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The Wind Powering America Anemometer Loan Program: A Retrospective

Tony Jimenez

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

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Tony Jimenez

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Executive Summary

This white paper details the history, mechanics, status, and impact of the Native American Anemometer Loan Program (ALP) conducted by the U.S. Department of Energy's (DOE's) Wind Powering America (WPA) initiative. Originally conceived in 2000 and terminated (as a WPA activity) at the end of FY 2011, the ALP has resulted in the installation of anemometers at 90 locations. In addition, the ALP provided support for the installation of anemometers at 38 additional locations under a related ALP administered by the Western Area Power Administration (Western). Finally, the ALP has been used as a template for ~20 state-administered ALPs.

The purpose of the ALP is to provide tribes a low-cost, low-risk means of quantifying their wind resource. Especially when the ALP was originally conceived, little hard data existed to make wind project production and economic performance estimates with any sort of precision. By significantly reducing the cost of quantifying the wind resource on tribal lands, WPA expected that more tribes would be encouraged to pursue wind development, eventually leading to the installation of wind turbines. Recent developments in remote wind assessment and mapping have made it easier to estimate local wind resources, but even with these technologies, holes exist in nationally derived data sets, and conducting local assessments remains important.

The Native American ALP consists of a suite of related lending programs (listed in Table 1). Table 1 also shows the division of responsibilities between WPA and Western for the various lending programs. WPA and Western jointly administer all programs with the exception of the Native American Tall Tower program, which is administered solely by WPA.

Table 1. Anemometer Loan Programs Summary

Name	Tower Height	# of Installations	Loan Approval	Equipment Shipping	Data Analysis
NA -Short	20 m	75	WPA	Western	WPA
NA- Tall	26 m – 50 m	15	WPA	WPA	WPA
Federal/Other	20 m	15	WPA	Western	WPA
Western	20 m	39	Western	Western	WPA
Total		144			

In addition to the ALP, WPA conducted other Native American outreach activities, such as an annual Wind Energy Applications Training Symposium (WEATS), support to the DOE's Tribal Energy Program (TEP), and occasional technical assistance. WPA staff coordinated activities with the much-larger TEP to avoid duplication of effort. Approximately one-quarter of the borrowing tribes submitted a successful TEP grant application after an anemometer loan.

1 History of the Anemometer Loan Program

When the DOE launched WPA in 2000, outreach to Native Americans was one of the original focus areas due to the large amount of land with good wind resources controlled by Native American organizations. Key activities under Native American outreach included inviting Native Americans to the pre-existing WEATS events, providing technical support to Native American organizations interested in deploying wind technologies, and the ALP. The first two activities would help the tribes better understand wind energy applications while the loan program would address what was considered one of the key barriers to wind energy development on tribal land: lack of data about the available wind resource. Western was interested in starting its own ALP to its customers, so WPA and Western collaborated to start a separate program for Western members based on a pre-existing Western equipment loan program. Western agreed to manage the one-on-one lending of anemometers for both lending programs. This enabled the National Renewable Energy Laboratory (NREL) project manager to manage one loan (of all the anemometers) to Western rather than dozens of loans to individual borrowers. In return, WPA conducts the wind data analysis for both programs.

For cost and ease of installation, the WPA team decided to use the NRG 20-meter (m) tilt-up tower with a Wind Explorer data logger. The cost of the package was approximately $2,000 per tower, and the lower tower height was seen as viable for initial wind prospecting. WPA purchased 45 of these towers. The WPA team believed that the 20-m tower was a good compromise among cost, ease of installation, and quality of data collected. The 20-m towers are a good height for wind turbine projects up to ~ 100 kilowatts (kW), while larger projects would require more extensive follow-on monitoring. The team believed a tribe would be more likely to conduct follow-on wind monitoring with taller towers if the 20-m data were promising while not committing the tribes to large-scale wind monitoring programs from the beginning.

The program received the first loan request (from the Bay Mills Indian Community in Michigan) on August 22, 2000. The first tower was installed at Bay Mills on October 3, 2000, and the program quickly generated a lot of interest. By the end of FY 2001, 18 towers had been installed, and WPA was assisting several states in setting up their own anemometer loan programs. Among the first states to set up loan programs were Utah and Virginia.

As shown in Table 2, there were many anemometer loans during the initial years (2001-2003) of the program, with 15 to 18 installations per fiscal year. Loan volume decreased to nine installations per year in FY 2004-05. After 2005, the number of short-tower installations declined to only one installation per year. The main focus of the work after 2005 shifted to the installation of taller measurement towers, primarily driven by the industry push to install turbines at greater heights as well as the developing industry understanding of higher wind shear exponents encountered in many areas, notably in the Great Plains region.

Although the tribes appreciated the 20-m towers, many tribes inquired about taller towers. In 2005, the ALP had the opportunity to receive approximately eight 40-m and 50-m anemometers from a Department of Defense (DOD) monitoring project. WPA agreed to take possession of the towers, refurbish them, and add them to the loan options under the ALP. Subsequently, WPA acquired additional towers from completed TEP projects. Demand for 50-m towers was high, and the available towers were quickly loaned out.

Table 3 lists the number of installations by state. This same information is shown graphically in Figure 1. In general, loans are concentrated where one would expect: the Plains states, the Southwest, California, the upper Midwest, and Alaska. There are ALP sites in 20 states. The top five states are California (12 loans), Alaska (10), Arizona (9), and Oklahoma (9). In some areas there is evidence of a "word-of-mouth" effect, in which a loan to a tribe results in subsequent loans to nearby reservations.

The latter half of the decade saw major changes in equipment availability; the manufacturer discontinued the 20-m towers and the Wind Explorer data loggers. Loans of short towers have virtually ceased as the equipment breaks down.

In FY10 data from the previous decade were collected and posted on a public website for use in support of commercial, scientific, and educational purposes. The website is complete and at the time of this writing, posting of the wind data is ongoing.[1]

Table 2. Native American Anemometer Loan Program Installations by Fiscal Year

Fiscal Year	# Installations (Short Tower)	# Installations (Tall Tower)	# Installations (Total)
2001	18		18
2002	15		15
2003	18		18
2004	9		9
2005	9		9
2006	1	5	6
2007	1	3	4
2008	1	4	5
2009	1	1	2
2010	2	0	2
2011	0	2	2

[1] Data are available at http://www.windpoweringamerica.gov/nativeamericans/anemometer_loan.asp

Table 3. Native American Anemometer Loan Program Installations by State

State	# Short Towers	# Tall Towers	Total	State	# Short Towers	# Tall Towers	Total
AK	8	2	10	**MT**	5	0	5
AZ	7	2	9	**NE**	1	1	2
CA	11	1	12	**NM**	2	0	2
IA	1	0	1	**NV**	2	2	4
ID	2	0	2	**NY**	0	1	1
KS	2	0	2	**OK**	9	0	9
MA	0	1	1	**SD**	7	0	7
ME	1	0	1	**TX**	1	0	1
MI	3	1	4	**WA**	4	1	5
MN	7	3	10	**WY**	2	0	2
				Total	**75**	**15**	**90**

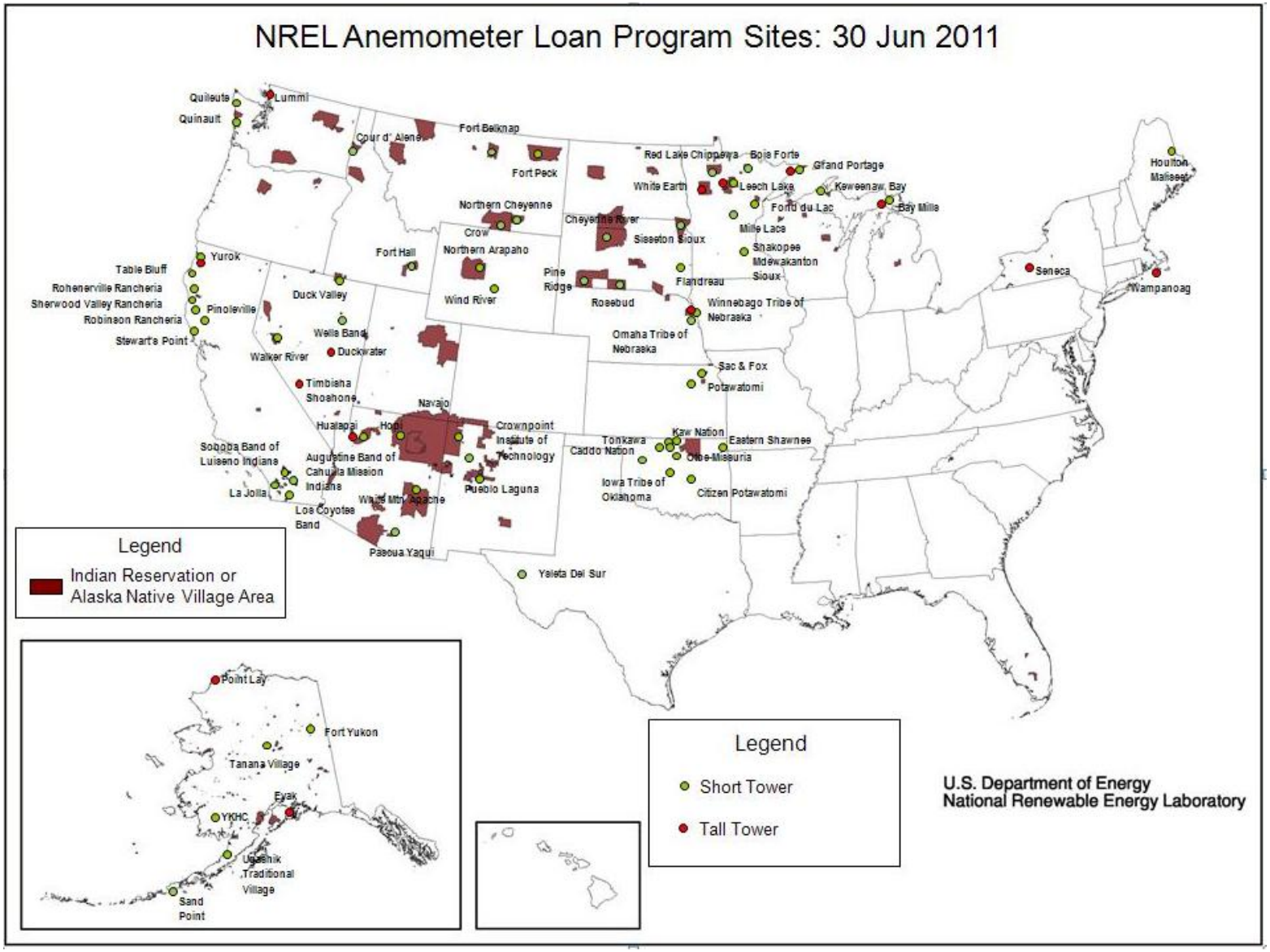

Figure 1. Native American tribes' anemometer loan locations

2 Mechanics of the Anemometer Loan Program

Figure 2 shows the tribal anemometer loan process. Potential borrowers submitted an application letter to WPA. WPA reviewed the application to ensure that the applicant was eligible, that the proposed monitoring site had a reasonable likelihood of having a feasible wind resource, and that the applicant had an acceptable project concept if the wind resource proved sufficient. This process usually involved one or more phone conversations with the applicant. Once the application was approved, WPA notified Western, which then executed a loan agreement with the borrower and shipped the anemometer. The borrower was responsible for providing the labor to install the tower. If the borrower lacked the in-house expertise to install the tower, WPA paid for an outside expert to supervise the tower installation. The borrower periodically (ideally every 1 to 2 months) mailed the data plug to NREL. Team members extracted and reviewed the data. At the end of the monitoring period, the borrower dismantled the tower and prepared it for shipment back to Western.

The tall-tower lending program was similar to the short-tower program but with a few differences. Due to the much higher cost of the equipment and the much higher cost to install the tall tower, the bar for approval was higher than for a short tower. A higher probability of a good wind resource was necessary, and the potential wind project concept required more detail. As a condition of the loan, the tribe was responsible for selecting and paying a contractor to install and dismantle the tower. Typical cost for this was approximately $10,000. A tribe that was willing to commit this level of funding was viewed as serious about the project and was considered more likely to move forward with a wind project upon monitoring completion.

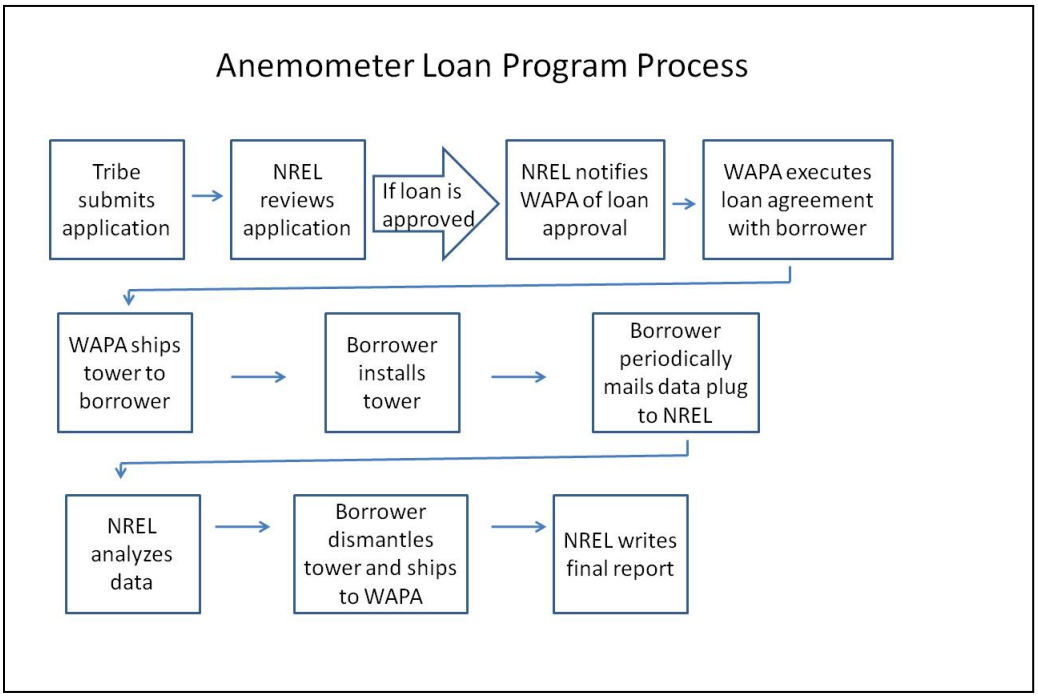

Figure 2. Anemometer loan process

3 Loan Results: The Program's Legacy

Table 4 summarizes the number of installations and tribes involved in the ALP. The number of tribes is fewer than the number of installations because several tribes extended the anemometer loans to conduct follow-on monitoring at additional locations within their respective reservations. The remaining rows summarize the follow-on wind development activities conducted by borrowing tribes: follow-on loans for additional wind monitoring, follow-on activities funded by the TEP, and wind installations.

Table 4: Native American Anemometer Loan Follow-On Activities

	Short	Tall	Total
# installations	75	15	90
# distinct tribes/organizations	58	14	65
# tribes conducting follow-on loans for additional wind monitoring	12	0	12
# tribes conducting TEP project after monitoring	16	1	17
# tribes with installed wind turbine after monitoring	1	0	1

Compared to WPA expectations in 2000, the number of installed turbines resulting from the ALP is fewer than expected: one 50-kW wind turbine installed by the Oglala Sioux of the Pine Ridge Reservation in South Dakota. Part of these unmet expectations can be attributed to a certain amount of naiveté within the WPA team. The prevailing belief was that lack of wind data was a key barrier to wind project development on tribal land. The WPA team believed that with the wind resource quantified, a significant fraction of borrowing tribes would have the data needed to move forward with a wind project. This view did not sufficiently take into account other significant barriers to tribal wind energy development that became apparent in subsequent years. These include the inability of tribally owned utility-scale projects to access federal incentives; the complexity of the development process on tribal lands, especially in light of the desire of many tribes to develop their own projects; and the generally tough economics of sub-utility-scale projects.

While the ALP has thus far resulted in a minimal number of tribal wind turbine installations, the program has been successful in helping spur tribes to follow-on wind development activities that may yet result in additional wind energy projects. As seen in Table 4, 12 tribes requested follow-on loans and conducted wind monitoring at additional sites within their respective reservations. Sixteen borrowing tribes have won subsequent TEP grants to conduct activities that include a wind energy component. These projects range from “first-steps” assessment projects to determine the tribe’s renewable energy resources (of which wind may be only one of several potential resources) to feasibility and development work focused on a specific wind energy project. As a final note, a few tribes folded their ALP anemometers into larger wind-monitoring efforts. The Sisseton-Wahpeton Sioux purchased a 20-m anemometer and conducted monitoring at an additional site concurrently with their ALP anemometer. The Yukon-Kuskokwim Health Corporation used its ALP anemometer to augment three anemometers acquired under a TEP grant to monitor at a total of four sites. Finally, the Lummi Nation is using an ALP tall anemometer to augment an existing TEP-funded wind monitoring effort.

Although most individuals involved in the ALP expected more loans to lead to expanded project development, the jury is likely still out regarding the longer-term impact of this project. This impact is not only focused on the installation of specific measurement towers but also on the institutional knowledge-building in tribes regarding the available wind resource brought on by the implementation of loaned equipment. These activities not only provided stronger indications of the level of wind resource available on tribal land but also expanded the potential for tribes to take a more active role in their energy future.

4 Lessons Learned

One objective of this report is to document lessons learned as a result of the ALP.

4.1 Value of the Anemometer Loan Program

Lesson learned: An ALP is an outreach program as much as a technical program.
In the beginning, the ALP certainly filled a void, as demonstrated by the large volume of loan applications in the early years of the project and the success of the state ALPs. When WPA introduced the ALP, wind resource data available to the public were limited. The main resource available was the generic 1987 Pacific Northwest National Laboratory Wind Atlas. High-resolution wind maps were available for only a handful of states. For most locations, the only way to quantify the wind resource was to install an anemometer.

Today, there is a great deal of wind resource data available for free or for a relatively low cost (a few hundred dollars up to several thousand dollars for a model-based virtual anemometer tower). These easily available data provide ammunition for the argument that anemometer loan programs are of relatively less value, especially for sub-utility-scale wind projects. However, ALPs still provide benefits.

On the technical side, while the high-resolution wind maps are continually improving, they can still be wrong for a particular location. Many local flow or channeling features are missed, even with high-resolution modeling.

An additional key benefit of an ALP is its outreach value. The hands-on aspects of installing an anemometer provide opportunities for learning and engagement that cannot be duplicated by simply gathering data on the Internet. The process of selecting a site, securing needed permissions, and installing the tower help to build borrower capacity and provide a preview of the steps needed to gain the approvals for a wind project. Once the tower is installed, its visibility can help make wind energy more tangible to members of the local community. As further evidence of this, the met-tower raising activity, often included as part of WEATS, always received high marks from the participants.

4.2 Maximizing the Utility of an ALP

Lesson learned: One way to maximize the value of an ALP is to ensure that it is part of a larger program that can help borrowers with site selection and other wind-project-related tasks. The most valuable ancillary activity to an ALP is assistance in project scoping and site selection.

In the early days of the program, the WPA team determined that it was not feasible for WPA staff to make site visits to all borrowers. The team decided to fill the gap using outside consultants, preferably ones relatively near the borrowing tribe. Once the WPA team made this decision, there was discussion about the appropriate number of site visits. One school of thought argued that an outside expert should perform a site visit prior to the anemometer installation to help the tribe select a good site. There should be a second visit to help install the anemometer if the borrower needed outside help. Finally, there should be a third visit at the conclusion of monitoring to review the results. Due to resource constraints, the WPA team decided that three visits per loan activity was not feasible. WPA would fund one site visit by an outside expert to confirm that the proposed location was reasonable and oversee installation of the met tower.

This works to a degree. In lieu of an initial site visit, the ALP project manager studies topographic maps of the proposed monitoring sites and consults with members of the NREL wind resource assessment team to reduce the number of poorly sited towers. One motivation for using local experts to oversee tower installation is to provide an opportunity for the borrowing tribe to establish a relationship with locally or regionally available expertise. In general, this did not happen, but in some cases, most notably in Oklahoma, valuable relationships were and continue to be established. In Oklahoma, the ALP benefitted from the presence of the Oklahoma Wind Power Initiative (OWPI), an established wind outreach program based at the University of Oklahoma. Most recently, in 2010 OWPI supervised the installation of an ALP 20-m anemometer at the Tonkawa Reservation and analyzed the data on behalf of the tribe.

The lack of activities to follow up a promising anemometer loan is greatly mitigated by the existence of the TEP since borrowers with a promising wind resource can receive technical support and additional development funding though the TEP. Twenty-five percent of the borrowing tribes have successfully pursued this option. These follow-on TEP projects mostly land in two categories. In the first category are tribes that move forward with further wind project development activities. In contrast, tribes in the second category take a step back and analyze their respective needs and energy resources as part of a strategic energy plan. With a plan in place, projects (which may or may not include wind energy) are selected that best support the plan.

The above discussion applies mostly to the short-tower loan program. The experience with the tall-tower program has been different. Given the greater expense and effort required to install a tall tower, the previous discussion about the need for a viable project concept and a good site applies even more. However, the majority of tribes requesting a tall-tower loan have successfully cobbled together additional resources so that the monitoring is part of a suite of pre-development activities. The majority of tall-tower borrowers have partnered with an outside entity to help scope out a potential project and select a suitable location. These outside entities include local colleges and universities or outside consultants hired with TEP or tribal funds. The result of these partnerships is that most tribes applying for a tall-tower loan have done a reasonable job at project scoping and site selection.

4.3 Working with Tribes

Lesson learned: Be flexible and patient. Be prepared to expend considerable effort to stay in touch.

There are more than 500 federally recognized tribes, with varying levels of organizational effectiveness. The ALP team tried to ensure that a borrowing tribe was "on board" with an anemometer loan by requiring a tribal government official to sign the loan request. In practice, a majority of the loan requests included a tribal resolution authorizing the tribal government to submit the loan request. A typical point of contact was a staffer within the tribal environmental quality or economic development departments. The commitment level of the point of contact is important. A good point of contact will return phone calls (or better yet, initiate them), conduct the legwork needed to find information or resolve issues, and work to gain the needed approvals to install the anemometer.

The borrowing tribes' wind energy knowledge varied a great deal. Some tribes were very knowledgeable, others were not. The quality of the loan applications also varied. Some tribes submitted well-researched applications, a solid project concept, and a good site. These applications could be approved with minimal discussion with the tribe. Other tribes needed extensive discussion to develop a minimally viable project concept. A few tribes never developed the minimally viable concept required to secure an anemometer loan.

The ALP team tried to strengthen ties with borrowing tribes as well as build tribal capacity by inviting actual or potential borrowing tribes to WEATS, the annual wind applications training workshop hosted by WPA for Native Americans. This made it possible to meet many of the tribal points of contact in person. Another useful venue for meeting with borrower representatives is the annual TEP Review.

Despite all the efforts detailed above, it has been a challenge to stay in contact with some of the tribes, especially if a tribe experiences personnel turnover. The ALP team has lost touch with several borrowing tribes during the monitoring period.

Lesson learned: Clearly communicate the borrowing tribe's expected financial outlay.

While there are exceptions, the tribes as a whole are not particularly wealthy. Originally it was expected that the tribes would pay for return shipment of the equipment at the end of the loan, typically a few hundred dollars. However, some borrowing tribes cited a lack of funds and requested that Western pay for return shipping (Western considers the requests on a case-by-case basis). Statistics do not exist, but the topic was of some concern to the Western equipment loan manager. The same issue also affected the tall-tower program. Even after initially agreeing to pay for return shipping, one borrowing tribe could not do so because its accounts had been frozen due to a factional dispute within the tribal government. The ALP project manager eventually decided to not pursue the issue and now budgets for return shipping on all tall-tower loans. NREL is eligible for significant shipping discounts due to a master contract it has with a national shipper. The most recent tall-tower loan agreements required borrowing tribes to properly package the equipment and take it to the nearest freight facility of this shipper.

One possible way to deal with this issue is by requiring a deposit from the borrowing tribe. The deposit would cover return shipping and replacement of lost items, with the balance returned to the tribe at the end of the loan. This has been considered for the tall-tower program but so far

rejected due to the red tape involved for NREL to receive and hold funds from a non-NREL entity. The cost in labor for NREL personnel to manage the paperwork involved in holding non-NREL funds could very well be greater than the cost of paying for return shipment of the towers.

Lesson learned: Seeds may sometimes take many years to sprout.
It is not uncommon for years to pass between the conclusion of an anemometer loan and the initiation of follow-on activities by the tribe. In one memorable example, a tribe borrowed an anemometer to quantify the wind resource for a potential community-scale (sub-utility-scale) wind project. During the monitoring period, the ALP project manager made repeated efforts to engage the borrowing tribe's point of contact, repeatedly inviting this individual to WEATS but without success. Some years after the conclusion of monitoring, the ALP project manager received an unexpected call from a consultant hired by that same tribe to investigate the feasibility of a wind farm. Since then, the tribe has borrowed a 50-m tower as part of TEP-funded wind development activities.

4.4 Managing an Anemometer Loan Program

Lesson learned: Keep good records, both administrative and technical.
The importance of good record-keeping cannot be overstated. Set up a structure and plan for a large program. Make use of others' experience. The ALP team's understanding of which information to track emerged only over time; thus the ALP recordkeeping system evolved over time. Tracking systems and report formats that worked well for the Wind Explorer data logger had to be modified when the ALP began loaning tall towers with the Symphonie data logger. Finally, it should be noted that the ALP does not use remote communications with its towers. The borrower must retrieve the data manually and send it to NREL. For most of the program's existence, the recordkeeping system consisted of a combination of paper and electronic records. In the last years of the program, the recordkeeping system was reorganized and all records are electronic. Table 5 lists the documents used to manage the program in its later years.

Lesson learned: Wind data analysis and plotting software are invaluable.
During the first several years of the ALP, the team used Excel to plot wind data. In 2004, the ALP team started using commercial wind data processing software. This made it much easier to analyze and plot wind data as it was received. The ALP team could now e-mail updated plots to the borrowing tribe every time a new batch of data was received.

Table 5. Anemometer Loan Program Forms and Files

Form	Purpose
Anemometer Loan Program Description	Explain the ALP to potential borrowers
Application Instructions	Detail the information to be included in an application letter
Loan Status Tracker (Excel spreadsheet)	Track status of each loan
Loan Worksheet	Ensure application has all required information
(one per site)	Record all required information: point of contact, proposed project, proposed site, etc.
	Help analyze proposed project concept to ensure there are no show-stoppers
	Record dates of key events
Site Notes	Record tower location
(one per site)	Record sensor height and configuration
	Record raw data as it is received
	Record creation of text files
	Record wind data issues
	Record notes on wind data as it is received

4.5 Value of Refurbishing Tall Towers (DISCUSSION)

At a minimum, refurbishing a tower includes replacing all the sensors (~ $1,400) to ensure the collection of high-quality data. Each loan also includes replacement of other ancillary items, such as anchors for the guy wires. The average cost for replacement items for the most recent batch of four tall-tower loans was ~$2,500. Other costs in addition to equipment replacement include the cost of shipping to NREL when a loan is completed and shipping from NREL to the next borrowing tribe. The final cost is the labor involved in unpacking a shipment, inspecting the contents, and repacking for the next loan and coordinating with NREL's shipping and receiving department. This typically involves 20 to 30 person-hours per loan. This process is necessary because 1) it's possible that the tribes will not properly palletize the equipment for return shipment to NREL, so the equipment must be repacked before shipping to a new destination, and 2) some items are returned worn or damaged and must be replaced.

When labor is included, the cost of shipping and refurbishing a 50-m met tower approaches, or perhaps exceeds, the cost of simply buying a new 50-m tower for each loan (~$17,000). On the other hand, it seemed wasteful to simply abandon the equipment. For several years, the ALP

team exercised the refurbishment option. However, as the most recent loans come due, the issue will come up again. As a practical matter, it may be time to scrap the towers. The equipment has reached its lifetime limit of two to three loans. In addition, the towers in question are older towers with 6-inch-diameter tubing. In recent years, the industry has switched to 8-inch-diameter towers and has re-designed the guy wire system.

4.6 Continued Usefulness of 50-m Towers (DISCUSSION)

In 2010, representatives of the ALP, TEP, and Western met to discuss this issue. The attendees recognized the decreasing value of 50-m wind data but were also apprehensive about the expense and effort needed to manage the loan of 60-m or 80-m towers. At that time it was decided not to make any changes to the equipment in the ALP inventory. As long as the ALP relies on donated equipment, this isn't really an issue; the program will use what it gets. If there is a decision to purchase anemometer equipment in the future, rather than rely on donations from completed projects, this discussion will re-emerge. Table 6 summarizes some of the available options.

Table 6. Current Anemometer Equipment Options

Option	Discussion
34-m met towers	Lowest cost and shortest tower currently available from NRG
	Easiest to install, but most tribes will probably require outside assistance
	Multiple monitoring heights
	Borrowers will have to conduct follow-on monitoring for most projects
50-m met towers	Current equipment in the ALP inventory
60-m met towers	Current minimum standard for financeable data
	Greater difficulty and expense to install
80-m met towers	Even more financeable
	Much greater equipment and installation expense
SODAR/LIDAR	No tower
	More expensive; equipment cost is roughly twice that of a 60-m met tower
	Requires greater expertise to analyze data
	In general, investors and lenders are still uncomfortable financing projects based on data gathered solely by remote sensing (it is becoming more common to combine traditional met towers with remote sensing)
Instrument existing communications towers	There is a company that has optioned more than 10,000 communications towers across the continental United States that can be instrumented for wind data collection (80 m and above)
	Lower overall cost than purchasing and installing an 80-m tower
	Towers may not be available where needed

5 Conclusions

As a result of the ALP, in the past 12 years anemometers were installed at 90 sites. Installations under related loan programs (Western and other) increase the total number of installations on tribal lands to 144. Due to the dearth of high-quality wind resource information, the ALP filled a need at the time of the program's inception, providing the borrower with a low cost means of quantifying the wind resource. The program's early success (in terms of high demand) resulted in the establishment of approximately 20 state-based anemometer loan programs. Since the initiation of the ALP, the quantity and quality of publically available wind resource information has increased dramatically. Despite the increased availability of wind resource data, local terrain features often affect the wind resource in ways that are not captured by the wind maps. On-site monitoring still adds significant value.

The legacy of the ALP is not what was expected when the program began. Wind turbine installations as a result of the program are fewer than expected. This is due in part to the WPA team underestimating barriers to tribal wind development. In other ways, the ALP has a more solid legacy. The process of scoping a potential wind project by installing an anemometer provides unmatched opportunities for engagement and learning. One-quarter of the borrowing tribes have successfully applied for TEP grants for follow-on wind resource assessment or wind energy project development.

Ten years of activity resulted in numerous lessons learned, including:

- An ALP is an outreach program as well as a technical program.
- One way to maximize the value of an ALP is to provide project scoping and siting assistance to potential borrowers.
- Good record-keeping is vital. Future programs should set up a system that can accommodate a large number of loans; continually refine the program.

Appendix A. Anemometer Loan Locations (Short Tower)

Location	State	Monitoring Begins	Monitoring Ends
Bay Mills Indian Community	MI	3-Oct-00	7-Nov-01
Bear River Band Rohnerville Rancheria	CA	13-Oct-00	8-Nov-01
Fort Belknap	MT	7-Feb-01	6-Nov-02
Hopi	AZ	24-Feb-01	23-Mar-02
Flandreau Sioux	SD	2-May-01	25-Jul-02
Iowa Tribe of Oklahoma	OK	4-Jun-01	15-Jul-02
Ugashik Traditional Village	AK	6-Jun-01	31-Jul-02
Walker River Paiute Tribe	NV	21-Jun-01	25-Jul-02
Duck Valley (Shoshone Paiute)	NV	21-Jun-01	7-Mar-02
Robinson Rancheria	CA	12-Jul-01	12-Sep-02
La Jolla Indian Reservation	CA	26-Jul-01	29-Jul-02
Fort Peck (A&S Tribal Industries #1)	MT	7-Aug-01	5-Apr-02
Shakopee Mdewakanton Sioux Community	MN	30-Aug-01	13-Aug-02
Quinault #1	WA	13-Sep-01	6-Nov-02
Tanana Village	AK	20-Sep-01	13-Oct-02
Houlton Maliseet	ME	26-Sep-01	11-Sep-02
Fort Yukon (Council of Athabascan Tribal Governments)	AK	4-Oct-01	27-Mar-02
Kaw Nation #1	OK	26-Oct-01	13-Nov-02
Pine Ridge	SD	29-Oct-01	22-Oct-02
Otoe-Missouria Tribe	OK	16-Nov-01	6-Nov-02
Shoshone-Bannock Tribes	ID	18-Dec-01	data to INEL
Quileute	WA	22-Jan-02	3-Feb-03

Location	State	Monitoring Begins	Monitoring Ends
Sherwood Valley Rancheria	CA	14-Feb-02	8-Nov-02
Caddo Nation of Oklahoma	OK	27-Mar-02	27-Feb-03
Navajo Tribal Utility Authority (Deeza Bluff)	AZ	5-Apr-02	29-Sep-03
Sac & Fox Nation of Missouri	KS	5-Apr-02	6-May-03
Winnebago Tribe of Nebraska	IA	20-Apr-02	16-Apr-02
Grand Portage	MN	16-May-02	18-Jun-03
Potawatomi	KS	14-Jun-02	18-Aug-03
Wind River (Northern Arapahoe)	WY	3-Jul-02	28-Jul-03
Crow	MT	14-Aug-02	5-Feb-04
Table Bluff Reservation	CA	23-Sep-02	13-Oct-03
Stewarts Point Rancheria	CA	14-Oct-02	31-Jan-03
Sisseton-Wahpeton Dakota Sioux	SD	18-Oct-02	30-Aug-03
Sisseton-Wahpeton Dakota Magic	SD	24-Oct-02	30-Aug-03
Fort Belknap #2	MT	6-Nov-02	5-Jan-03
Quinault #2	WA	18-Feb-03	9-Feb-04
Northern Cheyenne	MT	19-Feb-03	11-Nov-04
Yukon-Kuskokwim Health Corporation (YKHC) Bethel Hospital	AK	23-Feb-03	15-Dec-03
(YKHC) Kasayuli sub (Bethel)	AK	24-Feb-03	15-Dec-03
YKHC - Emmonak	AK	25-Feb-03	31-Dec-03
YKHC - Newtok	AK	25-Feb-03	1-Aug-03
Cheyenne River Sioux Tribe	SD	6-Mar-03	2-Jul-08
Soboba Band of Luiseno Indians	CA	23-Apr-03	
Kaw Nation #2	OK	6-May-03	16-Jun-04

Location	State	Monitoring Begins	Monitoring Ends
Pascua Yaqui	AZ	28-May-03	1-Apr-04
White Mountain Apache (Fort Apache)	AZ	9-Jun-03	2-Jun-04
Augustine Band of Cahuilla Mission Indians	CA	27-Jun-03	15-Mar-04
Los Coyotes Band of Indians	CA	1-Jul-03	4-Nov-04
Leech Lake Band of Ojibwe	MN	27-Aug-03	14-Dec-04
Ysleta Del Sur Pueblo	TX	8-Nov-03	18-Sep-04
Mille Lacs Band of Ojibwe	MN	19-Dec-03	8-Apr-04
Eastern Shawnee Tribe of Oklahoma	OK	19-Dec-03	1-Mar-05
Sand Point TDX Power	AK	14-Feb-04	6-Jul-05
Hualapai Nation	AZ	25-Mar-04	3-Jan-05
Fond du Lac Reservation	MN	8-Apr-04	4-Feb-05
Navajo #2 Black Mesa	AZ	13-Apr-04	25-Mar-05
Quinault #3 - Pt Grenville	WA	25-Jun-04	7-Jul-05
Navajo #3 Puerco Ridge	AZ	7-Jul-04	2-Dec-02
Kaw Nation #3	OK	15-Jul-04	23-Feb-07
Red Lake Chippewa	MN	7-Oct-04	14-Jul-05
Yurok	CA	9-Nov-04	2-May-05
Citizen Potowatomi	OK	15-Nov-04	24-Jan-06
Omaha Tribe of Nebraska	NE	15-Nov-04	13-Nov-06
Wind River - Bighorn Flats	WY	1-Mar-05	15-Feb-08
Pueblo of Laguna	NM	8-Jul-05	22-Sep-06
Cour d Alene	ID	27-Jul-05	22-Apr-06
Rosebud Sioux	SD	9-Sep-05	19-Nov-06

Location	State	Monitoring Begins	Monitoring Ends
Crownpoint Institute of Technology	NM	17-Nov-05	24-Oct-06
Bois Forte Band of Lake Superior Chippewa	MN	17-Jul-06	28-Mar-08
Keweenaw Bay Indian Community (KBIC) #1	MI	7-Jun-07	16-Jun-08
Pine Ridge (Loneman School)	SD	unknown	ongoing
Keweenaw Bay Indian Community (KBIC) #2	MI	28-Aug-09	24-Jun-10
Tonkawa	OK	24-Aug-10	19 Apr 2011
Pinoleville Pomo Nation	CA	27-Sep-10	19 Apr 2011

Appendix B. Anemometer Loan Locations (Tall Tower)

Location	State	Monitoring Begins	Monitoring Ends
Hualapai #1: Blue Mountain	AZ	14-Oct-05	4-Apr-06
Bay Mills	MI	7-Nov-05	Tribal college analyzed data
Hualapai #2: Peach Springs	AZ	14-Dec-05	Tribal consultant analyzed data
Leech Lake	MN	12-Aug-06	20-Nov-07
Winnebago	NE	21-Aug-06	ongoing
Cully Corporation (Point Lay)	AK	5-Oct-06	11-Sep-07
White Earth	MN	4-Nov-06	17-Apr-09
Grand Portage	MN	9-Mar-07	30-Jun-09
Wampanoag	MA	UMASS analyzed data	UMASS analyzed data
Timbisha Shoshone (Scotty's Junction)	CA	24-Oct-07	19-May-08
Seneca	NY	1-Nov-07	16-Feb-09
Village of Eyak	AK	13-Nov-07	31-Jul-09
Yurok	CA	15-Sep-09	20-Sep-10
Lummi Nation	WA	4-Feb-11	ongoing
Duckwater	NV	19-Jun-11	ongoing