Pueblo of Laguna Utility Authority

Renewable Energy Feasibility Study

DE-FG36-04GO15193, A000

Final Report

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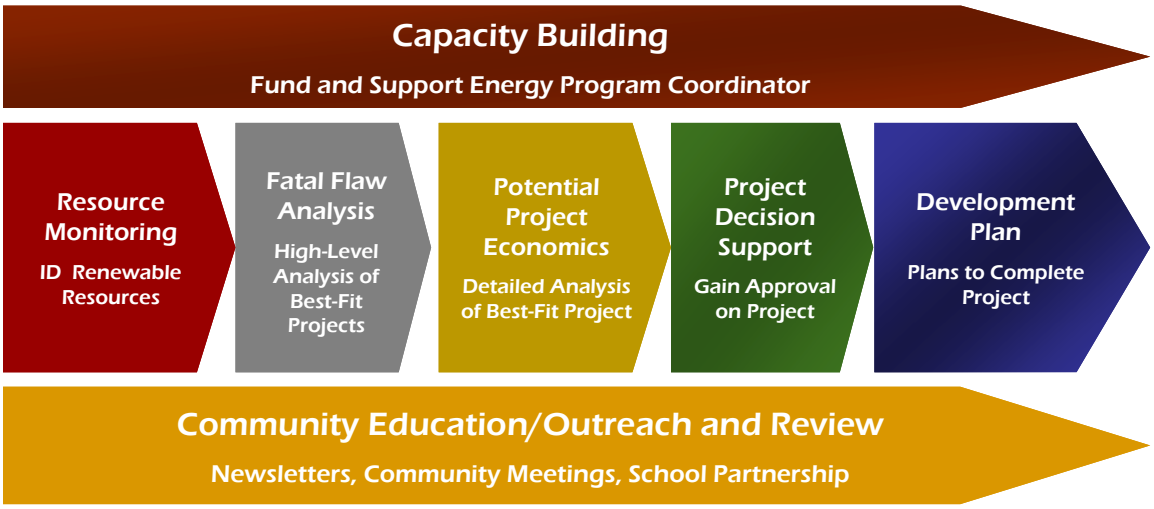
Executive Summary

The purpose of the study is to explore and identify possible renewable energy sources and the location of such sources on the Pueblo of Laguna, and to explore the possibilities of future projects that can assist Laguna in meeting their energy needs. The Laguna study was shaped by traditional methods involving land use, how Tribes live, how they regulate themselves, and those responsible for these processes. Laguna Capacity

The Project's ultimate objectives in considering renewable energy development were to improve quality and reliability of electric service on the reservation, work to promote energy self-sufficiency, encourage economic development, as well as contribute to environmentally clean energy.

Red Mountain Tribal Energy (Red Mountain) was the primary contractor for the Pueblo of Laguna Utility Authority during the course of this study. This report provides a summary of the activities performed and conclusions drawn during the course of the project. Project phases are summarized in the graphic below:



Capacity Building - Red Mountain believes that the capacity building, and use of DOE funding to support an energy intern, were probably the most important aspects of this feasibility effort. Very few projects could possibly succeed without development of significant internal knowledge, and a designated energy "champion". The Laguna energy intern selected, Thelma Antonio, is a respected member of the community and has developed into a knowledgeable and articulate spokesperson on behalf of energy, particularly renewable energy, issues.

Community Education Outreach and Review - At Laguna particularly, it was critical to involve the community, and to develop both communication materials and multiple opportunities for Laguna members to learn about renewable energy topics, critical Utility Authority issues, and provide input on possible renewable energy projects.

Resource Monitoring - Laguna lands are rich with both renewable and conventional fuel supplies, as well as access to both viable power markets and delivery infrastructure. Initially, wind appeared to be an especially abundant resource for Laguna. Laguna had previously requested and received one 20m tower from NREL and worked with Foresight Energy to install a 50m tower in July 2005. Although NREL maps indicated resources as great as Class 6 in and around Laguna, wind monitoring data for two locations at Laguna, provided by Foresight Energy, did not confirm the potential for a successful large-scale wind project. However, Laguna is located in an area with high insolation levels. According to NREL solar radiation maps, reservation lands are promising for PV, dual-axis tracker and concentrating solar power, with insolation indicated within ranges of 6-8 kWh/m2 per day.

Proposed Projects - With the Laguna resources previously described, and multiple project locations available, a number of potential projects were identified for initial consideration. Key criteria considered were based on the match between:

- Resource available and equipment types
- Electric usage
- High-level project economics, and
- Community considerations, including cultural fit, environmental impact, project footprint, view sheds and power cost impacts

Fatal Flaw Analysis - Potential projects in five locations were ultimately selected for further analysis, as summarized in the table below.

Site	Site Description	Load Served	Estimated 2027 Local Demand	Possible Project Configurations	Total Project Peak Capacity	Approximate Project Size (Land Requirement)
1	Rainbow Center, Casa Blanca	Nursing home, housing complex, junior/senior high school	541 kW	Large-Scale ***Concentrating*** Solar Arrays, firmed with Natural Gas Combustion Engine	788 kW	5 acres
				Large-Scale ***Tracking*** Solar Arrays, firmed with Natural Gas Combustion Engine	490-788 kW	4-5 acres
				Two 250 kW Wind Turbines, firmed with Natural Gas Combustion Engine	788 kW	Up to 10 acres
2	Southeast of Mesita Village	Village load	1.0 MW	Large-Scale ***Concentrating*** Solar Arrays, firmed with Natural Gas Combustion Engine	1.57 MW	8-10 acres
				Large-Scale ***Tracking*** Solar Arrays, firmed with Natural Gas Combustion Engine	1.06-1.28 MW	5-8 acres
				Two 250 kW Wind Turbines, firmed with Natural Gas Combustion Engine	1.33 MW	Up to 10 acres
3	Laguna Village, north of Transfer Station	Reservation, partial Reservation load, or power export	5.8 MW	Large-Scale ***Concentrating*** Solar Arrays, firmed with Natural Gas Combustion Engine	2.14 MW	10 acres
				Large-Scale ***Tracking*** Solar Arrays, firmed with Natural Gas Combustion Engine	0.8-5.14 MW	5-25 acres
				Large-Scale ***Tracking*** Solar Arrays, firmed with Natural Gas ***Turbine***	6.6 MW	35 acres
				Power Grid-Scale Natural Gas Combustion Turbine	75.9 MW	?
4	Rio Puerco, near Route 66 Casino	Reservation, partial Reservation load, or power export	5.8 MW	Large-Scale ***Concentrating*** Solar Arrays, firmed with Natural Gas Combustion Engine	2.14 MW	10 acres
				Large-Scale ***Tracking*** Solar Arrays, firmed with Natural Gas Combustion Engine	0.8-5.14 MW	5-25 acres
				Large-Scale ***Tracking*** Solar Arrays, firmed with Natural Gas ***Turbine***	6.6 MW	35 acres
				Power Grid-Scale Natural Gas Combustion Turbine	75.9 MW	?
5	Paraje, near old high school	Village or partial village load	1.5 MW	Large-Scale ***Concentrating*** Solar Arrays, firmed with Natural Gas Combustion Engine	1.57 MW	8-10 acres
				Large-Scale ***Tracking*** Solar Arrays, firmed with Natural Gas Combustion Engine	0.8-1.57 MW	5-10 acres

Potential Project Economics - Throughout 2007, evaluation of project locations, further data on project concepts, and economic analyses led to a focus on primarily solar projects. These included community scale hybrid solar/natural gas, small and large scale single axis tracking photovoltaic (PV) and high concentration photovoltaic (HCPV), as well as a community solar program.

Decision Support - The decision process ultimately resulted in the Laguna Utility Authority Board of Directors indicating its support for development of the following renewable projects on Laguna lands by passing Resolution 2007-1.

Community Member Solar Program

- Laguna UA provides solar power generation (PV panels), solar hot water heating and solar heating equipment to community members with the greatest need, where conditions indicate
  - Heating assistance
  - Appropriate location for solar
  - Community member requests (and can take the tax credit)
- Laguna UA would provide equipment to members at significantly reduced cost
  - Purchase wholesale and act as distributor
  - Provide installation services at a discount
  - Finance equipment installation for members
  - Support member tax credit analysis
- Laguna UA would bundle any applicable credits for community, for use in funding the program
  - White tags (energy conservation)
  - Carbon credit offsets
  - Renewable Energy Credits
- Funding requirement of roughly $3 million, assuming 150 requesting households of 200 households currently receiving energy assistance

Community Center Solar Pilot Project

- Each of the six Laguna villages would have the option to have solar equipment (PV panels, solar hot water heating, and solar heating) installed at their community centers
- Equipment and system costs would be covered by village or available grant funding
- Laguna UA would install/coordinate installation of equipment
- Laguna UA would bundle and sell Renewable Energy Credits and carbon offsets to cover its costs
- Villages would benefit from lower energy costs, due to reduced energy usage resulting from solar equipment installations
- The initial installations will utilize PV panels made available through the Western Area Power Administration, with other system equipment costs funded by the villages, or available Community Connect grant funding
- This program could also apply to any other Laguna facility interested in reducing its energy usage and costs
- Funding Requirement of $360,000 in capital for six community center systems

Reservation-Scale Concentrating Solar Project

- Laguna could develop and ultimately (after 5-7 years) own and operate a reservation-scale (2 MW) concentrating solar plant, which would help reduce peak power usage on its system
  - Grant funding would be needed to fund initial development costs
  - Laguna would partner with a financial institution that provided initial equity
  - Economics assume utilization of tax incentives (ITC)

- Economics assume utilization of New Market Tax Credits available from the New Mexico Finance Authority
- Power could be net metered or sold to its utility provider
- Renewable Energy Credits and carbon offsets could sold separately
- 13 acres of flat land needed
- Minimal water use (washing only)
- Funding Requirement of $14 million in project capital; $500,000 in development costs

Large-Scale Concentrating Solar Project

- Laguna could work with a development partner to develop, and ultimately (after 5-7 years) own and operate a large-scale (100 MW) concentrating solar plant, which would provide power to the grid to help New Mexico utilities meet their renewable energy requirements
  - Development partner would fund initial development costs
  - Tax partners would provide initial equity
  - Economics assume utilization of tax incentives (ITC)
  - Economics could assume utilization of New Market Tax Credits available from the New Mexico Finance Authority
  - Power would sold to nearby utilities
  - Renewable Energy Credits would likely be bundled and sold with project energy
  - Carbon offsets could be sold separately
  - 650 acres of flat land needed
  - Minimal water use (washing only)
  - Laguna could benefit from local manufacturing/component integration facilities needed
  - Funding Requirement of $340 - 560 million in project capital; $14 million in development costs
  - Funding requirement of $560 million in capital; $14 million in development costs

Red Mountain believes that the two continual phases of this project, Capacity Building and Community Education and Outreach, will ultimately provide the greatest sustainable value to Laguna as it considers its options, and determines which projects it should proceed with, and how it chooses to move forward. The analytical efforts were useful in that they provided independent and objective analyses of renewable resources, and provided Laguna with a range of options it could pursue to develop those resources to benefit the community in a number of ways. These benefits include reducing the energy burden of villages and individual members, lowering reservation-wide energy supply costs, and providing economic development opportunities and member jobs. Analyses completed during the Project provided Laguna the data it needs to proceed with development of renewable generation, whether as an owner, or participant in future projects.

Section 1: Project Background

"As long as the wind keeps blowing and the sun keeps shining, Mother Nature gives us the opportunity to use clean energy".

The Pueblo of Laguna's (Laguna) lands are blessed with many such resources, including solar energy and wind, as well as access to natural gas resources and infrastructure. Laguna has considered the potential value of these resources for quite some time, and their potential to offer environmental benefit, improved electric service quality, affordable electricity, energy self-sufficiency and clean sustainable growth for future generations. It was through the process of focusing on community needs and Laguna Utility Authority staff's desire to provide Laguna with a better quality of life for its people that led to this effort to pursue renewable energy alternatives.

The Pueblo of Laguna is a federally recognized Indian Tribe organized under the Indian Reorganization Act of 1934. The Pueblo of Laguna Indian Reservation encompasses 533,000 acres, north and south of Interstate-40, approximately 44 miles west of Albuquerque, NM, located primarily in Cibola County. The Pueblo of Laguna inhabitants have continuously occupied this land since the early 1400s. U.S. Census Bureau population estimates indicate the reservation is home to 4,294 residents living in six unincorporated villages (Laguna, Mesita, Paguate, Encinal, Seama, and Paraje) representing approximately 1,300 households. As a sovereign Nation, Laguna has demonstrated a long-standing commitment to the preservation of its resources and cultural heritage, and to the creation of opportunities for its members to thrive and become economically and socially self-sufficient as individuals, families and as a Tribal government. Laguna has a history of actively pursuing economic development, and has established multiple successful Tribal entities. Laguna has been pursuing renewable projects on the reservation for a number of years. It has successfully undertaken a number of smaller scale Tribal and Tribal entity projects utilizing its solar resources, such as the Majors Ranch, and at Laguna Industries.

The Pueblo has invested considerable funds in recent years to form a Utility Authority, responsible for all utility services provided to Pueblo members and businesses, and is considering acquisition of the electric system serving the Pueblo. In addition to promoting Tribal self-sufficiency, development of local generation would serve to resolve frequent power quality and reliability problems currently plaguing the Pueblo, which have had a significant impact on economic development. Depending upon the optimum project scale identified as part of the study, Project power could serve both Pueblo electric loads and ultimately provide off the Reservation to nearby Tribes, and to the wholesale market. And, if the Pueblo ultimately decides to develop renewable generation, Tribal member employment opportunities would be created, both in the short term for construction, as well as long-term for operations and maintenance of generating facilities.

The feasibility study leveraged work completed in January 2005 by NCI, work done in conjunction with the Pueblo's agreement with Foresight Energy to evaluate and potentially wind generation on the reservation, and an energy audit completed on behalf of the Laguna

in early 2005 by the Council of Energy Resource Tribes. NCI's analysis indicated potential viability of a number of renewable, hybrid, and conventional generation projects on Pueblo lands considering resource supply, preliminary transmission access and interconnection, potential power markets, finance alternatives, leveraging incentives, and other parameters.

The purpose of the study is to explore and identify possible renewable energy sources and the location of such sources on the Pueblo of Laguna, and to explore the possibilities of future projects that can assist Laguna in meeting their energy needs. The Laguna study was shaped by traditional methods involving land use, how Tribes live, how they regulate themselves, and those responsible for these processes. While Federal policy has changed some aspects of Laguna life, its sovereignty gives them the ability to return to traditional ways of thinking and doing.

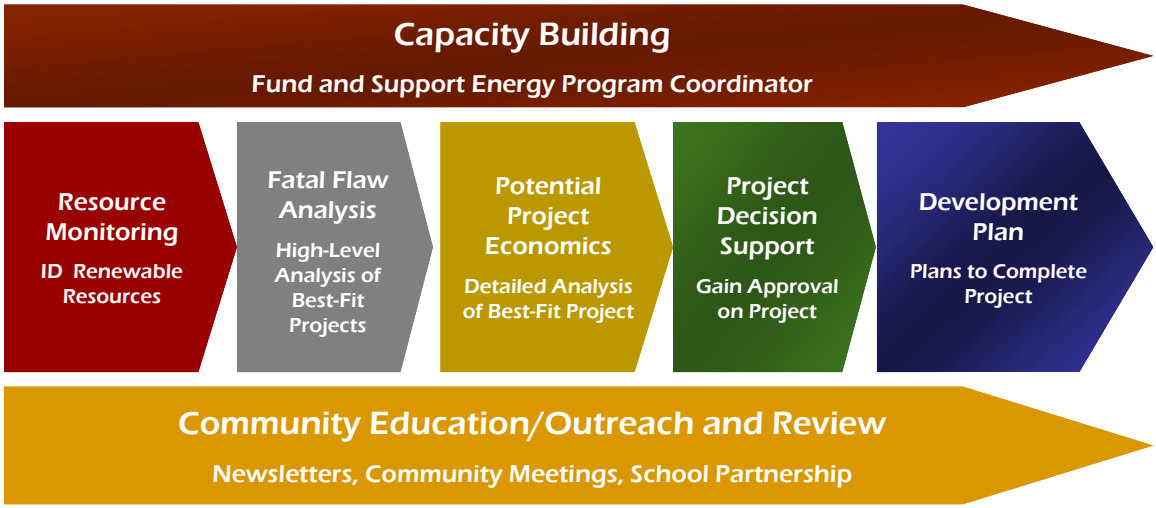
During this study Laguna Utility Authority staff worked to keep the community, Utility Authority, and Tribal leadership informed of the process, and aware of the information gathered. Through this education effort, staff hoped to unite all involved in a single focused approach to identify prospective projects, keep on track to identify project sites and help them become more aware of how to proceed in securing resources to make Laguna renewable energy projects a reality.

Section 2: Project Objectives and Scope

The Laguna Utility Authority undertook this feasibility study to evaluate opportunities on reservation lands to develop renewable energy generation projects, focused primarily on its indicated wind, solar and biomass resources, which appear to be considerable.

The Project's ultimate objectives in considering renewable energy development were to improve quality and reliability of electric service on the reservation, work to promote energy self-sufficiency, encourage economic development, as well as contribute to environmentally clean energy. Analyses completed during the Project provide Laguna the data it needs to proceed with development of renewable generation, whether as an owner, or participant in future projects.

Project phases are summarized in the following graphic, and described in more detail in the sections following.



Capacity Building was intended to fund, support, and mentor an Energy Intern position at the Utility Authority. This position was filled early in the study by Laguna member Thelma Antonio, who brought considerable experience and insights to the position through her prior community planning experience and work toward earning a Masters Degree in Community Planning. ***Objective: Identification of a staff resource to manage the project on behalf of the Utility Authority, and provide ongoing expertise to facilitate solutions to meet Utility Authority energy-related needs***

Resource Monitoring consisted of identification and confirmation of renewable energy resources at Laguna adequate to support a renewable energy project, and initial identification of possible projects. ***Objective: Identification of 4-6 potential self-supply or large scale generation projects***

Fatal Flaw Analysis included a high-level analysis of possible community-supported renewable energy projects that had been identified in prior stages of the project. ***Objective: Identification of projects to be eliminated from the potential list due to a significant issue that would cause it to be uneconomic, unsuitable, or inappropriate in the community.***

Community Education/Outreach was planned to occur throughout the study in multiple forms. The reason for emphasizing these activities is that Laguna communities are heavily involved in decision-making, and would be a key audience. During the project, numerous communication materials were planned, which would help Laguna members learn about renewable energy topics and critical Laguna Utility Authority issues, and allow community members an opportunity to provide input on renewable energy concepts and possible projects. ***Objective: Provide community education and gain support for a short-list of Pueblo of Laguna potential energy projects***

The Project Economics phase was planned to allow for detailed analysis of the most viable community-supported renewable energy project(s). ***Objective: Identification of a short list of potentially feasible energy projects***

Decision Support was to include development and presentation of project information in various forums in order to gain final approval for the selected renewable energy project(s). ***Objective: Gain Board and Tribal Council support and approval for a selected energy project***

Development Planning was anticipated to consist of development of the detailed plans agreements needed to support constructing the most viable community-supported renewable energy projects. ***Objective: Formulate a development plan and budget for the selected energy project.***

The study was completed by Red Mountain Tribal Energy (Red Mountain) under the direction of the Laguna Utility Authority, and has been underway since December 2005.

Section 3: Primary Project Tasks and Activities

Capacity Building

A critical component of the Project focused on developing capacity within the Utility Authority to pursue and manage energy projects. A job description was developed, and Laguna Utility Authority leadership identified a Laguna member, Thelma Antonio, who became the staff resource to manage the project for the Utility Authority, provided hands-on direction, thereby increasing Laguna Utility Authority knowledge and capacity. Red Mountain staff provided support and education on certain technical issues, and worked closely with the Laguna Utility Authority throughout the project term. By the end of the project, Thelma was the primary spokesperson to the Laguna Utility Authority Board, to Laguna Staff officers, and to Laguna Council. She was the principal author of the Laguna Utility Authority newsletter, coordinated community education, outreach and input opportunities, and presented renewable energy topics to outside audiences on numerous occasions. She also developed and coordinated customer service programs which successfully increased Laguna member aaccess to LIHEAP funding and weatherization programs.

Community Education/Outreach and Review

As the success of energy project development is highly dependent on community support, particularly at Laguna, efforts focused early in the Project and throughout the remaining period, on developing and implementing a community education and outreach program. The purpose of the community education/outreach plan was to:

- Provide the Laguna community:
  - Background information on utility service, energy, renewable and conventional generation issues
  - Insights into Laguna Utility Authority infrastructure and service plans
  - Insights into possible energy project types, locations and economics, and
  - Opportunities to provide input/ask questions about utility infrastructure/utility service plans and potential power project development plans
- Provide Laguna energy project proponents:
  - Insights into community utility service needs, desires and concerns
  - Opportunities to generate support for project concepts and plans
  - Identification of a short-list of potential projects
  - Greater assurance of successful project development

Red Mountain developed a proposed Laguna Utility Authority newsletter approach, style, format, proposed topics and schedule for the first twelve issues, and distribution scheme. Red Mountain also developed a proposed community meeting approach, and worked with the Energy Intern to prepare for a series of community forums on renewable energy, including discussion and review of potential project concepts, as well as supported development and publishing of the Laguna Utility Authority newsletter. Community input and perspective was vital to the success of the study, and community ideas, opinions and recommendations are still considered critical to the success of any planned projects. Possible projects could only achieve their desired benefit if they succeeded in meeting community needs and goals.

Resource Monitoring

In order to identify possible project concepts, Red Mountain supported Laguna monitoring of wind resources, researched solar resources, worked to identify potential biomass resources, and researched natural gas access issues at Laguna. Monitoring included review of wind data gathered by Foresight Energy. Solar resource research included review and summary of Sunlab and NREL insolation data. Geothermal resources were identified through collaboration with local experts. Biomass resource researched involved working with area BIA experts to understand existing known biomass resources and ongoing plans to update forest resource studies. In addition, Red Mountain identified access and cost of access to natural gas resources available on the reservation.

Another important aspect of the resource monitoring task was development of an electric load profile for Laguna. Electric usage data was requested from the electric provider, Continental Divide Electric Cooperative, on numerous occasions, but other than very high level indications, data was not provided during this portion of the analysis. Red Mountain developed a load forecast for the reservation, and for each of Laguna's six villages, by applying regional average household energy consumption and time-of-day use patterns, and by requesting electric bills from Laguna entities and facilities. This task was difficult to complete with any degree of accuracy given the lack of cooperation from the utility.

Once Laguna resources were known, and an estimated load study completed, Red Mountain worked with the Laguna Energy Intern to identify potential renewable energy project concepts and locations. The renewable energy resource monitoring, subsequent literature review and hands-on research of renewable technologies and equipment, and identification of project sites, combined with data about Laguna natural gas access and costs, and projected electric use, facilitated development of multiple possible Laguna project concepts for further consideration. Community input was sought on the group of projects considered most feasible, and education provided on the comparative benefits and trade-offs for each type of renewable generation equipment.

Fatal Flaw Analysis

Once a limited set of potential projects was identified for reservation-wide, community and facility use, Red Mountain conducted a high-level "fatal flaw" analysis of each, to determine if there were any significant issues that could potentially rule out a project. Components of the analysis included potential markets for power, a high-level environmental review of a number of specific sites, access to distribution or transmission systems and capacity, and calculation of preliminary levelized costs of energy for projects at each proposed site.

Potential Project Economics

Once the short list of potential energy project concepts was identified and community input provided, Red Mountain worked with the Laguna Utility Authority team to narrow the focus, and to select several projects for further consideration. Economics were developed for multiple solar projects, which included such aspects as identifying solar equipment and costs, electric interconnection costs, where applicable, surveying potential buyers for project power, completing high-levels reviews of potential environmental impacts, estimating operations and

maintenance costs, identifying project incentives and financing options, and developing a conceptual ownership structure.

Project Decision Support

Throughout the project, Red Mountain developed summary information for various audiences, including the Laguna Utility Authority Board, Laguna Staff Officers and Laguna Council on potentially feasible energy projects.

Development Plan

The final phase of the Project focused on creating a high-level development plan for the selected Laguna solar and energy projects. The combined development plan summarized the project concept and rationale for each, potential timing and economics, and various other details, specific to each solar project identified.

Section 4: Deliverables

Deliverables for the project fall into three primary categories, as indicated in the list below. Copies of each document are found in the Appendix.

Analyses

- 060205 Community Outreach Plan
- 060301 Solar Resource Assessment
- 060411 Natural Gas Access
- 060606 Preliminary Load Forecast
- 060608 POL Project Identification
- 060814 Fatal Flaw Summary
- 070718 Solar Project Update
- 080306 Renewable Development Plan

Community Information

- 060606 Gas Technology Resource Brief
- 060606 Solar Technology Resource Brief
- 060606 Wind Technology Resource Brief
- 060607 RE Village Discussions
- 070126 Community Input Questionnaire

Project Updates

- 060303 RE Study Update
- 060303 RE Study Update Staff Officers
- 060505 POLUA Board Update
- 060728 POL Board/Entity Update
- 061020 DOE Presentation_Laguna
- 070518 POL Board Update
- 071106 DOE Presentation_Laguna

Section 5: Conclusions and Recommendations

Through the study, the Pueblo of Laguna hoped to:

- ✓ Increase energy knowledge and capacity in the Utility Authority and community
- ✓ Improve quality and reliability of electric service on the reservation
- ✓ Promote energy self-sufficiency
- ✓ Encourage economic development
- ✓ Contribute to environmentally clean energy
- ✓ Provide data needed to proceed with renewable energy development, as an owner and/or a participant
- ✓ Provide for renewable and/or hybrid renewable generation to be a resource component in potential Utility Authority electric utility operations
- ✓ Identify business locations
- ✓ Address large scale needs of Laguna and selling excess power to the grid

Primary project conclusions, by project phase, are included below:

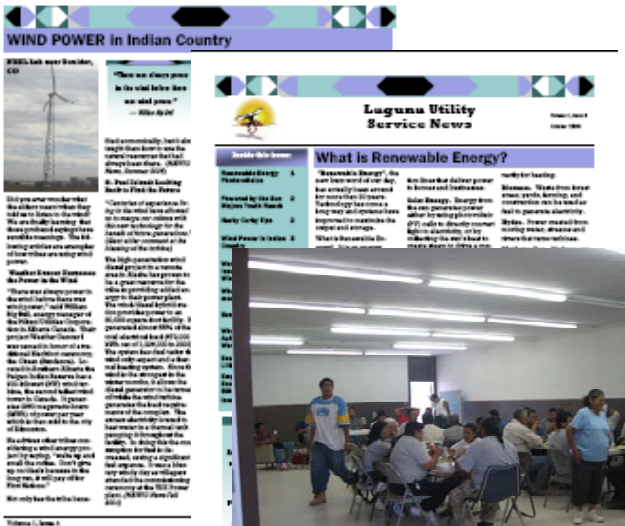
Capacity Building

Red Mountain believes that the capacity building, and use of DOE funding to support an energy intern was probably the most important aspect of this feasibility effort. Very few projects could possibly succeed without development of significant internal knowledge, and a designated energy "champion". The Laguna energy intern selected, Thelma Antonio, is a respected member of the community and knowledgeable and articulate spokesperson on behalf of energy, particularly renewable energy, issues.

Community Education Outreach and Review

At Laguna particularly, it was critical to involve the community, and to develop both communication materials and multiple opportunities for Laguna members to learn about renewable energy topics, critical Utility Authority issues, and provide input on possible renewable energy projects. While Red Mountain continues to believe this is the case, it was difficult to draw many members for evening meetings, but it is believed that the Laguna Utility Authority newsletters and materials were useful tools. The project team realized somewhat late in the process that Laguna schools were eager participants in the process, and Red Mountain believes that it would have been more effective to focus on school programs, which would naturally involve parents and other family members in the process.

Laguna UA Newsletter highlighted Renewable Energy education in several issues


WIND POWER in Indian Country

Laguna Utility Service News

What is Renewable Energy?


Pueblo of Laguna
Renewable Energy Project

Your input is invited.

Background

Project Overview

65 surveys completed reflecting very strong support for renewable energy development for member, community and large-scale projects

RED MOUNTAIN TRIBAL ENERGY

The renewable energy survey was an effective tool, and provided the Laguna Utility Authority and project team with rich input relative to community interest and opinions about renewable energy.

Comments from the surveys included those such as listed below:

"Our Father gave us an abundant amount of sun and wind. It is only plausible to make use of it."

"It is good to know that our Tribe is being proactive in considering all viable options in addressing renewable energy projects"

"The electrical and gas is so high it is hard to keep up with the cost."

"It is a good idea because it would help the tribe to be more independent..."

"I totally support renewable energy projects that are a good fit for our people, especially tribal members who don't have access to natural gas or households who must depend on wood only."

"It will be a good source of energy, providing all tribal members are in support..."...Council approval would even be greater. Sometimes, they don't always work towards what the people want."

"I have seen the use of solar energy in our area. We need to capitalize on our natural resources... Isn't this the purpose for the POLUA?"

"I think if our forefathers survived on the energy they primitively generated in their day, so can we. With the technology, we have a good opportunity on our hands"

"More than any other group, Native Americans are supposed to protect mother nature.."

"I think it's good for the world, our kids' future"

"I think it will help just not my family but the whole community.."

We have the resources all about us. Let's get with it. It's clean and efficient.

"I have a mobile home and the cost of propane is outrageous to me. If solar was available I would definitely make use of that."

"I believe it is a wonderful idea. We need it to help our future generations"

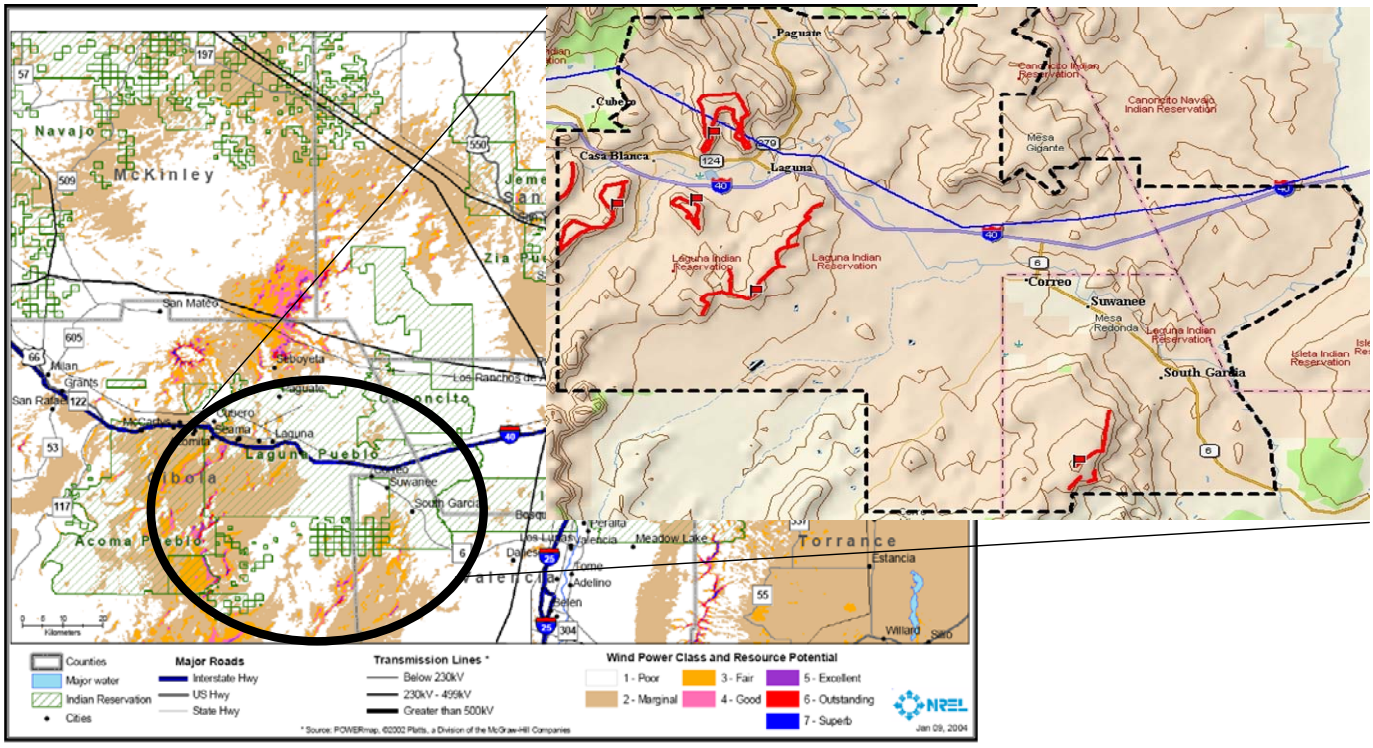
"It would be helpful to the elderly who are on a fixed income to help curb the cost of gas/electricity during the winter months."

"We would then have a form of energy power that would never run out like gas could."

Resource Monitoring

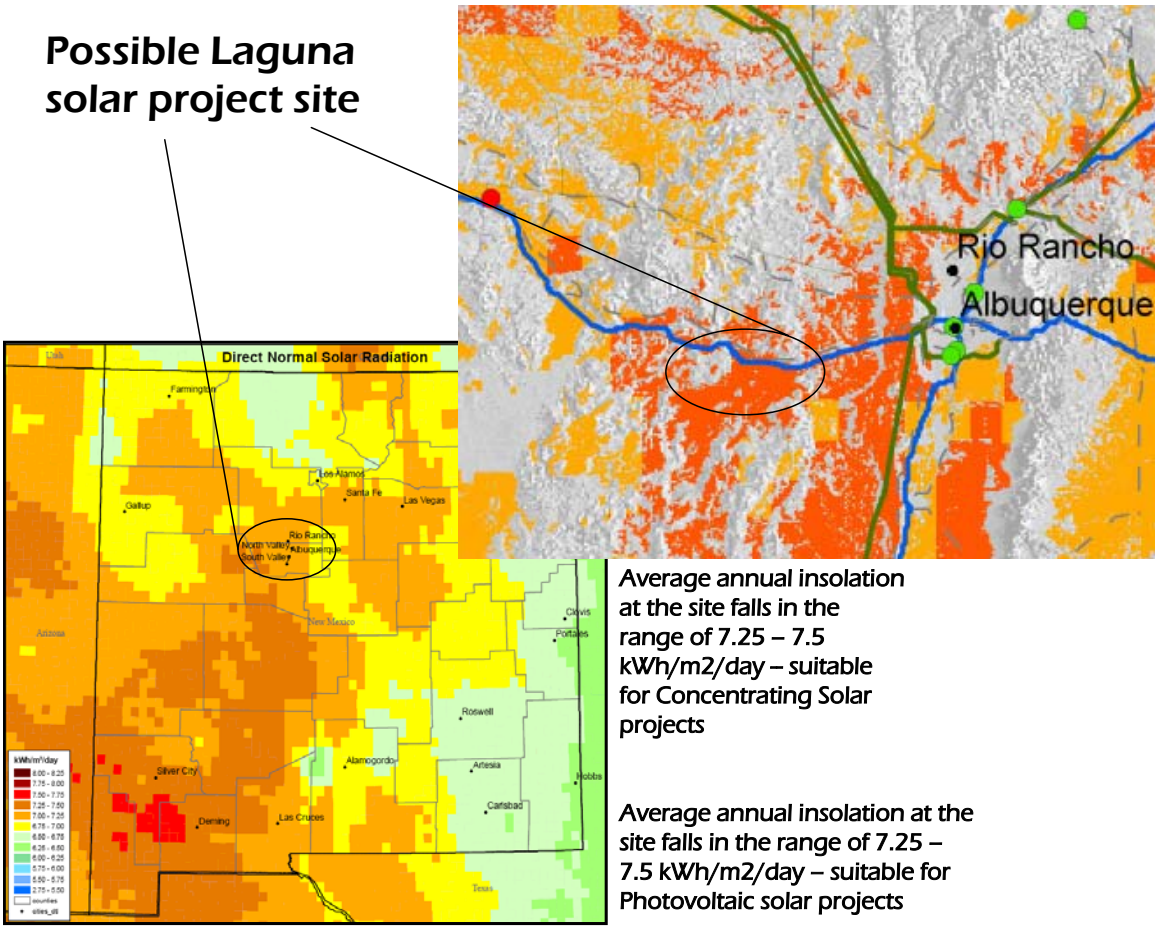
Laguna lands are rich with both renewable and conventional fuel supplies, as well as access to both viable power markets and delivery infrastructure.

Initially, wind appeared to be an especially abundant resource for Laguna. Laguna had previously requested and received one 20m tower from NREL and worked with Foresight Energy to install a 50m tower in July 2005. Although NREL maps indicated resources as great as Class 6 in and around Laguna, wind monitoring data for two locations at Laguna, provided by Foresight Energy, did not confirm the potential for a successful large-scale wind project.



RED MOUNTAIN TRIBAL ENERGY

Laguna is located in an area with high insolation levels. According to NREL solar radiation maps, Pueblo lands are promising for PV, dual-axis tracker and concentrating solar power, with insolation indicated within ranges of 6-8 kWh/m2 per day.



Average annual insolation at the site falls in the range of 7.25 – 7.5 kWh/m2/day – suitable for Concentrating Solar projects

Average annual insolation at the site falls in the range of 7.25 – 7.5 kWh/m2/day – suitable for Photovoltaic solar projects

Although Laguna is located in an area with good geothermal potential as indicated by NREL geothermal potential maps, more detailed research indicated that geothermal resources were not adequate to support power generation. However, several business opportunities were possible given the indicated resource, and Laguna requested further assistance on this issue. Potential Opportunities include the following particularly in the locations noted in the map below:

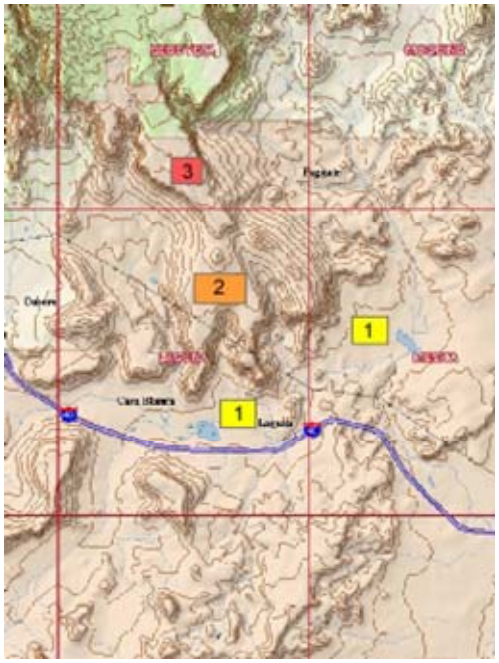
Direct-Use Geothermal

- Curing and drying
- District space heating
- Greenhouses
- Spa/resort
- Aquaculture (fish farm)
- Any process of interest to
- Pueblo of Laguna that requires large amounts of low-grade heat

Geothermal Heat Pumps (ground heat exchange)

- Heating and cooling
- Large buildings
- Homes

- **Scenario 1** (yellow boxes)
  - Rio San Jose Valley
  - Flat surface with shallow fresh water
  - Elevation 5,700 to 5,900 ft
- **Scenario 2** (orange box)
  - Clay and Frog Mesa south of Wheat Mountain
  - Relatively flat surface
  - Elevation 6,600 to 6,700 ft
- **Scenario 3** (red box)
  - Mesa Chivato north of Encinal
  - Relatively flat surface
  - Elevation 7,200 to 7,400 ft

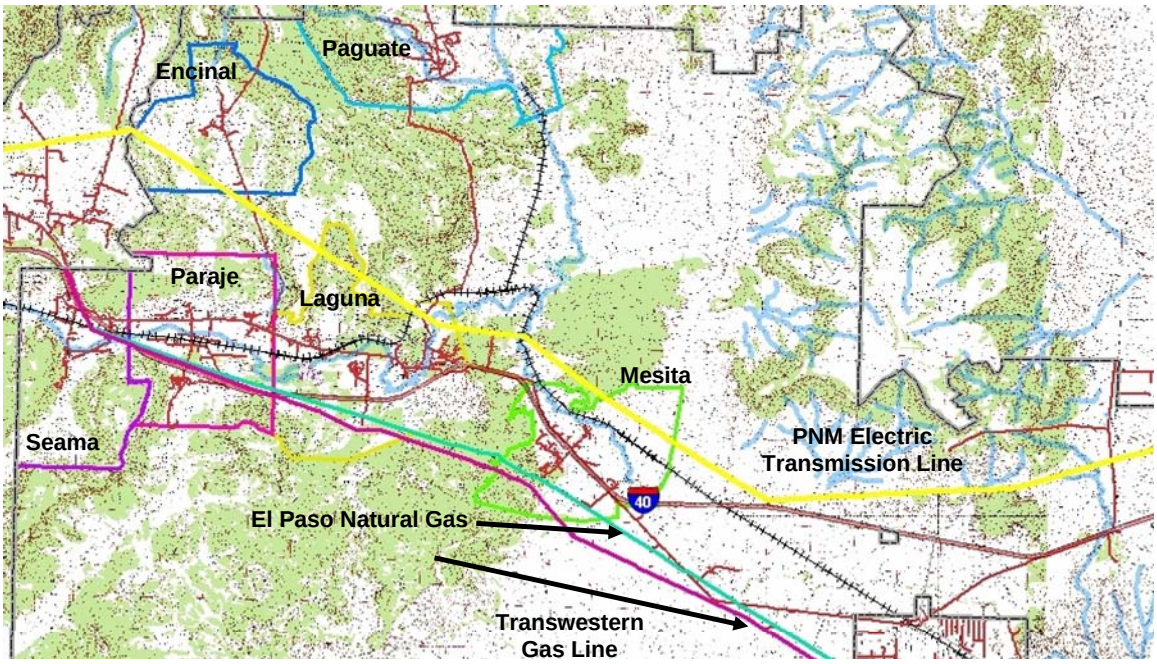


According to NREL biomass potential maps, the Pueblo is located in an area with good resources, including invasive salt cedar, however, existing studies did not indicate adequate resource to support power generation from woody biomass or municipal solid waste.

- **Forest** – Unclear if adequate resources; no existing logging infrastructure/forest management activity
- **Agriculture**: Extremely limited; agriculture limited to small family plots of corn, chile, alfalfa and assorted vegetables; no discernible residue stream
- **Animal wastes**: None
- **Landfill gas**: None; several abandoned landfills; contents "burned" before backfill, not lined nor monitored; gas production likely to be low
- **Food residues**: Yellow grease from restaurants hauled by septic firms; insufficient amounts to justify biodiesel production
- **Wastewater treatment**: Mostly uncovered lagoons with no methane recapture; wastewater treatment facility biosolids sent to digester in ABQ
- **Municipal solid waste**: 940 households
  - Delivered to transfer station and to ABQ; not likely enough tonnage to warrant consideration
- **Transfer station**: Modest amount of woody biomass from local C&D is ground up for free use by anyone

RED MOUNTAIN TRIBAL ENERGY

Laguna does have excellent access to natural gas, with two major natural gas transmission lines running through the reservation, and four of six Laguna villages with natural gas distribution service. This access would be adequate for power generation, or to "firm" a renewable resource.



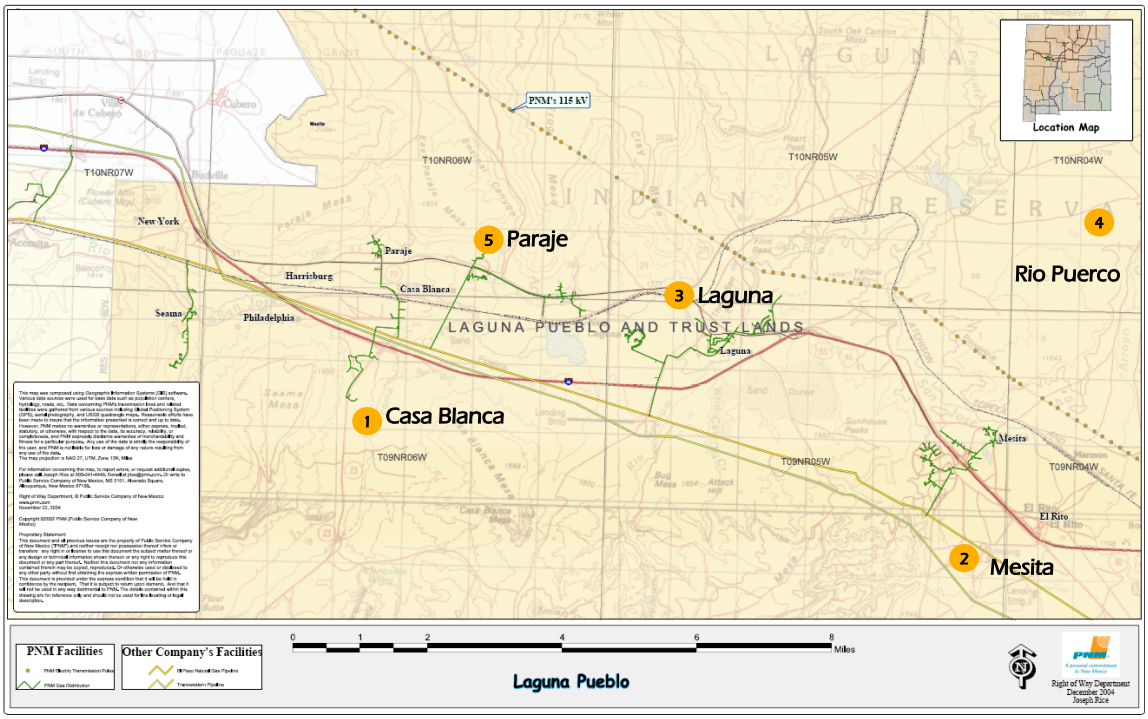
With the Laguna resources previously described, and multiple project locations available, a number of potential projects were identified for initial consideration. Key criteria considered were based on the match between:

- Resource available and equipment types
- Electric usage
- High-level project economics, and
- Community considerations, including cultural fit, environmental impact, project footprint, view sheds and power cost impacts

Fatal Flaw Analysis

Potential projects in five locations were selected for further analysis. Results were summarized in the table and locations indicated in the map below.

Site	Site Description	Load Served	Estimated 2027 Local Demand	Possible Project Configurations	Total Project Peak Capacity	Approximate Project Size (Land Requirement)
1	Rainbow Center, Casa Blanca	Nursing home, housing complex, junior/senior high school	541 kW	Large-Scale ***Concentrating*** Solar Arrays, firmed with Natural Gas Combustion Engine	788 kW	5 acres
				Large-Scale ***Tracking*** Solar Arrays, firmed with Natural Gas Combustion Engine	490-788 kW	4-5 acres
				Two 250 kW Wind Turbines, firmed with Natural Gas Combustion Engine	788 kW	Up to 10 acres
2	Southeast of Mesita Village	Village load	1.0 MW	Large-Scale ***Concentrating*** Solar Arrays, firmed with Natural Gas Combustion Engine	1.57 MW	8-10 acres
				Large-Scale ***Tracking*** Solar Arrays, firmed with Natural Gas Combustion Engine	1.06-1.28 MW	5-8 acres
				Two 250 kW Wind Turbines, firmed with Natural Gas Combustion Engine	1.33 MW	Up to 10 acres
3	Laguna Village, north of Transfer Station	Reservation, partial Reservation load, or power export	5.8 MW	Large-Scale ***Concentrating*** Solar Arrays, firmed with Natural Gas Combustion Engine	2.14 MW	10 acres
				Large-Scale ***Tracking*** Solar Arrays, firmed with Natural Gas Combustion Engine	0.8-5.14 MW	5-25 acres
				Large-Scale ***Tracking*** Solar Arrays, firmed with Natural Gas ***Turbine***	6.6 MW	35 acres
				Power Grid-Scale Natural Gas Combustion Turbine	75.9 MW	?
4	Rio Puerco, near Route 66 Casino	Reservation, partial Reservation load, or power export	5.8 MW	Large-Scale ***Concentrating*** Solar Arrays, firmed with Natural Gas Combustion Engine	2.14 MW	10 acres
				Large-Scale ***Tracking*** Solar Arrays, firmed with Natural Gas Combustion Engine	0.8-5.14 MW	5-25 acres
				Large-Scale ***Tracking*** Solar Arrays, firmed with Natural Gas ***Turbine***	6.6 MW	35 acres
				Power Grid-Scale Natural Gas Combustion Turbine	75.9 MW	?
5	Paraje, near old high school	Village or partial village load	1.5 MW	Large-Scale ***Concentrating*** Solar Arrays, firmed with Natural Gas Combustion Engine	1.57 MW	8-10 acres
				Large-Scale ***Tracking*** Solar Arrays, firmed with Natural Gas Combustion Engine	0.8-1.57 MW	5-10 acres



RED MOUNTAIN TRIBAL ENERGY

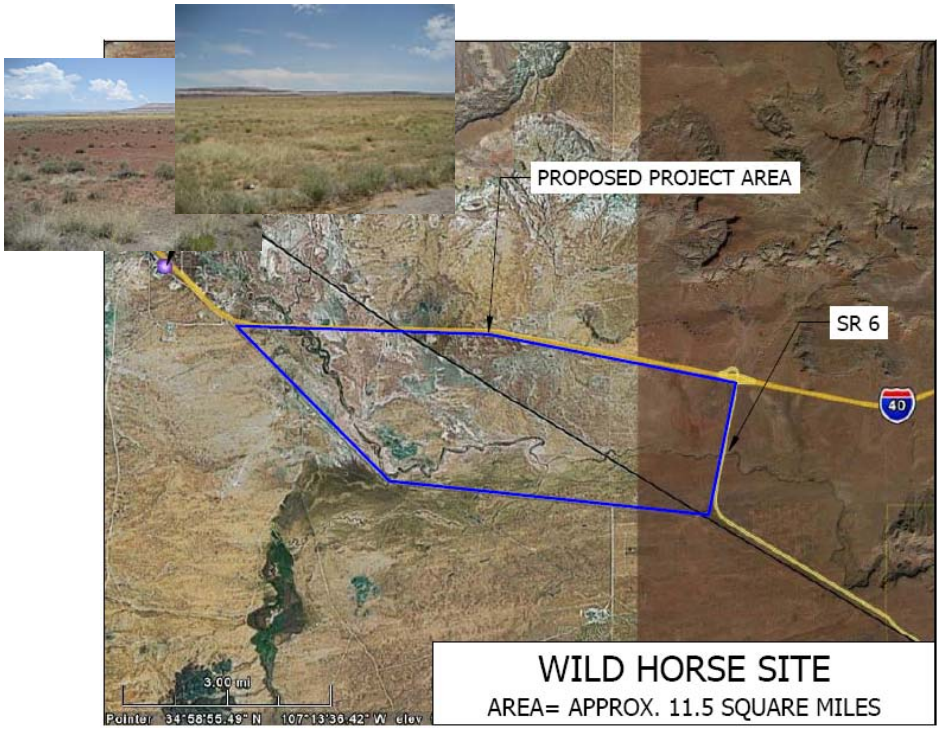
Potential Project Economics

Throughout 2007, evaluation of project locations, further data on project concepts, and economic analyses led to a focus on primarily solar projects. These included community scale hybrid solar/natural gas, small and large scale single axis tracking photovoltaic (PV) and high concentration photovoltaic (HCPV), as well as a community solar program. The table below summarizes the primary project analysis utilized to define the target projects selected for development planning.

	Project Capital Cost (includes development, transmission/ interconnection costs)	**Acreage Required**	**Levelized Cost of Energy * (Cents per kWh)**	**Capital Cost Considerations**
3 MW Single axis tracking PV	$28.3 million	30		Assumes lower-cost CIGS modules
50 MW Single axis tracking PV	$410 million	500		Assumes lower-cost CIGS modules; 20% economies of scale
50 MW HCPV	$188 million	530		Assumes projected CPV cost reductions
100 MW Single axis tracking PV	$604 million	1000		Assumes lower-cost CIGS modules; 30% economies of scale
100 MW HCPV	$340 million	1060		Assumes projected CPV cost reductions

* Assumes Tribal/tax partner JV; 30% ITC; no REC value or grant funding for capital outlays

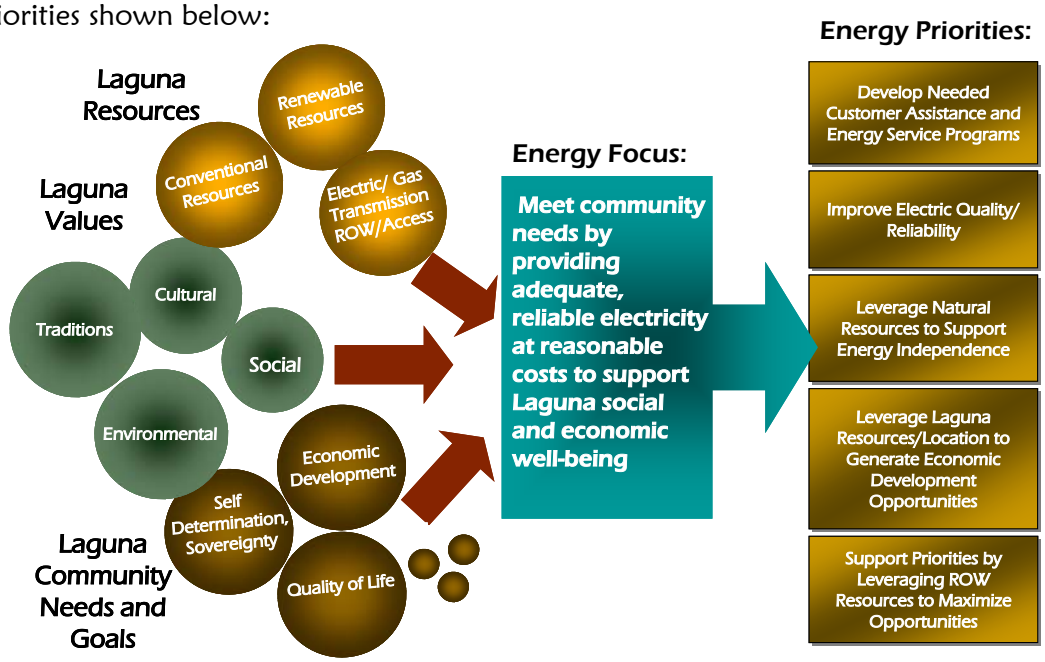
The primary project location identified is depicted in the photographs and aerial view below.



RED MOUNTAIN TRIBAL ENERGY

Project Decision Support

The decision process ultimately resulted in the Laguna Utility Authority Board of Directors indicating its support for development of renewable projects on Laguna lands by passing Resolution 2007-1. These projects are consistent with the Laguna Utility Authority energy priorities shown below:



Development Plan

The four proposed solar energy projects considered for development are summarized below:

Community Member Solar Program

- Laguna UA provides solar power generation (PV panels), solar hot water heating and solar heating equipment to community members with the greatest need, where conditions indicate
  - Heating assistance
  - Appropriate location for solar
  - Community member requests (and can take the tax credit)
- Laguna UA would provide equipment to members at significantly reduced cost
  - Purchase wholesale and act as distributor
  - Provide installation services at a discount
  - Finance equipment installation for members
  - Support member tax credit analysis
- Laguna UA would bundle any applicable credits for community, for use in funding the program
  - White tags (energy conservation)
  - Carbon credit offsets
  - Renewable Energy Credits

Funding Requirement:

- $3 million in total capital, assuming 150 requesting households of 200 households currently receiving energy assistance
    - $200,000 in seed capital (grant funding) needed to fund equipment for first 10 systems
- $50,000 in training/administration costs estimated annually

Community Center Solar Pilot Project

- Each of the six Laguna villages would have the option to have solar equipment (PV panels, solar hot water heating, and solar heating) installed at their community centers
- Equipment and system costs would be covered by village or available grant funding
- Laguna UA would install/coordinate installation of equipment
- Laguna UA would bundle and sell Renewable Energy Credits and carbon offsets to cover its costs
- Villages would benefit from lower energy costs, due to reduced energy usage resulting from solar equipment installations
- The initial installations will utilize PV panels made available through the Western Area Power Administration, with other system equipment costs funded by the villages, or available Community Connect grant funding
- This program could also apply to any other Laguna facility interested in reducing its energy usage and costs

Funding Requirement:

$360,000 in capital for six community center systems, assuming use of WAPA PV panels
$60,000 in training/engineering/administration costs annually

Reservation-Scale Concentrating Solar Project

- Laguna could develop and ultimately (after 5-7 years) own and operate a reservation-scale (2 MW) concentrating solar plant, which would help reduce peak power usage on its system
    - Grant funding would be needed to fund initial development costs
    - Laguna would partner with a financial institution that provided initial equity
    - Economics assume utilization of tax incentives (ITC)
    - Economics assume utilization of New Market Tax Credits available from the New Mexico Finance Authority
    - Power could be net metered or sold to its utility provider
    - Renewable Energy Credits and carbon offsets could sold separately
    - 13 acres of flat land needed
    - Minimal water use (washing only)

Funding Requirement:

$14 million in capital costs
$500,000 in development costs

Large-Scale Concentrating Solar Project

- Laguna could work with a development partner to develop, and ultimately (after 5-7 years) own and operate a large-scale (100 MW) concentrating solar plant, which would provide power to the grid to help New Mexico utilities meet their renewable energy requirements
    - Development partner would fund initial development costs
    - Tax partners would provide initial equity
    - Economics assume utilization of tax incentives (ITC)
    - Economics could assume utilization of New Market Tax Credits available from the New Mexico Finance Authority
    - Power would sold to nearby utilities
    - Renewable Energy Credits would likely be bundled and sold with project energy
    - Carbon offsets could be sold separately
    - 650 acres of flat land needed
    - Minimal water use (washing only)
    - Laguna could benefit from local manufacturing/component integration facilities needed

Funding Requirement:

$340-560 million in capital costs, depending on technology

$14 million in development costs

Section 6: Lessons Learned

"No stable, sustainable community can…exist without a secure, sustainable supply of energy at a steady price, and the only way that both security and price stability can be guaranteed is by having energy sources within community boundaries and under community control".

"Fossil fuels are non-renewable, unreliable, and do great harm to the environment in many ways. Alternative energy is the path to the future. If we are to teach our children cultural values and to respect Mother Earth, we have to live and practice those values."

"Cultural values are not only the arts of song and dance; it is the way in which we live our lives. Sustainability is investing in our people, in our peoples' future, staying true to our environment and in finding value in appropriate technology."

As illustrated in the comments above, Laguna community members had an extraordinary grasp of the value of renewable energy and energy self-sufficiency. "Energy Independence" is a goal Tribes continue to strive for, not only to provide the energy needs, but also to create training & employment opportunities. The push for alternative energy, energy self-reliance and energy efficiency continues to grow in Native communities across the country. Many Tribes are developing their own utility authorities, pooling consumers to secure better rates from local utility providers, and producing alternative forms of clean energy, and we must continue to strive for better energy solutions that meet the needs of our community.

Alternative energy is a key to addressing the energy issues without degrading the land, wasting water, or allowing external corporations to control tribal resources. As Indian people they have been taught to be conscious of their environment. Laguna is blessed with sunshine, has good seasonal wind, and has a source of invasive salt cedar that could potentially fuel a small biomass system. Solar systems, wind power, and a small biomass project could provide much needed energy for the Laguna communities.

Today, faced with a variety of challenges in the community, and with multiple outside forces at work, differences of opinion about energy matters could get in the way of Laguna identifying its primary goals with regard to energy-related opportunities, and committing to work together to achieve those goals. Red Mountain believes that the two continual phases of this project, Capacity Building and Community Education and Outreach, will ultimately provide the greatest sustainable value to Laguna as it considers its options, and determines which projects it should proceed with, and how it chooses to move forward. The analytical efforts were useful in that they provided independent and objective analyses of renewable resources, and provided Laguna with a range of options it could pursue to develop those resources to benefit the community in a number of ways. These benefits include reducing the energy burden of villages and individual members, lowering reservation-wide energy supply costs, and providing economic development opportunities and member jobs.

Section 7: Appendix

Analyses

- 060205 Community Outreach Plan
- 060301 Solar Resource Assessment
- 060411 Natural Gas Access
- 060606 Preliminary Load Forecast
- 060608 POL Project Identification
- 060814 Fatal Flaw Summary
- 070718 Solar Project Update
- 080306 Renewable Development Plan

Community Information

- 060606 Gas Technology Resource Brief
- 060606 Solar Technology Resource Brief
- 060606 Wind Technology Resource Brief
- 060607 RE Village Discussions
- 070126 Community Input Questionnaire

Project Updates

- 060303 RE Study Update
- 060303 RE Study Update Staff Officers
- 060505 POLUA Board Update
- 060728 POL Board/Entity Update
- 061020 DOE Presentation_Laguna
- 070518 POL Board Update
- 071106 DOE Presentation_Laguna