FINAL REPORT

UPPER SKAGIT WIND FEASIBILITY ASSESSMENT

Award Number:	DE-EE0002522
Covering Period:	April 1, 2010 to September 30, 2013
Recipient Organization:	Upper Skagit Indian Tribe 25944 Community Plaza Way Sedro-Woolley, WA 98284
Project Title:	Feasibility of Wind to Serve Upper Skagit's Bow Hill Tribal Lands and Feasibility Update for Residential Renewable Energy
Date of Report:	September 30, 2013
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Table of Contents

UPPER SKAGIT WIND FEASIBILITY ASSESSMENT 1
Table of Contents 2
Executive Summary 3
Project Overview 6
Objectives 6
Comparison of Actual Accomplishments to Project Goals and Objectives 6
Project Activities for Period of Funding 9
Products Developed Under the Award and Technology Transfer Activities 16
Conclusions and Recommendations 17
Lessons Learned 17

Executive Summary

A two year wind resource assessment was conducted to determine the feasibility of developing a community scale wind generation system for the Upper Skagit Indian Tribe's Bow Hill land base, and the project researched residential wind resource technologies to determine the feasibility of contributing renewable wind resource to the mix of energy options for our single and multi-family residential units.

Leading up to the project it was believed that the Bow Hill lands offered a consistent low velocity wind energy production opportunity. Bow Hill Tribal Lands are situated on the ridge above the Skagit valley within four miles of the shoreline, and receive winds predominantly north/south as well as seasonal east/west winds. The wind feasibility project intended to confirm the wind resource, develop preliminary site planning sufficient to support final engineering and interconnection options, financing recommendations, identify operations & maintenance costs and gather preliminary environmental data.

Convivium Renewable Energy provided the consultant services for the wind study project. The wind resource data identified annual monthly means of 3.36 m/s equivalent to 7.52 mph at the met tower site, below a typical viable resource, and insufficient to support a community wind enterprise. The project objectives were revised to support continued data collection and reporting and develop a viability triggers analysis. At the completion of the study the wind tower was dismantled and shipped per DOE/NREL instructions to support another entity's study.

A 60 meter NRG tower was installed and began collecting data for analysis from April 1, 2011 through March 31, 2013. A SODAR unit was also deployed during two separate seasons – March 2011 through June 2011 and November 2011 through March 2012 for approximately two weeks co-located with the tower site and then deployed for approximately four weeks at each of two additional study sites. Convivium correlated the 59-meter Met Tower data to the 80-meter, 100-meter, and 160-meter SODAR data at the two remote sites to provide an estimate of the wind speed at three potential hub heights. The synthesized Mean Wind Speeds incorporating corrected wind shear alphas is presented below for the two year study period:

Mean Wind Speeds April 1, 2011 - March 31, 2013				
Site	**Alias**	**Estimated Mean Wind Speed (m/s)**		
		80 m	**100 m**	**160 m**
Met Tower	-	3.69	3.95	4.53
SODAR - East of Casino	Site B	3.55	3.93	4.79
SODAR - South of Hotel	Site A	3.86	4.03	4.72

Convivium then investigated six reference sources for long-term correlation and determined the Skagit Regional Airport AWOS station the most suitable. The long-term mean hub-height wind speeds for the three study sites are presented in the following table:

Long Term Mean Wind Speeds Synthesized From Correlation to Skagit Regional Airport AWOS Station				
Site	**Alias**	**Estimated Mean Wind Speed (m/s)**		
		80 m	**100 m**	**160 m**
Met Tower	-	3.74	4.00	4.59
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The study shows that we have very low wind speeds, and that very tall towers with turbines made for very low wind speeds would be necessary. At this time technology is advancing to support efficient large rotor machines for moderate wind speeds but not enough for community scale investment where tower heights for our site would need to be above 100 meters.

The Viability Triggers analysis identified that a feasible wind energy project would need:

1. A suitable place to put the turbine,
2. Federal incentives that level the playing field for Tribes,
3. A fair value received for the power produced, and
4. An average wind speed of at least 5.5 meters per second.

The Tribe has a site (acreage at the top of a rise and open space near major electrical loads) that meets requirement one. The Tribe has access to the Tribal Energy Program which will fund up to 50% of the capital costs of a wind energy project. This incentive is approximately equal to the tax benefits received by corporate projects and meets requirement two. The Tribe could likely negotiate a net metering agreement and may in the future be able to get a long term Power Purchase Agreement (PPA) that is significantly better than todays depressed prices; under those conditions the Tribe could meet requirement three. The Bow Hill Complex has an average wind speed of 4 meters per second (9 mph) which is too low for viability in today's market; therefore this site cannot meet requirement four.

Pro-forma analyses were completed employing a base case scenario for a single turbine (or up to three turbines) option and a community scale investment option of ten turbines using the GE 1.6-100 MW wind turbine.. Viability triggers were identified for operating expense, project cost, incentive opportunities, power price, REC price, the power curve and tower height. The analyses show that wind is a poor energy resource option for the Tribe at this time and for the foreseeable future, however under some optimistic assumptions it could become an investment alternative. The Pro-forma assumptions are presented below:

Project Pro-Forma Assumptions				
	Base Case		**Viability Trigger**	
Factor	**Single Turbine**	**10 Turbines**	**Single Turbine**	**10 Turbines**
Operating Expense	$226,400	$1,421,200	$98,620	$57,416
Project Cost	$4,000,000	$32,000,000	$2,568,437*	$8,380,124*
Incentive Level	50%	50%	68%*	87%*
Power Price	$0.09/kWh	$0.05/kWh	$0.14/kWh	$0.12/kWh
REC Price	$0/MWh	$15/MWh	$56/MWh	$88/MWh
Power Curve	GE 1.6 100	GE 1.6 100	56% increase	115% increase
Tower Height	100 m	100 m	175 m	340 m
**Operating cost for these scenarios is reduced to 67% of base case.*				

Should wind operations come into being in the vicinity operating costs would likely benefit and fall. Improved operating costs along with increased power prices, technological improvements for low wind sites and incentives availability are key to supporting re-opening this energy option for investment analysis.

Rooftop wind technologies are also not as ready for residential deployment as the publicity that is associated with a number of available systems advertise. The Snohomish PUD is an entity that is testing two micro-wind units to assess performance that the Tribe has been following. Meanwhile, for purposes of this project, Ian Woofenden, a renewable energy author, speaker, instructor and sub-consultant to

Convivium provided Tribal staff with a tour of small wind systems, educated staff on market technologies, reviewed community wind data and summarized considerations for deploying such technologies and recommending alternatives to wind for our residential community. What may be of interest to others is that where wind is a resource (6-8 mph minimum, 10-12 mph ideal) and land is sufficiently open a residential tower unit can be viable. Additional considerations need to include regulatory issues such as height restrictions and ability to service and maintain the system. The Home Power article from the June & July, 2011 publication (#143), page 60 summarizes the small wind investment consideration as follows:

Do You Pass the Test?
So, how did you do? Ask yourself these questions:

- Do you have the space for a tower, and the type of neighbors who can live with it?
- Can you deal with (or work to change) local permitting or zoning regulations to install a productive system?
- Is there a reasonable wind resource at your site, preferably an average that falls within a 10 to 14 mph range?
- Can you afford to install a tall tower that gets your wind turbine rotor at least 30 feet above all nearby obstructions, including growing trees, for the life of the system?
- Can you afford a durable turbine that will stand up to conditions at your site for decades?
- Can you afford a large enough turbine to significantly offset your energy needs?
- Are you willing to maintain the turbine and tower or pay someone to do this on a regular basis, and are you prepared to deal the inevitable repair?

If your answer to any of these questions is “no,” there are many other options for you to reach your renewable energy goals. It will be better to have a successful solar- or hydro-electric system (along with household energy-efficiency improvements) than a poorly performing or failed wind system.

The Upper Skagit Indian Tribe appreciates the opportunity to complete the wind feasibility assessment and improve its understanding of wind technology.

Project Overview

The Tribe developed a Strategic Energy Plan in 2005 that included energy efficiency and renewable energy assessments. The Upper Skagit Indian Tribe has a long-term goal to strive for energy self-sufficiency to support economic gain, cultural protection, environmental protection, and health of the Tribe. Each implementation of energy efficiency improvements and renewable energy production will not only reduce the tribe's long-term operational costs, including subsidies, and offer reasonable capital cost rate of returns, but also reduce the tribe's carbon footprint and impact on climate change. Each step toward energy self-sufficiency advances the opportunity for the Tribe to improve services to the community.

Under this project, the Tribe explored the feasibility of wind development as a step towards achieving energy self-sufficiency. The Upper Skagit project goals were 1) to determine if wind, believed to be a meaningful contributor to the overall renewable energy plan of the Upper Skagit, can be employed to serve facilities at the Tribe's Bow Hill Reservation Complex and/or provide renewable energy to the local electric grid, and 2) investigate the emerging residential wind technology for the Helmick Road Reservation. The goals will be achieved through a site-specific wind assessment for the Bow Hill complex and a review of the state of the art in residential wind energy conversion technology for the Tribe by the consultant team, Convivium Renewable Energy.

Convivium's first year wind resource assessment report confirmed that the wind potential at the Bow Hill Complex was below economically viable options. The Tribe has a ten-year record of the wind resource for the Helmick Reservation land base (supports the residential and government services) that also reflects a low wind resource. The residential wind assessment and review of technologies being marketed for rooftop installations was determined to not be economically viable. In advance of the second year effort DOE worked with the Tribe to redevelop the second year work objectives. Following is a discussion of the first year objectives and accomplishments and the revised second year objectives and accomplishments.

Objectives

Comparison of Actual Accomplishments to Project Goals and Objectives

The Upper Skagit project goals were:

1) to determine if wind, believed to be a meaningful contributor to the overall renewable energy plan of the Upper Skagit, could be employed to serve facilities at the Tribe's Bow Hill Reservation Complex and/or provide renewable energy to the local electric grid, and
2) investigate the emerging residential wind technology for the Helmick Road Reservation.

The goals were achieved through a site-specific wind assessment for the Bow Hill complex and a review of the state of the art in residential wind energy conversion technology for the Tribe by the consultant team, Convivium Renewable Energy. The wind resource data identified annual monthly means of 3.36 m/s equivalent to 7.52 mph at the met tower site, below a typical viable resource, and insufficient to support a community wind enterprise. Similarly, the Helmick Road Reservation has very low winds and no viable open location for a wind tower to serve the community. Our hope that rooftop wind technologies could be viable for residential deployment was debunked with a better understanding of wind speed, power curves, turbines horizontal v.s. vertical axis wind turbines and similar designs. While

the feasibility study did not produce the outcomes we had expected the Tribe is in a better position to concentrate its efforts in efficiencies and other renewable resources for its energy consumption.

The project period shows efforts starting as of 4/1/2010 however the award notification arrived 6/4/2010. The Tribe immediately started with identifying the wind tower to be supplied to the project and initiating permitting. Permitting was completed March 7, 2011 and installation was completed March 29, 2011. Wind data was captured and analyzed for the period 4/1/2011 through 3/31/2013.

Permitting for the project site was forecast in the application however upon award and initial engagement with our county it was their opinion we were not subject to their permit and submittal requirements. After review with the Tribal Attorney's office and subsequent additional follow ups with the county it was finally correctly determined to require permit submittal to establish the wind monitoring site. The Tribe completed lot certification, special use and building permitting. The special use permitting was not thought to be a requirement at the time of application. Sorting out the need for permitting and then completing the special use permitting took eight months.

The site-specific wind assessment for the Bow Hill Complex employed one NRG 60meter wind tower and deployed SODAR equipment to two other wind sites in close proximity with the tower site after collocating with the wind tower. Capturing data for three sites allowed triangulation and data correlation from the SODAR sites with the met tower site. The consultant assisted with installation, produced monthly wind resource reports and during the SODAR deployment produced monthly reports for this data as well. The consultant provided a year one wind resource report, and a year two resource report that summarized the data collected for the period 4/1/2011 through 3/31/2013. The year one resource report confirmed that the wind resource was not economically viable to invest in. DOE and the Tribe collaborated on a revised second year work effort. DOE recommended continuing data collection and a year two wind resource report was produced with recommendations to the Tribe. The approach regarding development in year two was changed to the production of a viability triggers report to identify key factors in the wind marketplace that could trigger a future look again into wind renewable energy. The second year plan to engage the electric utility company to arrive at power and inter-connection agreements, advance preliminary design sufficient to support project development through final engineering, construction and commissioning to support construction financing were cancelled tasks.

Tribal staff maintained two metrological towers since 2003 for the Helmick Road Reservation and residential base of the community that contributed to understanding the applicability of emerging residential wind technology. Rooftop wind technologies are also not as ready for residential deployment as the publicity that is associated with a number of available systems advertise.

Community outreach and education has occurred during the project through newsletters and reported results from both investigations with management and Tribal Council.

Following are the summary changes to the proposed tasks under the original Statement of Project Objectives and the revised Statement of Objectives to show the representative changes that will be detailed in the next section.

Year 1 Statement Of Project Objectives (end of year 1)

Task Number Per SOPO	Title or Brief Task Description	Task Completion Date				Progress Notes
		Original Planned	Revised Planned	Actual	Percent Complete	
1	Site Assessment	Year 1 at least 12 months		Start April 1, 2011	90%	Tower installed and collecting data.
2	Sodar Deployment	Year 1 up to 5 months			100%	Sodar unit deployed and collecting information.
3	Permitting	Qtr3 2010		Qtr 1 2011	100%	Permits issued March 2011
4	Wind Resource Analysis and Reporting	End of Year 1	& End of Year 2		50%	Schedule adjusted by one month, due May 2012
5	Action Plan	Year 2				Work plan & budget revision under development
6	Residential Wind Technology Assessment	End of Year 1		Start Dec 2011	100%	Draft reviewed and comment submitted for finalization
7	Wind (Load) Assessment Report	End of Year 1	& End of Year 2		50%	50% based on proposed revised work plan, Year 1 goal is 100%
8	Transmission & Interconnection Coordination	Year 2				
9	Technology & Economic Analysis	Year 2				
10	Environmental Assessment	Year 2				
11	Preliminary System Design(s)	Year 2				
12	Professional Development	Year 2				
13	O&M Plans	Year 2				
14	Business Plan	Year 2				

Year 2 Revised Statement Of Project Objectives (end of year 2)

Task Number Per SOPO	Title or Brief Task Description	Task Completion Date				Progress Notes
		Original Planned	Revised Planned	Actual	Percent Complete	
1	Site Assessment	Year 1 at least 12 months	2 years	Start April 1, 2011	100%	Tower installed and collecting data.
2	Sodar Deployment	Year 1 up to 5 months			100%	Sodar unit deployed and information collected.
3	Permitting	Qtr3 2010		Qtr 1 2011	100%	Permits issued March 2011
4	Wind Resource Analysis and Reporting	End of Year 1	& End of Year 2		100%	Complete
5	Optimal Structure & Viability Trigger Report	End of Year 2			100%	Complete
6	Dismantle & Ship Met Tower	End of Year 2			100%	Dismantling completed in July and shipping completed in August.
7	Residential Wind Technology Assessment	End of Year 1			100%	Rooftop wind for compact housing neighborhoods is not considered viable at this time.
8	Environmental Data including birds & bats	Year 2			100%	Bird & bat data has been collected and summarized.

Project Activities for Period of Funding

Progress – Q3-2010

Notice of Award received

Objective: - Site Assessment

- Initiated investigation into tower options to meet Buy American requirements and site conditions.

Progress – Q4 – 2010

Objective: - Site Assessment

- NRG 60-meter tower kit was approved by the Tribe, ordered and stored by the consultant.

Objective: - Permitting

- Permitting through the county was initiated in July and jurisdiction and permit requirements resolved September.

Objective: - Professional Development

- Renewable Energy for the Pacific Northwest Law Seminar DVD was ordered and provided to Tribal Attorney's office due to schedule conflict for attending the Seattle area workshop.

Progress – Q1 – 2011

Objective: - Permitting

- Permit applications submitted to the county in October for special use permit, building permit and lot certification. Public notice and comment period issued by the county.

Objective: - Environmental Assessment

- Soils, wetland and well log data at the site and immediately adjacent were researched for permit applications. Although not complete some information was gathered.

Progress – Q2 – 2011

Objective: - Permitting

- Special use permit and building permit received March 7, 2011.

Objective: - Site Assessment

- Tower installation completed March 29, 2011.

Objective: - SODAR Deployment

- SODAR unit also set up to obtain co-location data.

Wind Assessment Data Collection Sites

Progress – Q3 – 2011

Objective: - Site Assessment

- Monthly wind data report summaries provided by consultant. Tribal staff conducted monthly site visits to download data for transfer to consultant and verify site is in good order.
- The BP sensor was noted as not working and a power supply and solar panel charger were installed at the tower on May 23, 2011 to allow barometric pressure to be recorded. No valid data was recorded for BP between March 30th and May 23rd.

Objective: - SODAR Deployment

- The first SODAR unit deployment was completed during the quarter:

USIT SODAR and Met Tower Locations
UTM Zone 10, NAD 83

Site	Alias	Easting	Northing	Elevation (m)	Distance to Met (m)	First Deployment Period
SODAR - Met Collocation	Site C	547866	5379889	101	103	3/28/2011 - 4/14/2011
SODAR - East of Casino	Site B	548589	5378772	69	1308	4/14/2011 - 5/26/2011
SODAR - South of Hotel	Site A	548177	5378093	81	1840	5/26/2011 - 6/23/2011

- SODAR data summaries provided by the consultant. Data reflected good correlation with the met tower and both met tower and SODAR indicate low wind resource.

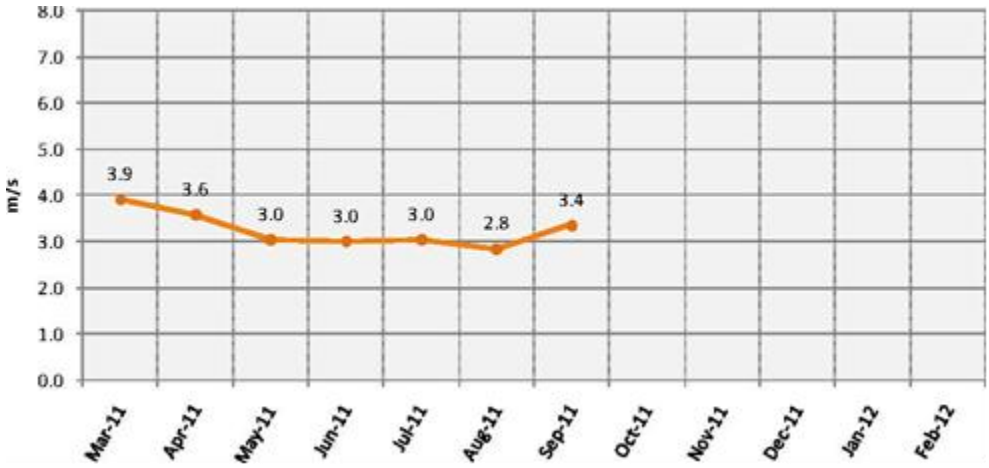
Objective: - Environmental Assessment

- Bird and bat sensor was installed at the tower April 28, 2011.

Progress – Q4 – 2011

Objective: - Site Assessment

- Monthly wind data report summaries provided by consultant. Tribal staff conducted monthly site visits to download data for transfer to consultant and verify site is in good order.
- Per consultant report: *"The cumulative mean wind speeds at 59 meters are approximately 3.1 m/s, which is at or below the cut-in wind speed where most turbines would begin producing power. This implies a relatively low predicted energy output for the period of record. This is somewhat expected as this region of Western Washington tends to have higher winds in the winter months and its lowest winds in the late spring and summer months."*



Progress – Q1 – 2012

Objective: - Site Assessment

- Monthly wind data report summaries provided by consultant. Tribal staff conducted monthly site visits to download data for transfer to consultant and verify site is in good order.

Objective: - SODAR Deployment

- The second SODAR unit deployment was started during the quarter and complete next quarter.

Objective: - Residential Wind Technology

- Staff meet with consultant and toured residential wind towers in the area. VAUTS and HAUTS (vertical or horizontal) axis wind towers was an education.
- Summary report directed at educating the lay person on small wind power systems was put together by the consultant. Alternative renewables are going to be a better fit for our community.


- Reference article *Thoughts on VAWTS*, Home Power Magazine, Edition 104, December 2004 & January 2005, and *VAWTS 7 HAWTS*, Home Power Magazine, Edition 143, June and July 2011.

Objective: - Professional Development

- Project Manager attended the annual program review in Denver, Colorado.

Objective: - Environmental Assessment

- Bird and bat data from the sensor collected by not analyzed yet.

Progress – Q2 – 2012

Objective: - Site Assessment

- Monthly wind data report summaries provided by consultant. Tribal staff conducted monthly site visits to download data for transfer to consultant and verify site is in good order.
- Reference stations were investigated by the consultant and the most suitable reference is the Skagit Regional Airport AWOS station, near Burlington. This AWOS station is less than 7.5 miles (as the crow flies) from our tower site. The period of record readily useful goes back to January 2005.
- Monthly wind data reflects below average wind speeds at the 59 meter height. A discussion with DOE Project Officer about the data resulted in a change of work plan that is in development and although monthly data collection at the tower site will continue through the next year.

Objective: - SODAR Deployment

- The second SODAR unit deployment was completed:

USIT SODAR and Met Tower Locations UTM Zone 10, NAD 83							
Site	**Alias**	**Easting**	**Northing**	**Elevation (m)**	**Distance to Met (m)**	**First Deployment Period**	**Second Deployment Period**
SODAR - Met Collocation	Site C	547866	5379889	101	103	3/28/2011 - 4/14/2011	11/15/2011 - 12/1/2011
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SODAR - South of Hotel	Site A	548177	5378093	81	1840	5/26/2011 - 6/23/2011	2/2/2012 - 3/2/2012

Progress – Q3 – 2012

Objective: - Site Assessment

- Monthly wind data report summaries provided by consultant. Tribal staff conducted monthly site visits to download data for transfer to consultant and verify site is in good order.
- The Year 1 Wind Resource Assessment Report analyzing the first year met and Sodar data has been completed.

- The revised year 2 Statement of Project Objectives was submitted.

Objective: - Environmental Assessment

- Software was purchased to assist with the bird and bat data analysis.

Progress – Q4 – 2012

Objective: - Site Assessment

- Monthly wind data report summaries provided by consultant. Tribal staff conducted monthly site visits to download data for transfer to consultant and verify site is in good order.

Progress – Q1 – 2013

Objective: - Site Assessment

- Monthly wind data report summaries provided by consultant. Tribal staff conducted monthly site visits to download data for transfer to consultant and verify site is in good order.

Progress – Q2 – 2013

Objective: - Site Assessment

- Monthly wind data report summaries provided by consultant. Tribal staff conducted monthly site visits to download data for transfer to consultant and verify site is in good order.

Objective: - Dismantle and Ship Met Tower

- Disposition Request forms submitted to obtain instruction on return of met tower equipment.

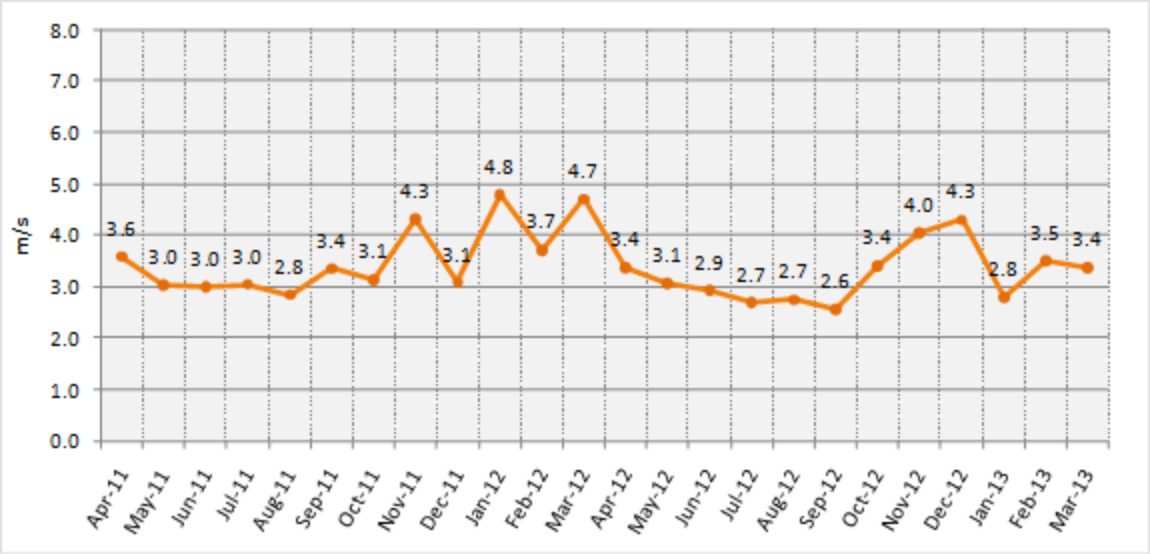
Progress – Q3 – 2013

Objective: - Site Assessment

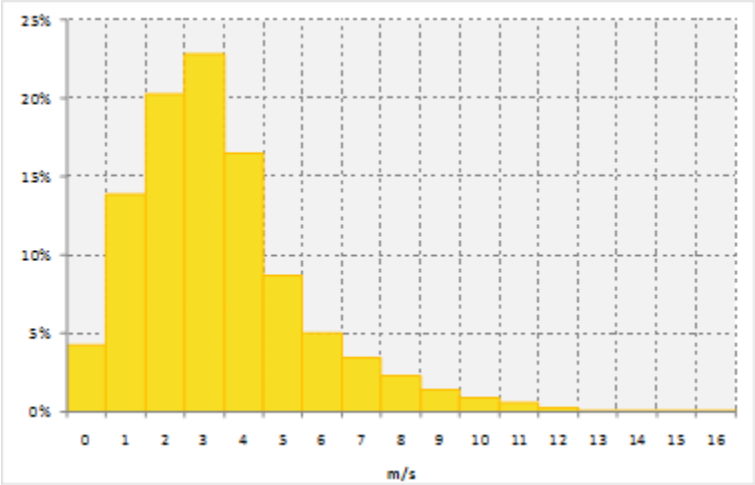
- Monthly wind data report summaries provided by consultant. Tribal staff conducted monthly site visits to download data for transfer to consultant and verify site is in good order.

Wind Resource Assessment and Viability Triggers Reports

- A 60 meter NRG tower was installed and began collecting data for analysis from April 1, 2011 through March 31, 2013. The monthly mean wind speeds (corrected for tower shadow) at 59 meters was captured:



The cumulative wind speed at 59 meters – useful in estimating energy production given a specific turbine power curve table with power output values (kW) is shown to be:



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- The Viability Triggers analysis identified that a feasible wind energy project would need:
    1. A suitable place to put the turbine,
    2. Federal incentives that level the playing field for Tribes,
    3. A fair value received for the power produced, and
    4. An average wind speed of at least 5.5 meters per second.

The Tribe has a site (acreage at the top of a rise and open space near major electrical loads) that meets requirement one. The Tribe has access to the Tribal Energy Program which will fund up to 50% of the capital costs of a wind energy project. This incentive is approximately equal to the tax benefits received by corporate projects and meets requirement two. The Tribe could likely negotiate a net metering agreement and may in the future be able to get a long term Power Purchase Agreement (PPA) that is significantly better than todays depressed prices; under those conditions the Tribe could meet requirement three. The Bow Hill Complex has an average wind speed of 4 meters per second (9 mph) which is too low for viability in today's market; therefore this site cannot meet requirement four.

Pro-forma analyses were completed employing a base case scenario for a single turbine (or up to three turbines) option and a community scale investment option of ten turbines using the GE 1.6-100 MW wind turbine. Viability triggers were identified for operating expense, project cost, incentive opportunities, power price, REC price, the power curve and tower height. The analyses show that wind is a poor energy resource option for the Tribe at this time and for the foreseeable future, however under some optimistic assumptions it could become an investment alternative. The Pro-forma assumptions are presented below:

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Should wind operations come into being in the vicinity operating costs would likely benefit and fall. Improved operating costs along with increased power prices, technological improvements for low wind sites and incentives availability are key to supporting re-opening this energy option for investment analysis.

Objective: - Dismantle and Ship Met Tower

- Additional Disposition Forms submitted to obtain instruction on return of met tower equipment.

Progress – Q3 – 2013

Objective: - Dismantle and Ship Met Tower

- The met tower was dismantled and prepared for shipment. This effort was completed 7/16/2013 after a one week delay due to the volume of shrub and planted alder growth at the site that required clearing.
- Shipping instructions were provided on 7/29/2013 and shipping occurred via Fed Ex for the datalogger, barometric pressure and temperature unit and cables for the tower. The heavy metal components of the tower and ginpole were shipped by Con-Way Freight. All items were received on 8/15/2013 and 8/22/2013 respectively.

Products Developed Under the Award and Technology Transfer Activities

No patents resulted from this award.

The Tribe's consultant Convivium Renewable Energy produced monthly summaries of wind data collected at the tower site, and produced summaries of the SODAR data collected by the unit during the two seasonal deployments. The consultant also produced a year 1 wind assessment report that allowed the Tribe to work with DOE to revise the project scope during the second year. The consultant provided a year 2 wind assessment report summarizing the full two years of data captured at the tower, by the SODAR deployment and reviewed in light of the longer term Skagit Regional Airport AWOS station data. The final product developed by the consultant was the Viability Triggers Report that describes conditions that would need to occur to make our low wind site conditions viable for wind investment.

Conclusions and Recommendations

Under this project, the Tribe explored the feasibility of wind development as a step towards achieving energy self-sufficiency. Both the Bow Hill Complex and the Helmick Road Reservation actually have low wind resources. The marketplace may offer viability for moderate wind resources but not low wind resources at this time. Alternative renewables are going to be a better fit for our community.

The data statistics for the met tower reflect excellent data recovery and the resulting annual monthly means of 3.36 m/s equivalent to 7.52 mph at the Bow Hill Complex is simply insufficient to support a community wind enterprise.

Upper Skagit Indian Tribe Met Tower UTM Zone 10 :: 547964 E, 5379921 N									
Channel	**Sensor**	**Type**	**Serial Number**	**Height (m)**	**Orientation**	**Data Recovery %**	**Mean**	**Min**	**Max**
1	NRG Max 40	Anemometer	153155	59	88	98%	3.4	0.4	16.0
2	NRG Max 40	Anemometer	153156	59	225	98%	3.3	0.4	15.8
3	NRG Max 40	Anemometer	153259	40	88	98%	3.0	0.4	14.5
13	NRG Max 40	Anemometer	153260	40	225	98%	2.8	0.4	14.5
14	NRG Max 40	Anemometer	153261	32	88	98%	2.5	0.4	13.1
15	NRG Max 40	Anemometer	153292	32	225	98%	2.5	0.4	13.1
7	NRG 200P	Vane	-	57	185	98%	152.7	0.0	359.0
8	NRG 200P	Vane	-	42	185	98%	154.0	0.0	359.0
9	NRG 110 S	Temperature	-	3	-	100%	9.4	-7.0	31.2
10	NRG BP-20	Pressure	-	3	-	93%	997.5	959.5	1020.8
Period of record: 4/1/2011 - 3/31/2013									
BP-20 Sensor was not configured properly prior to 5/23/2011									

Solar is an opportunity that has been demonstrated to be viable in the climate of the Pacific Northwest. The Tribe has a rooftop solar PV demonstration project that is achieving production specifications of the panels. Investment in solar is expanding and bringing costs down which will increase its viability. Energy efficiencies are essential and such efforts as heat pumps in addition to numerous other efficiency opportunities and options will need to be considered as well.

Lessons Learned

Technology is advancing to support efficient large rotor machines for moderate wind speeds but not enough to meet our low wind speed conditions where for community scale investment tower heights for our site would need to be above 100 meters.

In areas where wind is a resource (6-8 mph minimum, 10-12 mph ideal) and land is sufficiently open a residential tower unit can be viable, while rooftop technologies are not economically viable. Considerations for investing in a residential tower need to include regulatory issues such as height restrictions and ability to service and maintain the system. The Home Power article from the June & July, 2011 publication (#143), page 60 summarizes the small wind investment consideration as follows:

Do You Pass the Test?

So, how did you do? Ask yourself these questions:

- Do you have the space for a tower, and the type of neighbors who can live with it?
- Can you deal with (or work to change) local permitting or zoning regulations to install a productive system?
- Is there a reasonable wind resource at your site, preferably an average that falls within a 10 to 14 mph range?
- Can you afford to install a tall tower that gets your wind turbine rotor at least 30 feet above all nearby obstructions, including growing trees, for the life of the system?
- Can you afford a durable turbine that will stand up to conditions at your site for decades?
- Can you afford a large enough turbine to significantly offset your energy needs?
- Are you willing to maintain the turbine and tower or pay someone to do this on a regular basis, and are you prepared to deal the inevitable repair?

If your answer to any of these questions is “no,” there are many other options for you to reach your renewable energy goals. It will be better to have a successful solar- or hydro-electric system (along with household energy-efficiency improvements) than a poorly performing or failed wind system.