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Navajo Tribal Utility Authority: Electrification Demonstration Program Developing a Sustainable Tribal and Rural Cooperative Solar Program

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Abstract

Navajo Tribal Utility Authority: Electrification Demonstration Program: Developing a Sustainable Tribal and Rural Cooperative Solar Program. SHAUN TSABETSAYE (University of New Mexico, Albuquerque, NM, 87185), Paul S. Veers, Manager, Sandia Wind Technology Department (Org. 6214) and Sandra Begay-Campbell, Technical Advisor (Org. 6214).

There is a lack of electrical service on approximately 18,000 homes on the Navajo Nation because of isolation; these homes need to be electrified. The Navajo Electrification Demonstration Program (NEDP) was created in 2001 by Congressional appropriation to be implemented by the Navajo Tribal Utility Authority (NTUA), a 30-year-old rural utility co-op. For this fiscal year, this program allows for 50% of the multi-million dollar appropriation to implement 880-watt photovoltaic (PV) hybrid systems that use solar and wind technologies to electrify the off-grid homes.

The ultimate goal of our work is to help the Navajo Nation and NTUA sustain a solar energy program as a viable technology option for its people. NTUA can serve as a model for sustainable solar energy development for tribal governments and rural utility co-ops.

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RESEARCH METHODS

The project included learning about government-to-government relations that enabled NTUA's PV programs and how operation and maintenance (O&M) procedures is key to the sustainability of the program. The study was conducted by interviewing personnel, field studies, and experiencing hands-on maintenance of the PV systems. The work was documented by producing workflow diagrams and exchanging feedback. Learning the background of the program as well as analyzing the history of NTUA's relationship with Sandia National Laboratories was essential in conducting the study. Most of the work was based on documented and undocumented procedures to develop the workflow diagrams. These procedures are performed differently across the seven districts of NTUA and need to be standardized as an approved routine for conducting system O&M procedures. The work is modeled after the procedures used at the Kayenta District, which has been the leader in implementing the PV program for NTUA. It is important to understand the history of how the Navajo Electrification Demonstration program began, so research methods included extensive reading on the Navajo Tribal Utility Authority program documentation that included legislation, appropriation, deployment, project scope and viewing "Power from the Sun," an educational video about PV systems, in Navajo. Early in the internship, a field visit was made to the Four Corners region to understand the choices that the Navajo Nation was making to utilize the one hundred-year supply of coal that provided approximately 80% of the Navajo's annual budget. Later we made field visits to the Navajo Tribal Utility Authority to understand the progress of the electrification program. Then, to understand what the rest of society was doing locally, regionally, and nationally to address energy needs, we attended the Rebuilding New Mexico meetings in Albuquerque, NM; the Southwest Renewable Energy Conference in Flagstaff, AZ.; and the

American Solar Energy Society Conference in Austin, TX. At every field visit and conferences attended, interviews were conducted to get perspectives on renewable energy. Also documentation and creation of Troubleshooting and Operation & Maintenance flowchart diagrams were drafted and presented to the Navajo Tribal Utility Authority, and from there, dialogue was exchanged. Finally, a photovoltaic demonstration kit was built to get hands-on experience in understanding components used in photovoltaic system design.

THE NAVAJO ELECTRIFICATION DEMONSTRATION PROGRAM

As the largest Native American tribe in the United States enters the 21st century, the Navajo Nation strives to provide electricity to rural homes on its 26,000 square mile reservation. According to the 2000 U.S. Census, there are 47,603 occupied homes on the reservation. Of those homes, the Navajo Tribal Utility Authority (NTUA) estimates that 18,000 are without electricity [2]. NTUA has determined many of these homes are more than a mile away from an electrical grid and some as far as 45 miles. Recently NTUA used Global Positioning Systems (GPS) to verify these distances [6]. Extending electrical lines would cost each home $27,000 per mile [1]; therefore, it is difficult to provide modern-day conveniences such as lighting, refrigeration, and running water to these remote homes. Furthermore, a significant number of homes reside in clusters and are less than one mile away from large power transmission lines from the Four Corners region power plants that radiate onto the reservation, but these lines do not serve the Navajos directly because the cost of transformers to reduce high power to usable low power is too expensive for these customers. As a result, the cost of providing electricity to homes on the Navajo Nation is extremely high and requires a higher percentage of a family's income compared to what average Americans pay.

In 1993, the Navajo Nation received a grant from DOE (through the Western Area Power Administration) to launch the Photovoltaic Solar Electric system program through NTUA. This federal grant allowed NTUA to provide 200-watt PV systems to 40 rural homes. With the success of this initial effort, the Navajo Nation adopted the concept of renewable energy as a sustainable solution and authorized NTUA to spend about $2 million of the utility funds to implement 100 additional 640-watt PV systems in 1999 [1]. The funds, however, were insufficient for the remaining unelectrified homes.

On December 2000, Sandia National Laboratories (SNL), the Navajo Nation, and the U.S. Department of Energy (DOE) signed a Memorandum of Understanding (MOU), which authorizes collaboration and technology transfer for the Navajo Nation. The collaboration emphasizes energy, environment, education, economic development, and communication. The MOU reinforces Sandia's commitment to this effort. Under this MOU, SNL has made strides to provide technical assistance on behalf of DOE to help the Navajo Nation provide rural electricity. It is under the auspices of this technology transfer that the Navajo Nation sought to service the remaining unelectrified homes.

Then in the fiscal year 2001, a multi-million dollar Congressional authorization and appropriation, through New Mexico Senator Jeff Bingaman, was granted to the Navajo Nation for 5 years. NTUA was authorized again by the Navajo Nation to develop and provide sustainable electricity by line extension from a grid or by using stand-alone PV systems [1]. The current appropriation plan allocated half the budget to develop PV systems for the Navajo Nation. With technical assistance from SNL in fiscal year 2002, NTUA procured 42, 880-watt PV-hybrid systems to be leased to the remote NTUA customers. These systems use solar combined with wind energy resources to fulfill their electrical needs. The outlook of continuing

to provide these alternative systems looks promising, yet NTUA has determined that adequate federal funding in a timely manner still remains a factor.

Another key factor in successfully developing renewable energies on tribal lands is the care and sensitivity taken when conducting business with tribal governments. At issue is the government-to-government relationship between tribes and the federal government. Involved parties must understand that each tribal government is a sovereign government and is independent from other tribes and states in the United States, and the policy needs refinement. Sandra Begay-Campbell of SNL's Tribal Energy Program points out that policies vary from tribe to tribe and what works for one may not work for another [7]. However, constant refinement may be needed when there are changing tides internally with tribal governments. David E. Lewis of the Yavapai Apache expressed the difficulties that he faces as the director of the Tribal Energy Program when dealing with the tribal government. Mr. Lewis agrees that NTUA and the Navajo Nation serve as a great model, but it would be a difficult to deploy a similar effort within the Yavapai Apache reservation since most tribal members are already connected to the electrical grid. With an evolving tribal utility, Mr. Lewis states it is difficult to forecast political tides. This serves as an indicator that many decisions are made based on political reasons than for economical, cultural, or educational reasons. Arvin Trujillo, director of the Department of Natural Resources for the Navajo Nation, asserts this point by professing that venture capitalist companies who unsuccessfully persuade him to use the Navajo's natural resources resort to a lesser-informed tribal council to leverage the decision-making process. This result in political struggles that slow the process without taking into account real issues at hand, therefore unraveling any progress made. Mr. Trujillo also notes that leaders may at anytime assert their authority and practice tribal sovereignty. All parties involved have already indicated that

development on Indian lands has always been a challenge. Factors such as tribal sovereignty and government-to-government relationships have always been key issues in building capacity and sustainability in energy development. With this uncertainty lurking in the minds of decision-makers around the development of tribal lands, a careful and sensitive approach must be taken. Generic solutions are not applicable, yet models of current programs and relationships should be studied to identify successful solutions.

Beyond political issues, culture and tradition play major roles in the decision-making processes for Native Americans. Mr. Trujillo states, "We want to be a part of the American way without the Western philosophy." He further clarifies that the Navajo Nation wants to build a legacy using sustainable methods to develop infrastructure while considering economic, environmental, and cultural impacts, and ensuring that Navajo communities fit into this goal [4]. The Navajo Nation has a proven track record of sustainability in its PV program. The Yavapai Apache tribe has installed PV systems in non-utility federally funded programs such as the Housing and Urban Development (HUD) program, the Yavapai Apache Day Care Center, and a health clinic. The Zuni Pueblo implemented PV systems for ecological preservation through the Zuni Conservation Program, which uses PV systems to pump water for ranching, farming, reinvigorating native plants, and providing water for their aviary sanctuary for sacred eagles. The Hopi tribe began with NativeSun, a grassroots non-profit organization that later became for-profit, to provide electricity within the condensed villages to preserve their autonomy and sovereignty without public power lines and avoid cumbersome right-of-way issues that traditional utility companies must face [9]. These same tribes are key players in Arizona's renewable energy development as highlighted recently in Flagstaff, Arizona, at the Southwest Renewable Energy Conference. These same tribes with lands in Arizona showed great potential

for capacity building of renewable energies when new wind maps of Arizona were recently unveiled. Developers, however, should be cautioned that these tribes are at different levels of development and cannot be rushed quickly into deploying large-scale renewable energy programs.

There may be other solutions to help enable tribal energy development. For example, private enterprises such as Sacred Power may be used to segue into development. Sacred Power is a Native American-owned, for-profit company based at Laguna Pueblo, New Mexico that began in 2001. Sacred Power bids for contract work for federally funded programs and projects within New Mexico and elsewhere. Successful operation depends heavily on cash flow and can face economic troubles when federally funded contract work runs out and again can face sustainability problems within the company. David Melton, principal of Sacred Power, believes, however, that the company has large potential for success as it provides fluid system integration of pre-manufactured components that can reduce the cost of installation, system design, and O&M. Larry Ahasteen, renewable energy specialist at NTUA, would agree that operating the PV program using a business model is a viable, sustainable solution and has proved to have great economic value. Both Mr. Melton and Mr. Ahasteen have calculated the cost of system deployment and included O&M costs and concluded that contract work done by for-profit entities can save money and help in the sustainable development of tribal renewable energy programs. On the other hand, Mr. Ahasteen would advocate that deploying pre-manufactured systems still requires full knowledge of the PV systems by NTUA's electricians and technicians to ensure a sustainable program. Thus the role for SNL was to provide training and technical advice. With this acknowledged relationship, NTUA has been enabled by the efforts of DOE and SNL to become a sustainable program to provide electricity for the Navajo Nation. For the

coming fiscal year, NTUA plans to install 159 more 880-watt PV-hybrid systems, which will nearly double the number of systems already installed.

DISCUSSION

The overall goal of internship was to help create a baseline to standardize NTUA's processes and O&M procedures. The largest task in the project was to document successful processes and formalize the workflow associated with each process. Many of the methods used are not standardized across the seven districts of NTUA and are not yet system-wide, integrated procedures. One of the difficulties that electricians and program directors face is educating each other on the changing PV program, as well as educating NTUA's customers. The expertise required in understanding the system and relaying that knowledge both to electricians and end-users is complex. Installation procedures have been documented, but the process of documenting NTUA's O&M procedures has yet to be documented. A new flow chart will be developed to document NTUA's O&M process. It is at NTUA's discretion to use the developed flow chart.

FINAL REMARKS

This summer's internship experience has been a worthwhile experience that allowed me to share my perspectives as a Zuni Pueblo Indian and utilize my electrical engineering knowledge. I have come to realize that Native American tribes have a key role in developing their own under-utilized renewable energy resources. This experience has helped me to develop the ability to translate theory into application and understand how renewable energy can fit into Native American communities. This insight gained has inspired me to consider a long-term

career in tribal lands development, taking R&D operations to a business operations in order to help build infrastructure.

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