033	$ 16.85	($3,071,298)	7.1%	$ 44.85	$ 65.55

Again the base case has a negative IRR so no further downside cases were examined.

Increasing revenue and lowering costs had a similar impact for the 20 MW case as it did in the 50 MW scenarios. However, even after increasing the power price to 15% above the high case, removing all transmission costs and lowering capital and operating costs by 15%, the IRR was still only 7.1%, which may be too low to be of interest to investors. The 20 MW case is burdened by the fixed project costs.

8. SUPPLEMENTAL ANALYSIS – SMALL WIND

The Tribe is currently spending in excess of $90,000 a year in electric utility bills and this feasibility study for utility scale wind on tribal lands sparked a strong interest in exploring whether small wind could help the Tribe not only reduce those third party utility costs, but also help to build a sustainable development model for the future. As information was being collected and analyzed for the utility feasibility project, additional information was collected and analysis was performed to determine the feasibility of self-generation. This research included a detailed analysis of the Tribe's electricity usage, the potential sizes for a wind turbine installation, the regulations and requirements through the utility, as well as siting information for a turbine. This supplemental analysis presents the findings of that research and analysis.

8.1. Energy Sustainability

Energy Sustainability is the concept that energy can be provided and consumed without impacting the ability of future generations to meet their needs. Renewable energy is one avenue to sustainability; however, energy efficiency is also an effective method and oftentimes faster and lower cost than implementing renewable energy. The first step on the ladder to energy sustainability is understanding the Tribe's energy usage and identifying areas of waste and opportunities for shedding load or cutting usage without impacting normal business, such as replacing light bulbs, aging appliances, windows, etc. with more energy efficient options, and applying load shifting where possible. When normal operations have been optimized, then alternatives need to be examined where small investments can create long term energy savings, such as looking at processes and systems, and re-designing systems toward sustainability.

Integrating Tribal renewable energy generation is an exciting and interesting way to reduce the Tribe's carbon footprint and move toward sustainability from an electricity perspective. It should be noted that electricity is one aspect of energy usage –fuel in vehicles, LNG usage for heating and cool, and other areas of energy use can also be considered. Non-electricity energy usage is outside the scope of this study and is not discussed further.

Many renewable energy technologies focused on electricity generation are worth considering, including small wind, ground-source heat pumps, solar PV, and solar thermal for heating and cooling. The scope of this feasibility study is focused on wind power, and so this supplemental analysis will primarily focus on the feasibility of small wind, however other technologies will be mentioned where appropriate.

8.2. Electricity Consumption and Load

The first step toward understanding whether renewable energy is a suitable option for the tribe is determining the Tribe's current energy usage. Both the profile of usage (seasonal load, time of day (or diurnal) load, peak activities) and quantity of usage is important, as well as the actual cost of the electricity consumed. The Tribe is serviced by two electric utilities – the Central Rural Electric Cooperative (CREC), which has the bulk of the Tribe's load, and Oklahoma Gas and Electric (OGE). The

Tribe has approximately 24 accounts with CREC, which comprise the tribal complex and facilities south of Perkins, and 3 accounts with OGE, all of which are located in Perkins. The utility bills for all of the accounts were obtained and analyzed. Information for multiple years was obtained, and all information reviewed was from the period January 2008 to June 2012, although data was not available for each of the meters for this entire period. The billing is structured for both utilities with a fixed cost and a variable cost based on electricity usage. CREC calls its fixed cost a "Service Availability Fee" and the variable portion of the bill, based on the monthly kWh consumed is called the "Energy Charge". OGE has the same structure for one of the three accounts, however the fixed portion is titled the "Demand Charge" and the variable portion is an "Energy Charge".

8.2.1. Oklahoma Gas and Electric

OGE has a net metering program whereby residential customers can install up to a 25 kW system or any other industrial or commercial customer can install up to a 300 kW system, so the Tribe has the option of up to 300 kW of self-generation for its facilities within OGE. The customer is required to sign a standard Interconnection Agreement for Net Metering Facilities with the Utility. Any excess generation is credited back to the customer at the customer's rate schedule until the close of a monthly billing cycle, at which time any net excess generation credit expires. Any renewable energy credits created as a result of the net metering belongs to the customer, and so the Tribe could sell those RECs to another customer for an additional source of revenue.

The tribe holds three accounts with Oklahoma Gas and Electric. The service address for all three accounts are off of Highway 33 in Perkins, at the street addresses of 425 Highway 33 and 501 Highway 33. The Tribe has clinic facilities and the Office of Environmental Services at 425 Highway 33. The facilities at 501 Highway 33 include both a casino and an electric sign, which are metered separately. It was also noted that a smoke-shop was co-located with these facilities, however a separate meter was not identified for that facility. These two locations are in town and not ideal candidates for small wind due to noise and visual impact issues, although both facilities are located on the outskirts of town and may not have as much of an impact. The locations, however, may be suitable for a solar photovoltaic installation. In looking at the utility bills, it was found that each account has a different rate structure, which means that the rate paid for the electricity varies between the meters. A summary of the accounts, rate structures, usage and pricing is as follows:

Table 33: Summary of OGE Electricity Consumption and Rates

Service Address	Rate Structure	Average Rate ($ per kWh)[112]	Average Yearly Consumption (kWh)[113]
501 E. Highway 33	General Service Secondary Rate	$0.0827	96,960
501 E. Highway 33 #SIGN	Residential Rate	$0.1415	3,585
425 Highway 33	Power and Light Secondary Rate (includes demand charge)	$0.0826	160,200

Although an analysis for a photovoltaic facility is outside the scope of this grant, a very quick straight-line payback financial analysis was run for the two facilities with the largest load in order to determine if another renewable energy source could be utilized at these facilities instead of small wind due to the inherent siting issues. Those results are as follows:

Table 34: Straight-Line Payback for PV System at OG&E Facilities

Location	Approximate PV System Size (kWp) (DC)	Yearly Projected Energy Output (kWh-AC)[114]	Approximate Cost of System installed ($3.50/watt)	System Cost after Incentives[115]	Straight-line payback (years)
501 E. Hwy 33	65 kW	92,708	$227,500	$113,750	14.83
425 E. Hwy 33	110 kW	156,890	$385,000	$192,500	14.85

Photovoltaic systems are typically designed for 25 years, so this appears to be an attractive option and is worth further research. The net metering program from OGE facilitates a consideration of this project. The tribe would also be able to sell the RECS off of the project, however at the rate of $1.00 to $1.50/MWh it is probably not worth the administrative costs of doing so.

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[112] Rate varies, this is average over the time period analyzed.
[113] The yearly consumption was estimated based on 9 months of data. Bills were reviewed from October 2011 to June 2012 only.
[114] Calculated using PVWatts, City: Oklahoma_City: 0.77 DC to AC Derate Factor; Fixed Tilt Array
[115] Estimated 50% cost coverage under DE-FOA-0000852: Community Scale Clean Energy Projects in Indian Country. 50% match for projects greater than 50 kW; funds available from $50,000 to $1,500,000

8.2.2. Central Rural Electric Cooperative

Net metering has been available in Oklahoma since 1988 under Oklahoma Corporation Commission (OCC) Order 326195, however due to the fact that CREC is a rural electric cooperative, they have opted out of price regulation, which allows them to take exception to Order 326195. CREC has established a policy that customers seeking to connect a distributed generation facility to the utility must execute a Distributed Generation Interconnection Agreement, and within that agreement has the option to select either a net-metering agreement or a power purchase agreement[116]. A summary of these two options is as follows:

Table 35: Summary of CREC's Distributed Generation Policies

Facility Size	Options	Insurance Requirements	Treatment of Excess Power
< 25kW	Either Net Metering or Power Purchase Options	No additional Requirements	Meter will net during each billing period, however at end of billing period, any excess is sold to utility at avoided cost rates (not retail rates). Periods are typically one month.
25kW to 100kW	Power Purchase Compensation Method	Liability coverage minimum of $1 million required	Any excess energy not utilized by facility is sold to utility at avoided cost rates (not retail rates)
100kW +	Not applicable – must use a different interconnection process		

The net metering program with CREC is much less favorable than the program with OGE for two reasons:

1. Any excess energy not used within the billing period is sold to CREC at avoided cost vs. the rate that the customer is paying for that same electricity. The avoided cost rate is much less than the scheduled rate.
2. The OGE program[117] allows for a system capacity of up to 100 kW for net metering. CREC essentially restricts the net metering to 25 kW and then forces the generator to execute a power purchase agreement, in which case net metering is eliminated and any electricity generated in excess of load is paid at avoided cost.

Both programs have a single flaw which makes wind power less favorable than either solar PV or ground source heat pumps, and has to do with the profile of energy generation. Wind power tends to have a

[116] Central Rural Electric Cooperative Distributed Generation Interconnection Agreement & Guidelines Manual for Members, October 2012.
[117] "Standard Rate Schedule for Net Energy Billing Option (NEBO) for Producers of 300kW or Less", Issued July 19, 2012, Oklahoma Gas and Electric Company, Standard Pricing Schedule: NEBO, Net Energy Billing Option Rider

seasonal quality for generation – the resource will be a summer peaking or winter peaking, but steady wind through the year is not common for most wind resource areas. Solar power on the other hand, has fairly consistent generation month to month, with peaking generation in the summer months with longer days, but will generate year-round. Ground source heat pumps are even more stable than solar PV in their generation profile.

Both the OGE and CREC net metering program mandates net metering to occur only over a single billing period, which is one month. When the vast majority of wind generation occurs during one season, and this does not match the load profile, then a facility within CREC ends up spilling much of the electricity generated at avoided cost. The wind generator is basically penalized because seasonal fluctuations in generation are not averaged over more than one month. The diurnal fluctuations in this case are not as important; however, the month-to-month expected generation is very important to sizing the wind system.

An analysis of the Tribe's usage helps to highlight some of the limitations of small wind. The Tribe has approximately 24 customer accounts with CREC. Those facilities include the Tribal Complex, Pow-wow grounds, two water wells, the Eagle Aviary, the Fire and Police Stations, a Cemetery, and other facilities. CREC charges a fixed cost of $27/month per account service availability fee for being interconnected to their system, regardless of how much or how little power is drawn. In order to determine the actual cost paid by the tribe per kWh for their services at their various facilities, the $27/month charge was subtracted from each bill prior to calculating out the $/kWh paid by the tribe. Table 33 summarizes those accounts.

Table 36: Summary of CREC Consumption and Rates

Facility Name	Average Yearly Consumption (kWh)[118]	Average Rate ($ per kWh – Service Availability Fee)[119]
The Farm	9,008	**$ 0.1107**
Need address[120]	49,940	**$ 0.0853**
Multipurpose	81,680	**$ 0.0857**
Community Bldg	4,597	**$ 0.0882**
Youth Shelter	75,707	**$ 0.0867**
Pow-Wow	1,251	**$ 0.3719**[121]

[118] The yearly consumption was estimated based on 9 months of data. Bills were reviewed f21rom October 2011 to June 2012 only.
[119] Rate varies, this is average over the time period analyzed.
[120] "Need Address" is the reference on the utility bill. The account number is 1368600.
[121] The Pow-Wow bills have an additional charge titled a 'light charge' which runs approximately $30-35/month. This is skewing the rate.

Facility Name	Average Yearly Consumption (kWh)[118]	Average Rate ($ per kWh – Service Availability Fee)[119]
White Cloud	127,360	**$ 0.0851**
Northeast Water Well	14,969	**$ 0.1081**
Southwest Water Well	0	No power was used
Vocational Rehab	40,884	**$ 0.0854**
Multi-event Bldg	83,733	**$ 0.0852**
Cemetery Water Well	28	**$ 0.0851**
Office Annex	66,356	**$ 0.0851**
Police/Fire Bldg	26,976	**$ 0.1200**
7499 Pipestone Rd #1	2,565	**$ 0.0641**
7494 Pipestone Rd. #6	2,496	**$ 0.0665**
Child Development Ctr	131,947	**$ 0.0851**
Pow-Wow Arena	500	**$ 0.1068**
Eagle Aviary	19,787	**$ 0.0781**
7498 Pipestone Road #8	2,368	**$ 0.0623**
Sign - Hwy 177	5,056	**$ 0.0871**
Baseball field site	107	**$ 0.1000**
Chena Building	81,333	**$ 0.1107**

The seasonal energy use pattern for these facilities shows a strong trend. Figure 14: Seasonal Energy Usage Patterns shows the average energy usage per month using historical data from the period 2008 to 2012. This energy usage profiles have the greatest demand starting in June, peaking in late July, and exhibiting a steady decline from August to November, when the usage levels off somewhat. January may have a slightly higher load due to heating requirements.

Figure 14: Seasonal Energy Usage Patterns – Aggregated Demand

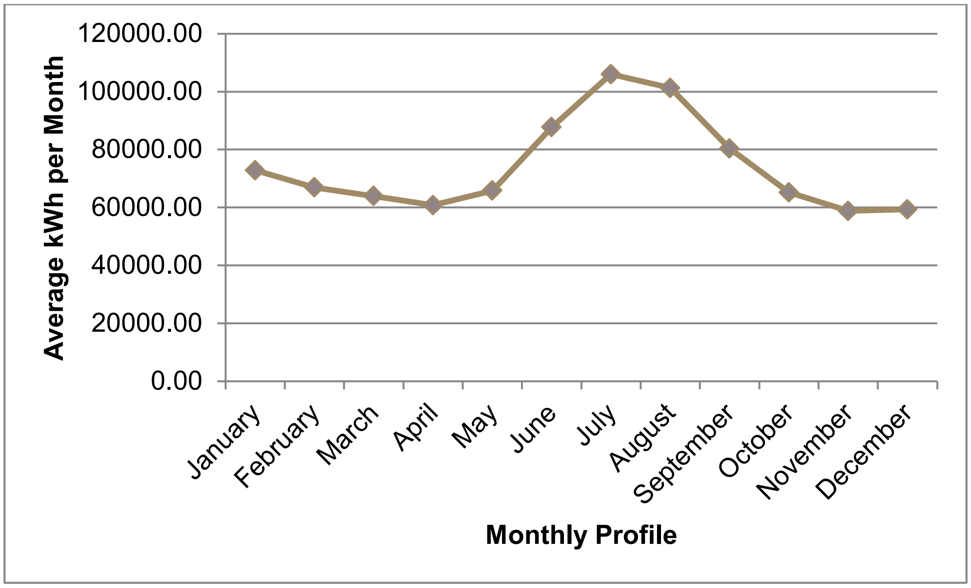
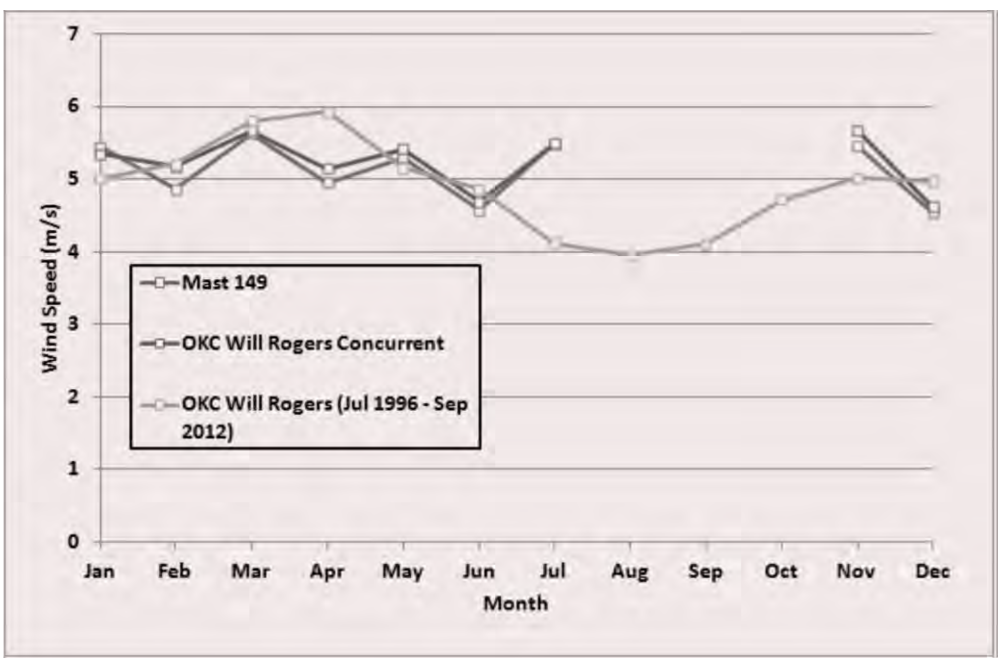


Figure 15 is a graph of the historical monthly wind speeds for the region, utilizing data from the met mast at Fallis and 16 years of historical data from the Will Rogers airport, which correlates well to the met mast over the same period. The graphic shows that historically the highest production months have been March and April, while the summer season from June through September has the lowest potential for wind production. The load from the Tribe and the wind generation profile are opposite, so the months when a turbine would be generating the most are the months when the Tribe's need for power is the lowest.

Figure 15: Historical Monthly Wind Speeds[122]



[122] "Preliminary Wind Resource Report", Figure 4, page 16. Author: AWS Truepower, dated September 20, 2012

In examining the utility costs, usage, and seasonal profiles, several conclusions can be drawn. The first is that a self-generation program that utilizes net metering needs to take into account seasonal energy use, and production profiles need to be layered onto the load profile to size the system such that base energy usage in the lowest month is not significantly exceeded. If the resource follows the load, that technology will have a strong advantage due to the fact that any excess generation in a particular month is given to the utility for little compensation. Since wind power generation does not follow the load, the wind turbine needs to be sized such that the maximum generation, which historically occurs in April does not exceed the minimum load, which also occurs in April.

It should be clarified that the aggregation of the data for electricity usage is not entirely representative of the actual situation and each of the 24 meters within CREC has its own yearly energy use patterns. This analysis however has helped to frame the limitations and requirements for the selection of a site and a turbine for the development of small wind. Those key finds are presented in Table 37.

Table 37: Key Findings - Electricity Consumption and Load

Key Findings	
1	A key criteria for wind turbine selection is that the capacity should fall below the 25kW limitation for net metering within CREC.
2	Each of the 24 individual meters requires analysis to determine which location has the best seasonal load profile to match the generation.
3	The turbine should be sized such that the month for highest generation does not exceed the lowest expected monthly usage.

8.2.3. Additional Observations and Recommendations

In addition to the key findings provided in Table 37, several ideas for cost savings can be drawn from the analysis of the electricity usage and cost. The first is that there are several accounts where little or no power is being drawn, however the tribe is paying a flat rate of $27/month for the service availability, which is the equivalent of $324/year per account. Reviewing these accounts for usage is the first opportunity for cost savings.

Table 38: Specific Opportunities for Cost Savings

Facility	Effective Rate of Electricity ($/kWh)	Comments
Southwest Water Well	$324/year for no benefit	No usage was experienced on this account for the period for which bills were reviewed. Research if this can be disconnected from service.
Cemetery Water Well	$11.66 per kWh	Over the period researched, 28 kW were utilized. Research if this can be disconnected from service and an alternative method like a solar or hand pump can be utilized.

Facility	Effective Rate of Electricity ($/kWh)	Comments
Baseball Field Site	$3.13 per kWh	All of the usage noted occurred in the month of April. With a heavy seasonal load, the Tribe should research the alternative of temporary service disconnection during the months when the facility is not utilized, or purchasing a portable generator for the games and disconnect permanently. A reconnection fee is $25, which is less than one month of the service availability fee.

Another observation that can be drawn from the data is that in aggregate form, the Tribe purchases approximately 829,000 kWh of electricity annually from CREC. That equates to more than $70,000 annually in expenses. If the Tribe has not already sat down with the utility to see what can be negotiated in terms of more favorable rates, it should do so. CREC has several rate schedules and the Tribe is a heavy consumer. The Tribe should be sure that it is considered as a single user, not 24 users, so that the most favorable rate schedule is utilized for all facilities.

A third observation is that the Tribe is just starting to scratch the surface of understanding its energy use patterns and ways to conserve energy and cut expenses. The business council should consider appointing an energy manager whose responsibility would be overall energy manager for the tribe. This role could be tasked with educating members about energy efficiency and savings, managing energy usage, implementing programs to conserve energy and reduce the tribe's carbon footprint, and help to reduce consumption overall.

8.3. Turbine Site Selection[123]

AWS Truepower was engaged by the Iowa Tribe to evaluate the use of small wind turbines for the Iowa Tribe of Oklahoma Wind Project located in Lincoln County, Oklahoma. The evaluation included the selection of a potential site for the deployment of a small wind turbine, the selection of several potential small wind turbine models, and annual energy estimates for each model.

Possible locations were evaluated using aerial imagery and information obtained by AWS Truepower and Solas Energy Consulting US Inc. (Solas) during visits to the site. The turbine location was selected by taking into consideration the proximity to the load and meter, noise constraints and minimizing obstacles that might impact performance. The selected location shown in

Figure 16: Location of Selected Wind Turbine meets these criteria as described below:

[123] This section primarily taken from the memo dated June 6, 2013, titled "Small Wind Turbine Recommendations for the Iowa Tribe of Oklahoma Wind Project" by AWS Truepower, with minor additions provided by Solas Energy Consulting.

Proximity to Load/Meter

The selected location is within approximately 100 m of a load center (tribal complex buildings), with close proximity to the tribal maintenance building. During the February 2013 site visit, AWS Truepower noted that at least one meter point was located within the tribal complex near the BKJ trailer; however, it was noted that additional electrical meters are located throughout the complex, including one in close proximity based on feedback from the Solas site visit.

Figure 16: Location of Selected Wind Turbine

Longitude and Latitude coordinates (35.929130, -97.024637)

Noise Constraints

The nearest buildings include a tribal maintenance building, meeting and office building, and health facilities. Noise from the turbine is not expected to be of significant impact to the facilities since they are not routinely occupied at night and will be subject to normal office noise levels when occupied (60-70 dB). The nearest sensitive receptors are the elder housing units located to the southwest of the proposed turbine location. Based on the wind direction distribution (wind rose) for this site, the wind primarily comes from the south (SSE to SSW) with occasional winds from the north-northwest and north. Because of this wind direction distribution, it is expected that minimal noise impacts will be experienced at the elder housing units.

Species and Habitat Assessment

Atwell completed a Species and Habitat Assessment[124] of the single wind turbine adjacent to the Iowa Tribal complex as shown in Figure 16. It included an approximate 0.3 mile collection line to the point of interconnection. A biologist visited the site on April 23 – April 25, 2013.

The project site lacks optimal habitat and provides limited potentially-suitable habitat for the least tern, the piping plover, and the whooping crane. The piping plover, least tern and whooping crane may pass within or adjacent to the project site as part of migration events, however their presence is unlikely due to the limited wetland and other aquatic habitats located within and adjacent to the project site. The potential presence of least terns on the nearby Cimarron River should not pose a problem because their occurrence at this location is rare, and the riverine habitat is preferable to habitat located within the project site. It is, therefore, unlikely that the proposed development would have an increased adverse impact on the least tern, the piping plover, and/or the whooping crane. Suitable habitat for the Texas horned lizard is available within the project site and harvester ant mounds, the preferred prey item for this lizard, were observed within the project site; additional informal coordination with the ODWC may be recommended to reduce potential adverse impacts to this species. In addition, the implementation of Best Management Practices (BMPs) within the project site is recommended during construction, operation, and maintenance activities to further reduce potential concerns for the Texas horned lizard, the least tern, the piping plover, and the whooping crane. If the project footprint is developed to impact the wetland feature observed on-site, a formal wetland delineation is recommended to determine the precise location of potentially-jurisdictional wetlands within the proposed construction footprint. Avoidance of wetlands and watercourse, including associated riparian corridors and/or floodplains located within the project site, is recommended to avoid potential permitting requirements through state and/or federal agencies.

Cultural Resources

Atwell performed a Phase I Pedestrian Archaeological Survey[125] for a single wind turbine adjacent to the Iowa Tribal complex. The project area encompasses 22 acres of land and includes a two-acre wind

[124] This section primarily taken from the report by Haas, Chris "Atwell Letter of Finding: Species and Habitat Assessment Iowa Tribe of Oklahoma Project, Single-Turbine Site Lincoln County Oklahoma" May 10, 2013

turbine pad and approximately 4,388 linear feet of underground collection line, including a 200-foot easement (100 feet on either side of centerline).

The Phase I archaeological survey conducted by Atwell was designed to identify and inventory cultural resources within the project area in order to comply with Section 106 of the National Historic Preservation Act (NHPA) and its implementing regulations (36 Code of Federal Regulations CFR Part 800).

A cultural resources records review conducted as part of this investigation did not identify previously-documented archaeological sites within the project area, nor did it identify historic properties listed on or eligible for listing on the National Register of Historic Places (NRHP) within one mile of the project area. A single archaeological survey has been previously conducted within a small portion of the project area.

The pedestrian archaeological survey indicated that the proposed turbine location is within a pasture currently grazed by bison (*Bison bison*). Additionally, the survey indicated that the proposed collection line routes have a large amount of previous disturbance. Archaeological or historic resources were not identified within the project area. Therefore, Atwell recommends that the proposed project be allowed to proceed as planned without further archaeological investigations, provided that 1) the project layout is not altered beyond the area surveyed during this investigation, or 2) no archaeological discoveries are made during project construction. It is possible, due to the nature of archaeological manifestations, that buried cultural deposits could be encountered during construction. If that occurs, we recommend construction should cease in the immediate area, the artifacts left in place, and the client's representative archaeologist be contacted immediately so that appropriate actions can be carried out as soon as possible.

Minimize Upwind Obstacles[126]

The proposed location is in an open field with some scattered trees to the west and southwest and the tribal complex buildings to the east. No nearby obstacles are located upwind of the turbine from the prevailing or secondary wind directions discussed above.

8.4. Turbine Selection[127]

The selection criteria for choosing an appropriate small wind turbine for the site were split into two main categories: the site limitations and technology requirements of the site, and the credibility and capability of the small wind vendor.

As discussed in the Key Findings in Table 37: Key Findings - Electricity Consumption and Load, the requirements of the Iowa Tribe of Oklahoma site limit the selection of the turbine technology to single phase turbines that are rated at 25 kW or less. The 25 kW limit is due to the net metering restrictions of

[125] Banks, Benjamin D. (Atwell) "Phase I Pedestrian Archaeological Survey with Shovel Testing for the Iowa Tribe of Oklahoma Wind Energy Project Wind Turbine Generator 1 Lincoln County, Oklahoma" April 24, 2013.
[126] ibid 123
[127] ibid 123

the local utility, and the available grid access at the site dictates that the turbine must be single phase. At the time of this report, additional information was not available regarding the ability to increase the kW level limitation by the utility, combine metering points, or adjust to 3-phase power. Based on status update meetings, AWS Truepower understands that Solas has requested permission to discuss alternate options with the local service provider.

In determining a suitable turbine for the site, AWS Truepower only considered small wind turbines that have been certified to AWEA 9.1 standards or have demonstrated their intent to achieve certification. The two active certifying bodies of AWEA 9.1 standards are Intertek and the Small Wind Certification Council (SWCC). AWS Truepower does not recommend buying a small wind turbine until it has achieved full certification.

One of the most important considerations of purchasing a small wind turbine is the understanding of the maintenance requirements for the turbine and how the turbine can be serviced or repaired if something should break at any point during its expected life (approximately 20 years). This includes understanding the turbine warranty coverage, the proximity of the site to technicians certified on the turbine, the capability of the owner to maintain the turbine, the availability of spare parts for the turbine, and how changes to these considerations could affect the turbine over time.

AWS Truepower focused the turbine selection based on the criteria above. The following turbine models were considered potentially viable options. Table 39 provides an overview of the specifications for each turbine model.

- Jacobs 31-20
- Endurance S-343 (5.4 kW)
- Bergey Windpower Company Excel 10

It should be noted that the Southwest Windpower Skystream 3.7 turbine was not included in this list as Southwest Windpower has closed their doors for business.

Table 39: Turbine Specifications

Turbine Specifications	Jacobs 31-20	Endurance S-343	BWC Excel 10
Peak Power	20 kW	5.9 kW	12.6 kW
Rated Power[128]	12 kW	5.4 kW	8.9 kW
Generator Type	Brushless AC Synchronous with outbound exciter	Dual mode, Induction Generator	Permanent Magnet Alternator
Yaw Control	Passive Tailvane	Passive Tailvane	Passive Tailvane
Rotor Diameter	9.5 m	6.37 m	7 m

128 The rated power of a small wind turbine is defined by AWEA Standard 9.1-2009, and is the power output at 11m/s.

Turbine Specifications	Jacobs 31-20	Endurance S-343	BWC Excel 10
Pitch Control	Variable Pitch	Stall Control	Stall Control
Rotor Speed	175-185 RPM	166 RPM	0-400 RPM
Towers	80ft, 100ft, 120ft, Lattice Tower	102ft or 120 guyed tower, 90ft monopole	60ft to 160ft guyed lattice, self supporting lattice, or monopole
IEC Class	II	Survival Speed 52m/s	Surival Speed 60 m/s
Wind Speed (cut-in, cut-out)	3.5 m/s	4.1 m/s, 25 m/s	2.5 m/s, Furling speed 15.6 m/s
Nominal Frequency	60 Hz	1 phase, 60 Hz	1 phase, 60 Hz
Nominal Voltage	240 VAC	120/240VAC	240 VAC
Apparent Noise Level	-	-	42.9 dBa
Temperature Range of STD	-10˚ C to 45˚ C	-	-40˚ C to 60˚ C

Key advantages and disadvantages for each turbine were assessed by gathering information from online resources and by contacting manufactures and turbine vendors. Table 40 provides an overview of these advantages/disadvantages as well as approximate costs for each model.

Table 40: Turbine Considerations and Costs

Turbine	Advantages	Disadvantages	Cost
Jacobs 31-20	5 year limited warranty covering turbine and inverter. Covers both material and labor. WTIC has been producing and distributing it since 1986. Certified to AWEA 9.1 standards by Intertek[129].	Nearest dealer is in North Texas - about 4 hours 20 minutes away. AWST was unable to confirm whether the dealer provided maintenance and repair services.	Prices range from \$63,525 – \$93,250[130] depending on tower height and tower type. Includes turbine, tower, and inverter. Total cost including installation is typically around \$110,000[131].
Endurance S-343	5 year warranty/service maintenance agreement, parts and labor A significant number of turbines installed in Oklahoma Endurance has a partnership network	Nearest dealer is in Greensburg, Kansas (BTI Wind Energy) – about 4.5 hours away from site	Prices range from \$50,000-\$60,000 installed, depending on foundation type, tower choice, and other installation costs

129 Intertek, www.intertek.com/wind/small/directory, June 6, 2013
130 WTIC, www.windturbine.net, June 6, 2013
131 Jacobs 31-20, www.2jcbs.com, June 6, 2013

Turbine	Advantages	Disadvantages	Cost
	of dealers and distributers that provide installation, maintenance, and support services. Notable partners include BTI Wind Energy and John Deere. Certified to AWEA 9.1 standards by the SWCC		
BWC Excel 10	All information available on Bergey website (pricing, manuals, instructions) 10 year warranty on blades and mechanical components, 5 year warranty on electronic components and towers supplied by BWC. Bergey office/factory is in Oklahoma, one hour from Lincoln County Widely deployed in Oklahoma and long operating track record in the US. Direct drive, permanent magnet Certified to AWEA 9.1 standards by the SWCC		$31,000 with inverter, towers range from $10,000 to $35,000[132]. Does not include installation or foundation costs.

Each of the turbine models provided in Table 40 offer distinct advantages and disadvantages compared with other competing models. While turbine selection is largely governed by economics, it is also important to thoroughly understand the operating needs of the turbine and what the requirements will be to maintain the turbine throughout its design life. The resources available at the BKJ site, including capabilities of technical staff, should heavily factor into the final turbine selection. A maintenance and repair strategy should be in place that outlines both short term and long term plans. Details including who is responsible for servicing the turbine, how costly is it to send a technician to the site, and how costly are repairs should be considered early in development. For small wind installations, these considerations can often have a larger impact on the long-term economics of the project than the initial differences in capital cost or energy production.

8.5. Energy Estimates[133]

Production estimates for each turbine were completed using the AWS Truepower *windTrends* dataset and *Virtual Met Mast + Energy (VMM+E)* software. All production estimates assume the proposed turbine location provided in Figure 16.

132 Bergey, Retail List Price, Jan 1, 2013
[133] ibid 127

Losses for the small wind turbine were lumped into two categories; an availability loss and an electrical loss. An availability loss of 10% was assumed for all models with a standard deviation of 2.3% and an electrical loss of 0.5% was assumed for all models. The electrical loss was applied as a bulk loss after the availability loss was applied. Table 41 provides a summary of the production results. The energy production uncertainty was not specifically calculated for this site; however, it should be noted that uncertainty in both wind speed and performance factors can have a significant effect on production. AWS Truepower uses a standard uncertainty of 20% for feasibility level analyses.

Table 41: Summary of production results

Energy Results / Turbine	Jacobs 31-20	Endurance S-343	Bergey Excel 10
Net Capacity Factor[134] (%)	7.4	13.8	10.2
Peak Output (kW)	20.2	5.9	12.6
Hub Height (m)	30	30	30
Annual Gross Energy Production (KWh)	14,600	8,000	12,600
Loss Estimate (%)[135]	10.4	10.4	10.4
Annual Net Energy Production (kWh)	13,100	7,100	11,300

8.5.1. Key Findings – Energy Production

A 30% federal Investment Tax Credit (ITC) is available for small wind, however the Tribe does not pay federal taxes and so that program is not applicable. The Tribe can take advantage of the local net metering provision, and can also apply for the Community Scale Renewable Energy Projects grant program as outlined in footnote 115. A small wind turbine location is proposed, placing the turbine due west of the Iowa tribal complex, which minimizes the interconnection distance and places the turbine free of obstructions from the prevailing wind direction. Considerations for several small turbine models are provided, detailing key decision criteria that should be weighed when selecting an appropriate turbine. Finally, approximate costs and annual energy estimates are provided for each model which can be used to evaluate the economic feasibility of the proposed small wind installation.

134 The net capacity factor (NCF) is the ratio of the actual annual energy output of a site, with losses, to the maximum possible output (rated capacity) if the turbines operate at full capacity at all times.
135 Losses associated with the inverter are assumed to already be included in the power curve

8.6. Small Wind Straight-line Payback

Table 42: Small Wind Straight-Line Payback

Manufacturer	Turbine Size	Yearly Projected Energy Output (kWh)	Approximate Cost of Turbine Installed	System Cost after Incentives[136]	Straight-line payback (years)[137]
Endurance	5.9 kW	7,100	$60,000	$30,000	49.71
Bergey	12.6 kW	11,300	$80,000	$40,000	41.65
Jacobs	20.2 kW	13,100	$110,000	$55,000	49.39

8.7. Final Conclusions on Small Wind

It does not appear that small wind at this site is an attractive option at this time. The underlying reason for the less desirable economics is the fact that this is a low wind speed site, especially at the 30-m level, which is the standard hub-height for small wind. The small wind market does not offer the technology available in the utility-scale market to optimize lower wind speeds. Capacity factors for the technologies researched ranged from 7.4% to 13.8%, which does not justify the expense. The straight-line payback in Table 42 considers a 50% capital cost grant match under the tribal energy program through the DOE.

The Tribe should first avail itself of every option to minimize energy usage and to actively manage their demand to reduce costs. Furthermore, a renewable energy option that appears to be significantly more attractive than small wind is solar PV. As demonstrated in Table 34, the straight-line payback for PV is under 15 years, which is well within the design life of the technology. Solar PV could be installed on the facilities both in OGE territory and CREC. The load in OGE could be almost completely offset with solar PV, and the seasonal load profile for those facilities mirrors the solar resource, which is also summer peaking, and helps to minimize the energy spilled to OGE due to the monthly true-up net metering provisions.

Multiple Tribal buildings are in the CREC service territory, each of which is separately metered and has varied electricity consumption. Although each PV installation would be behind individual building meters, the tribe could view the installation of solar PV at the Tribal complex as one project, thereby lowering the unit costs to install.

[136] Estimated 50% cost coverage under DE-FOA-0000852: Community Scale Clean Energy Projects in Indian Country. 50% match for projects greater than 50 kW; funds available from $50,000 to $1,500,000

[137] Assumed connection to the White Cloud building, offsetting projected energy by the power rate of $0.085/kW.

smartenergysource

Commercial Alternative Energy Analysis

PREPARED FOR THE

Iowa Tribe of Oklahoma

August 1, 2014

Prepared by

Jeff Pollard, PE, VP of Engineering
Ray Chambers, CEM, CEP, CEA, Commercial Energy Advisor
Randy Jarvis, VP of Corporate Development

1.0 Executive Summary

This report was compiled for the Iowa Tribe of Oklahoma by Smart Energy Source LLC (SES) certified energy professionals, Stillwater, Oklahoma. Information was provided to SES by the Iowa Tribe of Oklahoma in regard to the Iowa Tribe Wind Project Report prepared by AWS Truepower for Johnson Controls dated March 27, 2013 and the Wind Study Report for the Iowa Tribe of Oklahoma Wind Project provided to the Bureau of Indian Affairs by Solas Energy Consulting U.S. Inc. dated June 26, 2013. This information was used to compare the economic viability of stand-alone and utility grade wind and solar power generation systems when compared to the Iowa Tribe of Oklahoma connected meter loads as documented by Central Rural Electric Cooperative.

This report discusses the alternative energy systems as outlined in the scope of work. The information enclosed is intended to help the Iowa Tribe of Oklahoma achieve its energy efficiency objectives of reducing overall energy use and allow for a defined strategic energy plan going forward.

2.0 Scope of Work

The objective of this report is to define the viability of alternative energy systems in relationship to the Iowa Tribe of Oklahoma's historical electrical usage of individual meters and the aggregated load of all meters on the Central Rural Electric Cooperative's electrical distribution grid.

SES utilized the information in the referenced reports in addition to billing data provided by CREC and cost estimates associated with potential system impacts. These resources were used to develop assessments on wind and solar projects.

Facility Meter Data

The tables below show Iowa Tribe accounts with CREC. Annual kWh use and dollars spent are shown for each account.

Iowa Tribe of Oklahoma Accounts

Account	Account Number	Map Location	Electric Rate	Annual kWh Use	Annual $ Spent
Transitional Living	3142800	42 19 16	SMC 4	0	$354.96
Cemetery Water Well	2237100	42 14 08	SMC 4	63	$362.18
Chena Building	3192600	42 30 12	SMC 4	660	$414.07
Southwest Water Well	2194300	42 30 06	SMC 4	1,076	$442.55
Pow Wow Arena	2448900	42 30 09	SMC 4	1,355	$473.98
Pow Wow Area	1906500	42 30 04	SMC 4	2,227	$556.68
Gate at Eagle Aviary	3231100	42 19 18	SMC 4	2,444	$567.45
Sign-Hwy 177	2988600	42 30 10	SMC 4	2,632	$581.87
Community Building	1764000	42 22 06	SMC 4	4,107	$708.56
Fire Station	3217600	42 19 17	SMC 4	4,540	$733.64
The Farm	414207	42 19 03	SMC 4	8,934	$1,134.67
Northeast Water Well	2194100	42 30 05	SMC 4	13,837	$1,538.56
Baseball Field Site	3072600	42 30 11	SMC 4	22,960	$2,325.01
Vocational Rehab.	2202600	42 19 09	SMC 4	48,901	$4,586.49
Need Address	1368600	42 19 04	SMC 4	53,379	$4,891.46
Police/Fire Building	2281200	42 19 10	SMC 4	55,925	$5,224.13
Office Annex	2280800	42 19 11	SMC 4	62,566	$5,759.58
Multi-event Building	2222200	42 30 07	SMC 4	62,800	$5,773.77
Multipurpose Building	1623200	42 19 05	SMC 4	77,360	$7,088.79
Eagle Aviary	2617100	42 19 15	SMC 4	79,120	$7,085.02
Youth Shelter	1777000	42 19 06	SMC 4	86,564	$7,842.92
White Cloud	1912100	42 19 08	SMC 4	135,520	$12,148.90
Child Development Center	2427701	42 19 13	SMC 4	138,840	$12,267.97
			Totals	865,810	$82,863.21

Iowa Tribal Enterprises Accounts

Account	Account Number	Map Location	Electric Rate	Annual kWh Use	Annual $ Spent
607 E 116th St-Flea Market	2264103	41 01 11	SMC 4	476	$401.74
607 E 116th St-Gallery	740405	41 01 05	SMC 4	927	$435.70
Office Building RV Site	3048700	41 01 13	SMC 4	6,072	$868.34
607 E 116th St-RV Park	2373102	41 01 12	SMC 4	224,000	$19,504.47
			Totals	231,475	$21,210.25

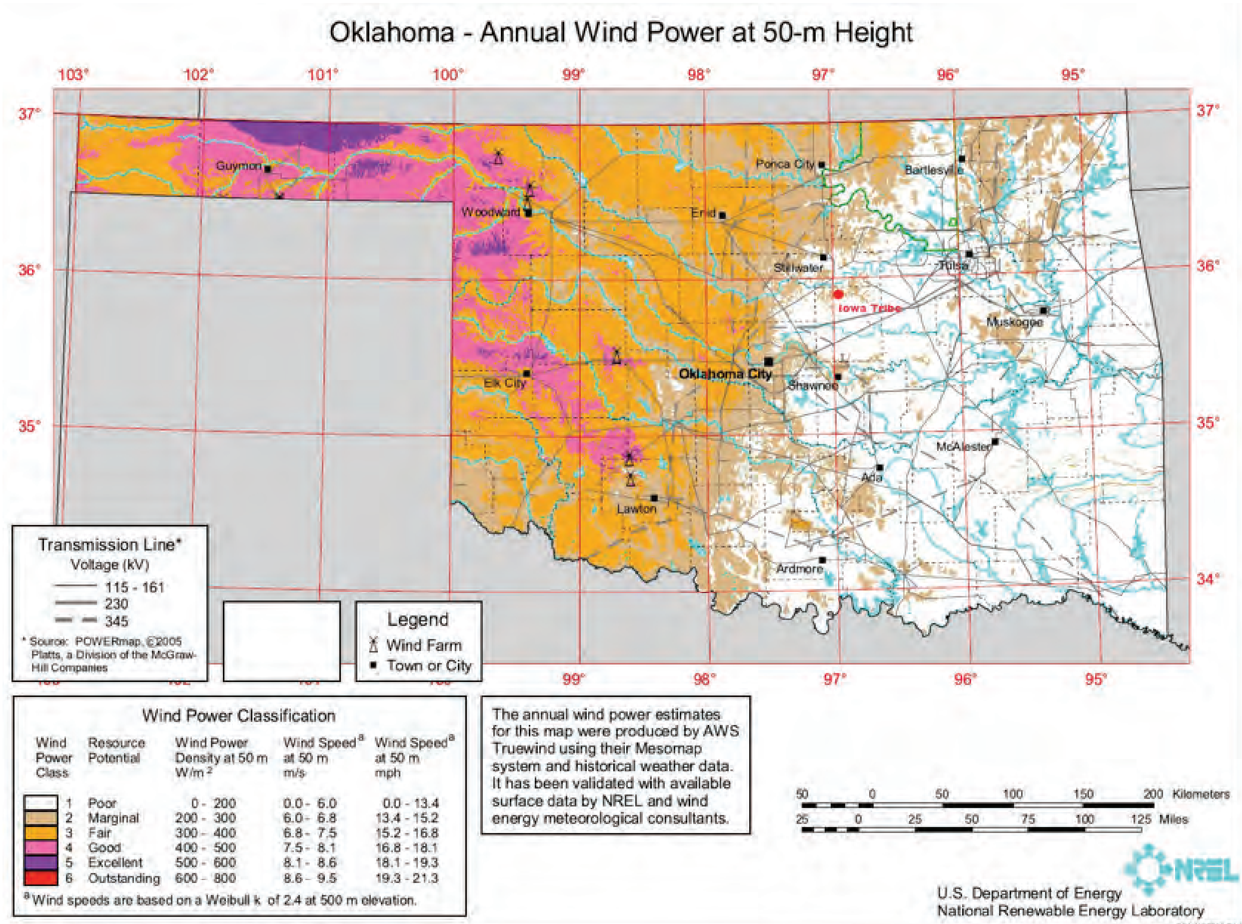


Figure 1 – *Courtesy the National Renewable Energy Laboratory for the Department of Energy*

Interpretation

In Figure 1, research from the National Renewable Energy Laboratory for the Department of Energy maps the Oklahoma annual wind power at 50-m height, which conclusively shows the Iowa Tribal Complex has poor to marginal wind resource potential.

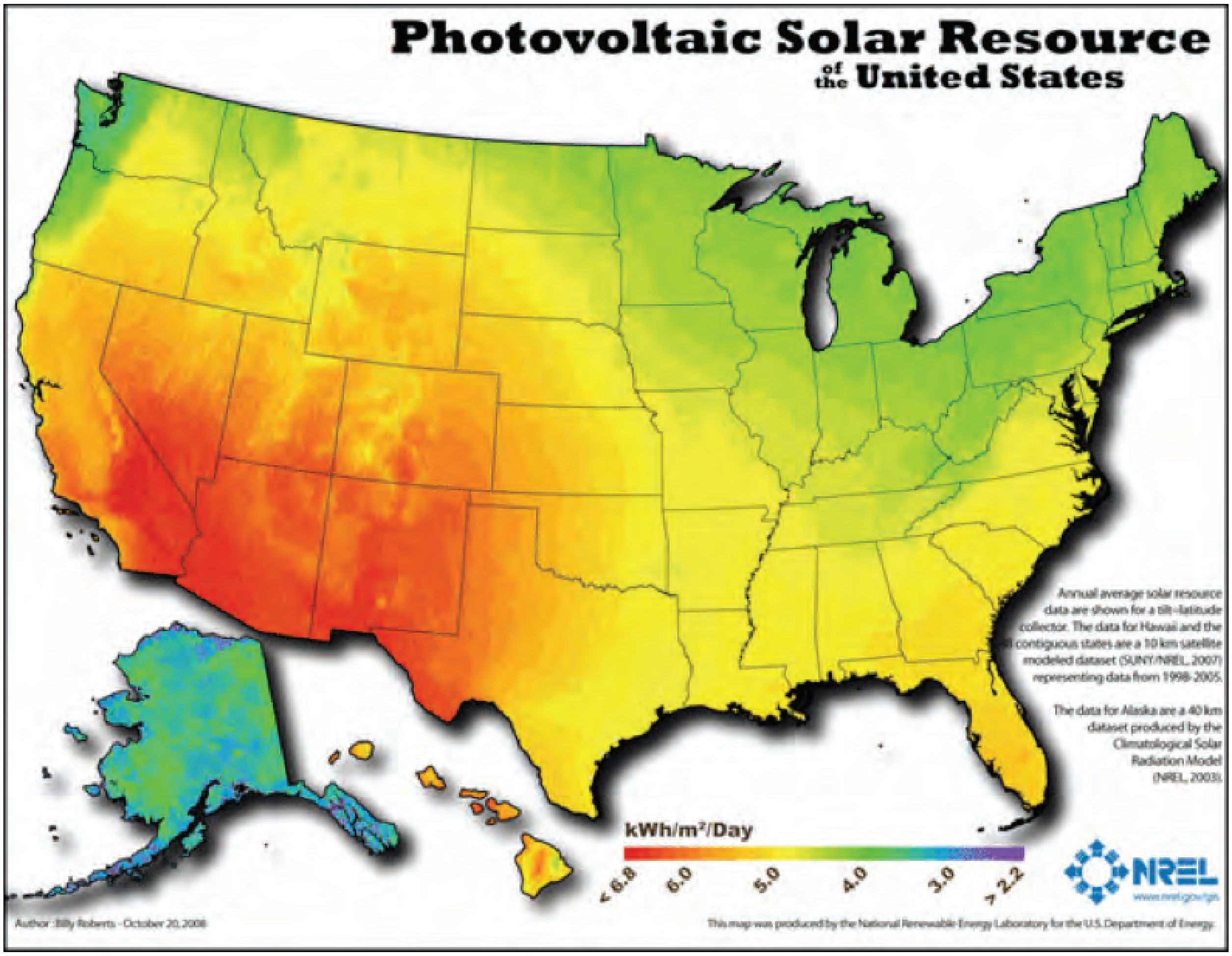


Figure 2 – *Courtesy the National Renewable Energy Laboratory for the Department of Energy*

Interpretation

In Figure 2, research from the National Renewable Energy Laboratory for the Department of Energy shows the Iowa Tribal Complex is located in an area where there is approximately 5 kWh/m2/day.

Assessment Resources

Facility and electric meter data was used to identify actual aggregated load for contiguous and non-contiguous electrical meters located on Central Rural Electric Cooperative's distribution grid to provide base load, peak and operational electrical use.

Wind and solar characteristics used in the report were supplied in the two alternative energy wind and solar data projects reports. The titles for each report only list wind; however, there is a section dedicated to solar (photovoltaic) projects in both. The reports are:

- Iowa Tribe Wind Project report prepared by AWS Truepower for Johnson Controls dated March 27, 2013
- Wind Study Report for the Iowa Tribe of Oklahoma Wind Project provided to the Bureau of Indian Affairs by Solas Energy Consulting US Inc. dated June 26, 2013

Green House Gas Emissions

- The web link, http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results provides the path to the Environmental Protection Agency calculator used to calculate carbon dioxide equivalent (CO2e) reductions in relationship to energy reduction projects.

Reference Reports

Project costs are estimates only using industrial averages and standards; however, SES always recommends bids from multiple contractors on any project to ensure a competitive and economical priced structure.

Assessment Constants

- Current load profiles for the metered locations served by Central Rural Electric Cooperative's distribution system, January 2013 through December 2013.
- Cost per watt for installed wind and solar systems are $3 per watt. The prices of solar systems are typically less expensive (per unit) for larger systems than smaller systems (economy of scale).
- Typical residential cost for electrical generation by wind is $4 per watt produced/installed – this cost is typically in the $5 to $6 range, based on research analysis of average cost across the United States.
- Typical, utility grade cost for electric generation by wind is $3 per watt. (large scale)
- Typical residential cost for electrical generation by solar is $4 per watt produced/installed – this cost is typically in the $7 to $9 range based on research analysis of the average cost across the United States.
- Typical utility grade cost for electrical generation by solar is $3 per watt. (large scale)
- Capacity factor for wind is 37.4 percent (capacity factor is the difference from time of actual use compared to full production) based on referenced report findings.
- Capacity factor for solar is 94 percent - First year (capacity factor is the difference from time of actual use compared to full production) based on referenced report findings.
- The estimated cost of interconnection engineering study (KAMO Power), $50,000.
- The estimated cost of interconnection substation (KAMO Power), $2,000,000.
- The estimated cost of distribution line per mile (CREC), $120,000.
- The estimated cost of transmission line per mile (KAMO Power), $350,000.

- Potentially, more costs could be associated with infrastructure upgrades depending on the results of the Interconnection Engineering Study.
- The estimated avoided cost of power is $0.02 per kWh.

Wind and Solar Assessments

The methodology of any assessment will provide a base line of information, or experimental control point, which can be used to gauge any study or assessment in the future to present conditions. The analytical process for current or future projects will be measured against this base line to validate project economics, processes and feasibilities that allow decision makers to realize estimated and or target savings potential.

SES has developed four alternative energy assessments from information included in the referenced reports. Additional historical energy use data and estimated distribution and transmission system impact costs were provided by Central Rural Electric Cooperative. This data was used in the wind and solar net metering assessments.

The assessments include:

- A. Wind – Utility Revenue Grade System
- B. Wind – Net Metering Contract
- C. Solar – Utility Revenue Grade System
- D. Solar – Net Metering Contract

Each assessment has an evaluation followed by a calculation worksheet. Each assessment includes an estimated cost for the generator plant, utility related system impact costs, the total project cost, revenue when applicable, payback in years and a return on investment.

A. Wind - Utility Revenue Grade System - Cost Avoidance Contract

This assessment is based on the installation of 11 1.62MW GE1.6-100 turbines as specified in the referenced reports. As a result of the local wind characteristics documented in the referenced reports, the system will operate at a 37.4 percent production factor, and based on the production factor the system will produce 57.6MWh per year. The system will have an estimated payback of 32 years with a ROI of 3.2 percent.

Evaluation

Project Description	Cost/Revenue
Generator Plant Cost (equipment only at $1.83 per watt installed)	$32,967,000
Transmission Line Cost ($350,000 per mile – 2.5 miles)	$875,000
Interconnection Study (Impact to system)	$50,000
Interconnect Substation	$2,000,000
Maintenance and Operations (average per year is 1.7% of capital for 25 years)	$560,439
Total Project Cost	**$36,452,439**
Revenue (Cost avoidance contract, estimated at $0.02 per kWh) per year	$ 1,151,657
Payback = 32 years	
ROI = 3.2%	

Calculation Worksheet

A. WIND	Count	MWh	kWh	# miles	$/mile		
Generator Plant $ @ $1.85/watt	11	17,820	6,771,600			$32,967,000	
37.4% of max kWh ->		6,665	6,664,680				
Overhead cost for Line (Transmission)				2.5	$350,000	$875,000	
Interconnection study						$50,000	
Plant substation						$2,000,000	
Maint. & Ops (per year avg - 25 yrs ops)						$560,439	
Production factor =	37.4%				Total	**$36,452,439**	
kW	2,493	MWh	GWh				
kWh/yr	57,582,835	57583	57.6		Yrs		
		ROI	**3.2%**	Payback	**32**	**$1,151,657**	@ $0.02/kWh
				GHG avoidance	15,466.7	Metric Tons of CO_2e	

B. Wind - Net Metering Contract

This analysis is based on the installation of one 1.62 MW GE1.6 turbine as specified in the referenced reports. As a result of the local wind characteristics documented in the referenced reports, the system will operate at a 37.4 percent production factor, and based on the production factor the system will produce 5.23 MWh per year. The system will have an estimated payback of 51.9 years with a ROI of 1.9 percent.

Evaluation

Project Description	Cost/Revenue
Generator Plant cost (equipment only at $1.85 per watt installed)	$ 2,997,000
Distribution Line Cost ($120,000 per mile – 2.5 miles)	$300,000
Interconnection Study (impact to system)	$50,000
Interconnection Substation	$2,000,000
Maintenance and Operations (average per year is 4.7% of capital for 25 years)	$50,949
Total Project Cost	**$5,397,949**
Net Metering cost reduction contract	
Payback = 51.9 years	
ROI = 1.9%	

Calculation Worksheet

B. WIND	Count	kWh		# miles	$/mile		
Generator Plant $ @ $1.85/watt	1	1,620				$2,997,000	
37.4% of max kWh ->		606					
Overhead cost for Line (Distribution)				2.5	$120,000	$300,000	
Interconnection study						$50,000	
Plant substation						$2,000,000	
Maint. & Ops (per year avg - 25 yrs ops)						$50,949	
Production factor =	37.4%	MWh	GWh		Total	**$5,397,949**	
kW	227	5,234.80	5.23				
kWh/Mo	436,234				Yrs		
kWh/Yr	5,234,803	ROI	**1.9%**	Payback	**51.9**		
				GHG avoidance	1,406.1	Metric Tons of CO_2e	

C. Solar - Utility Revenue Grade System - Cost Avoidance Contract

This assessment is based on the installation of 79,662 Yingli YL-280p solar modules. As a result of the local solar intensity characteristics documented in the referenced reports, the system will operate at a 94 percent production factor the first year, and based on the production factor the system will produce 20.9 MWh per year. The system modules will degrade over time. After 10 years, the systems will operate at an estimated production factor of 91.2 percent. Support system cost (frame/rack system) for solar panels are not known at this time. The system will have an estimated payback of 77.3 years with a ROI of 1.3 percent.

Evaluation

Project Description	Cost/Revenue
Generator Plant Cost (equipment only at $3 per watt installed)	$66,916,080
Transmission Line Cost ($350,000 per mile – 2.5miles)	$875,000
Interconnection Study (Impact to system)	$50,000
Interconnect Substation	$2,000,000
Maintenance and Operations (average per year is 1.7% of capital for 25 years)	$1,137,573
Total Project Cost	**$70,978,653**
Revenue (Cost Avoidance Contract, estimated at $0.02 per kWh) per year	$918,356
Payback = 77.3 years	
ROI = 1.3%	

Calculation Worksheet

C. SOLAR	Count	MWh	kWh	# miles	$/mile		
Generator Plant $ @ $3.00/watt	79,662	22.3	22,305			$66,916,080	
94% of max kWh -> (First Year)		21.0	20,967				
Overhead cost for Line (Transmission)				2.5	$350,000	$875,000	
Interconnection study						$50,000	
Plant substation						$2,000,000	
Maint. & Ops (per year avg - 25 yrs ops)						$1,137,573.36	
					Total	**$70,978,653**	
kW	20,967						
kWh/yr	45,917,814				Yrs		
		ROI	**1.3%**	Payback	**77.3**	$918,356	@ $0.02/kWh
				GHG avoidance	32,977.3	Metric Tons of CO_2e	

D. Solar Net Metering Contract

This assessment is based on the installation of 980 Yingli YL-280p solar modules. As a result of the local solar intensity characteristics documented in the referenced reports, the system will operate at a 94 percent production factor the first year, and based on the production factor the system will produce 1.1MWh per year. The system modules will degrade over time. After 10 years, the systems will operate at an estimated production factor of 91.2 percent. Support system cost (frame/rack system) for solar panels are not known at this time. The system will have an estimated payback of 31 years with a ROI of 3.2 percent.

Evaluation

Project Description	Cost/Revenue
Generator Plant Cost (equipment only at $3 per watt installed)	$823,200
Distribution Line Cost at $120,000 per mile – 2.5 miles)	$300,000
Interconnection Study (impact to system)	$50,000
Interconnection substation	$2,000,000
Maintenance and Operations (average per year is 4.7% of capital for 25 years)	$38,690
Total Project Cost	**$3,211,890**
Net Metering cost reduction contract	
Payback = 31 years	
ROI = 3.2%	

Calculation Worksheet

D. SOLAR	Count	kWh/day	ft^2	# miles	$/mile		
Generator Plant $	980	3,293	7,840			$823,200	@ $3.00/Watt
94% of max kWh -> (First Year)		3,095					
Overhead cost for Line (Distribution)				2.5	$120,000	$300,000	
Interconnection study						$50,000	
Plant substation						$2,000,000	
Maint. & Ops (per year avg - 25 yrs ops)						$38,690	
					Total	**$3,211,890**	
kW	258						
kWh/Mo	91,928				Yrs		
kWh/yr	1,103,141	ROI	**3.2%**	Payback	**31**		
				GHG avoidance	792.3	Metric Tons of CO_2e	

Considerations

The following items should be considered in determining the feasibility of alternative sources of power generation for the Iowa Tribe of Oklahoma.

- **Availablility of sustained wind at height of installation** – The observed mean wind speed provided by the AWS Truepower Report, Iowa Tribe of Oklahoma, Johnson Controls, March 27, 2013 at their measurement location (WGS84, Zone 14 – Easting 669343, Northing 3958302), page 1.
- **Cost of electric grid infrastructure upgrades** – Information and cost estimates provided by Jeff Pollard PE, System Engineer - Central Rural Electric Cooperative.
- **Initial cost of alternative energy projects** – The information provided for estimating the cost per watt for alternative energy is from the U.S. Energy Information Administration, "Levelized Cost of New Generation Resources in the Annual Energy Outlook 2013" published January 2013. http://www.eia.gov/forecasts/aeo/data.cfm

A key question must be answered by the collective body of the Iowa Tribe of Oklahoma before moving forward with any project. Does the development of a wind farm or solar park agree with the Iowa Tribe of Oklahoma's commitment to the environment?

Maps and Aerial Views

The following maps and aerial views show CREC infrastructure in comparison to Iowa Tribe facilities.

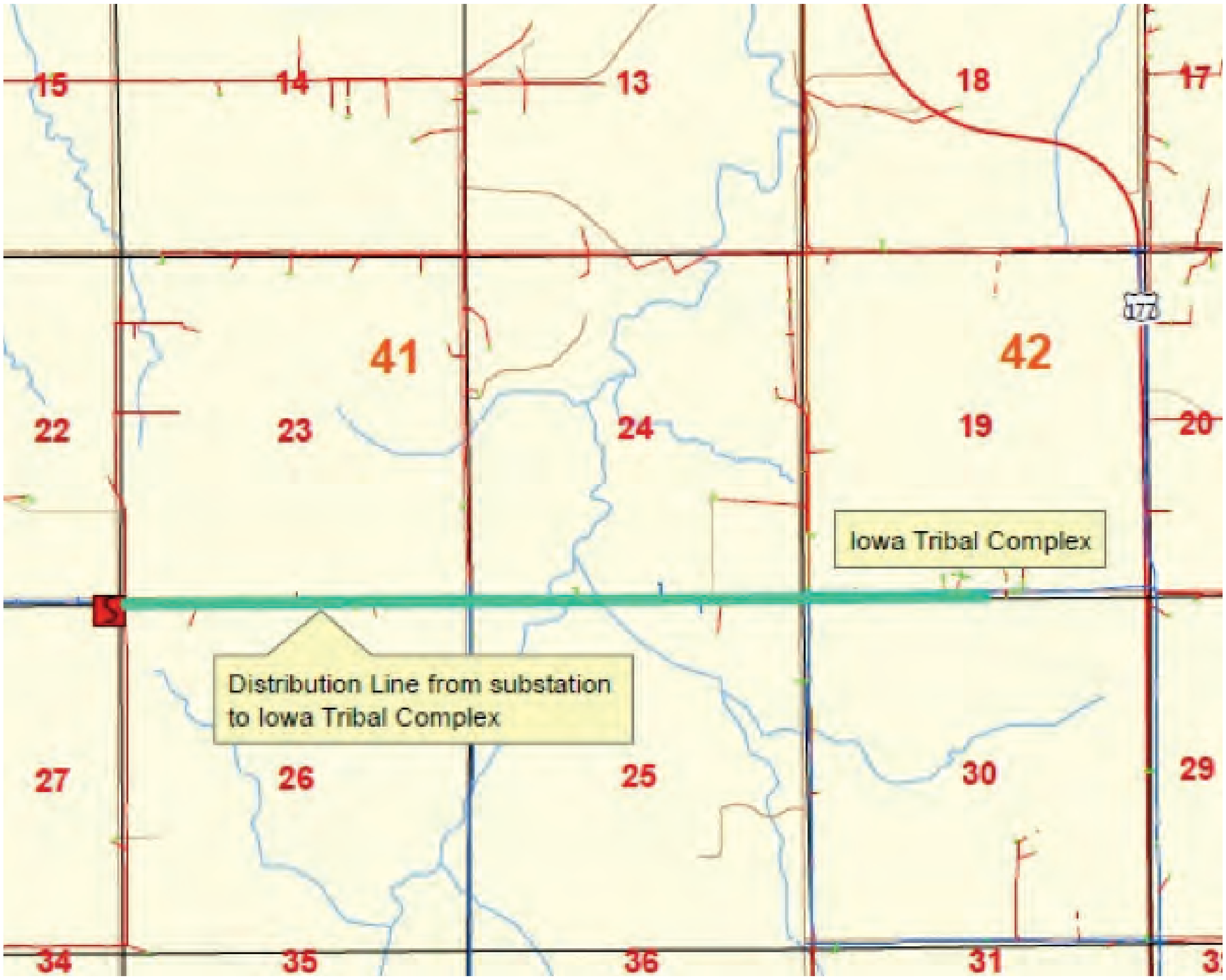


Figure 3 – Central Rural Electric Cooperative distribution line that serves the Iowa Tribal Complex

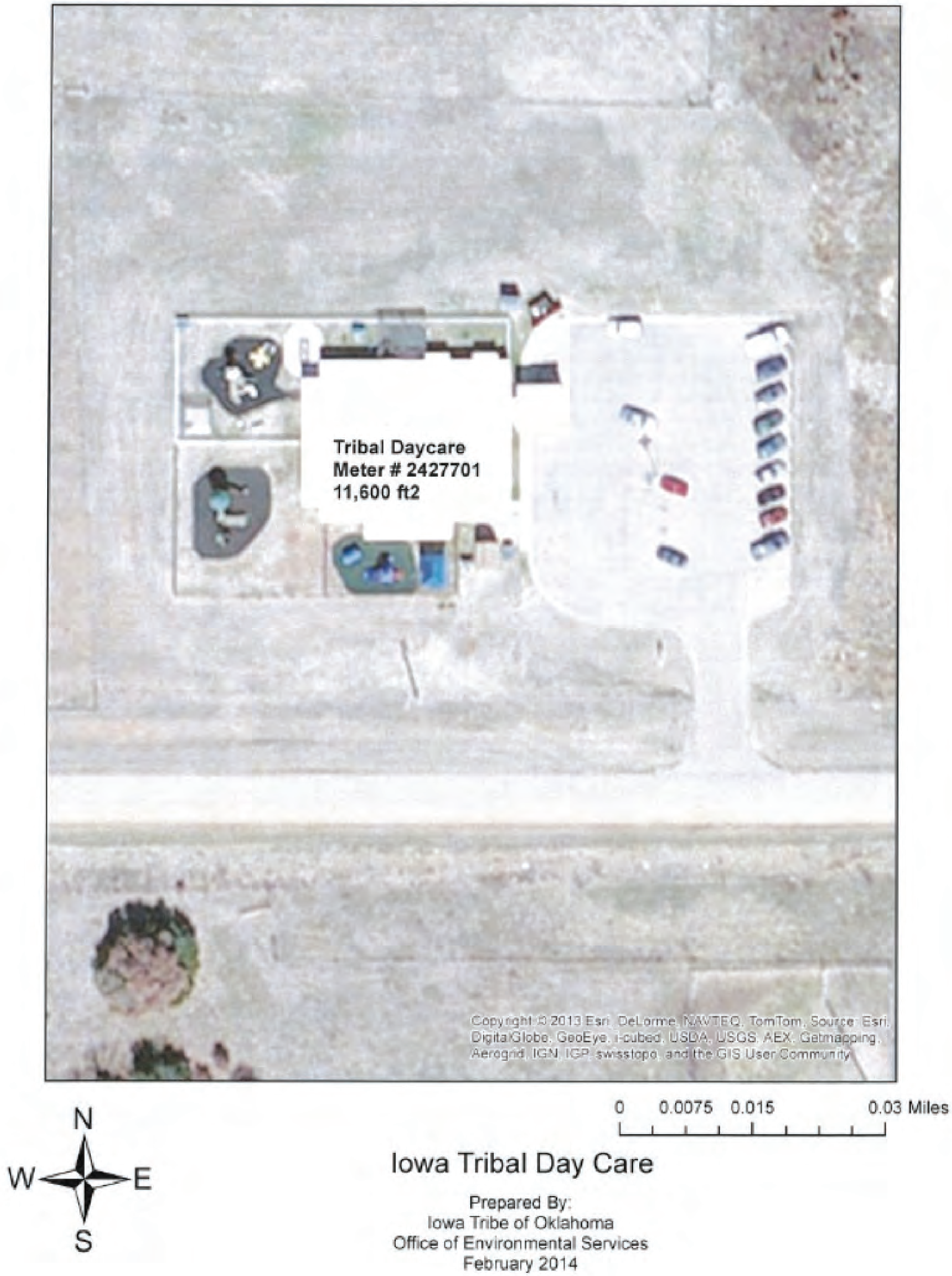


Figure 4 – Iowa Tribal Daycare Facility

Figure 5 – Iowa Tribal Police and Fire

Figure 6 – Iowa Tribal Aviary

Figure 7 – Iowa Tribal Equine Barn

Figure 8 – Iowa Tribal Pow-wow & Chena

Iowa Tribe of Oklahoma's

Assessment of Wind Resources on Tribal Land

DOE's Tribal Energy Program Review

March 24-27, 2014 - Denver, CO

Overview

- Iowa Tribe of Oklahoma
- Iowa Tribe Long Term Energy Vision
- Historical Renewable Energy Timeline
- Project Objectives
- Wind Study Reports
- New Location Update
- Changes and Challenges
- Next Steps and Final Report

Iowa Tribe of Oklahoma

- Tribal enrollment is over 780
- Organized under the Oklahoma Indian Welfare Act, which authorized the adoption of a tribal constitution, by-laws and a Business Committee
- Strong Commitment to Energy Efficiency & Renewables, Environmental Stewardship
- Largest employer in the area with 2 casinos, smoke shop, RV park, art gallery/gift shop and tribal government employees

Bah-Kho-Je Meaning

- “People of the Grey Snow” in Ioway language
- It derives its meaning from a translation over many decades passed down from our “Old People” through our oral history
- The fire-smoked grey snow covered villages in the winter
- The state of Iowa takes its name from the Bah-Kho-Je people

Business Committee 2014

Gary Pratt
Chairman

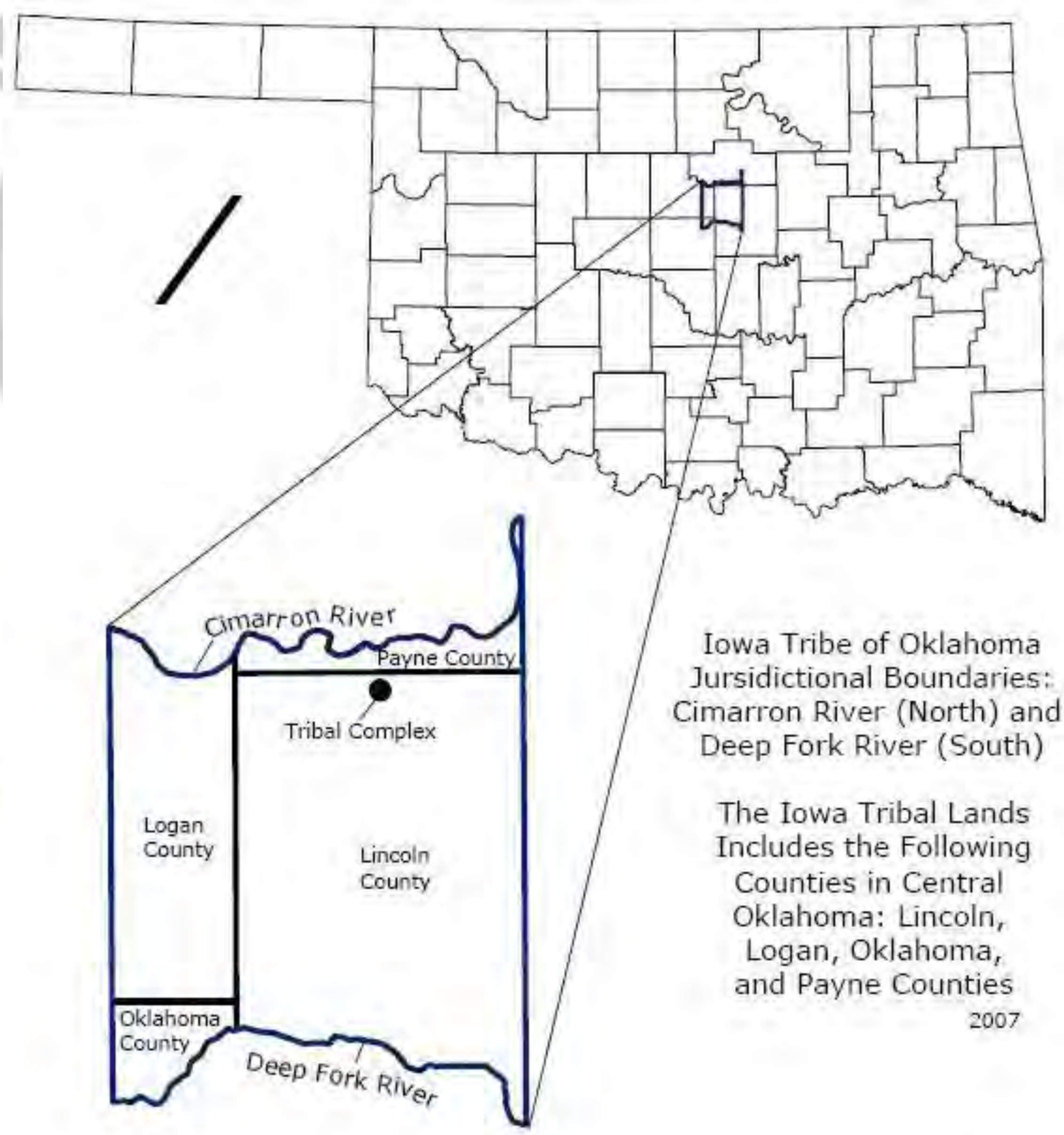
Bobby Walkup
Vice Chairman

Lisa Switch
Treasurer

Leslie Tanyan
Secretary

Renee Prince*
Councilperson

Iowa Tribe of Oklahoma's Traditional Jurisdictional Lands



Michelle L. Holiday

- The founder and president of Michelle Holiday and Associates, a Native woman-owned consulting company specializing in tribal energy and economic development, stakeholder relations, government relations/federal affairs, permitting and siting transmission projects, public affairs and communications, project management, and strategic planning
- Over 20 years of industry experience working for Edison International and Southern California Edison
- A new career direction as a consulting company but long term commitment working with and for tribes on energy matters
- Tribal member, former Tribal Development Director, 2000-2002, Tribal Representative with 4 prior Administrations
- Worked on the DOE Native American Anemometer Loan Program in 2001

MHA
MICHELLE HOLIDAY & ASSOCIATES

Iowa Tribe’s Long Term Energy Vision

- Energy Self Sufficient
  - Core to Economic Development
  - Environmental Philosophy
  - Sustainable Energy Development Model
  - Resource Development
    - Renewables Wind and Solar
    - Land, Oil, & Minerals
    - Energy Efficiency
      - EPA Grant
      - Lighting Retrofits & Motion Sensors

TIMELINE IOWA TRIBE WIND RESOURCE ASSESSMENT

5 Years

2010 | 2011 | 2012 | 2013 | 2014

DOE Awarded Grant
April 2010-December 31, 2011

Modification 1
Extended Project Period to June 30, 2012
Project Relocation to Site 2
Equipment Malfunction Site 1
NEPA Review/Approval
Contract Approval
Budget Justification
MET Tower Height Change

Modification 2
Extended Project Period
6/30/13

Tribal Complex Site 2
February, 2013 Relocation
MET Tower and SODAR Unit
Maintenance Issues

Resource and Energy Production
Report-Wind and Solar Analysis
March 27, 2013

Wind Study Report
Fallis Location June 30, 2013

CREC Energy Analysis
Small Wind Assessment
April, 2014 Pending

Final Report Due
June 31, 2014

Request Modifcation 3
Budget Justification
Business Plan April, 2014

Statement of Project Objectives

The overall objective of the Assessment of Wind Resource on Tribal Land project is to <u>conduct a wind resource assessment</u> in order to quantify the wind resource potential available on the Iowa Tribe's land. This information will be used to <u>develop a commercial scale wind farm</u> or <u>distributed generation application</u>, which will allow the Tribe to be energy independent and offer an additional revenue stream.

- **Objective 1**: Identify and address technical issues concerning wind energy development
- **Objective 2:** Conduct an in-depth feasibility study of wind energy to evaluate the actual value of wind
- **Objective 3:** Identify and address environmental issues concerning wind energy development and educate stakeholders about challenges of implementation

Lessons Learned From November Program Review 2012

- Find the Best Area to Place Met Tower
  - Land
  - Use Existing Wind Data
  - Transmission Opportunities
- Use a Redundant System
  - SODAR with Met Tower is a Great Combination
  - Data Correlation / Redundancy
  - Avoids Collection Disasters (Logger & SODAR)
- Find the Best Resources
  - Hire Expertise to Avoid Future Headaches

SOPO Tasks Executed
5 out of 8

- ✓ 1. Conduct a wind resource assessment: micrositing of met mast, purchase, install, and manage wind data collection at up to 200 Meters with a 60 meter anemometer and SODAR unit. (Completed for Site 1 with SOPO modification and budget to continue on Site 2)
- ✓ 2. Collect data for a 12-month period, 8,760-hours. (Completed for Site 1 only with SOPO, NEPA and budget modification)
- ✓ 3. Data collection, data verification and certification; such verification procedures are required for negotiation of power purchase agreements and as collateral for financing. Data will be verified on a weekly basis by a certified meteorologist. (Report data does not support pursuing this task)
- ✓ 4. Data analysis to determine the feasibility of constructing a commercial scale wind energy project-completed to offset local and distributed electrical loads and sell the excess power back into the grid.

  (Report data does not support pursuing this task)
- ✓ 5. Economic assessment for wind turbines that would be sited on tribal lands based on wind data and wind turbine performance data. (Completed for Site 1 for commercial scale. Site 2 assessment under review for small scale wind development)

Wind Study Report
Energy Assessment Key Findings
Location: Fallis

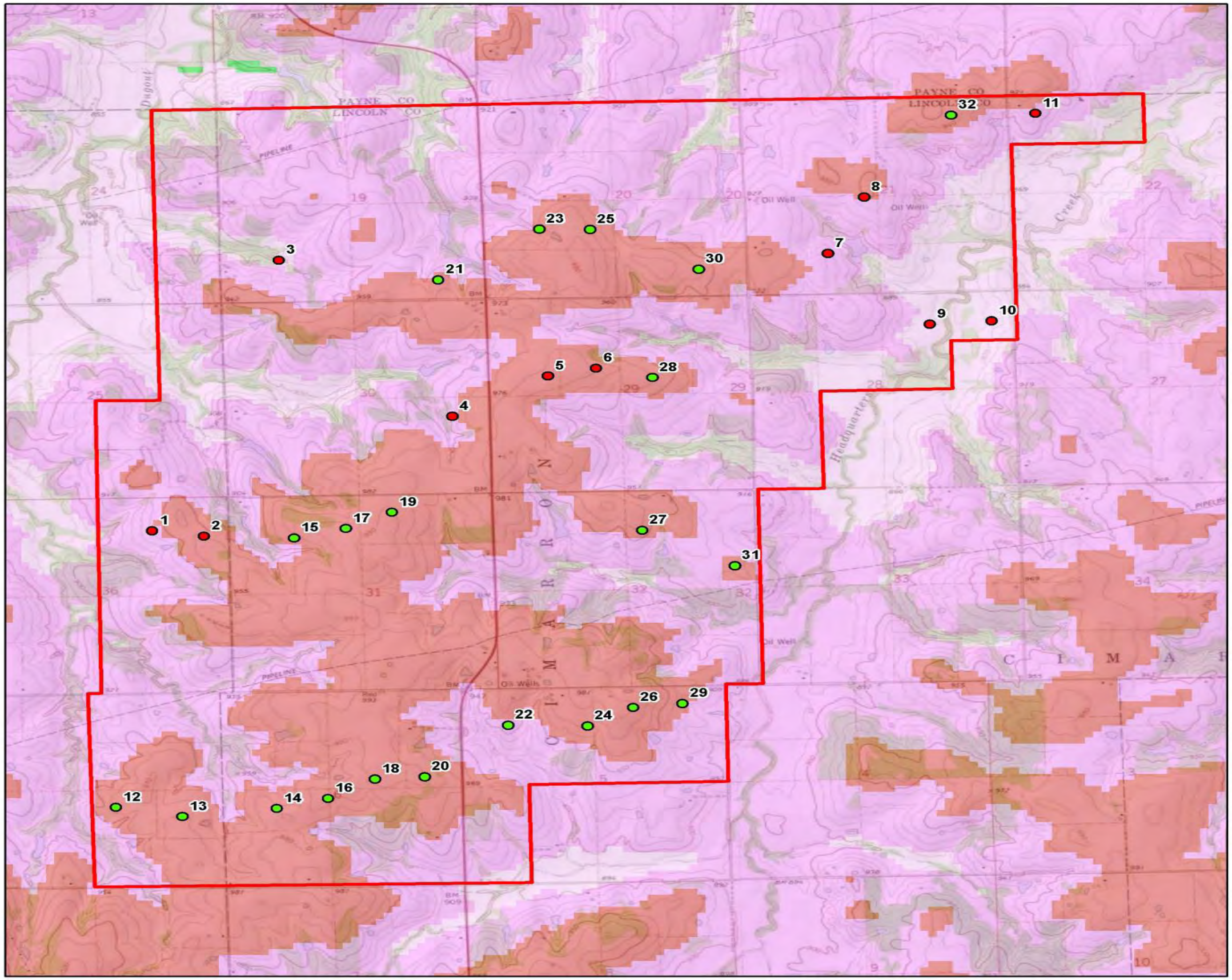
- The wind resource in the vicinity of the installed met mast near Fallis is not rigorous enough to support a commercial wind project.
- The wind resource in the new proposed project area is a class III, low wind resource. The wind resource is in the outer bounds of feasibility and the economics will be driven largely by the achievable power price for the project.
- A high degree of uncertainty regarding the wind resource exists at the proposed site and additional on-site information should be obtained to verify the projections of the report.
- 11 consultants prepared the extensive wind study report

Resource and Energy Production Report Location: Fallis

- Energy Production Summary Completed March 27, 2013

  AWS Truepower/Johnson Controls
- Installation and data collection of MET tower to access wind and solar to estimate the energy production potential, and design considerations beginning November 2011
- Based assessments on existing modeling for estimated wind energy production concluded from the data the average annual net production and capacity factor for the project was 58.4GWh and 37.4%, respectively
- Two sites, mean annual wind speed at 96 meters
- Site 32 on tribal land

Proposed Turbine Layout
Phases 1&2, Site 32



IOWA TRIBE OF OKLAHOMA
PROPOSED TURBINE LAYOUT
PHASES 1 & 2

Legend

GE 1.6 - 100 Turbine

- Phase 1
- Phase 2
- Project Area

Mean Annual Speed at 96 m

m/s	mph
< 5.75	< 12.9
5.75 - 6.00	12.9 - 13.4
6.00 - 6.25	13.4 - 14.0

Product

EPS

Disclaimer

This map was created by AWS Truepower™ using the Sitewind® system and historical weather data.

Reference

0 0.25 0.5 0.75 1 Kilometers
0 0.1 0.2 0.3 0.4 Miles

Wind Data Resolution: 50 m
Coordinate System: UTM 14 N
Datum: WGS84

N

Originator

Date: 03/15/2013
Department\Originator: CS\DJS
Client: BKJ Solutions

Changes and Challenges

Location Changes

- 1st Site Location (Fallis)
  - Vandalism of SODAR Unit
  - Wires cut and battery converter stolen
  - Repair and Relocated
- 2nd Site Location
  - (Tribal Complex)
  - Data collection from the SODAR Unit not recording for approx. 7 months
  - Battery Pack Inoperable
  - Weather Sensor Not Replaced
  - Modem not transmitting data

Human Resources Issues

- Tribal Capacity Issues
  - Lack knowledge transfer
  - Significant delays
- Employee Turn Over
  - 2 initial employees managing the wind project no longer work for the tribe
  - 4 months delay and fact finding review and assessment conducted
  - New tribal project team formed with energy consultant in August 2013

Location of Selected Wind Turbine

Small Scale Wind Development near the Iowa Tribe of Oklahoma's Tribal Complex in Perkins, Oklahoma

Longitude and Latitude coordinates (35.929130, -97.024637)

MET Tower

ASC SODAR Unit
Solar Panel and Battery Pack

SODAR Solar Panels

SODAR Unit

Next Steps for SOPO Completion

- The Iowa Tribe's energy team will work closely with the DOE to amend the modification to the Scope of Project Objectives: 6, 7 and 8 and include additional action items to complete the business plan.
- 6. Environmental assessment for cultural resources, natural resources and avian considerations that may be impacted by wind turbines' noise and visibility. Work cooperatively with the Iowa Tribe's Office of Environmental Services (OES) to obtain all necessary FAA and environmental permits and approvals.
- 7. Completion of business plan and model ready for submission to potential lenders.
- 8. Obtain letters of intent from local utilities for the sale of excess energy.
- Additional items to include in the modification and revised costs for the budget justification:
  - MET Tower Removal
  - SODAR Data File Transfer
  - Energy Analysis and Recommendations

Removal (1) 60m XHD Tower

- The Scope of Work includes the following:
- Transportation of Techs
- Transportation (mileage) of Crew/Installation Equip to Site
- Rent of Skid Steer
- Fastening materials (nuts, bolts, hardware, tape)
- Per Diem for techs
- Lodging accommodations for Techs
- Project Management Fee (per tower)

SODAR Data Files Transfer

Anemometry Specialists agrees to transfer data files for (1) ASC Sodar to the Iowa Tribe

Transfer Files Include:

- Raw Wind Data Files for Period of Record in Native Format
- SoDar Commissioning Form (From Original Commissioning)
- Maintenance Records (If Performed by ASI)
- Any Available Photos
- Most Recent Data Files

CREC/SES Energy Assessment

- Central Rural Electric Cooperative/Smart Energy Source
- Scope of Services
  - Assist in the analysis of electric wind generation equipment in regard to economic viability.
  - Provide an analysis of the electric load from tribal accounts with a detailed list of service points and buildings associated with each electric meter.
  - Provide analysis based on utility interconnection agreement options.

Cont. CREC Energy Assessment

- Scope of Services
  - All electric, natural gas, propane, water and sewer consumption
  - Thermal characteristics of the building envelop
  - Lighting
  - Heating ventilating and air condition systems
  - Water heating
  - Appliances
  - Specialty equipment

CREC/SES Deliverables

- Energy Assessment
  - A comprehensive tool designed to empower the Iowa Tribe to make informed decisions about energy use and implement energy efficiency measures.
- Energy Efficiency Recommendations
  - This report identifies the energy efficiency options recommended by SES Energy Professional. These recommendations are intended to help the Iowa Tribe to achieve its energy efficiency objective of reducing overall energy use.

Final Report

- 90 Day Plan
- Receive Approval to Proceed with Revised Modification of the Scope of Project Objectives
- Conduct Environmental Assessment
- Review Energy Analysis of the Iowa Tribe’s Account Information
- Prepare Final Report with Recommendations