

Renewable Energy and Energy Efficiency Initiatives on the Laguna Pueblo Reservation

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Abstract

The objective of this paper is to describe the initiatives that the Pueblo of Laguna is undertaking to incorporate renewable energy and implement energy efficiency measures into its communities. Renewable energy awareness and energy efficiency practices are being encouraged throughout the Pueblo of Laguna.

Renewable energy relies on the natural occurrence of wind, running water, sunlight, growing plants, and geothermal heat. Energy efficiency means doing more with less energy. These concepts have always been part of the traditional ways of native people. Today, as tribes grapple with new challenges, they are seeking ways to develop their communities based on sound, long-term, sustainable practices. Renewable energy and energy efficiency offer the prospect for sustainable energy with important links to the past.²

No group of people in the United States is more motivated to pursue sustainable energy development than Native Americans. In contrast to conventional energy, many

¹ Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC-04-94AL85000.

² Busch, J. *et al.* *Native Power: Native American Renewable Energy Education Project*. Energy and Resources Group, University of California, Berkeley and Environmental Energy Technologies Division, Lawrence Berkeley National Laboratories. 1998. Page 5.

Native Americans see renewable energy and energy efficiency as friendly to the environment and compatible with their lives.³

Throughout history Native Americans have always had a special bond with Mother Earth. Mother Earth is our provider; she has given us natural resources for food, shelter, and health. Throughout history she has provided all things necessary to live. With changing times and evolving federal policy, we are moving farther away from practicing the skills that enable us to survive from the land. Instead of building our own homes from natural materials from the earth, we depend on a quick fix such as government subsidized homes or mobile homes. Instead of eating healthy, home-grown food, we depend on drive-thru service. The public is now realizing that the old ways of living were more energy efficient and didn't have a negative impact on the environment. We are realizing that the way we traditionally farmed is organic and the way our ancestors built used green architecture based on scientific principles of heating and cooling—the thermal and insulating properties of the building materials and design. Today our style of living and the amenities that we have grown accustomed to are not sustainable.

The research information gathered for this paper was taken from the internet, books, Power Point presentations and personal interviews. The Pueblo of Laguna is the focus of this research. Laguna is ready to take its green initiatives to the next level by creating a renewable energy program focused on solar energy and by being energy

³ Busch, J. *et al.* *Native Power: Native American Renewable Energy Education Project*. Energy and Resources Group, University of California, Berkley and Environmental Energy Technologies Division, Lawrence Berkley National Laboratories. 1998. Page 5.

efficient in each of its communities. Laguna seeks to improve the overall quality and reliability of electric services within its community.⁴

Background and Context

Laguna is located in rural New Mexico, primarily in Cibola County, 45 miles west of Albuquerque. The reservation is bisected by Interstate 40. The Laguna reservation covers 533,000 acres and comprises six distinct villages: Laguna, Pagate, Seama, Paraje, Encinal, and Mesita⁵. Laguna tribal enrollment is at 8,000 members.⁶

Pueblo of Laguna Utility Authority (POLUA) was created in 2005 by tribal council. The utility was formed for two reasons: (1) Water and sewer services used to be run by the Tribal facilities department and social services ran the solid waste department. Tribal council decided that they wanted to combine water, sewer, and solid waste into one entity. (2) The current utility company that the Pueblo of Laguna uses does not provide the same type of service to Laguna tribal members as it does for people who live in the surrounding communities. Consequently, due to electric reliability and quality issues from their service provider, they wanted to operate their own electric utility. After creating the Utility Authority, Laguna was able to apply for grants which, in turn, made it possible for them to apply for DOE Tribal Energy Program grants that helped fund the Pueblo's feasibility studies.

Eventually, POLUA wants to take over the electricity system and discontinue using outside service providers. The Pueblo's current service provider is working with them to help accomplish this goal. POLUA wants to provide the same services that any

⁴ Stewart, C. Project Abstract for a Department of Energy Grant Application. Pueblo of Laguna Utility Authority. 2008. Page1.

⁵ Stewart, C. Project Abstract for a Department of Energy Grant Application. Pueblo of Laguna Utility Authority. 2008. Page1.

⁶ Antonio, T. "Pueblo of Laguna Utility Authority". Power Point Presentation. 2006. Slide 4.

other utility company provides such as providing information on energy efficiency, renewable energy programs, safety, bill information, and payment options. They also want to stay connected to the community and would like to produce electrical generation without negatively affecting the environment (*i.e.*, they would like to be environmentally friendly).

The Pueblo of Laguna is committed to working toward its energy goals while remaining as environmentally responsible as is practical and wants to promote responsible energy self-sufficiency. Laguna believes that it can achieve all tribal energy goals sustainably while encouraging economic development for the benefit of the Tribe and its members.⁷

In December 2007, the Pueblo of Laguna completed a renewable energy feasibility study to see what renewable energy resources they could take advantage of on the Laguna Reservation. After identifying which renewable energies were available and determining what projects were feasible, they began to search for funding.⁸ Details about funding sources for renewable energy projects on the reservation are provided later in this report.

POLUA is working towards four goals. The first is to reduce fossil fuel use from coal-fired generating plants by 30%. Second is to provide social benefits such as higher employment, reduced energy burdens for tribal members, and achieving sustainability. Third, they want to provide energy that is environmentally clean. Finally, they want to

⁷ Stewart, C. Project Abstract for a Department of Energy Grant Application. Pueblo of Laguna Utility Authority. 2008. Page1.

⁸ Antonio, T. "Pueblo of Laguna Utility Authority". Power Point Presentation. 2008. Slide 1

provide a renewable energy program so that the tribe can be self sufficient. POLUA, as a public service entity, strives to help its people.⁹

Energy Efficiency in Laguna Pueblo

POLUA began publishing newsletters as an information vehicle to keep tribal members up to date on issues pertaining to the organization. Topics covered in these newsletters are related to water, waste water, solid waste, and energy. Additionally “Utility Authority Newsletters” were established to provide community education on renewable energy and energy efficiency tips.¹⁰ These newsletters, provide energy saving tips for tribal members to practice in their homes. Tips include weatherizing your home, using sunlight to heat the home, and turning off the computer when it’s not in use because of phantom loads. They also encourage tribal members to buy energy star appliances and explain the benefits of using these products. The following tips on energy efficiency are recommended to POLUA to share with tribal members:¹¹

⁹ Antonio, T. “Pueblo of Laguna Utility Authority”. Power Point presentation. 2008. Slide 8.

¹⁰ Antonio, T. “Pueblo of Laguna Utility Authority”. Power Point presentation. 2006. Slide 15.

¹¹ El Paso Solar Energy Association. Energy Efficiency-Low cost/No Cost. July 2008.

<http://www.epsea.org/nocost.html>.

No-cost Tips

- Turn water heater down to 120 °F (49 °C)
- Clean refrigerator coils
- Switch refrigerator to 'power miser' setting
- Set refrigerator temperature from 36-39 °F (2-3 °C)
- Set freezer from 0-5 °F (-18° to -15 °C)
- Keep refrigerator/freezer full
- Turn off water while shaving and brushing teeth
- Use cold water for wash
- Wash full loads
- Collect rainwater
- Use the right size pot/pan on the stove burner
- Do not preheat your oven except for baking
- Cover pots/pans when cooking
- Drain some water from your water heater to remove sediment



Figure 1. Rainwater Collection

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Low-cost Tips

- Install low-flow shower heads and aerators on faucets
- Insulate water heater
- Insulate electrical outlets and switches
- Caulk the inside of doors and windows
- Insulate/caulk all pipe penetrations in walls and ceiling
- Install a bleed line on the evaporative cooler and run the line to a tree
- Replace furnace filter every month in winter
- Replace light bulbs with compact fluorescent bulbs
- Insulate the bottom and sides of waterbeds
- Use a quilt or comforter on waterbeds
- Purchase a water saving toilet or use toilet dams
- Make a 'draft dodger' for use on doors or windows

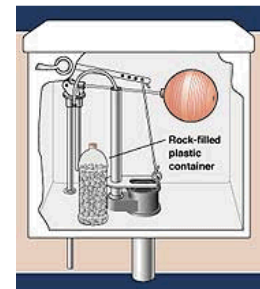


Figure 2. Toilet Dam¹³

Winter Tips

- Turn thermostat down 10 °F (5.5 °C) at night
- Turn thermostat down 10 °F (5.5 °C) when leaving for four hours or more
- Keep curtains open on the south side of the house during the day
- Keep curtains closed on north windows
- Dress in layers

¹² Solarharvest.org. Conservation: Conservation planned management of resources. July 2008. <http://www.solarharvest.org/conservation.htm>.

¹³ 57 Ways to Protect Your Home Environment and Yourself. (no update date) University of Illinois Extension. July 2008. http://www.thisland.uiuc.edu/57ways/57ways_57.html.

Summer Tips

- Close curtains on the sunny sides of home
- Turn off furnace pilot light
- Open windows on the cool sides of home
- Wear loose, light-colored clothing
- Use fans to circulate air in the home

The push for renewable energy, energy self reliance, and energy efficiency has been growing in Native communities across the country. Native communities such as Laguna Pueblo are stepping up and trying to encourage their people to live as energy efficiently as possible while remaining true to their roots.

In pursuit of Laguna Pueblo's goal to begin a community solar power program, POLUA is making energy efficiency a criterion for people to meet to qualify to receive a photovoltaic (PV) system. It is important that a tribal member's home be energy efficient *before* the PV system is installed. If the home is not energy efficient, the home's energy burden will be hard to meet and tribal members may not see a difference in their utility bills even with the PV system.

Renewable Energy in Laguna Pueblo

What is renewable energy? It is an energy source that can be renewed by nature and can provide clean sources of electricity generation.¹⁴ Renewable energy sources include solar energy, wind power, geothermal, biomass, hydro power and methane gas.¹⁵ In December 2005, members of POLUA's Renewable Energy Workgroup began working with outside consultants to identify possible renewable energy resources and potential

¹⁴ *Laguna Utility Service News*. Volume 1, Issue 4. October 2006. Page 1.

¹⁵ *Laguna Utility Service News*. Volume 1, Issue 4. October 2006. Page 1.

projects that could provide power to the reservation or that could be sold into the back to the regional power grid.¹⁶

In December 2007, POLUA sent a survey to all community members asking them what they thought about renewable energy. POLUA received 65 completed surveys, which indicated strong support for renewable energy development for member, community, and large-scale projects.¹⁷ Of the 65 responses (see Figure 3), 85% noted a need for renewable energy power generation; 5% felt that Laguna Pueblo didn't need to make use of renewable energy; and 9% had no response to the question.

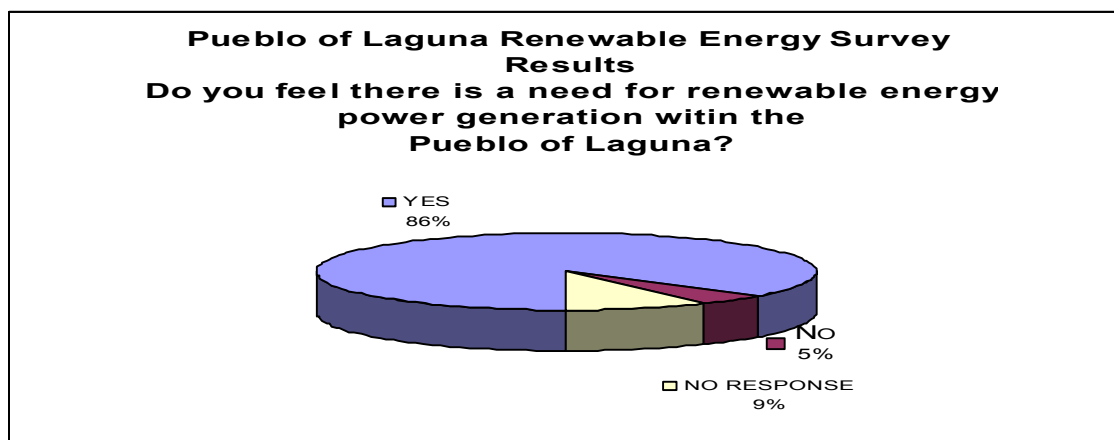


Figure 3. POLUA Survey Results—Need for Renewable Generation

Other survey results (see Figure 4) indicated that people felt that renewable energy was a good idea, but 78% of the tribal members who completed the surveys had no experience with renewable energy. The 22% of the respondents who did have experience with renewable energy said that they themselves or relatives had used PV panels to operate water pumps for livestock.¹⁸

¹⁶ *Laguna Utility Service News*. Volume 1, Issue 1. April 2006. Page 3.

¹⁷ Antonio, H., *et al.* Pueblo of Laguna Utility Authority: Sections 4-9. 2007. Energy Section: Page 13.

¹⁸ Pueblo of Laguna Utility Authority. "Renewable Energy Survey". 2007.

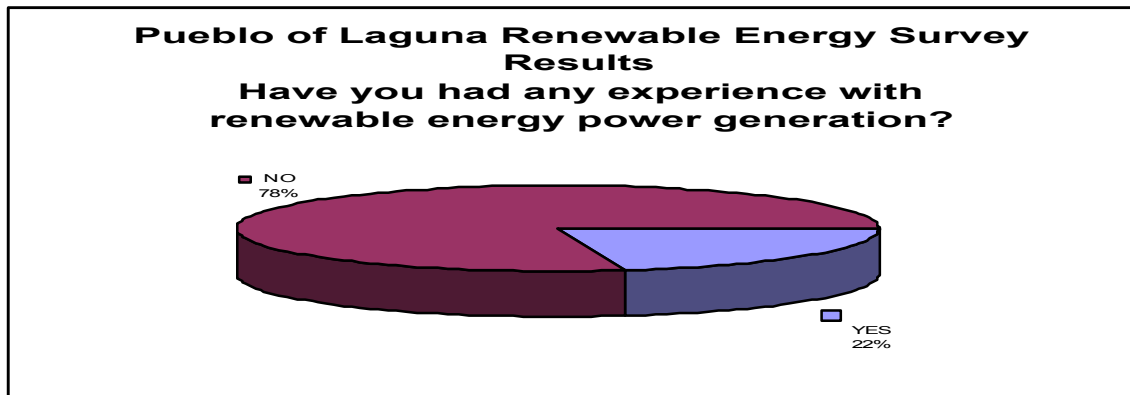
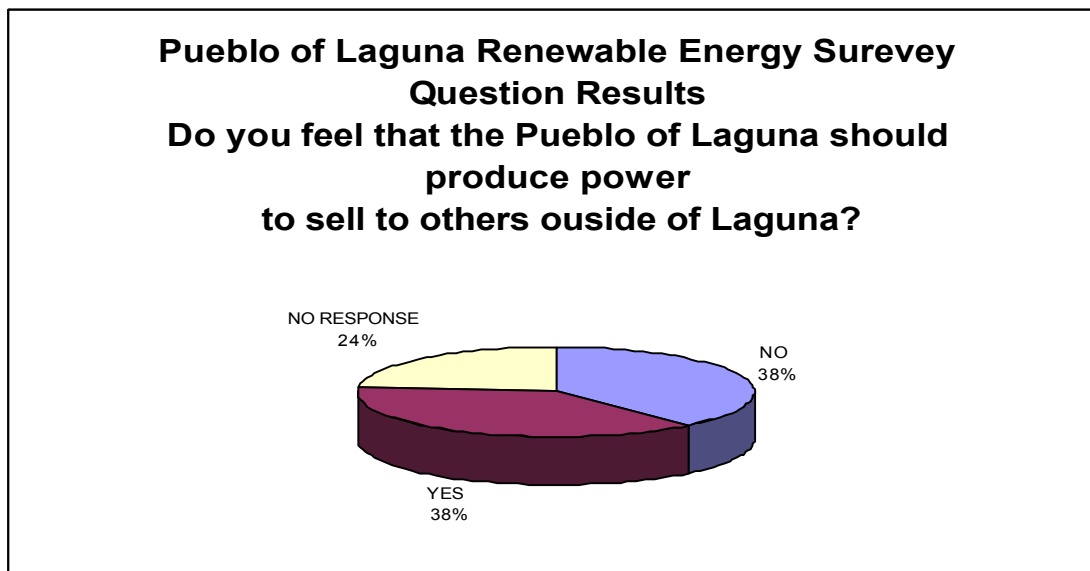


Figure 4. POLUA Survey Results–Experience with Renewable Generation

Another question asked “*Do you feel that the Pueblo of Laguna should produce power to sell to others outside of Laguna?*” Of the 65 responses (see Figure 5) 38% responded positively to the idea of selling power to people outside of the reservation. Comments left on the survey regarding this question indicated that it would be a great opportunity for economic development to be brought into the Pueblo. Nevertheless, a majority of people said that selling electricity should not be done until all Laguna Tribal members are receiving electric service.¹⁹

Figure 5. POLUA Survey Results–Selling Power Back to the Grid



¹⁹ Pueblo of Laguna Utility Authority. “Renewable Energy Survey”. 2007.

After analyzing the results of the survey, POLUA concluded that there was strong interest in renewable energy in Laguna. The results of the survey also revealed that the community was willing to support POLUA in its efforts to start a project based on renewable energy. Community support efforts are critical to the success of any Laguna program. Consequently, both the program announcement information and educational materials describing the program (including its rationale and its effects) will be developed and widely available to community members, organizations, and Laguna schools during the development of these projects.²⁰

Renewable Energy Education in Laguna

Community

As the DOE-funded Renewable Energy Feasibility Study was being developed, the POLUA created a newsletter highlighting renewable energy and utility issues, facilitated community discussions, and established the means for receiving input from the community.²¹ According to Thelma Antonio, Utility Planner for POLUA and coordinator of the Community Solar Program; community members are educated using newsletters and pamphlets that are available at the POLUA office or distributed at housing fairs plus through Power Point presentations. POLUA is also interested in hosting a utility fair where they will distribute information about issues pertaining to POLUA and renewable energy projects.

²⁰ Stewart, C. Project Abstract for a Department of Energy Grant Application. Pueblo of Laguna Utility Authority. 2008. Page 2.

²¹ Stewart, C. Project Abstract for a Department of Energy Grant Application. Pueblo of Laguna Utility Authority. 2008. Page 2.

Schools

Ms. Antonio also stated that Laguna Middle School has shown an interest in renewable energy and would welcome program support from POLUA.²² She talked about empowering the teachers to do more projects on their own to teach kids about conservation, recycling, and renewable energy. She also said that POLUA is interested in getting involved with the school's science fair and doing a renewable energy education presentation for the students.²³ The information provided by POLUA has been so useful and interesting that the school chose "Energy" as the theme of its 2007 science fair.

Fatal Flaw Analysis

A fatal flaw analysis is an attempt to identify events or conditions that could cause a problem that prevents a project from achieving its goals. A fatal flaw can be relatively transparent and associated with assumptions made or can be intangible and difficult to identify.²⁴ The fatal flaw analysis performed at Laguna Pueblo revealed that wind turbines, biomass, geothermal energy, hydro power, and methane gas are not feasible for meeting the Pueblo's energy needs.²⁵ Solar power was identified as the most feasible renewable technology. These resources and their feasibility for use on the Laguna Reservation are summarized below.

Geothermal

Geothermal energy comes from underground in the form of hot springs. Laguna Pueblo has the necessary water resources; they are, however, too far from the villages and

²² Stewart, C. Project Abstract for a Department of Energy Grant Application. Pueblo of Laguna Utility Authority. 2008. Page 2.

²³ Antonio, T. Interview. June 2008.

²⁴ Skelly and Loy Engineering –Environmental Consultants. Fatal Flaw Analysis. July 2008. <http://www.skellyloy.com/services/engineering/mining/description/index.cfm?ID=51>.

²⁵ Antonio, T. Interview. June 2008.

they don't reach the temperature required to generate power.

Wind Power

The *Foresight Energy Study of Laguna Wind Development Feasibility* indicated that commercial-scale wind development is not feasible at the Laguna sites studied. Laguna Pueblo is Wind Class of 3. Class 4 is recommended to improve the chances of the project being cost effective. Class 7 is the optimum level and is seen in many Midwest states.

Hydro Power

Hydro power is created from moving water (*e.g.*, streams and rivers) that turn turbines such as those at Hoover Dam. Laguna pueblo does not have the high volume of water needed for a dam to create hydro power.

Methane Gas

Methane is produced from waste streams such as landfills, animal waste, and wastewater treatment plants. The treatment plant in Laguna doesn't generate enough methane to use for power generation. Because its villages are far apart, lagoon systems are used.

Biomass

Biomass comes from waste from forest areas, yards, farming, and construction. It can be burned as fuel to create steam to generate electricity or wood pellets could be made from waste and then burned to create energy. Laguna is not presently capable of using biomass as an energy source until further study identifies forested areas capable of providing a high volume of wood pellets. Nevertheless, biomass generation may be

possible and may support a recovery program for trees killed by bark beetle damage as well as a salt cedar eradication program.

Solar Power

POLUA's efforts to develop a PV program could benefit to elderly, disabled, or economically disadvantaged members of the Pueblo. POLUA is planning to use existing and new staff members to organize and implement two solar equipment installation programs, one for community centers and one for residences.

Community Scale: Community Center Solar Program

The Community Center Solar Program will provide PV system installation to all villages that want to participate. The use of the PV systems is expected to reduce the energy burden on the community centers.

Residential Scale: Stand-alone PV Systems

Recipients of PV systems will be Low-income Home Energy Assistance Program (LIHEAP) participants who meet specific housing requirements. LIHEAP provides grants to local governments and non-profit agencies to assist eligible households in meeting the costs of home heating and cooling.²⁶ In addition to LIHEAP participation, the home structure must also meet specific criteria to be considered for PV system installation. Specifically, the candidate house must be south facing and the roof structure must be able to support the solar panels. Before tribal members are considered eligible for receiving

²⁶ Florida Department of Community Affairs. Division of Housing and Community Development. August 2008. <http://www.dca.state.fl.us/fhcd/liheap/index.cfm>.

the PV systems their homes must also be energy efficient. Another important criterion is the home's location—homes in the village plaza most likely will *not* be eligible for a system. LIHEAP participants with the highest energy burdens will have priority over others. Tribal members who are not LIHEAP participants can purchase a PV system and will not be charged for its installation. PV system recipients will be trained on how to manage their energy load and how to be energy efficient.

Laguna Pueblo's PV Program

How did it begin?

A feasibility study that was completed in Laguna Pueblo indicated that solar power was the best option for Laguna Pueblo. POLUA also heard from numerous tribal members that their bills were too high and it was getting more expensive to pay for their utilities. Some families were in fear their utilities would be disconnected or already had been living without service for long periods because they could no longer afford their utility bills. A mail-in survey was conducted to determine the community's thoughts about renewable energy and the completed surveys showed a positive response. From there utility planner Thelma Antonio began to envision the community program.

Where did the solar panels come from?

After contacting various sources within DOE's Tribal Energy Program, POLUA located several hundred used solar panels which could be donated to the tribe because they had been marked as excess property by the Western Area Power Administration (WAPA). Once the excess property had been identified and located Sandra Begay-Campbell of Sandia National Laboratories recommended that a tribal utility capable of using the panels should be contacted to make donation arrangements. Specifically, she

recommended that the Pueblo of Laguna receive the panels to assist in the efforts to begin a renewable energy program focused on solar power.²⁷

How do PV systems work?

PV technology makes use of the abundant energy in the sun and has little effect on the environment.²⁸ PV systems work like any other electrical power generating systems; they just use different equipment. A PV system is composed of several elements that convert solar energy into electricity. These components conduct, control, convert, distribute, and store the energy produced by the array. Depending on the functional and operational requirements of the system, the specific components required may include major components such as a DC-AC power inverter, battery bank, system and battery controller, auxiliary energy sources, and sometimes the specified electrical load (appliances.)²⁹

Several types of PV systems are available and include simple interactive PV systems, stand-alone PV-hybrid systems, battery-based interactive PV systems, and stand-alone PV systems with AC/DC loads.³⁰ Figure 6 through Figure 10 show the components of each system and give a general idea of how each operates.³¹ The type of

²⁷ Antonio, T. Interview. June 2008.

²⁸ U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. Solar Energy Technologies Program. July 2008. <http://www1.eere.energy.gov/solar/photovoltaics.html>.

²⁹ Florida Solar Energy Center. "How a PV system works." July 2008. http://www.fsec.ucf.edu/en/consumer/solar_electricity/basics/how_pv_system_works.htm.

³⁰ Dunlop, J. "Designing for Uninterruptible Power: Opportunities for Battery-Based Photovoltaic Systems". *The Energy Chronicle*. July 2008.

<http://www.fsec.ucf.edu/En/media/newsletters/echron/archives/2006/Q1/uninterruptible-pwr.htm>

³¹ Dunlop, J. "Designing for Uninterruptible Power: Opportunities for Battery-Based Photovoltaic Systems". *The Energy Chronicle*. July 2008.

<http://www.fsec.ucf.edu/En/media/newsletters/echron/archives/2006/Q1/uninterruptible-pwr.htm>

PV system used is determined by the electrical load. A load is the amount of electricity demand on the system.

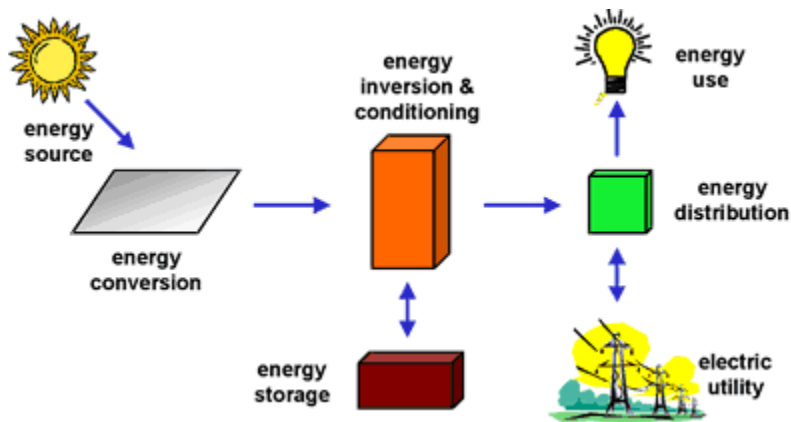


Figure 6. PV system and typical components.

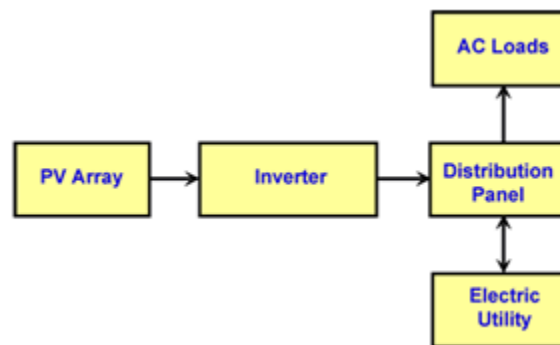


Figure 7. Simple interactive system.

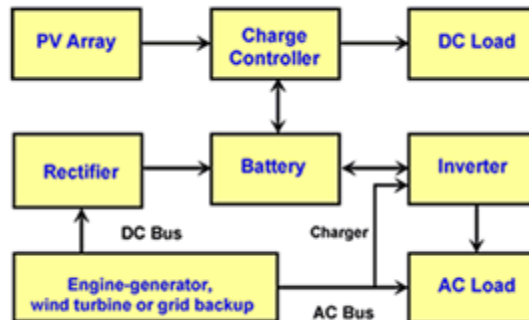


Figure 8. Stand-alone PV-hybrid system.

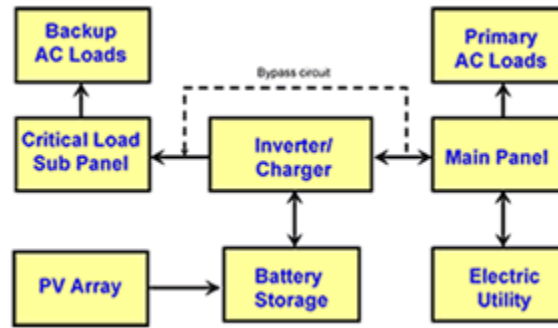


Figure 9. Battery-based interactive PV system.

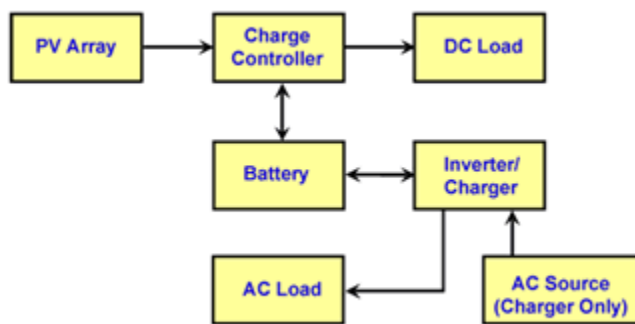


Figure 10. Stand-alone PV system with AC/DC loads.

PV systems work (in general) by collecting solar radiation from the sun with solar panels and actively converting that energy to electricity. Solar panels comprise several individual solar cells. The conversion of sunlight to usable electrical energy has been dubbed the *photovoltaic effect*.³²

Residential grid-tied PV power systems allow homeowners to meet most of their daily electrical energy needs and to exchange excess daytime power for future energy needs (*i.e.*, nighttime use). The house can remain connected to the electric utility at all times, so any power needed above what the solar system can produce (day or night) is simply drawn from the utility. PV systems can also include battery backup or

³² Solar Panel Info. Renewable Solutions. July 2008. <http://www.solarpanelinfo.com/solar-panels/how-solar-panels-work.php>.

uninterruptible power supply (UPS) capability to operate selected circuits in the residence for hours or days during a utility outage (see Figure 6).³³

There are two general types of electrical designs for PV power systems for homes: grid-tied systems with no battery backup (see Figure 7) and grid-tied systems include battery backup (see Figure 10). PV-hybrid systems most commonly take the form of PV systems integrated with wind turbines or diesel generators (see Figure 8).³⁴ Grid-tied PV systems operate in conjunction with a conventional electric utility feed. If the PV system produces more power than needed to operate local loads, the excess is sold to the utility (*i.e.*, the electric meter runs backwards and generates a billing credit). When the local loads exceed the power generated by the PV system (*e.g.*, at night or when large loads are being operated) the meter runs forward.³⁵

Who will receive PV systems?

Tribal members who are LIHEAP participants will receive the PV systems. The LIHEAP program is a state and federally funded program that helps tribal members pay their utility bills.³⁶ Those with the highest energy burden are the ones who receive this help.³⁷ A majority of LIHEAP recipients fall far below the national/state poverty level.³⁸

³³ *A Guide to Photovoltaic (PV) System Design and Installation*. Consultant Report. California Energy Commission. July 2008. http://www.energy.ca.gov/reports/2001-09-04_500-01-020.PDF.

³⁴ Atomstromfreie Website. Hybrid Photovoltaic Systems. July 2008. <http://www.pvresources.com/en/hybrid.php>.

³⁵ Karn, P. "My Home Photovoltaic (PV) Power System." July 2008. <http://www.ka9q.net/pv/>.

³⁶ Antonio, T. "Pueblo of Laguna Utility Authority". Power Point Presentation. 2008. Slide 2.

³⁷ Antonio, T. Interview. June 2008.

³⁸ Antonio, T. "Pueblo of Laguna Utility Authority". Power Point Presentation. 2008. Slide 3.

How will the tribe benefit from this program?

The Pueblo of Laguna believes that are concrete benefits for the Laguna Community Solar Program for both the Tribe and its community members. This Program was designed to meet the needs of six Laguna communities and its economically disadvantaged members and will ultimately lead to stronger community interest and acceptance and political support for large-scale solar development. The Program would generate clean energy and offset nearly 210,000 kWh of fossil-fuel generation annually and would reduce energy costs for Laguna's six village community centers and the majority of Laguna members receiving LIHEAP assistance for member-owned homes.³⁹

This Program proposes to provide solar power generation, solar hot water heating, and solar heating equipment to community members with the greatest need. Its purpose is to reduce energy burdens, improve the reliability of energy services, and promote the use of renewable resources. POLUA Solar Program staff will coordinate program planning, act as a wholesale distributor for equipment, complete installation training, install all solar equipment, provide maintenance services, and bundle any applicable incentives to support future program operations.⁴⁰

POLUA would use existing and new staff members to organize and implement two different solar equipment installation programs: the Community Center Solar Program and the LIHEAP Community Member Solar Program. The Community Center Solar Program includes installing PV and solar hot water heating systems at the six village community centers on the Laguna Reservation. The installed solar systems would

³⁹ Stewart, C. Project Abstract for a Department of Energy Grant Application. Pueblo of Laguna Utility Authority. 2008. Page 2.

⁴⁰ Stewart, C. (2008) Project Abstract for a Department of Energy Grant Application. Pueblo of Laguna Utility Authority. 2008. Page 1.

offset the required 30% minimum of energy use for each community center.⁴¹ The LIHEAP Community Member Solar Program includes installing PV, solar hot water, and solar air heating systems at approximately 90 LIHEAP-approved Laguna member residences. The installed systems would offset 30% of energy use (the minimum goal for the Program) for each of the residences.⁴²

Conclusion

The Pueblo of Laguna is just one of the tribes that is trying to become self sustaining and energy efficient. They are already one step ahead in their Community Solar Power Program with the donation that they received from WAPA.

The Community Solar Power Program not only provides a new form of energy for households with high energy burdens, but it also provides employment opportunities for tribal individuals who are interested in pursuing a career in the solar field. A tribal representative will attend a PV installation workshop in August and will then share that knowledge with other tribal members who could become certified PV technologists.

From the results from the survey that was sent out in 2007, we can assume that there is support from the community on renewable energy programs. In many tribes projects have began and aren't finished because the momentum of the project stops. Often there is a great start and then tribal administration lose interest because they don't see immediate progress or it is pushed aside for other projects or events that take priority. Thelma Antonio, who is trained in community and environmental planning, has taken a

⁴¹ Stewart, C. (2008) Project Abstract for a Dept. of Energy Application. Pueblo of Laguna Utility Authority by energy consultant p.1

⁴² Stewart, C. (2008) Project Abstract for a Dept. of Energy Application. Pueblo of Laguna Utility Authority by energy consultant p.1

huge role in this Program. She has a great passion for its completion and strives for a successful program.

Ms. Antonio's efforts in planning with the Laguna tribal members begin with re-education. Part of her education format, she explains is "going back to our roots" by reminding tribal members that "customs and tradition" begin with good community planning. She explains that her ancestors built the village on sandstone foundations, incorporating passive solar design, using cisterns and stream flow for water needs, and building with natural resources with appropriate thermal and insulating properties, all of which were good planning techniques. Reminding members that these "old traditional ways" have great value in mainstream society today, helps to ensure that tribal culture and identity remains intact for the future.

Recommendations

POLUA should consider providing incentives for people who are committed to keeping their monthly utility bills low by weatherizing their homes, practicing energy efficiency, and using solar or wind power to ease household energy burdens. These incentives should be available to all tribal members. Customer education is also a key factor. Another possibility is that tribal members could participate in the Public Service Company of New Mexico's (PNM's) PV program after their PV systems have been installed. Under this program, tribal members who own and operate grid-connected PV systems would be able to purchase renewable energy certificates (or RECs) from PNM. PNM would then purchase RECs from customers at a rate of 13 cents per kilowatt-hour as part of monthly billing. The REC purchase is in addition to the kilowatt-hour credit

that participating customers receive when their meters run backward under PNM's net metering program.⁴³

Reflection

At the beginning of my internship I understood the concept of renewable energy, but I didn't understand it in-depth. At every site visit, conference, or meeting that I participated in, I learned a great deal. It's such a great feeling to learn something new, to be able to understand it, and to explain to other people. I've learned so much while participating in this internship. I was told that this program may not be offered next summer. It would be a shame if other students could not gain the knowledge and experience learned during an internship; knowledge that can't be learned in a classroom. The summer internship experience is invaluable to the native student. The opportunities that can be created by such a program are boundless.

This has truly been one of the greatest summers for me. I was able to work with some great people and form lasting friendships. I think that it is great to be working with people who have the same interests and are willing to share their knowledge and passion for helping native communities.

Throughout the summer there were several times when I encountered a 'moment of clarity' and finally understood a concept clearly. Sandra Begay-Campbell calls such moments "Ah-Ha" moments. The first "Ah-Ha" moment on the trip was when the PV systems were explained in detail to us by the electricians from the Navajo Tribal Utility Authority (NTUA). I had an idea of how they worked, but was unsure of what exactly they were capable of and was unclear on the interaction between the various system

⁴³ Public Service Company of New Mexico. Solar PV Program: Renewable Energy Certificates. July 2008. <http://www.pnm.com/customers/pv/rec.htm>

components. Vircyynthia Charley, an NTUA electrician, explained in detail how each component works and what the system is cable of handling. I learned that energy from the sun enters the panels and creates electrons which go into an inverter that changes the power from direct current (DC) to alternating current (AC). This power then can be stored in batteries until ready to be used. I also learned that a small wind turbine can help create more energy when the sun isn't as bright or when the sun goes down. It was clear to me by the end of the day how residential PV systems worked. I felt like it all came together for me from that day forward.

The next “Ah-Ha” moment came when we went to Willie Moore’s residence. He is a Hopi tribal member. Mr. Moore lives in a modular home with his wife. It’s amazing how they were able to weatherize their modular home so well that it is very energy efficient. Their home is powered by solar energy using a small PV system and a small wind turbine and, when need it; a generator for back-up. They seemed to be very happy and proud of their lifestyle. They were proud of the fact that they were self sustaining.

When my internship concluded, I was amazed that I was able to learn so much in such a short time. I will always remember the journeys that the other interns and I took with our fearless leader Sandra Begay-Campbell. I made long lasting friendships and gained knowledge that will never be forgotten.