Section 7: Appendix

Analyses

- Proposed Community Education/Outreach Plan
- Solar Resource Assessment
- Natural Gas Access
- Preliminary Study: Laguna and Village Electric Usage
- Potential Project Options
- Fatal Flaw Results Summary
- Solar Project Feasibility Update
- Renewable Energy Development Plan

Community Information

- Firming Renewable Generation with Natural Gas: A Technology Brief
- Generating Electricity from the Sun: A Technology Brief
- Generating Electricity from the Wind: A Technology Brief
- Community Meeting
- Renewable Energy Project Options

Project Updates

- Study Update: Project Identification Meeting
- POLUA Board of Directors: Status Report
- POLUA Board and Entity Update
- DOE Program Review October 2006
- DOE Tribal Energy Program Review October 2007

Analyses

- Proposed Community Education/Outreach Plan
- Solar Resource Assessment
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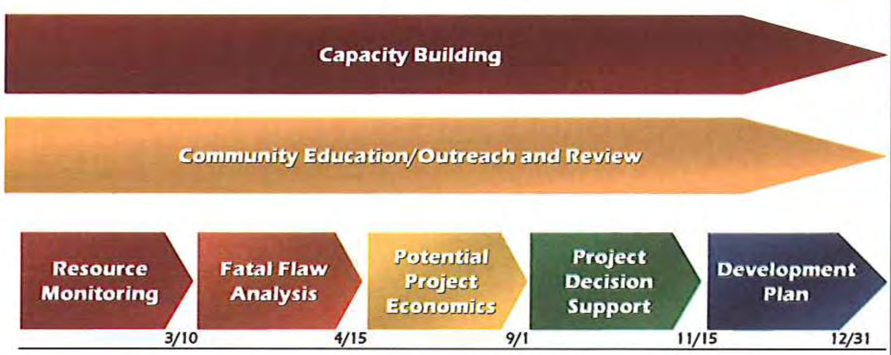
Pueblo of Laguna Renewable Energy Feasibility Study

Proposed Community Education/Outreach Plan

February 2006

Pueblo of Laguna Renewable Energy Feasibility Study

Project Phases



Community Education/Outreach Plan is a primary component of the Community Education/Outreach and Review Phase

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Pueblo of Laguna Renewable Energy Feasibility Study Project Objectives

- 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 or participant
- Provide for renewable and/or hybrid renewable generation to be a resource component in potential Utility Authority electric utility operations

Community Education/Outreach Plan Outline

- Pueblo of Laguna Background
- Community Education/Outreach Plan Purpose
- Community Education/Outreach Plan Components
  - Utility Authority Newsletter
    - Approach
    - Style
    - Sections
    - Topics
    - Preparation
    - Distribution
  - Community Meetings
    - Approach
    - Content
    - Agenda
    - Participants
    - Schedule

Pueblo of Laguna Background

- Federally recognized Indian Tribe organized under the Indian Reorganization Act of 1934
- Project undertakes a feasibility study on Pueblo lands to develop renewable energy generation projects
- Ongoing Pueblo interest in renewable energy has focused on wind, solar and biomass resources
  - Prior projects included solar facilities at Majors Ranch and Laguna Industries
- Feasibility Study designed to expand on previously completed studies
  - Utility formation
  - Generation opportunities
  - Energy self-sufficiency options
  - Energy management integration with economic development
- Pueblo access to nearby gas pipelines could allow for a "hybrid" project, providing a "firm" power product
- Recent Utility Authority formation and operations could allow power generated to serve both Pueblo electric loads and wholesale power markets
- Renewable generation project development can have significant positive impacts
  - Provide local generation to help resolve existing on-reservation power quality and reliability problems
  - Create local short-term and long-term employment opportunities
  - Promote energy self-sufficiency and economic development opportunities

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Community Education/Outreach Plan Purpose

- Provide the Laguna community (Utility Authority staff, Tribal staff and leadership and community members):
  - Background information on utility service, energy, renewable and conventional generation issues
  - Insights into Utility Authority infrastructure and service plans
  - Insights into possible energy project types, locations, and economics
  - Opportunities to provide input/ask questions about utility infrastructure/utility service plans and potential power project development plans
- Provide Pueblo of Laguna energy project development 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

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Utility Authority Newsletter Approach

- Provide direct written communication from Utility Authority, and Pueblo of Laguna leadership to Laguna community
- Introduce Laguna community to a variety of utility and energy issues
- Provide background information, advance plans, and education on critical issues for members
- Each monthly issue will have a focus, supported by multiple articles
- Focus area will be identified as close to newsletter preparation/distribution timing as possible to ensure timeliness of topic

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Community Education/Outreach and Review

Utility Authority Newsletter Style

- Written so that members with no prior background can understand the topics and articles
- Articles will focus on customers and customer needs, where applicable
- Tone of articles to be respectful, and positive
- Look, feel and tone will be as "traditional" as possible

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Utility Authority Newsletter Sections

- Recurring sections to be included in each newsletter
  - Lead – varies each issue
  - Second lead – varies each issue
  - Focus area – varies each issue
  - Customer Corner – timely customer/service questions/answers
  - Energy Lines – renewable energy, natural gas, propane, electric and energy management/use issues
  - Water Reflections – water service, infrastructure updates
  - Waste Collections – Wastewater, septic, and solid waste updates
  - Employee Focus – feature on Utility Authority employees
  - GM Message – timely topics from Utility Authority leadership
- Topics ideas identified for 2006 in monthly "units"
  - "Unit" components can be modified, or entire "units" interchanged

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Utility Authority Newsletter Topics

- Focus Areas
  - Utility Rates
  - Water Services
  - Energy Costs
  - Solid Waste Services
  - Wastewater/Septic Services
  - Renewable Energy
  - Telecom Services
  - Energy Efficiency
  - Water System Improvements
  - Propane/Natural Gas
  - Rate and Service Changes
  - Utility System Improvement Plans

RED MOUNTAIN ENERGY PARTNERS

Utility Authority Newsletter Topics

Water
Renewable Energy
Wastewater/Septic
Energy
Telecom
Solid Waste
UA Rates
UA Infrastructure
Customer Service

Issue	Focus	Lead	Second Lead	Focus	Customer Corner	Energy Lines	Water Reflections	Waste Collections	Employee Focus	GM Message
1	UA Rates		Renewable Energy	Water	Telecom	Energy	Water	Solid Waste	Water	
2	Water	UA Rates	UA Rates	Water	UA Rates	Renewable Energy	Water	Wastewater/Septic	Water	Water
3	UA Rates	UA Infrastructure	Water	UA Rates	Customer Service	Energy	Water	Solid Waste	Energy	Energy
4	Solid Waste	Energy	UA Rates	Solid Waste	Customer Service	Energy	Water	Solid Waste	Solid Waste	Solid Waste
5	Wastewater/Septic	UA Infrastructure	Wastewater/Septic	Wastewater/Septic	Customer Service	Energy	Water	Wastewater/Septic	Wastewater/Septic	Wastewater/Septic
6	Renewable Energy	Renewable Energy	Energy	Renewable Energy	Customer Service	Renewable Energy	Water	Solid Waste	Renewable Energy	Renewable Energy
7	Telecom	Renewable Energy	Energy	Telecom	Energy	Energy	Water	Wastewater/Septic	Telecom	Telecom
8	Energy	Energy	Renewable Energy	Energy	Energy	Renewable Energy	Water	Solid Waste	Energy	Energy
9	Water	Energy	Energy	Water	Water	Energy	Water	Wastewater/Septic	Water	Water
0	Energy	Renewable Energy	UA Rates	Energy	Telecom	Renewable Energy	Water	Solid Waste	UA Rates	UA Rates
11	UA Rates	Renewable Energy	Energy	UA Rates	Energy	Energy	Water	Wastewater/Septic	UA Rates	UA Rates
12	Solid Waste	UA Rates	UA Rates	Solid Waste	UA Rates	Renewable Energy	Water	Solid Waste	Solid Waste	Solid Waste

RED MOUNTAIN ENERGY PARTNERS

Community Education/Outreach and Review

Utility Authority Newsletter Topics

Issue 1

- Focus - Utility Rates
- Utility Authority Formation
- Renewable Energy Feasibility Study
- Proposed Rates and Services
- Customer Corner – Telecom Service Efforts
- Energy Lines - Energy Assistance Available
- Water Reflections – Why are We Paying for Water?
- Waste Collections – Collection/Transfer Station Operations
- Employee Focus – Harold Johnson
- GM Message – Building Capacity

Issue 2

- Focus - Water Services
- How to Read Your Utility Bill
- Tribal Utility Rate Comparisons
- What is Water Quality?
- Customer Corner – Customer Billing Plans
- Energy Lines – Renewable Energy Technologies
- Water Reflections – From the Ground to your Tap
- Waste Collections – Wastewater/Septic System Operations
- Employee Focus – Water
- GM Message – Upcoming Water System Improvements

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Utility Authority Newsletter Topics

Issue 3

- Focus – Energy Costs
- System Upgrades Planned
- Water System Priorities
- What You can do to Reduce Energy Costs
- Customer Corner – Billing and Customer Service Policies
- Energy Lines – How Do I Read My Electric Bill?
- Water Reflections – Planned Water System Improvements
- Waste Collections – Focus on Recycling
- Employee Focus – Energy
- GM Message – Increasing Energy Costs – What You Can Do

Issue 4

- Focus – Solid Waste Services
- Electric Service Reliability
- Water Service Rate Comparisons
- Transfer Station Operations
- Customer Corner – Customer Payment Plans
- Energy Lines - Energy Efficiency Tips
- Water Reflections – Making Water Service Available
- Waste Collections – How Recycling can Lower Solid Waste Costs
- Employee Focus – Transfer Station
- GM Message – Impact of Waste Carrier Negotiations

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Utility Authority Newsletter Topics

Issue 5

- Focus – Wastewater/Septic Services
- Laguna Infrastructure Construction Plans
- Wastewater/Septic Plans
- Wastewater/Septic System Description
- Customer Corner – Customer Support for non-UA Services
- Energy Lines – What to do when your electricity goes off
- Water Reflections – The Water Cycle
- Waste Collections – Septic System Tips
- Employee Focus – Wastewater/Septic
- GM Message – Challenges for Septic System Users

Issue 6

- Focus – Renewable Energy
- Community Input Sought for Renewable Energy Projects
- Nationwide Gas and Electric Cost Increases
- Renewable Energy Options at Laguna
- Customer Corner – What if I can't pay my bill?
- Energy Lines – Renewable Energy Impacts on Costs of Electricity
- Water Reflections – Water Issues in New Mexico
- Waste Collections – Special Transfer Station Programs
- Employee Focus – Renewable Energy
- GM Message – Renewable Energy Fit with Laguna Culture

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Utility Authority Newsletter Topics

Issue 7

- Focus – Telecom Services
- Community Inputs on Renewable Energy Projects
- Projected Energy Prices
- Telecom Infrastructure Project Plans
- Customer Corner – Impact on Energy Bills of Improving Energy Efficiency
- Energy Lines – Requesting Natural Gas Service
- Water Reflections – Water System Construction Update
- Waste Collections – Wastewater System Improvements Planned
- Employee Focus – Telecom
- GM Message – Telecom History at Laguna

Issue 8

- Focus – Energy Efficiency
- Energy Price Forecasts
- Renewable Energy Study Update
- Weatherization Grants Available
- Customer Corner – Weatherization/LIHEAP for Low-Income Households
- Energy Lines – Native American Wind Energy Program
- Water Reflections – Water System Improvement Funding
- Waste Collections – Transfer Station Use Suggestions
- Employee Focus – Energy Efficiency
- GM Message – Energy Efficiency vs. Payment Assistance

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Utility Authority Newsletter Topics

Issue 9

- Focus – Water System Improvements
- What You Can do to Keep Energy Costs Down
- Propane Feasibility Study Update
- Water System Update
- Proposed Rates and Services
- Customer Corner – Water Bills as a Percentage of Income Comparison
- Energy Lines – Propane Distribution Plans
- Water Reflections – Village Water System Improvement Plans
- Waste Collections – Wastewater System Improvement Funding Sources
- Employee Focus – Water
- GM Message – Water Conservation

Issue 10

- Focus – Propane/Natural Gas
- Renewable Energy Self-Generation Options
- How Rates are Developed
- Propane Feasibility Study Results
- Customer Corner – Telecom Service Plans
- Energy Lines – Role of Renewable Energy
- Water Reflections – Water Metering Plans
- Waste Collections – Waste Collection Route Changes
- Employee Focus – Propane/Natural Gas
- GM Message – Propane Study Impacts on Customer Costs

RED MOUNTAIN ENERGY PARTNERS

Utility Authority Newsletter Topics

Issue 11

- Focus – Rate and Service Changes
- Renewable Energy Study Outcomes
- Energy Price Forecast Update
- Upcoming Rate and Service Changes
- Customer Corner – Energy Bills as a Percentage of Income
- Energy Lines – Update on UA Energy Service Plans
- Water Reflections – Water and Power
- Waste Collections – Comparison of NM Wastewater/Septic Rates
- Employee Focus – Rates
- GM Message – Purpose of Rate Phase-In

Issue 12

- Focus - Utility System Improvement Plans
- New Rates Effective January 1
- Utility Authority Funding Sources
- 2006 Utility Infrastructure Improvement Plans
- Customer Corner – Utility Bill Changes
- Energy Lines - Renewable Energy Project Development Process
- Water Reflections – Water Issues in the West
- Waste Collections – Planned Transfer Station Changes
- Employee Focus – Utility System Improvements
- GM Message – Importance of System Planning

Utility Authority Newsletter Preparation

- Topic Selection
  - By 3 weeks prior to end of month
  - Utility Authority GM, Staff
- Article Development
  - RMEP project staff drafts initial versions
  - Utility Authority staff drafts articles, if needed for specific topics
  - Utility Authority GM to review, edit, approve
- Printing
  - UA staff to print (1200 copies) in color on 11x17 paper, fold
  - UA staff to print labels from Customer Billing system data

Utility Authority Newsletter Distribution

- Utility Authority customers
  - Mail
  - Solid Waste Collection personnel
  - Utility Authority office
- General Laguna community
- Tribal Administration
- Other Laguna locations
  - Tribal Administration building
  - Retail establishments/restaurants
  - Schools

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Community Meeting Approach

- Eight Community meetings to be held
  - Scheduled about once every 6 weeks
  - Estimated 2-hour duration
- All meetings open to all village members
  - Transportation provided for elders, or those unable to drive
  - Utility Authority staff, Tribal leadership strongly encouraged to attend
- Four meetings held at community-wide locations
  - Tribal Administration
  - Dancing Eagle
  - Schools
- Four meetings held at village locations
  - Villages can volunteer to host
- Field trip potential also a possibility, depending on project availability
  - Wind farm
  - Biomass
  - Solar installation
- Evening or weekend meetings suggested
  - Meal "pitch-in" may draw more attendance
  - 6 PM dinner; 6:30 PM meeting
- Meeting notes should be taken, and made available upon request

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Community Meeting Content

- Meeting topics to be determined based on need/timeliness
- Topics intended to follow up on Utility Authority newsletter focus topics
  - Utility Rates
  - Water Services
  - Energy Costs
  - Solid Waste Services
  - Wastewater/Septic Services
  - Renewable Energy
  - Telecom Services
  - Energy Efficiency
  - Water System Improvements
  - Propane/Natural Gas
  - Rate and Service Changes
  - Utility System Improvement Plans

Community Meeting Agenda

- Opening and Introductions – 10 minutes
- Utility Authority update – 15 minutes
- Renewable Energy Study update – 15 minutes
- Primary topic presentation – 30 minutes
- Questions and Answers – 30 minutes
- General Comments – 20 minutes

Community Meeting Participants

- Utility Authority General Manager
- Utility Authority Staff
- Utility Authority Board of Directors, Committees
- Tribal leadership
- Village officers

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Community Meeting Schedule

Newsletter Focus	Target Meeting Completion Date	Meeting Lead Topic	Renewable Energy Content	Location
Utility Rates				
Water Services	March 10	UA Rates	RE Project Description	Community
Energy Costs	April 15	Water Quality	RE Resources Identified	Village
Solid Waste Services	May 31	Energy Pricing	RE Technologies	Community
Wastewater/Septic Services	July 15	Renewable Energy Project Input	RE Projects Identified	Community
Renewable Energy	August 30	Infrastructure Plans	RE Project Feasibility Update	Village
Telecom Services	September 30	UA Services Expansion	RE Project Feasibility Update	Village
Energy Efficiency	November 15	Energy Efficiency/ Weatherization	RE Projects Proposed	Village
Water System Improvements	December 31	Renewable Energy Project Plans	RE Project Approval Status	Community
Propane/Natural Gas				
Rate and Service Changes				
Utility System Improvement Plans				

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Pueblo of Laguna
Renewable Energy Feasibility Study

Solar Resource Assessment

February 2006

Solar Resource Assessment Outline

- Overview of Solar Energy Technology Options
  - Residential & Commercial (Distributed) Solar Systems
    - Photovoltaic (PV) Modules
    - Tracking Systems
  - Large-Scale (Central Station) Solar Systems
    - Power Tower
    - Parabolic Trough
    - Dish-Engine
    - High Concentration Photovoltaics (HCPV)
- Solar Resource on the Pueblo
  - Fixed-Tilt Flat Plate PV Measurements
  - Two-Axis Tracking Concentrator Measurements
- Technology Fit with Solar Resource on the Pueblo

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Overview of Solar Energy Technology Options: Residential & Commercial (Distributed) Solar Systems


Thin film BIPV


Polycrystalline silicon


Multi-junction cells


Single & dual axis tracking

- Photovoltaic (PV) Modules
  - Vary in composition and feedstock materials
    - "Thin-film" cells make use of ultra-thin photovoltaic material deposited on an inexpensive material such as glass or plastic; both efficiency and cost are comparatively low
    - Silicon cells can have different molecular "crystal" structures (polycrystalline, homogeneous, or amorphous); proportional trade-off between cost of manufacturing and energy conversion efficiency
    - Cells can be made of other compound semiconductors (Gallium Arsenide, Indium Phosphide, etc.); generally higher cost & efficiency
    - "Multi-junction" cells make greater use of the sun's energy by layering different materials that have higher response to varying portions of the light spectrum; higher performance allows for use of less semiconductor material

Cost	Output	Market Maturity
$	+	+++
$$	++	+++++
$$$	+++	++
$$$	+++++	+

  - Vary by structure
    - Fixed, flat-plate: may be horizontal, fixed tilt, or Building Integrated PV (BIPV)
    - Single-axis tracking: uses mechanical tracking to follow the sun's most intense angle of incidence
    - Two-axis tracking: uses mechanical tracking to follow the sun's most intense angle in two directions; higher efficiency than single-axis

Solar systems can be distributed for direct on-site energy use, or deployed for large-scale power generation.

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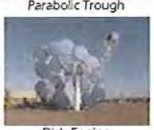
Overview of Solar Energy Technology Options: Large-Scale (Central Station) Solar Systems


Power Tower


Parabolic Trough


Dish-Engine


HCPV

Large-scale systems for central-station generation typically* use Concentrating Solar Power (CSP) Technologies. CSP:

- Produces electric power by using lenses or mirrors to convert sun's energy into high-temperature heat to drive turbines or engines, or directly into electricity via high-efficiency PV cells
- Consists of two major subsystems: (1) solar radiation collection/concentration component, and (2) energy conversion component
- Can be sized for distributed generation (10-35 kilowatts) or central grid-connected applications (up to several hundred Megawatts)
- Can be readily "hybridized" with fossil fuel and in some cases adapted to utilize thermal storage; hybridization and thermal storage enable dispatchability of generated power and operation during periods when solar energy is not available, thus enhancing the economic value of the electricity produced and reducing its average cost
- Four Primary CSP Technologies are:
  - Power Tower
  - Parabolic Trough
  - Dish-Engine
  - High Concentration Photovoltaics (HCPV)

Large-scale solar systems tend to use concentrator assemblies to increase the sun's thermal or optical intensity.

** Central station plants on the order of 5-10 MW have also used conventional PV modules.*

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Overview of Solar Energy Technology Options: Large-Scale (Central Station) Solar Systems


Power Tower


Parabolic Trough


Dish-Engine


HCPV

- Primary CSP Technologies
  - Power Tower
    - Uses a circular field array of heliostats (large individually-tracking mirrors) to focus sunlight onto a central receiver mounted on top of a tower, which produces steam to power a conventional turbine generator to produce electricity
  - Parabolic Trough
    - Uses parabolic trough-shaped mirrors to focus sunlight on thermally efficient receiver tubes that contain a heat transfer fluid; fluid is heated and pumped through a series of heat exchangers to produce superheated steam, which powers a conventional turbine generator to produce electricity
    - Nine trough systems between 14 and 80 MW, built in the mid to late 1980's, are currently generating 354 MW in Southern California
  - Dish-Engine
    - Uses an array of parabolic dish-shaped mirrors (stretched membrane or flat glass facets) to focus solar energy onto a receiver located at the focal point of the dish; fluid in the receiver is heated and used to generate electricity in a small engine or turbine attached to the receiver
  - High Concentration Photovoltaics (HCPV)
    - Uses high efficiency PV cells with concentrating (Fresnel) lenses that multiply the sun's intensity, requiring hundreds of times less photovoltaic material to achieve the same energy output as PV cells without concentration

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Overview of Solar Energy Technology Options: Comparisons of Cost and Performance

Examination of kWh delivered per dollar expended is useful in considering technology investment decisions. Some solar technologies may have lower first-costs, but also much lower performance, and thus longer payback periods.

Installation	Cost ($/Watt)	Performance (kWh/kW-yr)	kWh/$
Fixed – Horizontal	5.25	1,250	4.75
Fixed – Latitude	5.25	1,630	6.20
Tracking – Horizontal	5.50	2,350	8.55
Tracking – Latitude	6.50	2,450	8.25
HCPV	6.00	2,030	6.75
Parabolic Trough	4.00	2,000	10.00
HCPV - Future	3.00	2,400	16.00
Dish/Turbine - Future	2.50	2,400	19.20

Source: Arizona Public Service, 2005. Data reflects insolation levels specific to Arizona.

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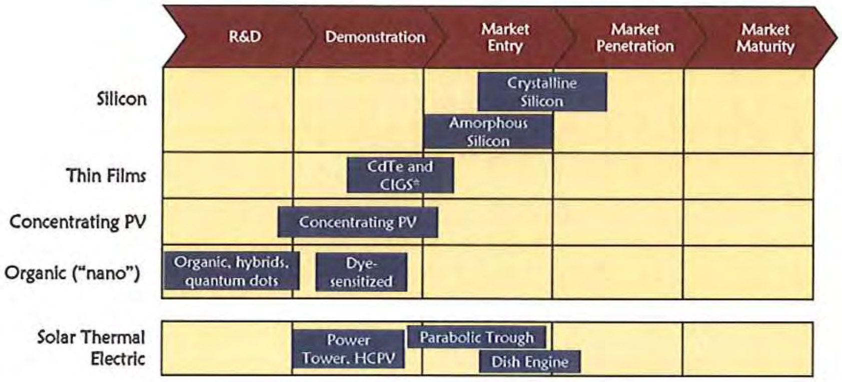
Overview of Solar Energy Technology Options: Market Maturity

Crystalline silicon PV technology has experienced the most market penetration relative to other solar technologies. Dish engine systems may achieve significant market reach in the near term, pending the outcome of power purchase agreements currently being negotiated in California.

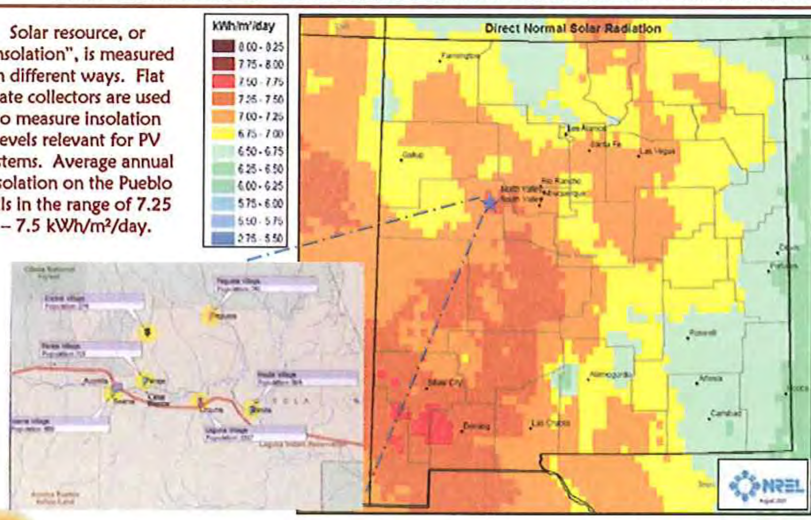


* Cadmium telluride (CdTe) and copper indium gallium selenide (CIGS)

Source: Navigant Consulting, Inc.

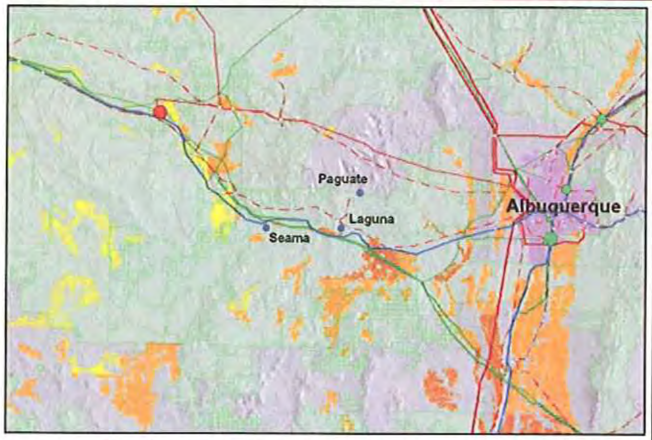
Solar Resource on the Pueblo: New Mexico's Direct Normal Solar Radiation

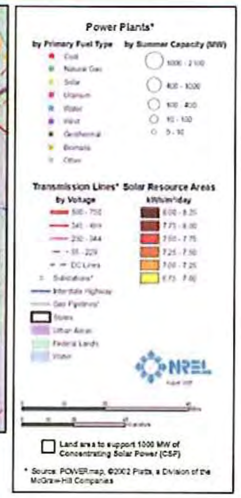
Solar resource, or "insolation", is measured in different ways. Flat plate collectors are used to measure insolation levels relevant for PV systems. Average annual insolation on the Pueblo falls in the range of 7.25 – 7.5 kWh/m²/day.



Source: National Renewable Energy Lab (NREL)

Solar Resource on the Pueblo: Regional Prospects for Concentrating Solar Power





Insolation relevant for CSP technology is measured with collectors that track the sun. Parts of the Pueblo have concentrator insolation levels in the range of 7.25 – 7.5 kWh/m²/day, well within the range suitable for large-scale solar projects.

Source: National Renewable Energy Lab (NREL)

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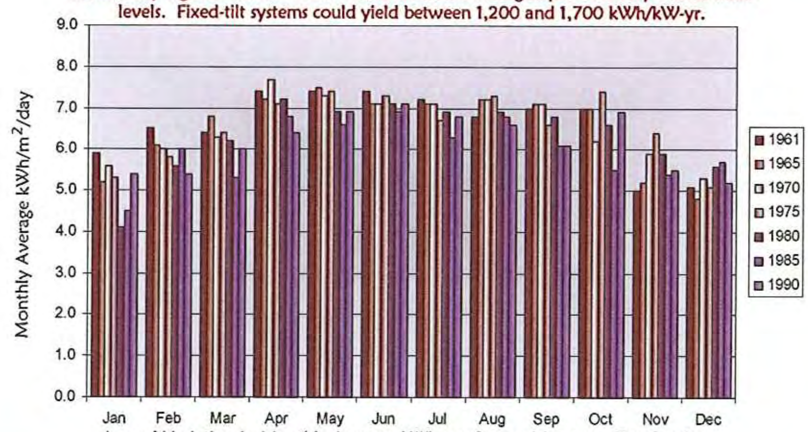
Solar Resource on the Pueblo: Insolation for Flat-Plate Collector Facing South, Fixed Tilt at Latitude

Surface measurements taken over a thirty year period in the Albuquerque area indicate consistently high insolation levels. Photovoltaic technologies perform very well at these levels. Fixed-tilt systems could yield between 1,200 and 1,700 kWh/kW-yr.



Annual Variation In Monthly Average kWh per Square Meter per Day for the Albuquerque Region, 1961 – 1990*

** Source: Red Mountain Energy Partners, National Solar Radiation Database (NSRDB) Insolation Archive, 1961-1990*

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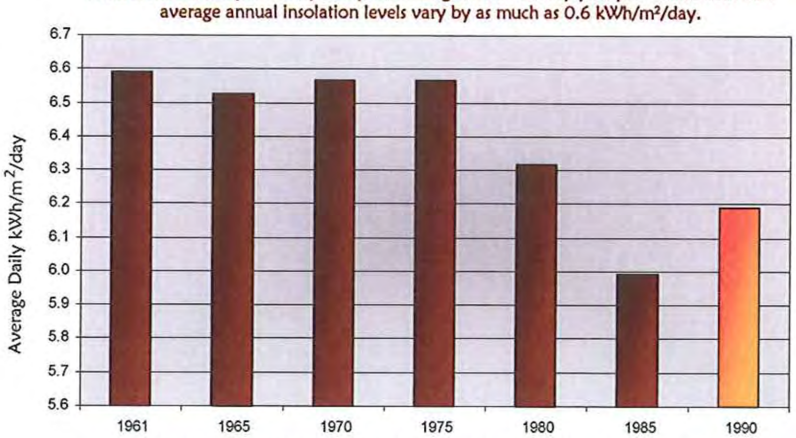
Solar Resource on the Pueblo: Insolation for Flat-Plate Collector Facing South, Fixed Tilt at Latitude

Measurements sampled every five years during the same thirty year period illustrate that average annual insolation levels vary by as much as 0.6 kWh/m²/day.



Annual Average kWh per Square Meter per Day, by Year for the Albuquerque Region, 1961 – 1990*

Source: Red Mountain Energy Partners, National Solar Radiation Database (NSRDB) Insolation Archive, 1961-1990

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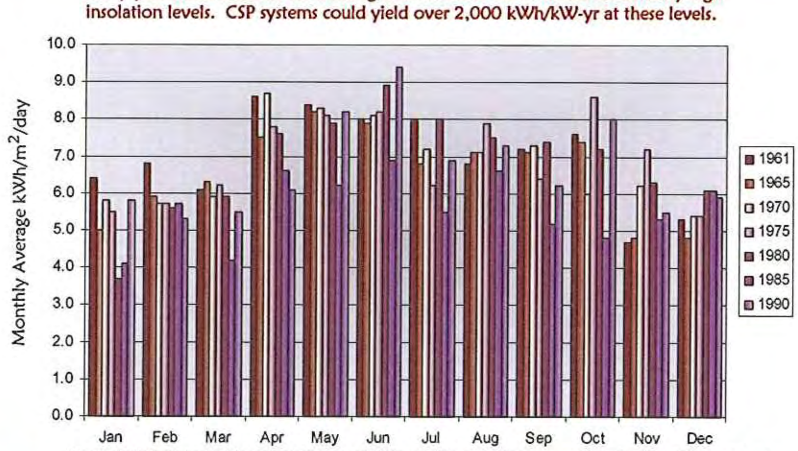
Solar Resource on the Pueblo: Insolation for Two-Axis Tracking Concentrating Collector

Thirty-year measurements for tracking concentrators also indicate consistently high insolation levels. CSP systems could yield over 2,000 kWh/kW-yr at these levels.



Annual Variation In Monthly Average kWh per Square Meter per Day for the Albuquerque Region, 1961 – 1990*

Source: Red Mountain Energy Partners, National Solar Radiation Database (NSRDB) Insolation Archive, 1961-1990

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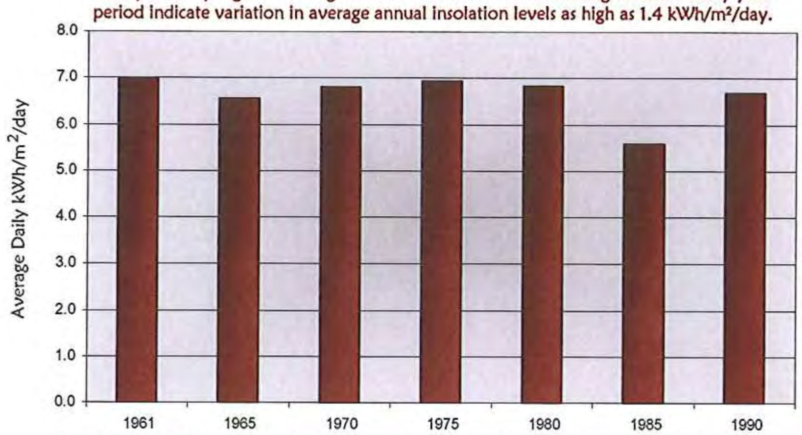
Solar Resource on the Pueblo: Insolation for Two-Axis Tracking Concentrating Collector

Five-year samplings of tracking concentrator measurements during the same thirty year period indicate variation in average annual insolation levels as high as 1.4 kWh/m²/day.



Annual Average kWh per Square Meter per Day, by Year for the Albuquerque Region, 1961 – 1990*

** Source: Red Mountain Energy Partners, National Solar Radiation Database (NSRDB) Insolation Archive, 1961-1990*

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Technology Fit with Solar Resource on the Pueblo: Comparison of PV Alternatives

Screening Criteria

	Match with Insolation Needs	Technology Maturity	Market Maturity	Reliability	Intermittency (Operational Concerns)	Output Efficiency, %	Installed Capital Cost	Renewable Portfolio Standard (RPS) Efficacy	Effective Load Carrying Capability (ELCC)
Metric	Strong match = ■■■■	High maturity = ■■■■	High maturity = ■■■■	High reliability = ■■■■	Low capacity factor (high intermittence) = ■	High efficiency = ■■■■	High installed capital cost = ■	High efficacy = ■■■■	High ELCC = ■■■■
Polycrystalline Silicon, Fixed-Tilt PV Modules	■■■■	■■■□	■■	■■■	■■	■	■		■■
Polycrystalline Silicon, Fixed-Horizontal PV Modules	■■■■	■■■□	■■	■■■	■■	■	■		■■
Thin-Film, BIPV	■■■■	■■	■■	■■	■■	□	■■		■□
Single-Axis Tracking Silicon PV Modules	■■■■	■■■	■	■■■	■■	■■	□	■■	■■■
Dual-Axis Tracking Silicon PV Modules	■■■■	■■■	■	■■■	■■	■■	□	■■	■■■■
Nano-technologies	■■■■	■			■■	■■■			

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Technology Fit with Solar Resource on the Pueblo: Comparison of CSP Alternatives

Screening Criteria

	Match with Insolation Needs	Technology Maturity	Market Maturity	Reliability	Intermittency (Operational Concerns)	Output Efficiency, %	Installed Capital Cost	Renewable Portfolio Standard (RPS) Efficacy	Effective Load Carrying Capability (ELCC)
Metric or Weighting Coefficient	Strong match = ■■■■	High maturity = ■■■■	High maturity = ■■■■	High reliability = ■■■■	Low capacity factor (high intermittence) = ■	High efficiency = ■■■■	High installed capital cost = ■	High efficacy = ■■■■	High ELCC = ■■■■
High Concentration PV (HCPV), Silicon	■■■■	■□	■	■■■	■■	■■	■	■■■■	■■■■
HCPV, Multi-Junction PV Cells	■■■■	■□	■	■■	■■	■■■■	■	■■■■	■■■■
Dish-Engine Systems	■■■■	■■■	■■?	■■	■■	■■■	■■■■	■■■■	■■■■
Dish-Turbine with Storage	■■■■				■■	■■■■	□	■■■■	■■■■
Parabolic Trough	■■■■	■■■■	■■	■■■■	■■	■■■	■■■	■■■■	■■■
Power Tower	■■■■	■■	□	■■	■■	■■■	■	■■■■	■■■■

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Technology Fit with Solar Resource on the Pueblo: Comparison of CSP Alternatives

Observations

- Technology selections for any project should be weighed against considerations specific to the Tribe's needs and objectives
  - Insolation levels in and around the Pueblo appear to be well-suited for most solar technologies
  - Large scale systems are a better fit if RPS Efficacy, and sales of Renewable Energy Credits (RECs) are a goal
  - For distributed generation applications, ELCC is an important criterion in determining a system's payback period
  - Output efficiency and installed capital costs must be examined by pro forma analysis to understand the true costs and revenue potential of produced energy
  - Intermittency and operational concerns are relevant to both distributed (on and off-grid) and centralized projects

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Technology Fit with Solar Resource on the Pueblo: Comparison of CSP Alternatives

Observations, continued:

- Insolation levels in and around the Pueblo villages are clearly well-suited to support distributed and centralized photovoltaic applications
- Cooler temperatures in the high-desert region yield higher operating efficiency for photovoltaics
- Insolation appears to be sufficient for larger scale CSP technologies, but actual site measurements would be required to support project investment decisions
    - Project economics for installations in even higher insolation areas are highly dependent upon financing, project structure, enabling incentives, etc.
    - As with any "free fuel" renewable project, annual kWh produced and sold will make or break project profitability, and thus accurate resource characterization is critical
    - Technology advances and volumetric deployments are expected to bring capital costs down in the next several years

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Pueblo of Laguna
Renewable Energy Feasibility Study

Natural Gas Access

April 2006

Pueblo of Laguna Renewable Energy Feasibility Study

Project Phases

Capacity Building

Community Education/Outreach and Review

Resource Monitoring → Fatal Flaw Analysis → Potential Project Economics → Project Decision Support → Development Plan

Natural Gas Access is a primary component of the Resource Monitoring Phase

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Report Outline

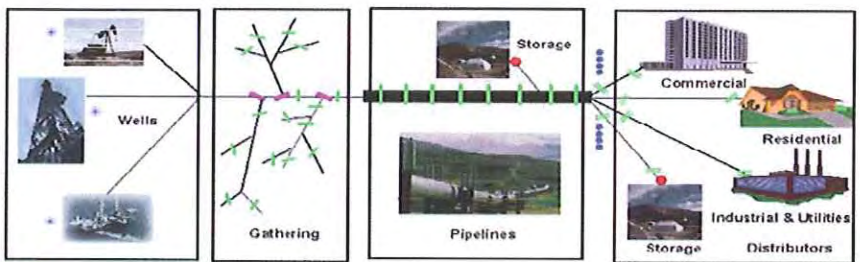
- Natural gas basics
- Pueblo of Laguna natural gas access
  - Interstate pipelines
  - PNM distribution system access
- Other potential natural gas access
- Natural gas supply sources
- Natural gas prices
- Natural gas applications
- Potential natural gas projects

Natural Gas Basics

- Units of measure
  - Volume – Cubic foot (cf)
  - Heating value – British Thermal units (Btu)
  - MMBtu = Mcf = Dth
- Moving natural gas
  - More gas can be moved at higher pressures
  - Natural gas is pressurized (at compressor stations)
  - Measure is psi (pounds per square inch)
  - Pressure determines type of pipeline/construction required
  - Regulation reduces natural gas pressure
  - Capacity indicates whether there is room on the pipeline to transport needed gas supply
- Gas utility service components
  - Gas supply
    - Cost of natural gas and interstate pipeline transportation
  - Gas delivery
    - Cost of gas distribution system delivery

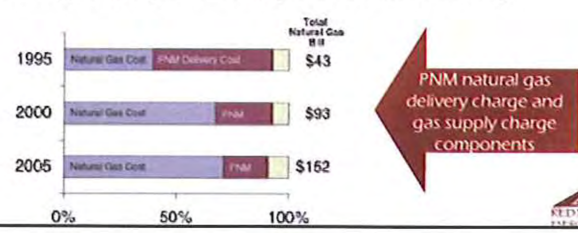
Natural Gas Basics

- Delivery system
  - Gathering system (wellhead to transmission)
  - Transmission system (gathering to utility distribution)
    - Interstate (across multiple states)
    - Intrastate (within a single state)
  - Distribution (transmission to service)
    - Utility delivery system
    - Connects
  - Service
    - Utility line to home/business



Natural Gas Basics

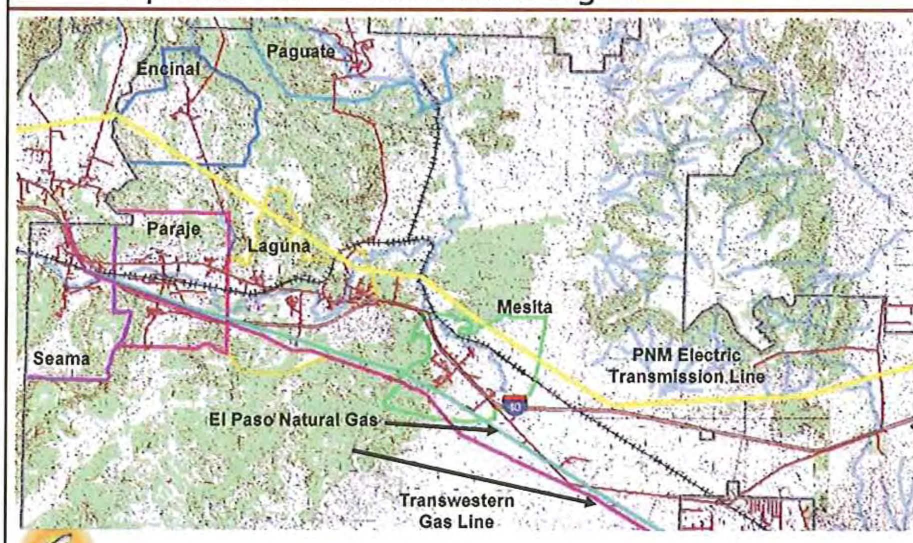
- Rate components
  - Delivery Charge
    - Reflects the cost of moving the gas from the citygate (interconnection with interstate pipeline company) to customer's meter
      - Gas utility margin is included
  - Gas Supply Charge
    - Reflects the costs of gas supplies (gas commodity and pipeline transportation/capacity) purchased on interstate pipelines or from local production
      - No gas utility margin is added
      - Pipeline transportation/capacity price is set by FERC
    - Commodity price is set by the marketplace; utilities use hedging instruments to moderate price volatility
      - Prices typically adjusted monthly and reconciled annually



Pueblo of Laguna Natural Gas Line Access

- Interstate pipelines on Laguna provide interconnection potential for very high-volume natural gas use
  - TransWestern Pipeline
  - El Paso Natural Gas Pipeline
- PNM transmission/distribution system service on portions of Laguna provides access for industrial. commercial, government and residential access
- Next step activities to include review of pipeline agreements and any provisions regarding rights to tap line(s), other provisions which could make interconnection cost prohibitive or cost effective

Pipelines Located on Pueblo of Laguna



Interstate Natural Gas Pipeline Access

- Cross Country/Transwestern Pipeline owned by CCE Holdings, LLC
  - Joint venture of Southern Union Company and GE Commercial Finance's Energy Financial Services
    - TransWestern has Bi Directional Flow Capability
    - Access to San Juan production and Rocky Mountain production via San Juan interconnections with TransColorado and Northwest Pipeline
    - Access to Gulf and Anadarko production

Interstate Natural Gas Pipeline Access

- El Paso Natural Gas
  - Northern line crosses Central/Northern New Mexico
  - Access to San Juan, Permian, and Anadarko Basin gas

Pipeline Interconnection Process and Potential Costs

- Interconnection process
  - Interstate Pipeline/Facilities -
    - File Application of Public Convenience and Necessity to authorize pipeline expansions, for authority to construct any metering facilities, compressor stations, or lateral extensions to connect any facility with Federal Energy Regulatory Commission (FERC)
    - For Intrastate Pipelines/Facilities –
      - File application with the New Mexico Public Regulation Commission
- Interconnection costs may include
  - Certificate and environmental permits
  - Land rights (easements)
  - Pipeline equipment and construction
  - Cathodic Protection and Electrical Mitigation systems
  - Initiation of pig launchers and receivers – equipment used to inspect the pipelines
  - Installation of meter and regulator stations
  - ROW cleanup, regrading, seeding, and restoration
  - Completion of an "as-built" survey of the entire pipeline system
  - Installation of pipeline markers
  - Commissioning the pipeline

  - Rule of thumb costs per mile: $1 million per mile (16-inch diameter)

Natural Gas Supply Sources

- San Juan Basin
- Rocky Mountains
- Permian Basin
- Anadarko
- Gulf of Mexico

- Possible Tribal sources
  - Southern Ute
  - Jicarilla Apache

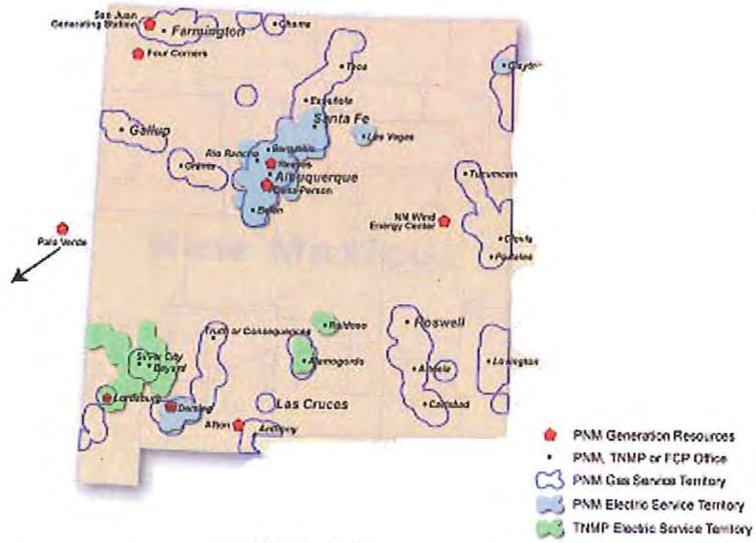
Natural Gas Supply Contracting Basics

- Term Gas Supply
  - Contracts for firm supplies with terms in excess of 30 days with multiple gas suppliers, often for gas produced in nearby producing areas
  - Term contracts, priced based upon first of the month indices, have varying durations
- Secondary Market Transactions
  - Capacity release is a mechanism by which pipeline long-line and storage capacity and gas supplies under contract can be resold in the secondary market
  - Capacity release facilitates higher utilization of contracted capacity and supply during those times when the full contracted capacity and supply are not needed helping to mitigate the fixed costs associated with maintaining peak levels of capacity and gas supply
  - Through pre-arranged agreements and day-to-day electronic bulletin board postings, interested parties can purchase this excess capacity and supply
- Spot Market Gas Supply
  - Typically 30-day spot market with gas purchased based on price and as other circumstances dictate
- Purchasing Requirements (aggregated gas purchases or utility gas purchases)
  - Executed contracts (term, spot, etc) with gas marketers for supply, or gas companies for supply and/or transport, and/or pipeline companies for transportation
  - Required letters of credit or balance sheet for gas contract counterparties
  - Ability to physically accept gas at identified receipt point(s)
  - Possible supply portfolio diversification – mix of long-term fixed and short term contracts to offset prices and take advantage of price fluctuations

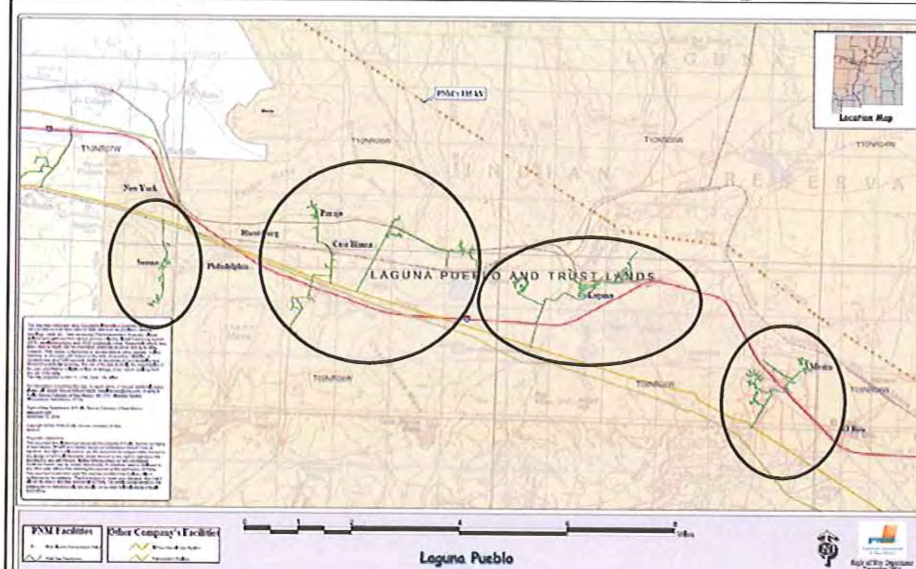
Other Potential Natural Gas Access

- Potential interest in pipeline system development (Four Nations gas project) starting at Jicarilla Apache, routing south through Pueblo of Jemez, Pueblo of Zia, and Pueblo of Sandia
- Some scenarios included continuing south through Albuquerque along existing rail rights of ways to interconnect with current pipeline infrastructure to the South; would have required additional tribal right of way partner, Pueblo of Isleta
  - Potential gas producers
    - Jicarilla Apache
    - Southern Ute
- Project originally sought large anchor customer, e.g., gypsum plant at Zia; Intel, in order to make pipeline economically feasible

PNM Gas Distribution System



PNM Gas Distribution System on Pueblo of Laguna



Existing PNM Natural Gas Distribution Service Customers

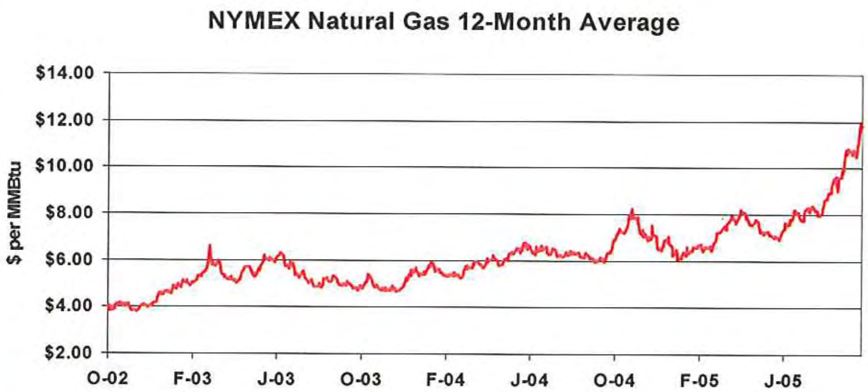
- Laguna
  - Residences
  - Tribal Administration
  - Schools
- Mesita
  - Residences
  - School
  - Laguna Industries
- Seama
  - Residences
- Paraje
  - Residences
  - Casa Blanca businesses, Laguna facilities
  - School

PNM Gas Distribution System Access

- PNM distribution system access
  - PNM will invest in facilities up to the point of economic feasibility (potential revenues exceed system installation cost)
    - Company provides cost estimate to serve customer
    - If cost estimate is over $100,000 requires a customer-paid Special Economic Study
  - Customer-paid extension also available

Natural Gas Access

Spot Market Natural Gas Prices



NYMEX prices indicated significant gas cost increases through 2005

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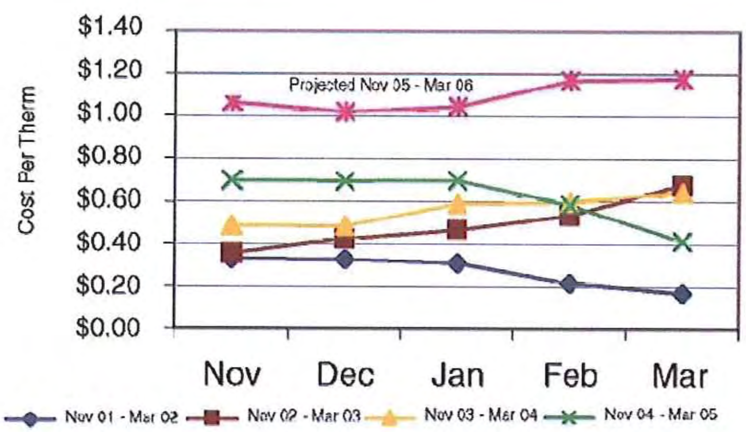
Natural Gas Access

PNM Historical Winter Gas Costs



PNM forecasted natural gas costs to be nearly double those of the prior winter

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Recent Natural Gas Prices – New Mexico Winter 2005/2006

Monthly Pricing - NM	2005 Aug	2005 Sept	2005 Oct	2005 Nov	2005 Dec	2006 Jan
City Gate	6.87	7.53	10.11	9.14	9.42	8.42
Residential	14.42	15.29	16.80	15.69	13.83	12.86
Commercial	9.37	10.18	12.65	13.39	12.57	11.60
Industrial	7.79	8.61	11.12	12.93	12.86	11.00

(Dollars per Thousand Cubic Feet)

Natural gas costs have declined from anticipated highs over the winter months

Gas Prices – Annual New Mexico & National Compared
Gas Prices – Regional Q1 2006 through Q4 2007

Annual: NM & National	2000	2001	2002	2003	2004	2005	2006	2007
NM Wellhead	3.43	3.89	2.68	4.56	4.97			
Wellhead (National)	*3.68*	*4.00*	*2.95*	*4.88*	*5.46*	*7.51*		
NM City Gate	3.79	3.99	2.90	4.78	5.40	7.04		
City Gate (National)	*4.62*	*5.72*	*4.12*	*5.85*	*6.65*	*8.64*		
NM Residential	6.10	7.72	6.13	8.41	9.57	11.02		
Residential (National)	*7.76*	*9.63*	*7.69*	*9.63*	*10.75*	*12.82*	*13.02*	*13.89*
NM Commercial	4.90	5.99	4.75	6.89	7.94	9.19		
Commercial (National)	*6.59*	*8.43*	*6.63*	*8.40*	*9.41*	*11.57*		
NM Industrial	4.39	4.10	3.87	5.48	6.66	8.99		
Industrial (National)	*4.45*	*5.24*	*4.02*	*5.89*	*6.56*	*8.48*		
Electric Power (New/National)	*4.38*	*4.61*	*3.68*	*5.57*	*6.11*	*not available*		

Regional: Base Case	Q1 2006	Q2 2006	Q3 2006	Q4 2006	Q1 2007	Q2 2007	Q3 2007	Q4 2007
Delivered Residential Mountain	10.63	10.95	13.45	12.23	12.37	11.19	13.79	12.55
Delivered Commercial Mountain	9.76	9.33	10.21	10.92	11.15	9.53	10.48	11.03
Delivered Industrial Mountain	9.12	7.99	8.30	9.95	10.59	8.19	8.96	9.98
Delivered City Gate Mountain	7.89	7.00	7.48	8.91	9.43	7.12	7.70	9.01
El Paso San Juan (AZ)	6.67	6.31	6.95	8.59	9.13	6.47	7.16	8.56

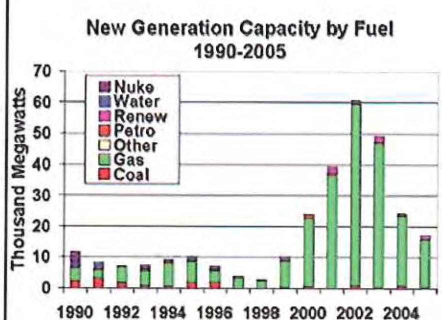
New Mexico – delivered natural gas costs consistently lower than national averages

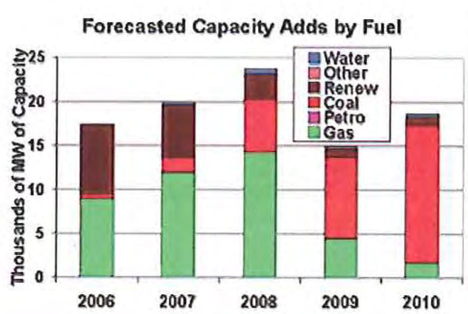
Natural Gas - Fired Power Generation Basics

- Natural Gas Generation
  - Burn gas in boiler to produce steam, used by a steam turbine to generate electricity
  - Burn gas in a combustion turbine and use exhaust to make steam to drive a steam turbine; achieves higher efficiency by using same fuel twice
- Environmental impacts
  - Air emissions
    - Produces nitrogen oxides and carbon dioxide
      - ½ as much carbon dioxide as a coal plant
      - 1/3 as much nitrogen oxide as a coal plant
  - Water resource use
    - Burning natural gas requires very little water
    - Gas-fired boiler and combined cycle systems require water for cooling
  - Water discharges
    - None in combustion turbines
    - Boilers and combined cycle systems create water pollutants and heat
  - Solid waste
    - No significant solid waste produced
  - Land resource
    - Potential to impact natural habitats for animals and plants in generation plant footprint

Source: http://www.epa.gov/cleanrgy/natgas.htm

Natural Gas - Fired Generation Trends/Forecast





Natural gas –fired generation additions have declined in recent years; higher prices have resulted in lower forecasted natural gas capacity additions

Source: http://www.apachecorp.com/Explore/Articles/200601/Topic_Report_New_Power_Generating_Capacity/

Natural Gas Generation

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Large Scale: Natural Gas Combined Cycle Cogeneration

- Small Combined Cycle / Cogeneration
  - Combined Cycle with steam export for industrial or commercial use
  - More fuel efficient and cost effective than separate power and heating/cooling plants
  - Capacity from 10 to 100 MW
  - Requires 5 to 20 acres of land
  - Requires 2 to 5 years to develop and construct
  - Capital cost between $50 million and $100 million
  - Up to 100 jobs during construction, about 20 jobs during operation

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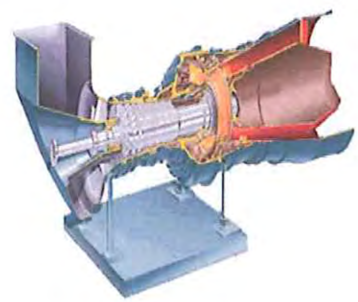
Large Scale: Natural Gas Simple Cycle

- Combustion Turbine or Reciprocating Engine only
- Lower capital cost, but lower fuel efficiency
- Appropriate for summer peak operation
- Capacity from 20 to 100 MW
- Requires 5 to 20 acres of land
- Requires 1 to 3 years to develop and construct
- Capital cost between $10 million and $50 million
- Up to 50 jobs during construction, about 10 during operation



Distributed Generation Options

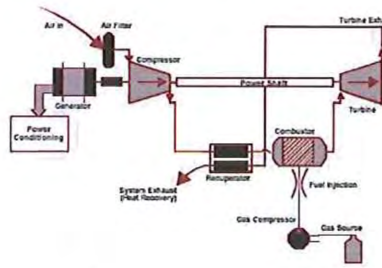
- Numerous natural gas-fired options available
- Several new technologies available

Distributed Energy Technologies	Commercially Available	Emerging Technology
Microturbines	✓	✓
Combustion Turbines	✓	
Reciprocating Engines	✓	
Stirling Engines		✓
Fuel Cells	✓	✓
Energy Storage / UPS Systems	✓	✓
Photovoltaic Systems	✓	
Wind Systems	✓	
Hybrid Systems		✓
Combined Heat & Power (CHP)	✓	✓

http://www.energy.ca.gov/distgen/equipment/equipment.html

Microturbines

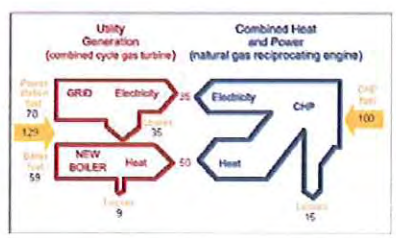
- Natural gas-fired microturbines available today
- Commercial microturbines range in size from 25 kW to 500 kW
- Produce both heat and electricity on a small scale
- Capital cost range from $700-$1100/kW
- Fuel-energy to electrical-conversion efficiencies from 20 to 30%
- Cogeneration may be an option with efficiencies as high as 85%
- Addition of a heat recovery system adds between $75 - $350/kW to capital costs
- Microturbine manufacturers targeting future capital costs below $650/kW



http://www.energy.ca.gov/distgen/equipment/equipment.html

Combined Heat and Power (CHP)

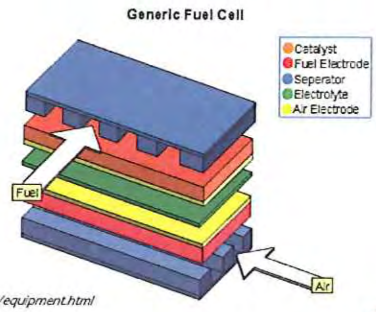
- Combined heat and power (CHP) systems capture and utilize excess heat generated during the production of electric power
- Offer economic, environmental and reliability-related advantages compared to power generation facilities that produce only electricity
- Typical applications
  - Hot water production
  - Space heating
  - Hot air/steam for industrial process heat
  - Space cooling (requires an absorption chiller)
  - Dry air generation (with the use of a desiccant)
- CHP systems available
  - Large and Medium Industrial Systems – greater than 25 MW
  - Small industrial system – 50 kW to 25 MW
  - Smaller commercial and institutional systems – 25 kW+
  - Residential – 1 kW to 25 kW



http://www.energy.ca.gov/distgen/equipment/equipment.html

Fuel Cells

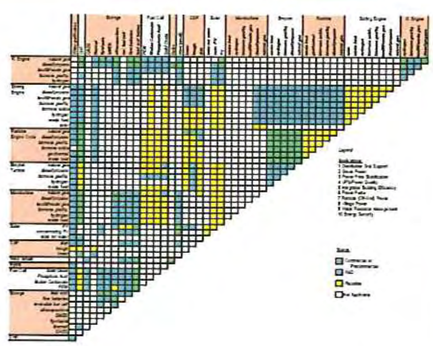
- Natural-gas supplied fuel cells available today
- Most of 600 systems producing 10+ kW fueled by natural gas
- First cost of fuel cells high compared to other distributed technologies
  - Commercially available products are about $5,500/kW installed
  - Developers targeting costs below $1,500/kW
  - Fuel cells used in high value, "niche" markets where reliability is premium, or where electricity prices are very high and natural gas prices are low
- Fuel cells are expected to have minimum (annual) inspection and maintenance requirements



http//www.energy.ca.gov/distgen/equipment/equipment.html

Hybrid Systems

- Hybrid systems can increase overall fuel utilization efficiency and/or reliability
- Numerous options available
  - Solid oxide fuel cell/gas turbine combination
  - Small Stirling engine/solar dish hybrid systems from 5 to 25 kW
  - Large solar dish/Stirling plants with outputs of 1 to 20 MW
  - Wind turbines with energy storage backup generation (i.e., reciprocating engine, turbine, or fuel cell)



http//www.energy.ca.gov/distgen/equipment/equipment.html

Potential Laguna Natural Gas Applications

- Large scale gas-fired generation
  - Meet reservation load, plus sales to grid
  - Consideration of economies of scale in relation to possible interconnection and pipeline lateral costs
- "Firm" a renewable resource w/natural gas generation
  - Large scale
  - Small scale
- Village-scale microturbine
- Facility location
  - Turbine or CHP
- Gas distribution operations
  - Provide retail utility gas service to residential and commercial customers on the reservation
  - Probable substantial capital investment required for infrastructure
  - Provision of service to current vs. new customers
  - Could consider as a second phase of an initial phase generation-related project that would require a lateral pipeline extension

Further Information

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Pueblo of Laguna
Renewable Energy Feasibility Study

Preliminary Study
Laguna and Village Electric Usage

June 2006

Discussion Outline

1. Project Overview
2. Load Forecast Methodology
3. Laguna Summary Load Forecast Results
4. Key Observations
5. Appendix: Village Load Forecast Results

1

Discussion Outline

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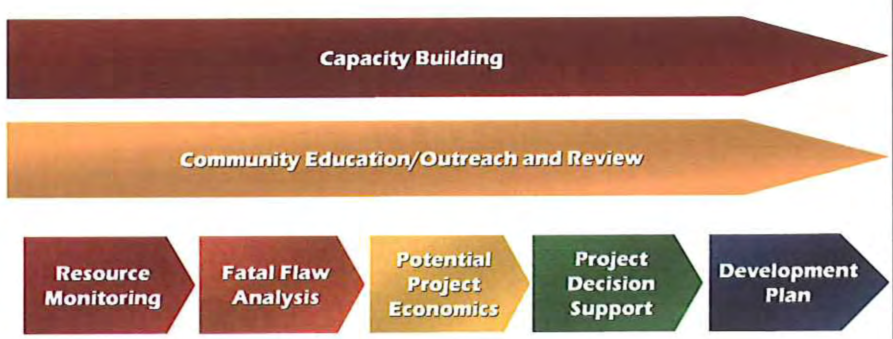
2

Renewable Energy Feasibility Study Project Overview



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Load Forecast Methodology

- Residential: Red Mountain conservatively applied regional average household energy consumption to estimate energy use for occupied households within the Pueblo of Laguna

Housing Occupation by Village

	Occupied	Vacant	Total
Encinal	55	33	88
Laguna	381	117	498
Mesita	224	67	291
Paraje	191	141	332
Paguate	174	114	288
Seama	141	76	217
Other-Laguna	8	19	27
	1174	567	1741

- Residential annual use patterns (load shapes) were adapted using annual energy consumption and time-of-day use patterns consistent with regional climate characteristics (cooling and heating requirements)
- Nonresidential: Energy requirements were derived for nonresidential energy consumers based upon individual electricity bills, POL annual energy consumption patterns, and prototypical building type usage patterns; Route 66 Casino electric usage was excluded from the study
- Residential and nonresidential annual hourly loads were combined to yield one composite load shape for each village and for the entire reservation

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Pueblo of Laguna

Load Forecast Summary

PUEBLO OF LAGUNA

2007 Rate Class Populations, Energy Usage, and Electric Demand

	Consumers	Avg. Annual Energy (kWh)	Projected Energy (kWh)	Demand kW	Avg. kW
Residential	1,294	6,230	8,063,459	2,112	1.6
Small Commercial	93	66,676	6,174,853	1,293	14.0
Medium Commercial	17	567,186	9,379,839	2,021	122.2
	1,403		23,618,151	5,426	
			Coincident Peak	4,845	

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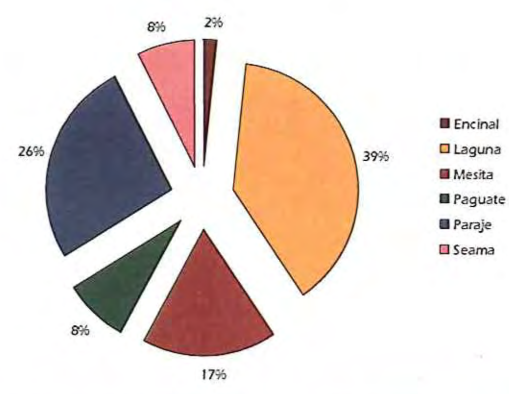
Pueblo of Laguna Villages
2007 Electric Loads

	Encinal	Laguna	Mesita	Paguate	Paraje	Seama	All Villages
Consumers							
Residential	61	429	247	192	211	155	1,294
Small Commercial	1	48	1	10	22	10	93
Medium Commercial	0	8	2	0	5	2	17
Total Consumers	62	485	250	202	238	167	1,403
percent of total	*4.4%*	*34.5%*	*17.8%*	*14.4%*	*17.0%*	*11.9%*	
Energy Requirements (kWh)							
Residential	380,347	2,634,849	1,549,074	1,203,288	1,320,831	975,069	8,063,459
Small Commercial	12,676	3,712,765	103,942	750,585	1,120,527	474,358	6,174,853
Medium Commercial		2,859,823	2,420,635		3,764,809	334,572	9,379,839
Total Energy	393,023	9,207,437	4,073,652	1,953,873	6,206,168	1,783,999	23,618,151
percent of total	*1.7%*	*39.0%*	*17.2%*	*8.3%*	*26.3%*	*7.6%*	
Demand (kW)							
Residential	99.6	690.2	405.8	315.2	346.0	255.4	2,112.2
Small Commercial	2.7	777.2	21.8	157.1	234.5	99.3	1,292.5
Medium Commercial		616.1	521.5		811.1	72.1	2,020.9
Peak Demand	102	2,083	949	472	1,392	427	5,426
Peak Coincident Demand	101	1,842	864	421	1,263	382	4,845
percent of total	*2.1%*	*38.0%*	*17.8%*	*8.7%*	*26.1%*	*7.9%*	

8

Pueblo of Laguna Villages
Energy Use

Pueblo of Laguna Village Energy Use

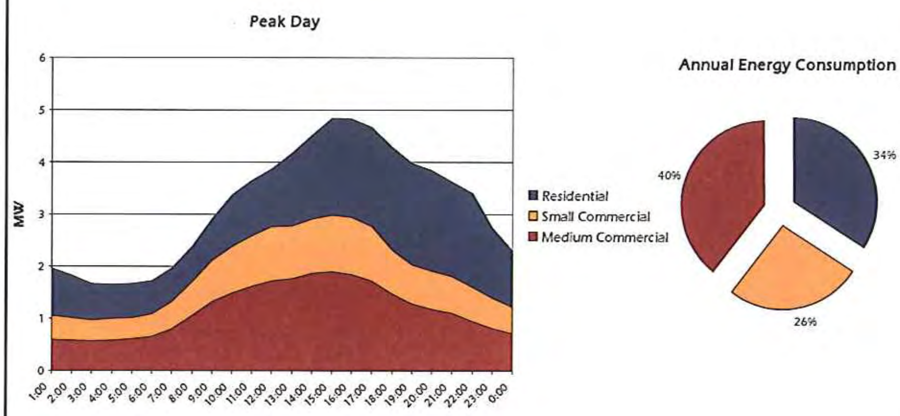


Approximately two-thirds of Pueblo of Laguna reservation energy use (65% percent) takes place within the Laguna and Paraje villages (study excludes Route 66 Casino)

9

Pueblo of Laguna

Electric Demand and Energy Consumption

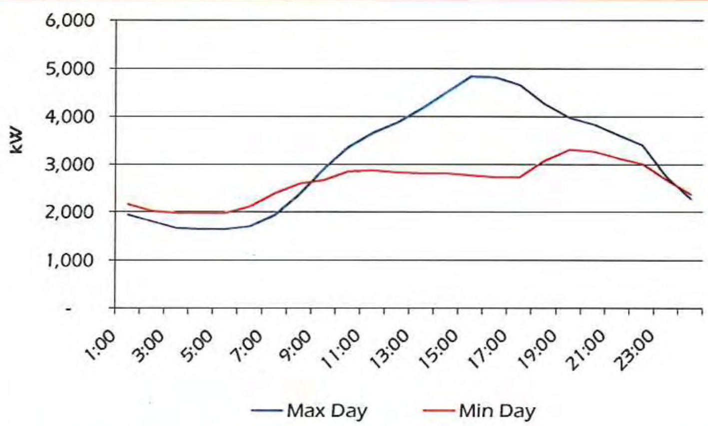


Peak day electric demand in Megawatts (MW) occurs on the first Tuesday in September; energy consumption is approximately two-thirds (66 percent) commercial use

10

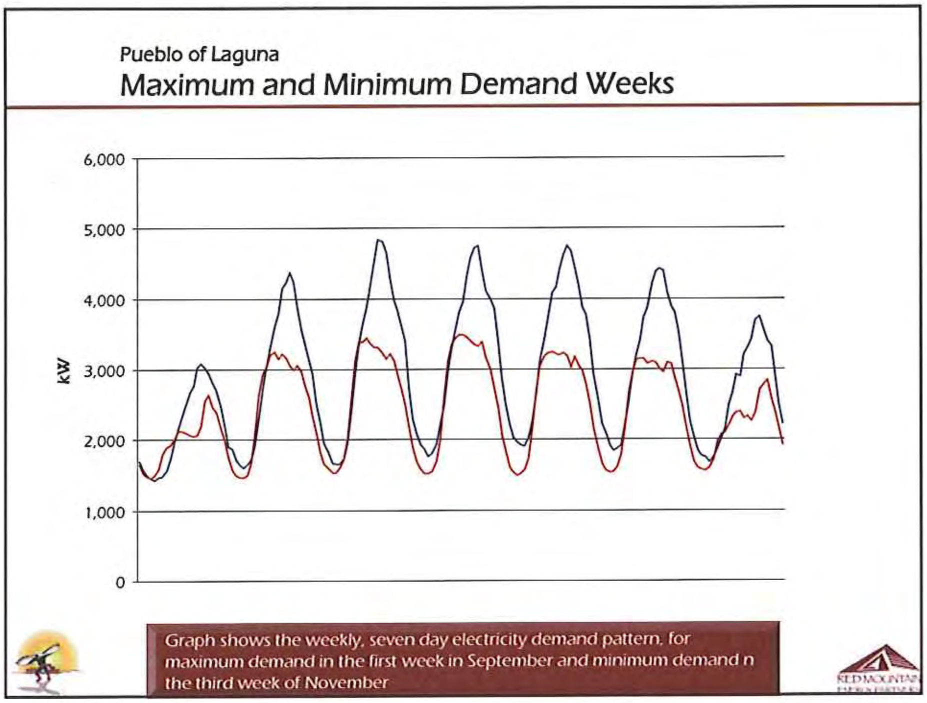
Pueblo of Laguna

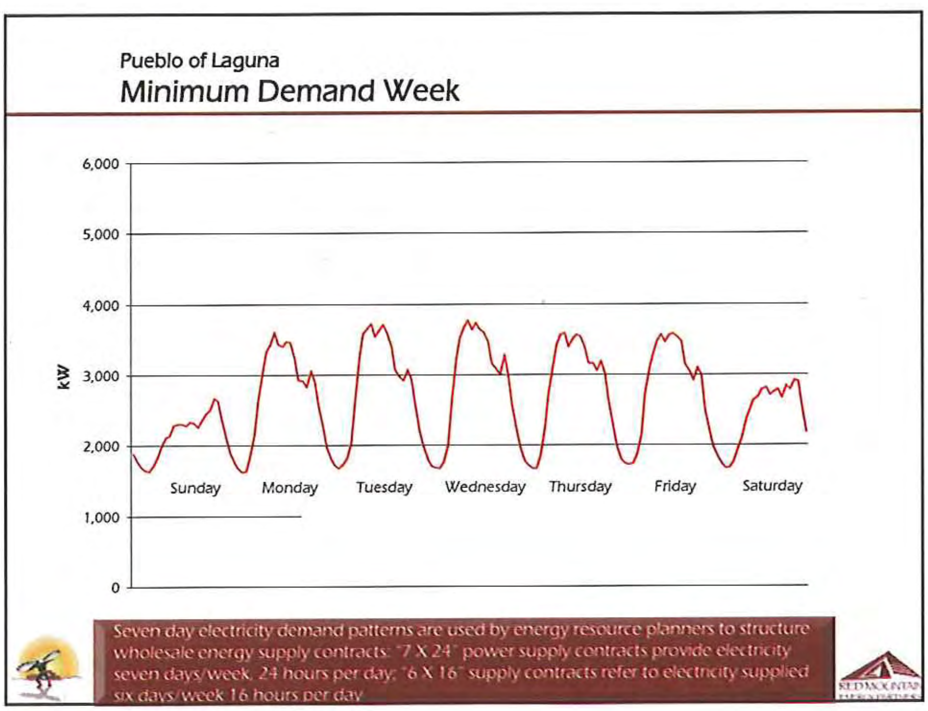
Annual Load Variation



Combined reservation electricity demand varies by time of day and seasonally; electric resource planning must accommodate this demand variability

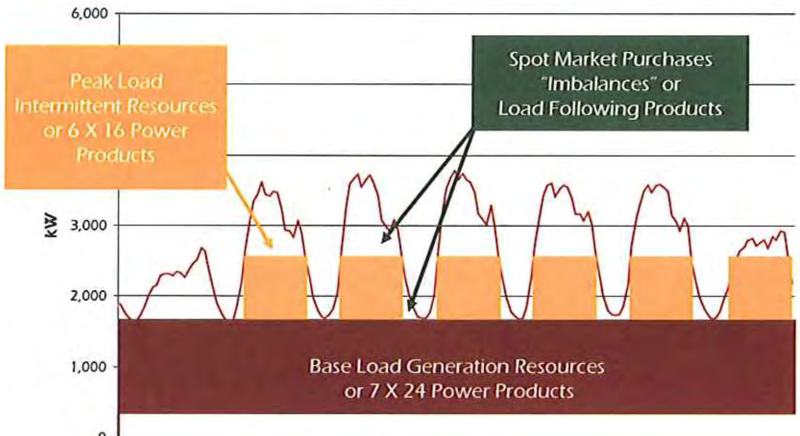
During peak demand, on the first Tuesday in September, electric loads vary 3,200 kW between 3:00 AM and 12:00 noon; lowest demand occurs on the third Monday in November


Pueblo of Laguna
Maximum and Minimum Demand Weeks
6,000
5,000
4,000
3,000
2,000
1,000
0
kW
Graph shows the weekly, seven day electricity demand pattern, for maximum demand in the first week in September and minimum demand n the third week of November


Pueblo of Laguna
Minimum Demand Week
6,000
5,000
4,000
3,000
2,000
1,000
0
kW
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Seven day electricity demand patterns are used by energy resource planners to structure wholesale energy supply contracts: "7 X 24" power supply contracts provide electricity seven days/week, 24 hours per day; "6 X 16" supply contracts refer to electricity supplied six days/week 16 hours per day

Pueblo of Laguna

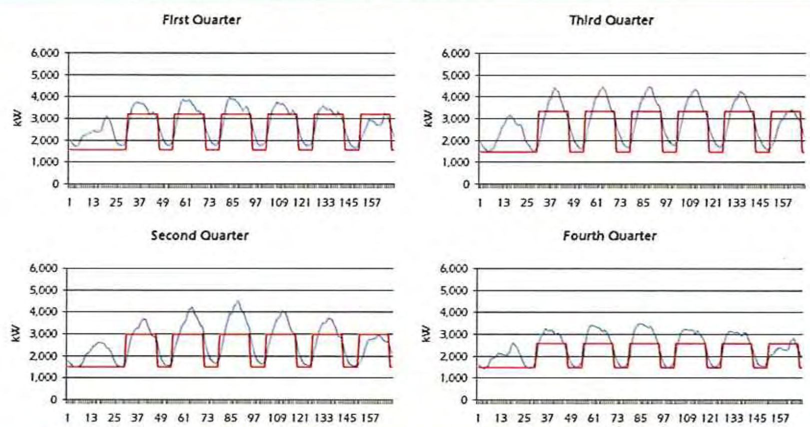
Minimum Demand Week



Energy may be acquired by means of wholesale power contracts or generation resources (power plants) best suited to provide energy as needed; seasonal and time-of-day demand patterns define supply requirements whether supplied by a power plant or contracts for a power plant's output

Pueblo of Laguna

Load Plots and Power Blocks



Total Energy	Spot Purchases
23,618,151	14.8%

On-Peak Energy	Spot Purchases
15,770,609	10.1%

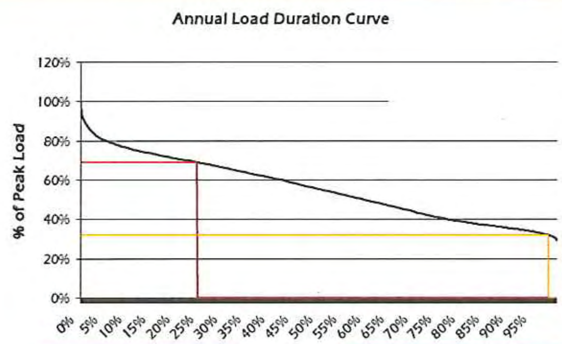
Quarter	7X24	6X16	Dumped kWh	Req. kWh	Qtr % kWh
1	1600	1600	180,465	6,072,495	2.97%
2	1500	1500	177,710	5,867,152	3.03%
3	1500	1850	386,443	6,024,284	6.41%
4	1500	1100	56,392	5,654,221	1.00%
			601,010	23,618,151	3.39%

	Energy Purchases (kWh)	
7X24	13,356,000	54.7%
6X16	7,457,600	30.5%
Spot On-Peak	1,599,218	6.5%
Spot Off-Peak	2,006,343	8.2%
Total	24,419,161	100.0%

Wholesale power contracts can be tailored to quarterly demand variations: planners try to limit spot market purchases to under 15% and dumped energy to approximately 2%

Pueblo of Laguna

Electric Load Characteristics



Capacity Requirement (MW)	
Peak	1.6
Intermediate	1.9
Base Load	1.6
Total	*5.0*

Energy (%)	
Peak Period	6.8
Intermediate Period	28.2
Base Load	57.0

Load duration curves are used to define amounts and types of power resources required; capacity shows size of required generation resource (contract or power plant), and energy shows relative reliance on each resource type (hours of supply)

Discussion Outline

1. Project Overview
2. Load Forecast Methodology
3. Laguna Summary Load Forecast Results
4. **Key Observations**
5. Appendix: Village Load Forecast Results

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Key Observations

When addressing Pueblo of Laguna total electric energy requirements:

- The majority of Pueblo of Laguna energy demand is associated with nonresidential activity (66%)
- Among Pueblo of Laguna villages, the villages of Laguna and Paraje comprise the majority of energy demand (65%)
- Peak demand is approximately 5 MW, however loads can vary as much as 3.2 MW in a single day
- Resources required to serve the total reservation electric demand:
  - 1.6 MW base load supply (7 X 24)
  - 1.9 MW intermediate (6 X 16)
  - 1.6 MW Load following (spot market purchases)
- 57% of all energy consumed can be provided by constant duty cycle base load (7 X 24) generation resources
- 28% of all energy consumed can be provided by intermediate resources (including solar and wind power generation)
- Remaining energy can be procured on the spot market without exceeding 15% (appropriately avoiding market uncertainties)

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Further Information

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Discussion Outline

1. Project Overview
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3. Laguna Summary Load Forecast Results
4. Key Observations
5. Appendix: Village Load Forecast Results

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Encinal

Load Forecast Summary

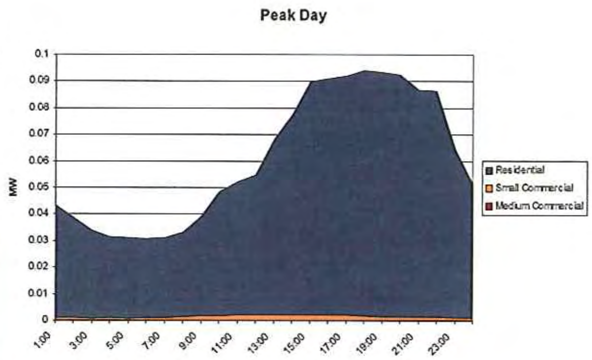
2007 Rate Class Populations, Energy Usage, and Electric Demand

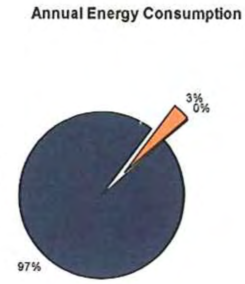
		Accts	Avg. Annual Energy (kWh)	Projected Energy (kWh)	Demand kW	Avg. kW
RESIDENTIAL		69	5,476	380,347	100	1.4
SMALL COMMERCIAL		1	9,034	12,676	3	1.9
MEDIUM COMMERCIAL		0	0	0		0.0
	Total	71		393,023	102	
				Coincident Peak	101	

21

Encinal

Electric Demand and Energy Consumption





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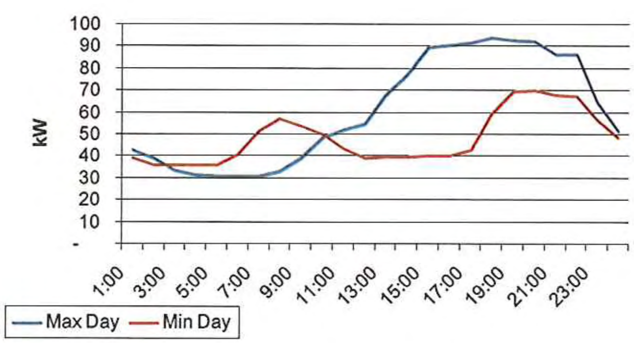
Encinal

Annual Load Variation



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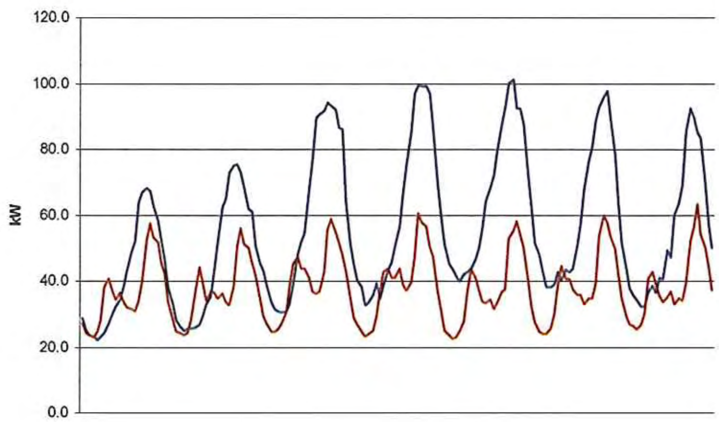
Encinal
Maximum and Minimum Demand Weeks



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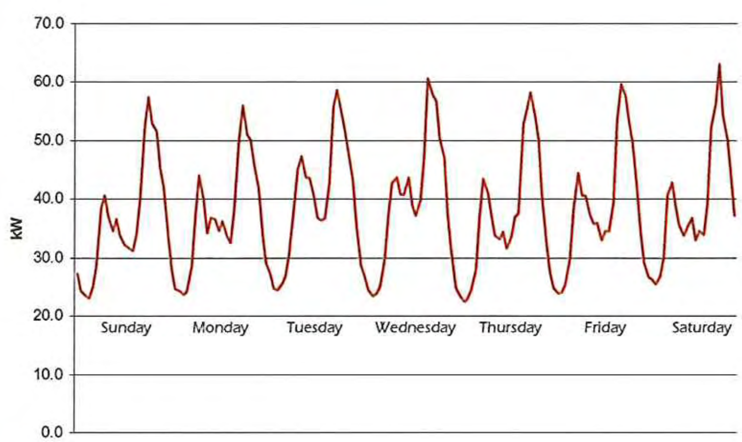
Minimum Demand Week



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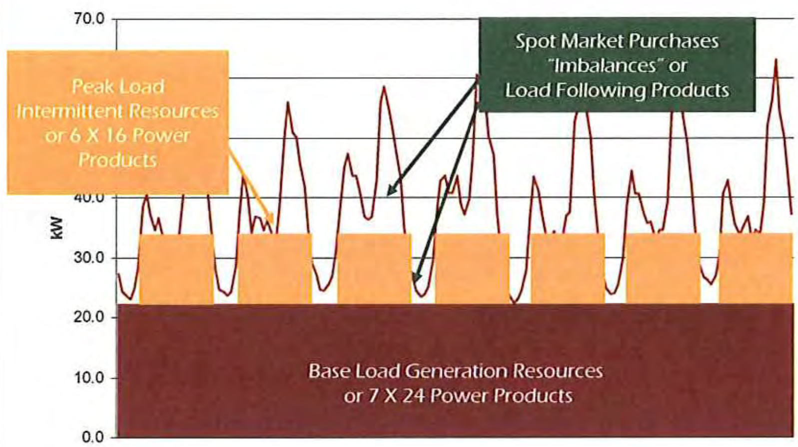
Encinal
Minimum Demand Week



26

Laguna
Load Forecast Summary

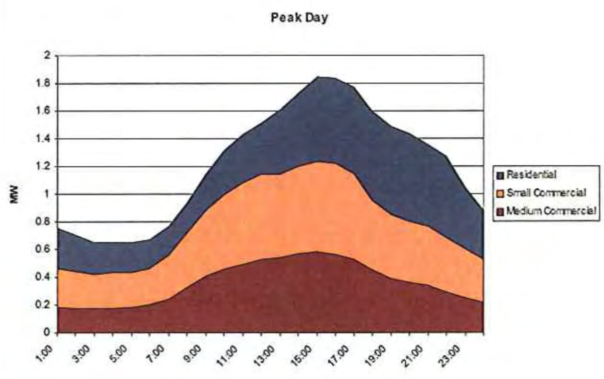
2007 Rate Class Populations, Energy Usage, and Electric Demand

	Accts	Avg. Annual Energy (kWh)	Projected Energy (kWh)	Demand kW	Avg. kW
RESIDENTIAL	429	6,144	2,634,849	690	1.6
SMALL COMMERCIAL	48	77,822	3,712,765	777	16.3
MEDIUM COMMERCIAL	8	345,859	2,859,823	616	74.5
Total	485		9,207,437	2,083	
			Coincident Peak	1,842	

27

Laguna

Electric Demand and Energy Consumption



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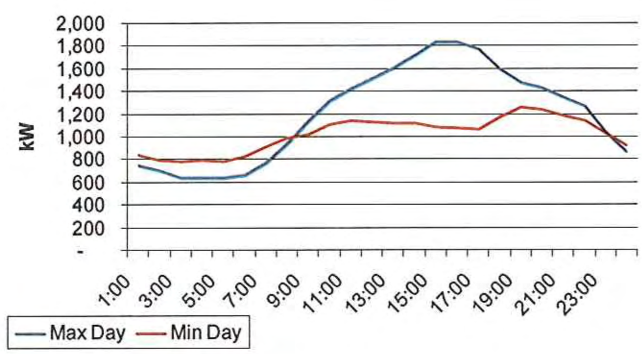
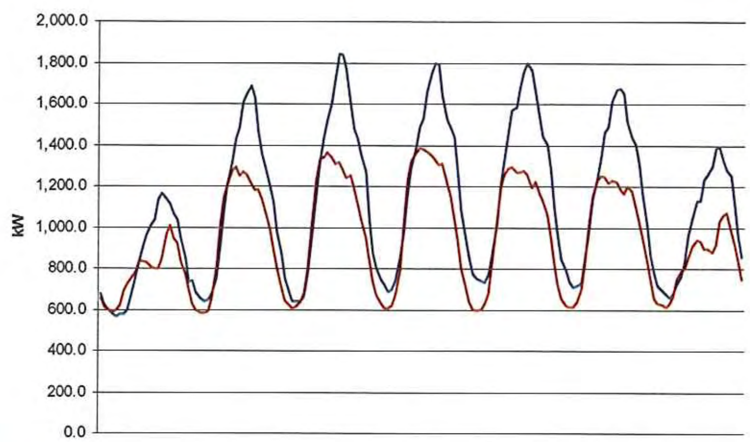
Laguna

Annual Load Variation



Laguna

Maximum and Minimum Demand Weeks



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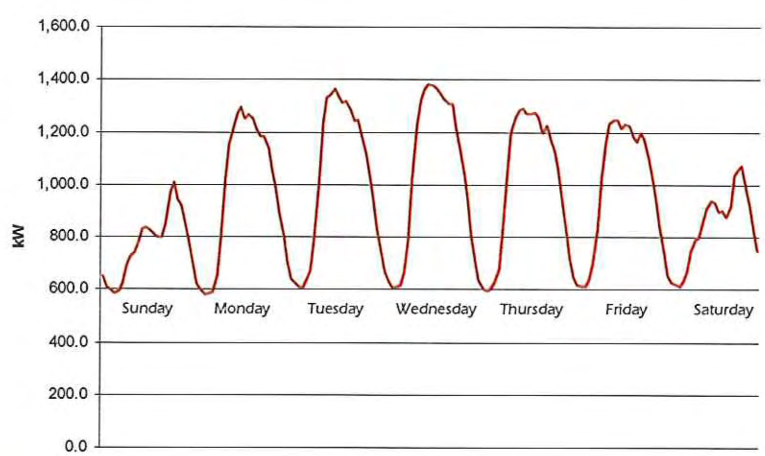
Laguna

Minimum Demand Week



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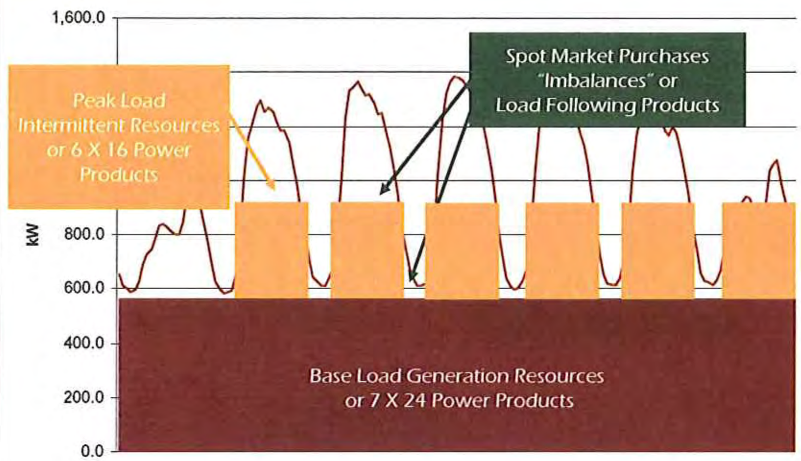
Laguna
Minimum Demand Week



32

Mesita
Load Forecast Summary

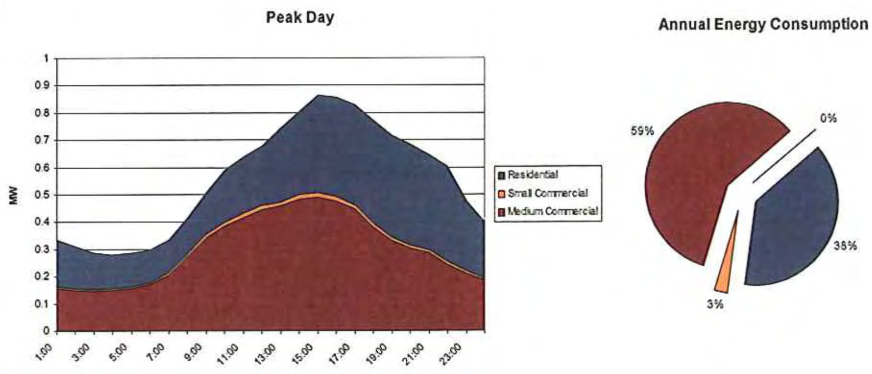
2007 Rate Class Populations, Energy Usage, and Electric Demand

	Accts	Avg. Annual Energy (kWh)	Projected Energy (kWh)	Demand kW	Avg. kW
RESIDENTIAL	256	6,056	1,549,074	406	1.6
SMALL COMMERCIAL	1	74,076	103,942	22	15.5
MEDIUM COMMERCIAL	2	1,463,725	2,420,635	522	315.4
Total	259		4,073,652	949	
			Coincident Peak	864	

33

Mesita

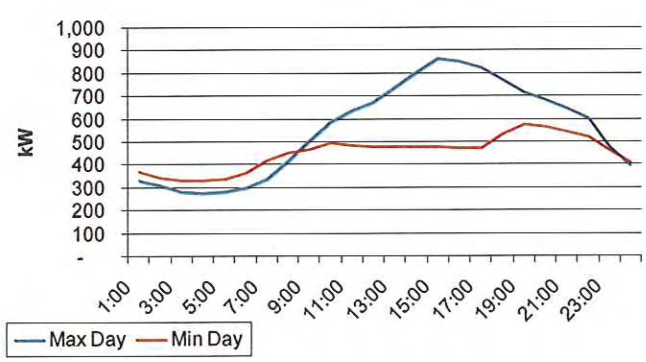
Electric Demand and Energy Consumption

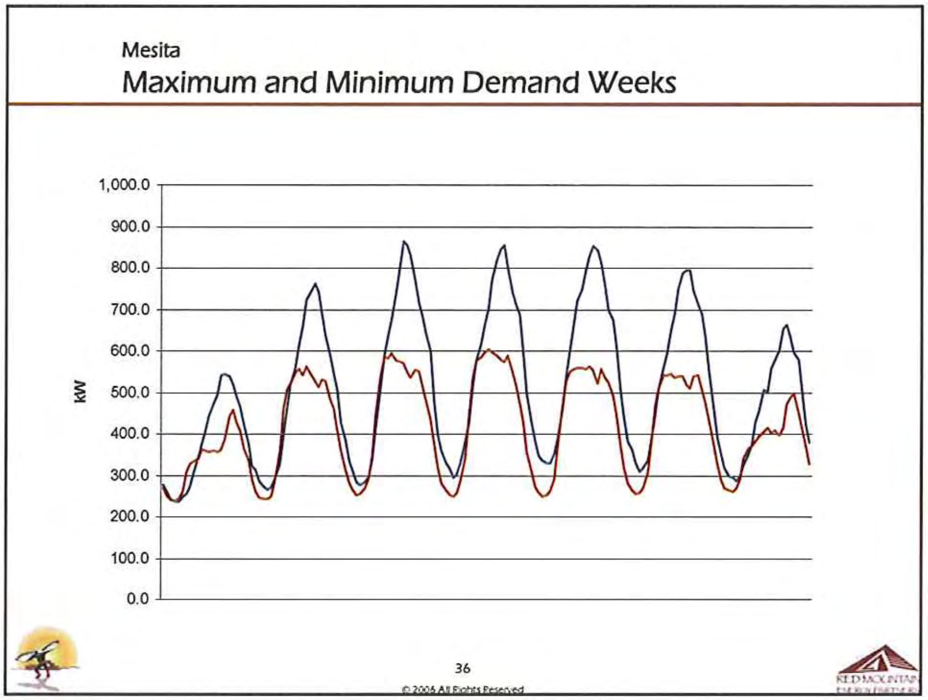


34

Mesita

Annual Load Variation




Mesita
Maximum and Minimum Demand Weeks
1,000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
kW
36
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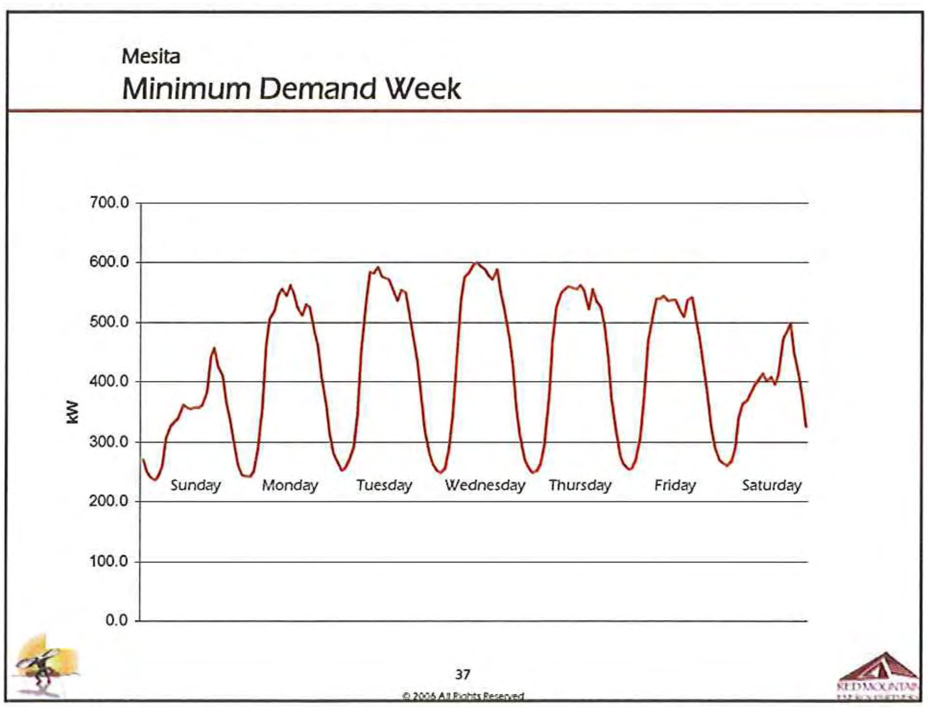
Mesita
Minimum Demand Week
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
kW
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
37
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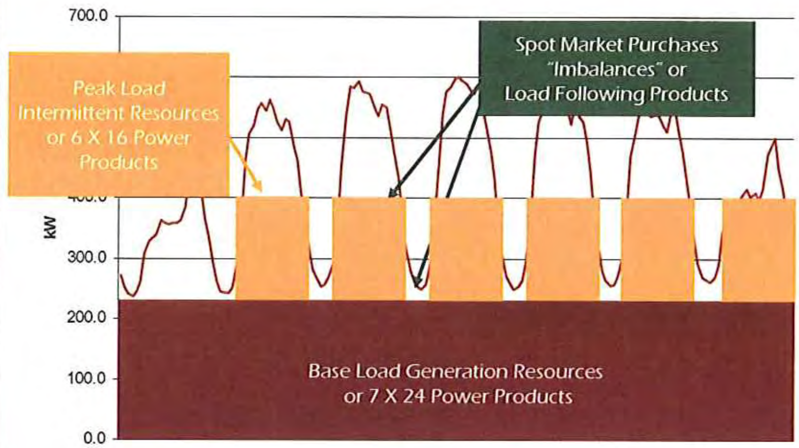
Mesita

Minimum Demand Week



38

Paguate

Load Forecast Summary

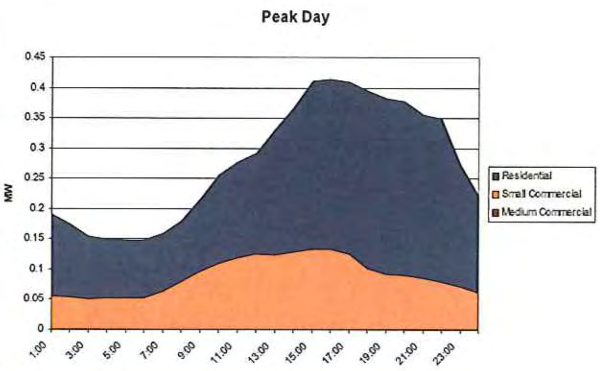
2007 Rate Class Populations, Energy Usage, and Electric Demand

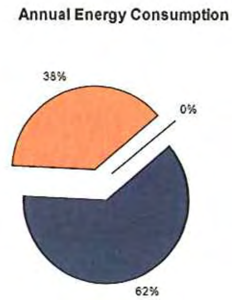
	Accts	Avg. Annual Energy (kWh)	Projected Energy (kWh)	Demand kW	Avg. kW
RESIDENTIAL	201	5,997	1,203,288	315	1.6
SMALL COMMERCIAL	10	76,417	750,585	157	16.0
MEDIUM COMMERCIAL	0	0	0		0.0
Total	210		1,953,873	472	
			Coincident Peak	421	

39

Paguate

Electric Demand and Energy Consumption

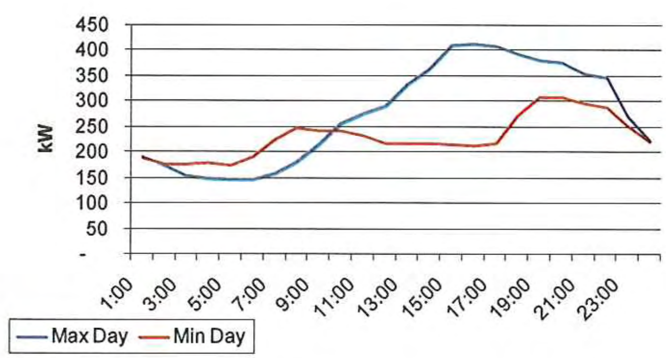




40

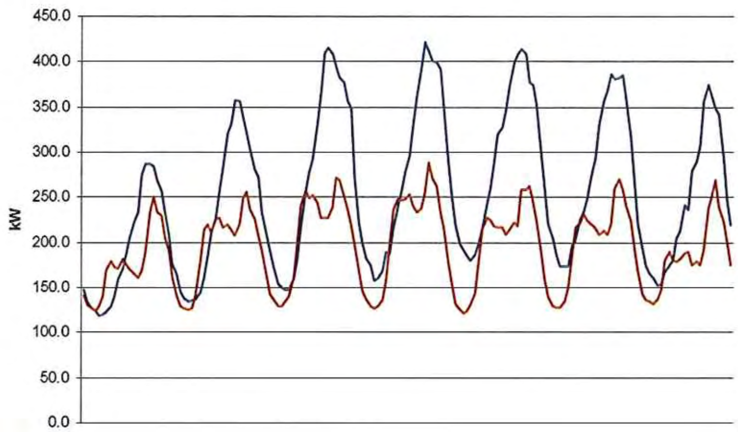
Paguate

Annual Load Variation



Paguate

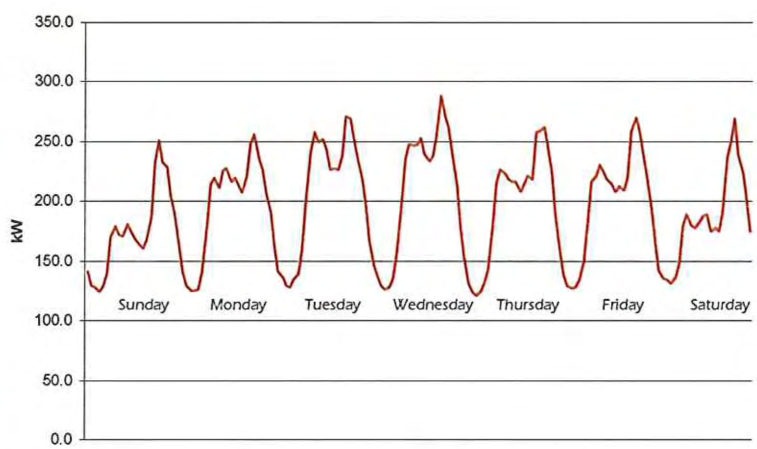
Maximum and Minimum Demand Weeks



42

Paguate

Minimum Demand Week



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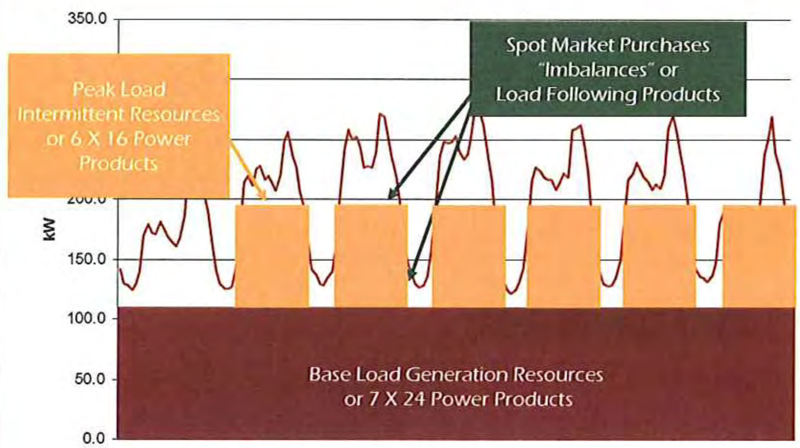
Paguate
Minimum Demand Week



44

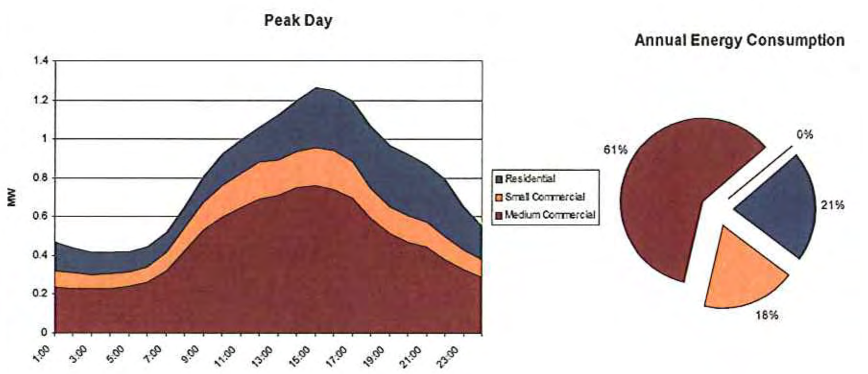
Paraje
Load Forecast Summary

2007 Rate Class Populations, Energy Usage, and Electric Demand

	Accts	Avg. Annual Energy (kWh)	Projected Energy (kWh)	Demand kW	Avg. kW
RESIDENTIAL	219	6,020	1,320,831	346	1.6
SMALL COMMERCIAL	22	49,910	1,120,527	235	10.4
MEDIUM COMMERCIAL	5	758,843	3,764,809	811	163.5
Total	247		6,206,168	1,392	
			Coincident Peak	1,263	

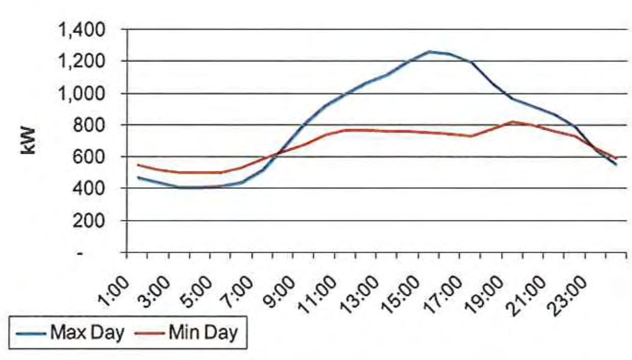
45

Paraje
Electric Demand and Energy Consumption



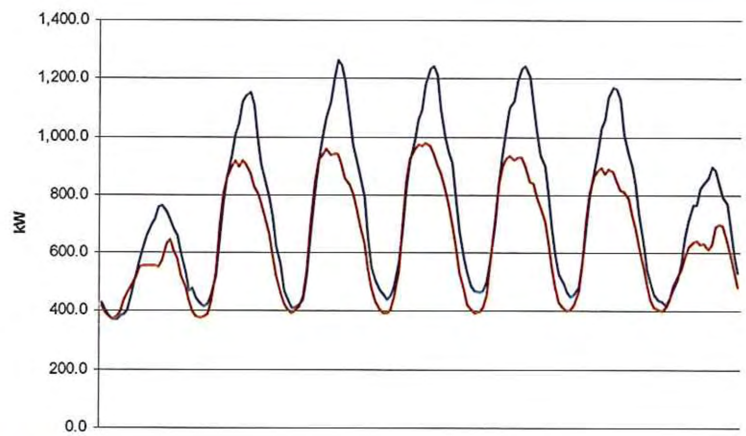
46

Paraje
Annual Load Variation



Paraje

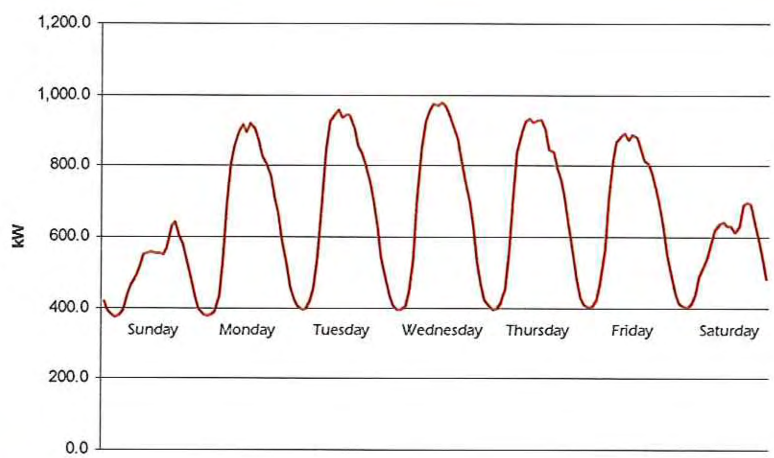
Maximum and Minimum Demand Weeks



48

Paraje

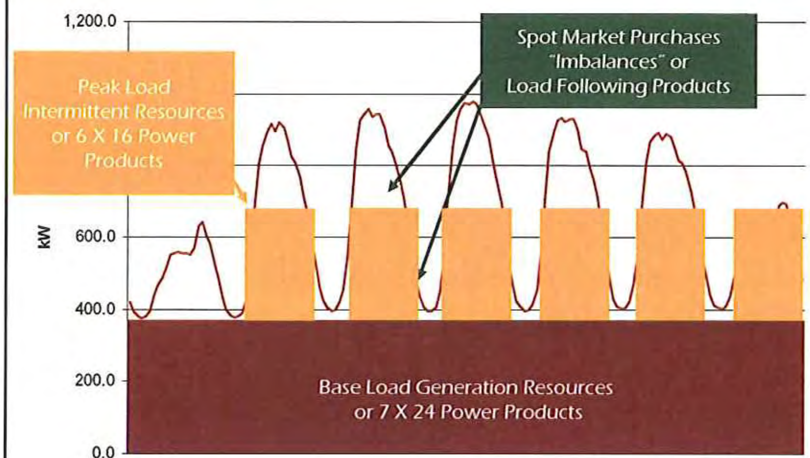
Minimum Demand Week



49

Paraje

Minimum Demand Week



50

Seama

Load Forecast Summary

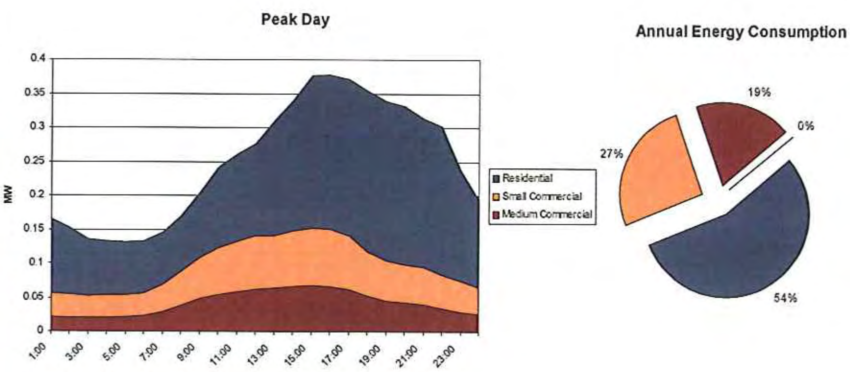
2007 Rate Class Populations, Energy Usage, and Electric Demand

	Accts	Avg. Annual Energy (kWh)	Projected Energy (kWh)	Demand kW	Avg. kW
RESIDENTIAL	164	5,936	975,069	255	1.6
SMALL COMMERCIAL	10	48,294	474,358	99	10.1
MEDIUM COMMERCIAL	2	202,311	334,572	72	43.6
Total	176		1,783,999	427	
			Coincident Peak	382	

51

Seama

Electric Demand and Energy Consumption



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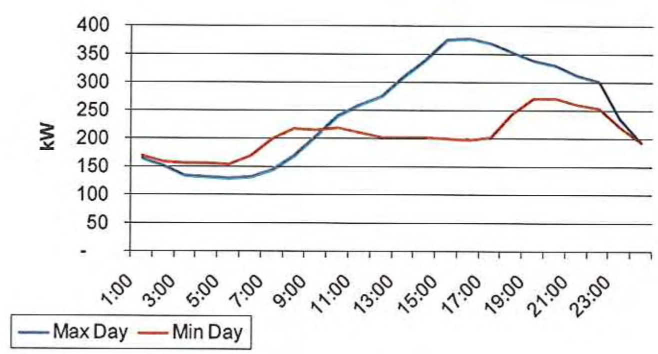
Seama

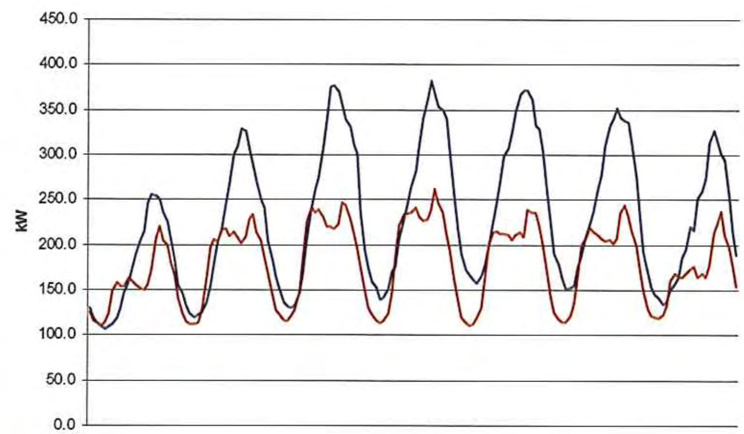
Annual Load Variation



53

Seama

Maximum and Minimum Demand Weeks



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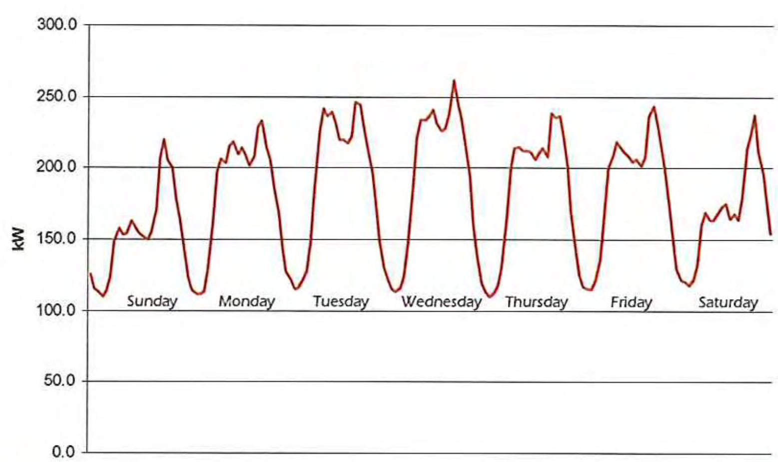
Seama

Minimum Demand Week



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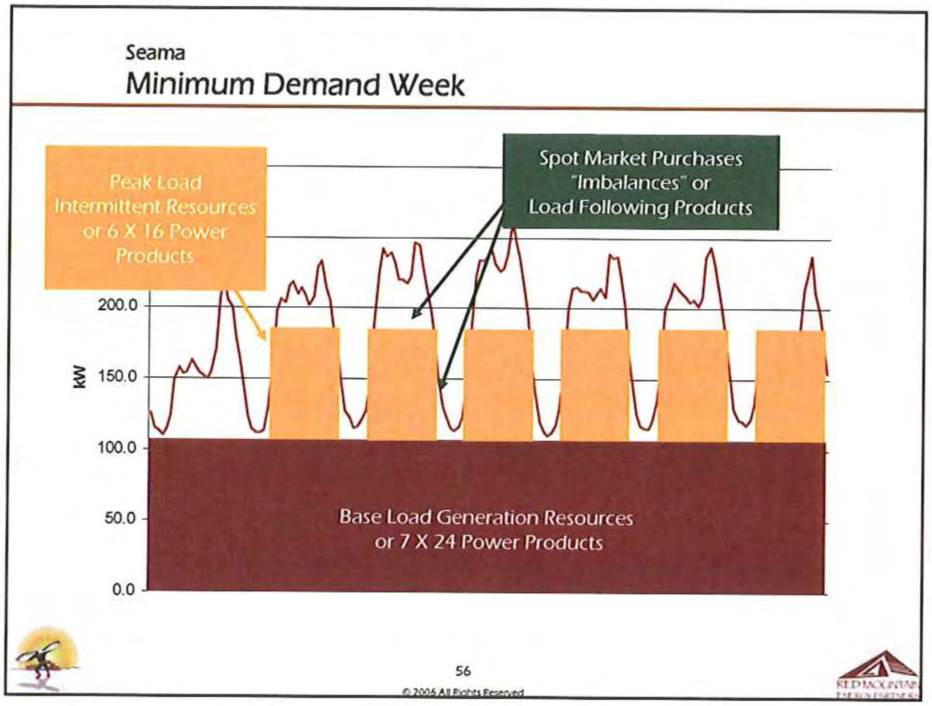
Seama
Minimum Demand Week
Peak Load
Intermittent Resources
or 6 X 16 Power
Products
Spot Market Purchases
"Imbalances" or
Load Following Products
200.0
150.0
100.0
50.0
0.0
kW
Base Load Generation Resources
or 7 X 24 Power Products
56

RED MOUNTAIN
ENERGY PARTNERS

Pueblo of Laguna
Renewable Energy Feasibility Study

Potential Project Options

June 2006

Discussion Outline

1. Project Background
2. Electric Needs Indications for Power Generation
3. Possible Project Options
4. Wind Generation Options
5. Solar Generation Options
6. Natural Gas Generation Options
7. Summary of Community Input
8. Recommended Project Locations

Pueblo of Laguna Renewable Energy Feasibility Study

Project Phases

Capacity Building

Community Education/Outreach and Review

Resource Monitoring → Fatal Flaw Analysis → Potential Project Economics → Project Decision Support → Development Plan

Project Identification is the final component of the Resource Monitoring Phase

2

RED MOUNTAIN

Discussion Outline

1. Project Background
2. Electric Needs Indications for Power Generation
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3

RED MOUNTAIN

Pueblo of Laguna
Load Forecast Summary

PUEBLO OF LAGUNA

2007 Rate Class Populations, Energy Usage, and Electric Demand

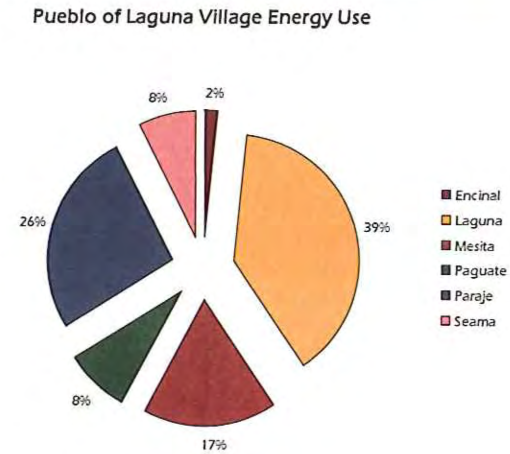
	Consumers	Avg. Annual Energy (kWh)	Projected Energy (kWh)	Demand kW	Avg. kW
Residential	1,294	6,230	8,063,459	2,112	1.6
Small Commercial	93	66,676	6,174,853	1,293	14.0
Medium Commercial	17	567,186	9,379,839	2,021	122.2
	1,403		23,618,151	5,426	
			Coincident Peak	4,845	

Pueblo of Laguna Villages
2007 Electric Loads

	Encinal	Laguna	Mesita	Paguate	Paraje	Seama	All Villages
Consumers							
Residential	61	429	247	192	211	155	1,294
Small Commercial	1	48	1	10	22	10	93
Medium Commercial	0	8	2	0	5	2	17
Total Consumers	62	485	250	202	238	167	1,403
percent of total	*4.4%*	*34.5%*	*17.8%*	*14.4%*	*17.0%*	*11.9%*	
Energy Requirements (kWh)							
Residential	380,347	2,634,849	1,549,074	1,203,288	1,320,831	975,069	8,063,459
Small Commercial	12,676	3,712,765	103,942	750,585	1,120,527	474,358	6,174,853
Medium Commercial		2,859,823	2,420,635		3,764,809	334,572	9,379,839
Total Energy	393,023	9,207,437	4,073,652	1,953,873	6,206,168	1,783,999	23,618,151
percent of total	*1.7%*	*39.0%*	*17.2%*	*8.3%*	*26.3%*	*7.6%*	
Demand (kW)							
Residential	99.6	690.2	405.8	315.2	346.0	255.4	2,112.2
Small Commercial	2.7	777.2	21.8	157.1	234.5	99.3	1,292.5
Medium Commercial		616.1	521.5		811.1	72.1	2,020.9
Peak Demand	102	2,083	949	472	1,392	427	5,426
Peak Coincident Demand	101	1,842	864	421	1,263	382	4,845
percent of total	*2.1%*	*38.0%*	*17.8%*	*8.7%*	*26.1%*	*7.9%*	

Pueblo of Laguna Villages

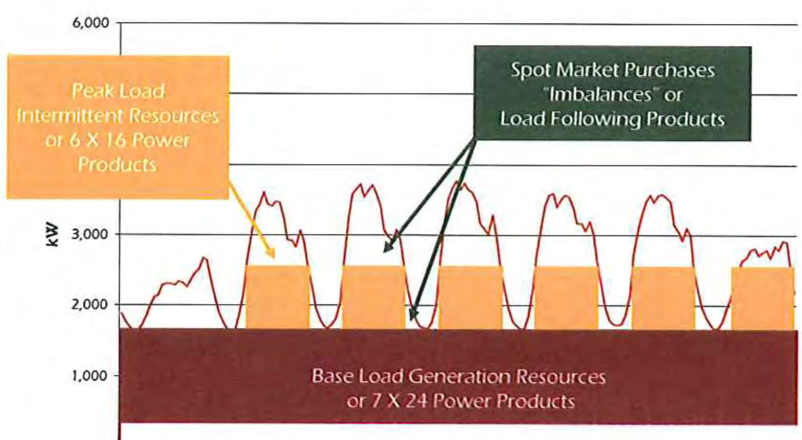
Energy Use



Approximately two-thirds of Pueblo of Laguna reservation energy use (65% percent) takes place within the Laguna and Paraje villages (study excludes Route 66 Casino)

Pueblo of Laguna

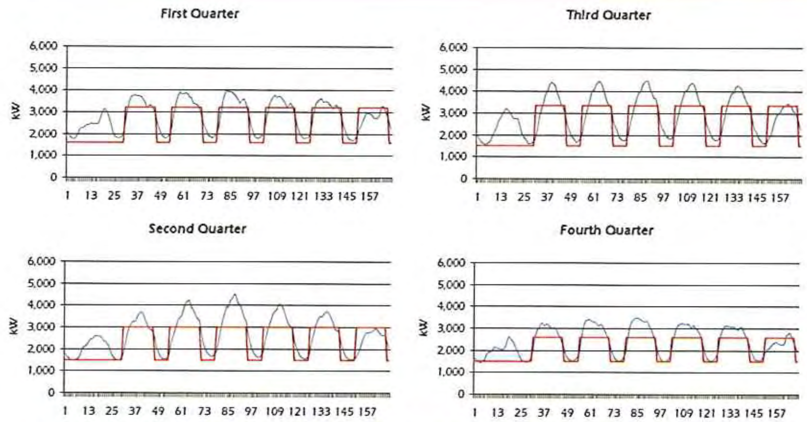
Minimum Demand Week



Energy may be acquired by means of wholesale power contracts or generation resources (power plants) best suited to provide energy as needed; seasonal and time-of-day demand patterns define supply requirements whether supplied by a power plant or contracts for a power plant's output

Pueblo of Laguna

Load Plots and Power Blocks



Total Energy	Spot Purchases
23,618,151	14.8%

On-Peak Energy	Spot Purchases
15,770,609	10.1%

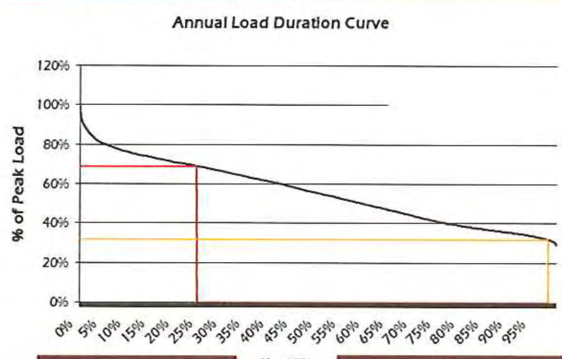
Quarter	7X24	6X16	Dumped kWh	Req. kWh	Qtr % kWh
1	1600	1600	180,465	6,072,495	2.97%
2	1500	1500	177,710	5,867,152	3.03%
3	1500	1850	386,443	6,024,284	6.41%
4	1500	1100	56,392	5,654,221	1.00%
			801,010	23,618,151	3.39%

Energy Purchases (kWh)		
7X24	13,356,000	54.7%
6X16	7,457,600	30.5%
Spot On-Peak	1,599,218	6.5%
Spot Off-Peak	2,006,343	8.2%
Total	24,419,161	100.0%

Wholesale power contracts can be tailored to quarterly demand variations; planners try to limit spot market purchases to under 15% and dumped energy to approximately 2%

Pueblo of Laguna

Electric Load Characteristics



Capacity Requirement (MW)	
Peak	1.6
Intermediate	1.9
Base Load	1.6
Total	*5.0*

Energy (%)	
Peak Period	6.8
Intermediate Period	28.2
Base Load	57.0

Load duration curves are used to define amounts and types of power resources required; capacity shows size of required generation resource (contract or power plant), and energy shows relative reliance on each resource type (hours of supply)

Key Observations

When addressing Pueblo of Laguna total electric energy requirements:

- The majority of Pueblo of Laguna energy demand is associated with nonresidential activity (66%)
- Among Pueblo of Laguna villages, the villages of Laguna and Paraje comprise the majority of energy demand (65%)
- Peak demand is approximately 5 MW, however loads can vary as much as 3.2 MW in a single day
- Resources required to serve the total reservation electric demand:
  - 1.6 MW base load supply (7 X 24)
  - 1.9 MW intermediate (6 X 16)
  - 1.6 MW Load following (spot market purchases)
- 57% of all energy consumed can be provided by constant duty cycle base load (7 X 24) generation resources
- 28% of all energy consumed can be provided by intermediate resources (including solar and wind power generation)
- Remaining energy can be procured on the spot market without exceeding 15% (appropriately avoiding market uncertainties)

Discussion Outline

Possible Project Option Considerations

- Project should generate adequate power to meet a portion or all of specific electric needs
  - Reservation
  - Village
  - Entity
- Customers generally assumed to have continued connection to the grid
  - Projects were not intended to meet 100% of needs
- Laguna renewable projects considered do not generate firm power
  - Solar
  - Wind
- Purpose of gas-generation would be to firm a renewable resource

Possible Project Summary

Type of Generation	Annual Demand KW	Annual Usage (Million kWh)	Wind	Solar	Biomass	Geothermal	Natural Gas	Hybrid: RE/Natural Gas
Laguna Reservation-Scale+ Generation	5,426	23.6	X	X			X	X
Laguna Village-Scale Generation	2,083	9.2	X	X		X	X	X
Mesita Village-Scale Generation	949	4.1	X	X		X	X	X
Encinal Village-Scale Generation	102	.4	X	X		X	X	X
Seama Village-Scale Generation	427	1.8	X	X		X	X	X
Paguate Village-Scale Generation	472	1.9	X	X		X	X	X
Paraje Village-Scale Generation	1,392	6.2	X	X		X	X	X
Facility-Scale Generation	Varies	Varies	X	X	X	X	X	X

Wind Generation Comparison

Type of Installation	Typical Power Required for Laguna Sites (kW)	Physical Size	Typical Turbine Sizes Required	Land Required (Footprint)	Cost ($ per Turbine)	Performance (kWh/yr per turbine)
Residential or Remote (e.g. – telecom site, pumping station, etc.)	10 kW	Blade (rotor) diameter of 20-25 ft.; tower height of 80 - 100 ft.	One 10 kW unit	1 acre	$28,000 to $35,000	10,000 to 18,000
Facility-Scale Wind	10 kW – 400 kW	Blade (rotor) diameter of 20-100 ft.; tower height of 80 - 175 ft.	One 10 kW unit up to two 250 kW units	1 – 10 acres per turbine	$28,000 to $500,000	10,000 to 750,000
Intermediate – Village power, distributed, or hybrid power	100 kW – 1.5 MW	Blade (rotor) diameter of 70-230 ft.; tower height of 115 - 280 ft.	One 100 kW unit up to one 1.5 MW unit	5 – 100 acres per turbine	$250,000 to $2M	150,000 to 5 million
Reservation-Scale Wind Farm	5 - 10 MW	Blade (rotor) diameter of 230 ft.; tower height of 280 ft.	Several 1.5 MW units	~100 acres per turbine	~$2M	3 to 5 million
Power Export to Grid	60 MW	Blade (rotor) diameter of 230 ft.; tower height of 280 ft.	30 – 40 1.5 MW or 2.0 MW units	100 - 125 acres per turbine	$2M to $2.6M	3 to 5 million

Wind Generation Benefits & Trade-Offs

- Environmental, cultural, economic benefits
  - Low operating costs
  - No fuel supply/cost risks
  - No cooling water required
  - No wastes, no emissions
- Trade-Offs
  - High capital costs
  - Non-dispatchable

Solar Generation Comparison

Type of Installation	Typical Power Required for Laguna Sites	Physical Size	Typical Technologies Applicable	Land Required (Footprint)	Cost w/o BOS[1] ($ per kW)	Performance (kWh/yr per 1 kW installed)
Residential or Remote (e.g. – telecom site, pumping station, etc.)	1 - 5 kW	Arrays ranging from 8' x 24' to 16' x 20' (typical for fixed flat plat)	Fixed or tilted roof-mounted flat plate PV arrays, ground-mounted tracking PV arrays	Array dimensions for fixed flat plate; 1.5 – 2 times spacing for tilted arrays. Addition spacing required for ground-mounted tracking	$5,000 to $6,000	1.25 million to 1.5 million
Facility-Scale Solar	10 kW – 400 kW	Arrays ranging from 24' x 60' for flat plate up to 45' x 55' per 25kW module for tracking [2] concentrator systems	Fixed or tilted roof-mounted flat plate PV arrays, ground-mounted tracking PV arrays, tracking concentrator systems	Roughly 40' x 48' for fixed flat plate up to 4 acres for ground-mounted tracking concentrator systems	$5,000 to $6,000	1.25 million to 2 million

1. "BOS", Balance of System refers to all other required system components in addition to PV modules, such as inverters, mounting assemblies, and electrical wiring and connection equipment. Installation cost is not included.
2. Tracking in a north-south, one-axis configuration gives roughly 21% to 27% more annual energy output when compared to a fixed array, at near latitude tilt, and two-axis tracking improves the annual output energy by 37% to 43% compared to a fixed array (source: APS).

Solar Generation Comparison

Type of Installation	Typical Power Required for Laguna Sites	Physical Size	Typical Technologies Applicable	Land Required (Footprint)	Cost w/o BOS[1] ($ per kW)	Performance (kWh/yr per 1 kW installed)
Intermediate – Village power, distributed, or hybrid power	100 kW – 1.5 MW	Arrays ranging from 24' x 60' for flat plate up to 45' x 55' per 25kW module for tracking [2] concentrator systems	Fixed or tilted roof-mounted flat plate PV arrays, ground-mounted tracking PV arrays, tracking concentrator systems	Roughly 40' x 48' for fixed flat plate up to 4 acres for ground-mounted tracking concentrator systems	$5,000 to $6,000	1.25 million to 2 million
Reservation-Scale Wind Farm	5 - 10 MW	Arrays of 45' x 55' per 25kW module for tracking concentrators, up to 1-1/2 to 2 acres per MW for trough solar field	Tracking concentrator systems, dish-engines, parabolic trough	Roughly 20 – 30 acres	$4,000 to $6,000	2 million to 2.5 million
Power Export to Grid	60 MW	Arrays of 45' x 55' per 25kW module for tracking concentrators, up to 1-1/2 to 2 acres per MW for trough solar field	Tracking concentrator systems, dish-engines, parabolic trough	Roughly 90 – 120 acres	$4,000 to $6,000	2 million to 2.5 million

1. "BOS", Balance of System refers to all other required system components in addition to PV modules, such as inverters, mounting assemblies, and electrical wiring and connection equipment. Installation cost is not included.

Solar Generation Benefits & Trade-Offs

- Environmental, cultural, economic benefits
  - Low operating costs
  - No fuel supply/cost risks
  - No cooling water required
  - No wastes, no emissions
  - Good load following characteristics
- Trade-Offs
  - High capital costs
  - Non-dispatchable

Gas-Fired Generation Comparison

Type of Installation	Typical Power Required for Laguna Sites (KW)	Project Size	Type	Cost ($ per kW)	Efficiency
Residential or Remote (e.g. – telecom site, pumping station, etc.)	10 kW	5 kW – 10 MW	Reciprocating Engine	$300 - 900	25–40%
Facility-Scale	10 kW – 400 kW	25-500 kW 5 kW – 10 MW	Microturbine Reciprocating Engine	$700-1100 $300 - 900	20-30%; w/CHP up to 85% 25–40%
Intermediate – Village power, distributed, or hybrid power	100 kW – 1.5 MW	500 kW – 25 MW	Combustion Turbine	$300-1000	20-45%
Reservation-Scale Gas Generation	5 - 10 MW	500 kW – 25 MW	Combustion Turbine	$300-1000	20-45%
Power Export to Grid	60 MW	500 kW – 25 MW	Combustion Turbine	$300-1000	20-45%

Gas-Fired Generation Benefits & Trade-Offs

Microturbines

- Environmental, cultural, economic benefits
  - Small number of moving parts
  - Low emissions
  - Long maintenance intervals
  - Compact
  - Dispatchable
  - Can utilize waste fuels
  - Good efficiencies w/cogeneration
- Trade-offs
  - Low fuel to electric efficiencies
  - Loss of power output/efficiency with higher ambient temperatures

Reciprocating Engines

- Environmental, cultural, economic benefits
  - Low capital costs
  - Good efficiencies
  - Quick startup
  - Fuel flexibility
  - High reliability
  - Low natural gas pressure required
- Trade-offs
  - Emissions
  - Noisy
  - Frequent maintenance intervals

Gas-Fired Generation Benefits & Trade-Offs

Combustion Turbines

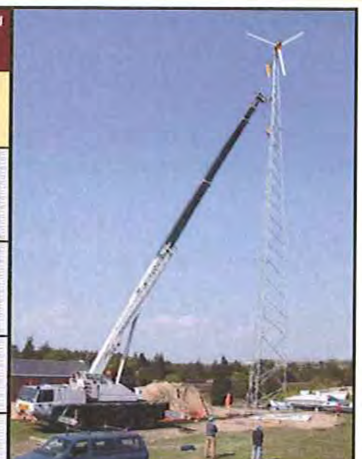
- Environmental, cultural, economic benefits
  - High efficiency, low cost
  - Wide range of power outputs
  - Can produce high temperature steam
  - Well-established channels
  - High power to weight ratio
  - Proven reliability/availability
- Trade-offs
  - Reduced efficiencies at part load
  - Sensitive to ambient conditions
  - Cost/efficiency not as good in small systems

Discussion Outline

1. Project Background
2. Electric Needs Indications for Power Generation
3. Possible Project Options
4. **Wind Generation Options**
5. Solar Generation Options
6. Natural Gas Generation Options
7. Summary of Community Input
8. Recommended Project Locations

Wind Generation: Visual and Physical Characteristics

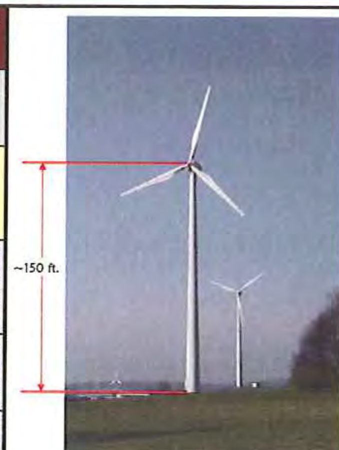
Type of Installation	Physical Size	Typical Turbine Sizes Required	Land Required (Footprint)
Residential or Remote (e.g. – telecom site, pumping station, etc.)	Blade (rotor) diameter of 20-25 ft.; tower height of 80 - 100 ft.	One 10 kW unit	1 acre
Facility-Scale Wind	Blade (rotor) diameter of 20-100 ft.; tower height of 80 - 175 ft.	One 10 kW unit up to two 250 kW units	1 – 10 acres per turbine
Intermediate – Village power, distributed, or hybrid power	Blade (rotor) diameter of 70-230 ft.; tower height of 115 - 280 ft.	One 100 kW unit up to one 1.5 MW unit	5 – 100 acres per turbine
Reservation-Scale Wind Farm	Blade (rotor) diameter of 230 ft.; tower height of 280 ft.	Several 1.5 MW units	~100 acres per turbine
Power Export to Grid	Blade (rotor) diameter of 230 ft.; tower height of 280 ft.	30 – 40 1.5 MW or 2.0 MW units	100 - 125 acres per turbine



Bergey 10 kW BWC Excel Model

Wind Generation: Visual and Physical Characteristics

Type of Installation	Physical Size	Typical Turbine Sizes Required	Land Required (Footprint)
Residential or Remote (e.g. – telecom site, pumping station, etc.)	Blade (rotor) diameter of 20-25 ft.; tower height of 80 - 100 ft.	One 10 kW unit	1 acre
Facility-Scale Wind	**Blade (rotor) diameter of 20-100 ft.; tower height of 80 - 175 ft.**	**One 10 kW unit up to two 250 kW units**	**1 – 10 acres per turbine**
Intermediate – Village power, distributed, or hybrid power	Blade (rotor) diameter of 70-230 ft.; tower height of 115 - 280 ft.	One 100 kW unit up to one 1.5 MW unit	5 – 100 acres per turbine
Reservation-Scale Wind Farm	Blade (rotor) diameter of 230 ft.; tower height of 280 ft.	Several 1.5 MW units	~100 acres per turbine
Power Export to Grid	Blade (rotor) diameter of 230 ft.; tower height of 280 ft.	30 – 40 1.5 MW or 2.0 MW units	100 - 125 acres per turbine



Fuhrlander 250 kW Turbine

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Wind Generation: Visual and Physical Characteristics

Type of Installation	Physical Size	Typical Turbine Sizes Required	Land Required (Footprint)
Residential or Remote (e.g. – telecom site, pumping station, etc.)	Blade (rotor) diameter of 20-25 ft.; tower height of 80 - 100 ft.	One 10 kW unit	1 acre
Facility-Scale Wind	Blade (rotor) diameter of 20-100 ft.; tower height of 80 - 175 ft.	One 10 kW unit up to two 250 kW units	1 – 10 acres per turbine
Intermediate – Village power, distributed, or hybrid power	**Blade (rotor) diameter of 70-230 ft.; tower height of 115 - 280 ft.**	**One 100 kW unit up to one 1.5 MW unit**	**5 – 100 acres per turbine**
Reservation-Scale Wind Farm	Blade (rotor) diameter of 230 ft.; tower height of 280 ft.	Several 1.5 MW units	~100 acres per turbine
Power Export to Grid	Blade (rotor) diameter of 230 ft.; tower height of 280 ft.	30 – 40 1.5 MW or 2.0 MW units	100 - 125 acres per turbine

Fuhrlander 100 kW Turbines

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Wind Generation: Visual and Physical Characteristics

Type of Installation	Physical Size	Typical Turbine Sizes Required	Land Required (Footprint)
Residential or Remote (e.g. – telecom site, pumping station, etc.)	Blade (rotor) diameter of 20-25 ft.; tower height of 80 - 100 ft.	One 10 kW unit	1 acre
Facility-Scale Wind	Blade (rotor) diameter of 20-100 ft.; tower height of 80 - 175 ft.	One 10 kW unit up to two 250 kW units	1 - 10 acres per turbine
Intermediate – Village power, distributed, or hybrid power	Blade (rotor) diameter of 70-230 ft.; tower height of 115 - 280 ft.	One 100 kW unit up to one 1.5 MW unit	5 - 100 acres per turbine
Reservation-Scale Wind Farm	**Blade (rotor) diameter of 230 ft.; tower height of 280 ft.**	**Several 1.5 MW units**	**~100 acres per turbine**
Power Export to Grid	Blade (rotor) diameter of 230 ft.; tower height of 280 ft.	30 – 40 1.5 MW or 2.0 MW units	100 - 125 acres per turbine


GE 1.5 MW Turbine

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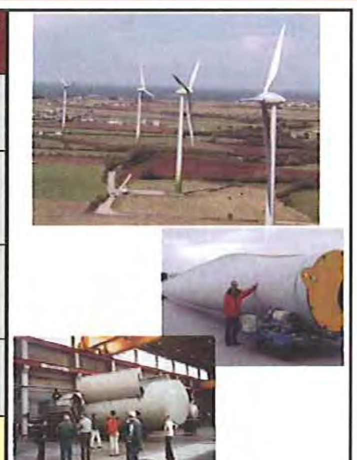
Wind Generation: Visual and Physical Characteristics

Type of Installation	Physical Size	Typical Turbine Sizes Required	Land Required (Footprint)
Residential or Remote (e.g. – telecom site, pumping station, etc.)	Blade (rotor) diameter of 20-25 ft.; tower height of 80 - 100 ft.	One 10 kW unit	1 acre
Facility-Scale Wind	Blade (rotor) diameter of 20-100 ft.; tower height of 80 - 175 ft.	One 10 kW unit up to two 250 kW units	1 - 10 acres per turbine
Intermediate – Village power, distributed, or hybrid power	Blade (rotor) diameter of 70-230 ft.; tower height of 115 - 280 ft.	One 100 kW unit up to one 1.5 MW unit	5 - 100 acres per turbine
Reservation-Scale Wind Farm	Blade (rotor) diameter of 230 ft.; tower height of 280 ft.	Several 1.5 MW units	~100 acres per turbine
Power Export to Grid	**Blade (rotor) diameter of 230 ft.; tower height of 280 ft.**	**30 – 40 1.5 MW or 2.0 MW units**	**100 - 125 acres per turbine**


Middelgrunden 2 MW Turbines

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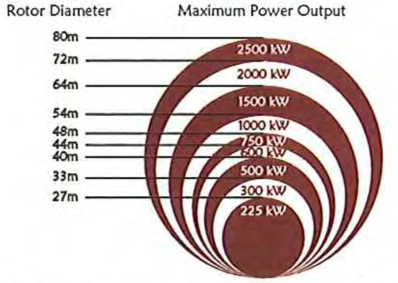
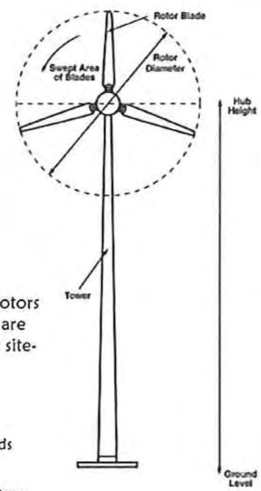
Sizing Considerations for Wind Turbines





Power Output Increases with the Swept Rotor Area, but larger rotors require higher wind speeds in order to turn. Wind turbine sizes are selected to minimize the ¢/kWh production cost, and to address site-specific considerations such as:

- Grid interconnection constraints
  - Capacity
- Costs of transport & delivery (e.g. – large cranes), construction access roads
- Operational risks of several small turbines vs. fewer large turbines
- Electricity output fluctuation of several small turbines vs. fewer large turbines

Source: Danish Wind Industry Association

Energy Production Cost Ranges for a 50 MW Wind Farm

- Private ownership, project financing: 4.95 cents/kWh including PTC, 6.56 cents/kWh without PTC.
- IOU ownership, corporate financing: 3.53 cents/kWh including PTC, 5.9 cents/kWh without.
- Public utility ownership, internal financing: 2.88 cents/kWh including REPI, 4.35 cents/kWh without.
- Public utility ownership, project financing: 3.43 cents/kWh including REPI, 4.89 cents/kWh without.

Sensitivity Parameters:

- Utility vs. developer ownership: utilities have access to 7.5% debt compared to 9.5% for a developer.
- Utilities enjoy longer debt payment periods (20 years compared to 12 for a developer)
- Developers are subject to a "debt service coverage ratio" (DSCR) requirement, which obligates a wind project to generate enough cash each year to exceed loan payments. Typically, this results in a smaller loan than would be most advantageous for the developer.
- Investors have higher return on equity requirements for wind projects in general (typically 18%) than those for gas projects (typically 12%).

- Above LCOEs assume a 50-MW wind farm with an installed cost of $1,000/kW, a 30% capacity factor, and operations and maintenance (O&M) expenses of 0.65 cents/kWh
- Source: Ryan Wiser and Edward Kahn of Lawrence Berkeley Laboratory's Energy and Environment Division

Laguna Wind Sizing & Configuration Considerations

Expected Turbine Performance Based on Laguna Wind Data

Bergey Excel 10 kW		Fuhrlander 30 kW		Fuhrlander 100 kW		Fuhrlander 250 kW		Vestas 660 kW		GE 1.5 MW	
Capacity Factor	Annual kWh Output	Capacity Factor	Annual kWh Output	Capacity Factor	Annual kWh Output	Capacity Factor	Annual kWh Output	Capacity Factor	Annual kWh Output	Capacity Factor	Annual kWh Output
6.86%	6,388	6.06%	56,400	24.20%	225,223	19.90%	462,921	16.61%	1,087,382	20.56%	3,059,491

Possible Wind Project Configurations for Laguna

Village or Reservation Application	Peak Demand (kW)	Annual Usage (kWh)	Load Factor	Possible Project Configurations (All Grid-Supplemented)	Peak Power (kW)	Projected Capacity Factor	Projected Annual kWh	Initial Capital Cost [1]
Laguna Industries Generation	544	1,620,000	34.0%	Two Fuhrlander 250 kW Turbines [2]	500	21.14%	871,507	$1.25M - $1.75M
Encinal Village-Scale Generation	102	393,023	44.0%	One Fuhrlander 100 kW Turbine	100	24.2%	225,223	$250k - $300k
Laguna Village-Scale Generation	2,083	9,207,437	50.5%	One GE 1.5 MW Turbine	1,500	20.6%	3,059,491	$2.0M - $2.25M
Mesita Village-Scale Generation	949	4,073,652	49.0%	One Fuhrlander 600 kW Turbine [2]	600		1,000,000	$950k - $1M
Paguate Village-Scale Generation	472	1,953,873	47.3%	Two Fuhrlander 250 kW Turbines [2]	500	21.14%	871,507	$1.25M - $1.75M
Paraje Village-Scale Generation	1,392	6,206,168	50.9%	One GE 1.5 MW Turbine	1,500	20.6%	3,059,491	$2.0M - $2.25M
Seama Village-Scale Generation	427	1,783,999	47.7%	Two Fuhrlander 250 kW Turbines [2]	500	21.14%	871,507	$1.25M - $1.75M
Laguna Reservation-Scale Generation	5,426	23,618,151	49.7%	Four GE 1.5 MW Turbines	6,000	20.6%	12,237,964	$8M - $9M
Power Export to Grid	6MW	N/A	N/A	Forty GE 1.5 MW Turbines	6MW	120.6%	122,379,640	$75M - $85M

1. Initial capital costs are rough estimates only and do not include "all-in" development costs. Actual costs will vary with quantities, commodity market fluctuation, tax credit cycles, and other factors.
2. Wind generation alone (without a firming resource) may not be cost effective at this Village scale, but may prove viable upon further analysis and/or consideration of hybrid configurations.

Discussion Outline

1. Project Background
2. Electric Needs Indications for Power Generation
3. Possible Project Options
4. Wind Generation Options
5. **Solar Generation Options**
6. Natural Gas Generation Options
7. Summary of Community Input
8. Recommended Project Locations

Solar Generation: Visual and Physical Characteristics

Type of Installation	Typical Power Required for Laguna Sites	Physical Size	Typical Technologies Applicable
Residential or Remote (e.g. – telecom site, pumping station, etc.)	1-5 kW	Arrays ranging from 8' x 24' to 16' x 20' (typical for fixed flat plat)	Fixed or tilted roof-mounted flat plate PV arrays, ground-mounted tracking PV arrays
Facility-Scale Solar	10 kW – 400 kW	Arrays ranging from 24' x 60' for flat plate up to 45' x 55' per 25kW module for tracking ² concentrator systems	Fixed or tilted roof-mounted flat plate PV arrays, ground-mounted tracking PV arrays, tracking concentrator systems

3 kW roof top system

500kW ground-mount system

Solar Generation: Visual and Physical Characteristics

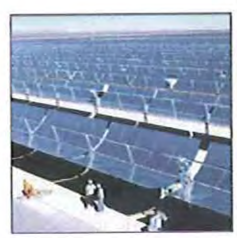
Type of Installation	Typical Power Required for Laguna Sites	Physical Size	Typical Technologies Applicable
Intermediate – Village power, distributed, or hybrid power	100 kW – 1.5 MW	Arrays ranging from 24' x 60' for flat plate up to 45' x 55' per 25kW module for tracking [2] concentrator systems	Fixed or tilted roof-mounted flat plate PV arrays, ground-mounted tracking PV arrays, tracking concentrator systems

25kW tracking concentrator

Solar Generation: Visual and Physical Characteristics

Type of Installation	Typical Power Required for Laguna Sites	Physical Size	Typical Technologies Applicable
Intermediate – Village power, distributed, or hybrid power	100 kW – 1.5 MW	Arrays ranging from 24' x 60' for flat plate up to 45' x 55' per 25kW module for tracking [2] concentrator systems	Fixed or tilted roof-mounted flat plate PV arrays, ground-mounted tracking PV arrays, tracking concentrator systems
Reservation-Scale Wind Farm	5 - 10 MW	Arrays of 45' x 55' per 25kW module for tracking concentrators, up to	Tracking concentrator systems, dish-engines, parabolic trough
Power Export to Grid	60 MW	Arrays of 45' x 55' per 25kW module for tracking concentrators, up to 1-1/2 to 2 acres per MW for trough solar field	Tracking concentrator systems, dish-engines, parabolic trough


25 kW Stirling Dish-Engine System


Parabolic trough solar collector field

Solar Generation: Economies of Scale Impacts

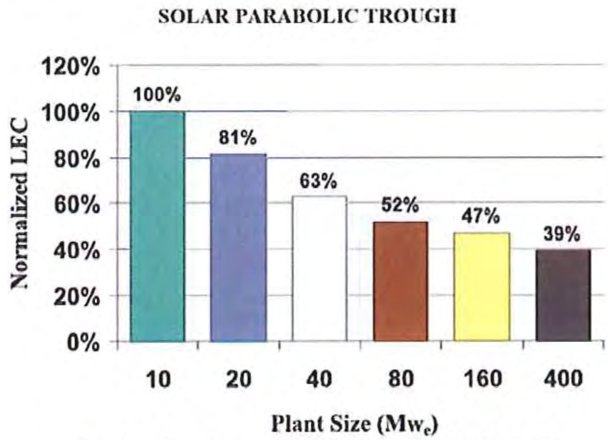


Figure 5. Effect of power plant size on normalized levelized COE.

Source: NREL

Possible Solar Project Configurations for Laguna

Village or Reservation Application	Peak Demand (kW)	Annual Usage (kWh)	Load Factor	Possible Project Configurations (All Grid-Supplemented)	Peak Power (kW)	Expected Capacity Factor	Projected Annual kWh	Initial Capital Cost [1]
Laguna Industries Generation	544	1,620,000	34.0%	Twenty 25 kW Dish-Engine Modules	500kW	25%	1.1 GWh	$2.5M
Encinal Village-Scale Generation	102	393,023	44.0%	Four 25 kW Amonix HCPV [2] arrays	100kW	23%	203,000	$600k
Laguna Village-Scale Generation	2,083	9,207,437	50.5%	Parabolic Trough	2MW	25%	4.4 GWh	$8M
Mesita Village-Scale Generation	949	4,073,652	49.0%	Parabolic Trough	1MW	25%	2.2 GWh	$4M
Paguate Village-Scale Generation	472	1,953,873	47.3%	Twenty 25 kW Dish-Engine Modules	500kW	25%	1.1 GWh	$2.5M
Paraje Village-Scale Generation	1,392	6,206,168	50.9%	Parabolic Trough	1MW	25%	2.2 GWh	$4M
Seama Village-Scale Generation	427	1,783,999	47.7%	Sixteen 25 kW Amonix HCPV [2] arrays	400kW	23%	812,000	$2.4M
Laguna Reservation-Scale Generation	5,426	23,618,151	49.7%	Parabolic Trough	5MW	25%	10.9 GWh	$20M
Power Export to Grid	60 MW	N/A	N/A	Parabolic Trough	Sized to project need	25%	132 GWh	$240M

1. Initial capital costs are rough estimates only and do not include "all-in" development, BOS, or installation costs. Actual costs will vary with quantities, commodity market fluctuation, tax credit cycles, and other factors.
2. HCPV: High Concentration Photovoltaic.

Discussion Outline

1. Project Background
2. Electric Needs Indications for Power Generation
3. Possible Project Options
4. Wind Generation Options
5. Solar Generation Options
6. **Natural Gas Generation Options**
7. Summary of Community Input
8. Recommended Project Locations

Gas-Fired Generation Comparison

Type of Installation	Typical Power Required for Laguna Sites (kW)	Physical Size	Type	Cost ($ per kW)	Efficiency
Facility-Scale	10 kW – 400 kW	25-500 kW	Microturbine	$700-1100	20-30%; w/CHP up to 85%
		5 kW – 10 MW	Reciprocating Engine	$300 - 900	25–40%
Intermediate – Village power, distributed, or hybrid power	100 kW – 1.5 MW	500 kW – 25 MW	Combustion Turbine	$300-1000	20-45%
		5 kW – 10 MW	Reciprocating Engine	$300 - 900	25–40%
Reservation-Scale Gas Generation	5 - 10 MW	500 kW – 25 MW	Combustion Turbine	$300-1000	20-45%
Power Export to Grid	60 MW	50 MW - ??	Combustion Turbine	$300-1000	20-45%

Gas Generation: Visual and Physical Characteristics

Type of Installation	Physical Size	Typical Turbine Sizes Required	Land Required (Footprint)
Facility-Scale Gas Generation	25-500 kW	Capstone C30 30kW	30" x 70"
Intermediate – Village power, distributed, or hybrid power	500 kW – 25 MW		
Reservation-Scale Gas Generation	500 kW – 25 MW		
Power Export to Grid	50 MW - ??		

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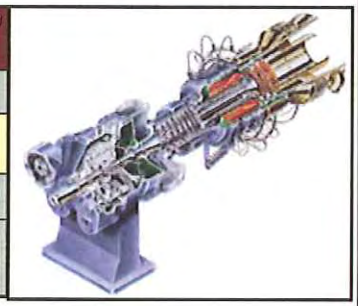
Gas Generation: Visual and Physical Characteristics

Type of Installation	Physical Size	Typical Turbine Sizes Required	Land Required (Footprint)
Facility-Scale Gas Generation	25-500 kW		
Intermediate – Village power, distributed, or hybrid power	500 kW – 25 MW	Solar Saturn 20 1.2 MW	6' x 23'
Reservation-Scale Gas Generation	500 kW – 25 MW		
Power Export to Grid	50 MW - ??		



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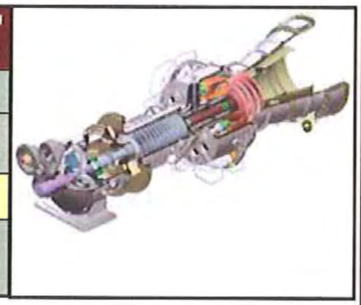
Gas Generation: Visual and Physical Characteristics

Type of Installation	Physical Size	Typical Turbine Sizes Required	Land Required (Footprint)
Facility-Scale Wind	25-500 kW		
Intermediate – Village power, distributed, or hybrid power	500 kW – 25 MW		
Reservation-Scale Gas Generation	500 kW – 25 MW	Solar Saturn 65 6.3MW	8' x 32'
Power Export to Grid	50 MW - ??	MS6001FA 75.9 MW	



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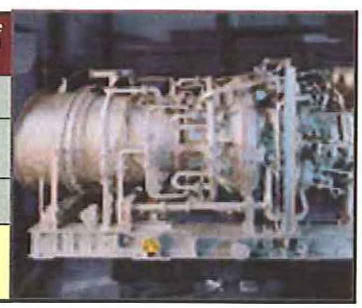
Gas Generation: Visual and Physical Characteristics

Type of Installation	Physical Size	Typical Turbine Sizes Required
Facility-Scale Wind	25-500 kW	
Intermediate – Village power, distributed, or hybrid power	500 kW – 25 MW	
Reservation-Scale Gas Generation	500 kW – 25 MW	
Power Export to Grid	50 MW - ??	MS6001FA 75.9 MW



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Possible Laguna Gas-Fired Project Configurations

Village or Reservation Application	Peak Demand (kW)	Annual Usage (kWh)	Load Factor	Possible Project Configurations	Installed Capacity	Heat Rate	Installed Cost per kW
Laguna Industries Generation	544	1,620,000	34.0%	Caterpillar G3512 90 TA	570kW	13,040	$1263
Encinal Village-Scale Generation	102	393,023	44.0%	Olympian G125G1	114kW	14,000	$1300
Laguna Village-Scale Generation	2,083	9,207,437	50.5%	Caterpillar G3612 TA 90 LE	2.3MW	11,384	$1231
Mesita Village-Scale Generation	949	4,073,652	49.0%	Caterpillar G3606 TA 130 LE	1MW	11,652	$1348
Paguate Village-Scale Generation	472	1,953,873	47.3%	Caterpillar G3512 90 TA	570kW	13,040	$1263
Paraje Village-Scale Generation	1,392	6,206,168	50.9%	Caterpillar G3612 TA 90 LE	1.5MW	11,594	$1245
Seama Village-Scale Generation	427	1,783,999	47.7%	Caterpillar G3512 90 TA	570kW	13,040	$1263
Laguna Reservation-Scale Generation	5,426	23,618,151	49.7%	Caterpillar GCM34	5.9MW	9,724	$1200
Power Export to Grid	60 MW	N/A	N/A	GE MS6001 FA	75.9MW	9,760	n/a

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Discussion Outline

1. Project Background
2. Electric Needs Indications for Power Generation
3. Possible Project Options
4. Wind Generation Options
5. Solar Generation Options
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7. **Summary of Community Input**
8. Recommended Project Locations

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Summary of Community Inputs to Date

- Visual impacts of renewable technologies may not be acceptable for village-specific projects
- Anticipate better support for facility or reservation-wide projects in areas with limited visibility
- Improved likelihood of success if projects were located in existing industrial or commercial areas
- Potential interest in Casa Blanca area, near Rainbow and LA JR/SR High School
- Potential interest for LDC facilities/partnering opportunity with PNM
- Best wind resources, and minimal visual impacts will be off mesas currently being monitored

- Further input needed from community
- Suggest multiple venues (Laguna newspaper, UA newsletter, additional village/reservation-wide meetings) to provide education, seek input

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Discussion Outline

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Recommended Project Locations

- Casa Blanca
  - Optimally sized wind/gas or solar/gas southeast of Rainbow Center
- Mesita
  - Optimally sized solar/gas southeast of village
- Laguna
  - Optimally sized solar/gas north of transfer station
- Rio Puerco
  - Optimally sized solar/gas near eastern edge of reservation
- Paraje
  - Optimally sized solar/gas in general vicinity of old high school

- Key sizing considerations
  - Economics
  - Project size dependent on Utility Authority involvement with electric operations
    - Reservation-sized if operating electric utility system
    - Facility/village-sized if not operating electric utility system

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Pueblo of Laguna
Renewable Energy Feasibility Study

Fatal Flaw Results Summary

August 10, 2006

Discussion Outline

1. Project Background
2. Fatal Flaw Summary Results
   - Power Markets/Buyers
   - Environmental Review
   - Transmission/Interconnection
   - Initial LCOE Estimates
   - Homer Model Assumptions
3. Next Steps

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Project Background

Renewable Energy Feasibility Study

Department of Energy Funded Study Project Objectives:

- Increase energy knowledge and capacity
- Improve quality and reliability of electric service
- Contribute to development of environmentally clean energy
- Provide data/analysis to support Laguna involvement in renewable energy projects as an owner or participant

Capacity Building
Identify staff resources and provide ongoing education/support

Community Education/Outreach and Review
Develop/implement community education tools (newsletter, meetings) in order to gain community support for identified projects

Resource Monitoring
Understand renewable resources, power needs, and identify possible projects

Fatal Flaw Analysis
Identify major issues that would eliminate possible projects

Potential Project Economics
Evaluate feasibility of community-supported projects

Project Decision Support
Presentation/decisions re: pursuit of feasible projects

Development Plan
Create development plan, budget and contact possible funding sources

Completed Fatal Flaw Analysis of Potential Projects

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Fatal Flaw Results – Power Markets/Buyers

Power Markets/Buyers

- Power markets/buyers
  - New Mexico utilities
    - Investor Owned (4)
    - Public Power (7)
    - Electric Cooperatives (18)
- Drivers for power purchases from POLUA generation projects:
  - Renewable Portfolio Standard (RPS) compliance
  - Competitive power prices
  - PNM interest in green power and associated Renewable Energy Certificates (RECs) from non-wind projects

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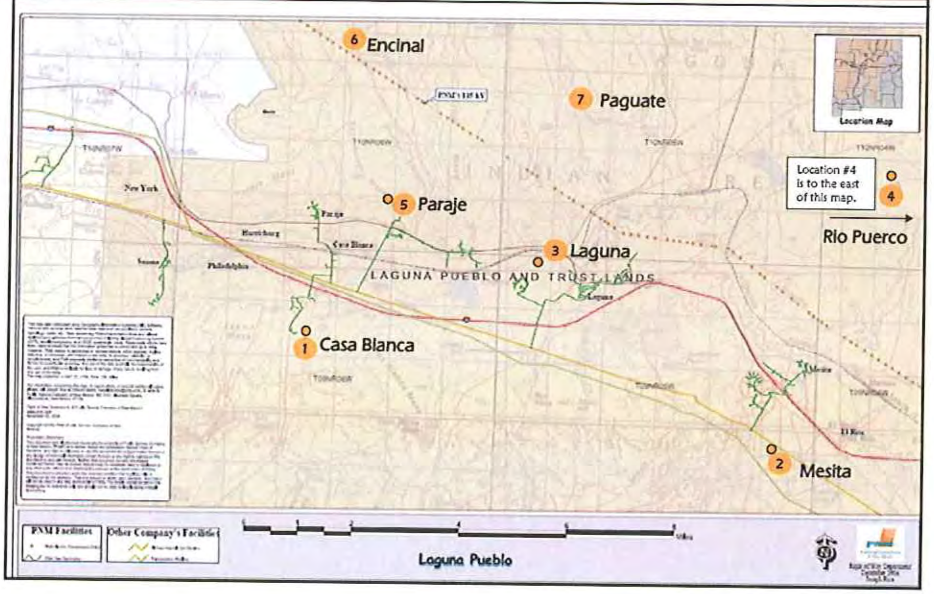
Project Locations Considered



Preliminary Environmental Review

- Sites under consideration have been/adjacent to properties previously impacted by some activity (i.e. development, grazing, agriculture, access roads, etc.)
- All sites appear clear of any immediate cultural or historical fatal flaws
- Washes present at sites #1 and #5, but sites flexible re: mitigation
  - Dry washes; no apparent endangered species issues
- Multiple sites available allow for protection of "view sheds"
- Additional transmission/distribution ROWs yet to be reviewed
- Alternative sites must be identified under any Environmental Assessment
- FONSI (finding of no significant impact) may not be considered, since proposed projects are a "change in use"

Fatal Flaw Results – Environmental Review

Environmental Review Summary

Issue	Casa Blanca	Mesita	Laguna	Rio Puerco	Paraje	Encinal	Paguate
General Site Description	SE of Laguna Acoma HighSchool	East of Village, South of I-40	North of Transfer Station	Near Eastern Edge of Reservation	NE of Old High School	West of Village	East of Village
Geological/ Water Use	None Observed	None Observed	None Observed	None Observed	None Observed	None Observed	None Observed
Geological Hazard/ Soil Erosion	Yes	None Observed	None Observed	None Observed	Yes	None Observed	None Observed
Water Quality	Specific to Gas Firming Technology	Specific to Gas Firming Technology	Specific to Gas Firming Technology	Specific to Gas Firming Technology	Specific to Gas Firming Technology	Specific to Gas Firming Technology	Specific to Gas Firming Technology
Airborne Dust	During Construction Only	During Construction Only	During Construction Only	During Construction Only	During Construction Only	During Construction Only	During Construction Only
Noise	Nominal	Nominal	Nominal	Nominal	Nominal	Nominal	Nominal

1 In the event that excavation activities associated with construction were to disturb any underground contamination deposits, which in turn could affect existing aquifers or otherwise release such contamination; water quality, site runoff, and/or local species and their habitat could be affected
2 Red Mountain surveys did not reveal the presence of contamination in the areas under consideration. However, the observations are high-level and should not be regarded as exhaustive.
3 Any available soils reports, EA reports or CERCLA analysis should be examined.

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Fatal Flaw Results – Environmental Review

Environmental Review Summary

Issue	Casa Blanca	Mesita	Laguna	Rio Puerco	Paraje	Encinal	Paguate
Wildlife Habitat	None Observed	None Observed	None Observed	None Observed	None Observed	None Observed	None Observed
Fish/Wildlife Species	None Observed	None Observed	None Observed	None Observed	None Observed	None Observed	None Observed
Land Use	Vacant	Vacant	Vacant	Vacant	Vacant	Vacant	Vacant
Visual Resources	Visibility or project will be low; not readily discernable beyond 5 Miles	Visibility or project will be low; not readily discernable beyond 5 Miles	Visibility or project will be low; not readily discernable beyond 5 Miles	Visibility or project will be low; not readily discernable beyond 5 Miles	Visibility or project will be low; not readily discernable beyond 5 Miles	Visibility or project will be low; not readily discernable beyond 5 Miles	Visibility or project will be low; not readily discernable beyond 5 Miles
Hazardous Waste	None Reported or Observed	None Reported or Observed	None Reported or Observed	None Reported or Observed	None Reported or Observed	None Reported or Observed	None Reported or Observed
Traffic	No significant impacts expected	No significant impacts expected	No significant impacts expected	No significant impacts expected	No significant impacts expected	No significant impacts expected	No significant impacts expected
Health/ Human Safety	None Expected	None Expected	None Expected	None Expected	None Expected	None Expected	None Expected

1 In the event that excavation activities associated with construction were to disturb any underground contamination deposits, which in turn could affect existing aquifers or otherwise release such contamination; water quality, site runoff, and/or local species and their habitat could be affected
2 Red Mountain surveys did not reveal the presence of contamination in the areas under consideration. However, the observations are high-level and should not be regarded as exhaustive.
3 Any available soils reports, EA reports or CERCLA analysis should be examined.

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Other Considerations Summary

Issue	Casa Blanca	Mesita	Laguna	Rio Puerco	Paraje	Encinal	Paguate
Cultural Resources (1)	None Documented	None Documented	None Documented	None Documented	None Documented	None Documented	None Documented
Community Concerns	TBA	TBA	TBA	TBA	TBA	TBA	TBA
Construction Access	Excellent	Excellent	Good	Moderate	Excellent	Moderate	Moderate
Topography Observations	Generally Level and sloping toward wash	Generally Level	Generally Level	Generally Level	Generally level with existing buildings on site	Generally Level	Generally Level
Interconnection Issues	See Circuit 51000 and Gas Distribution Map	See Circuit 51000 and Gas Distribution Map	See Circuit 51000 and Gas Distribution Map	See Circuit 51000 and Gas Distribution Map	See Circuit 51000 and Gas Distribution Map	See Circuit 51000 and Gas Distribution Map	See Circuit 51000 and Gas Distribution Map
Other	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved

1 In the event that excavation activities associated with construction were to disturb any underground contamination deposits, which in turn could affect existing aquifers or otherwise release such contamination; water quality, site runoff, and/or local species and their habitat could be affected

2 Red Mountain surveys did not reveal the presence of contamination in the areas under consideration. However, the observations are high-level and should not be regarded as exhaustive.

3 Any available soils reports, EA reports or CERCLA analysis should be examined.

Major Environmental Assumptions

- Siting will be done in accordance with Pueblo laws, ordinances, and customary processes
- Transmission interconnection and distribution will be overhead on tribal lands, or in public rights-of-way
- Underground transmission may be necessary onsite depending on the scale of the specific project
- Construction will be done using generally accepted construction methods for runoff and dust mitigation
- As siting is preliminary, community concerns will still need to be addressed and mitigated
- Construction can be completed in 6-18 months depending on the scale of the project
- Additional environmental assessments may be necessary as specific projects are identified and proceed to more in-depth studies

Transmission/Interconnection

- Transmission
  - Previous studies indicated 60 MW of capacity available for power export via PNM 115 kV transmission line
    - Projects involving facility-scale, village-scale, or partial village-scale loads are likely to require some distribution line upgrades
- Interconnection
  - Interconnection for large projects could occur at the Paguate Substation or new substation being considered
  - Interconnection at other project sites will require additional equipment to coordinate system protection schemes (fuse cut-outs, breakers, relays)

Preliminary Project Cost/LCOE Estimates: Modeling Approach

- Utilized NREL's "HOMER" Micropower Optimization Model to estimate overall project costs
- Modeling exercises included 2-3 potential configurations from each proposed project site
- Cost analysis utilized:
  - Actual load profiles, escalated through 2027
  - Actual solar and wind resource for Laguna
    - Wind data derived from preliminary anemometry results
    - Solar data extracted from National Solar Radiation Database for Albuquerque Region, 1961-1990
- In each modeled case, a specified minimum renewable generating component was required
- HOMER optimizes project design and seeks least cost on the basis of:
  - Overall Net Present Value for the life of the project
  - Levelized Cost Of Energy
  - Optimal contributions of grid-supplied energy and renewable and/or fossil generating resources
- Summary data includes: 1) equipment configurations as specified, and 2) optimized results
- ***No incentives are factored in fatal flaw analysis; LCOE results will improve once incentives are considered***

Initial Levelized Cost of Energy (LCOE) Estimates

LCOE Ranges without Incentives/Alternate Funding

Case #	Site Description	Load Served	Proposed Project Scale	Grid-Parallel Project Scenarios				Optimum Sizes			Expected Project Net Present Value	LCOE* per Spec ¢/kWh	Optimized LCOE* ¢/kWh
				Generating Resource #1	Qty	Generating Resource #2	Qty	Grid kW	Gen1 kW	Gen2 kW			
1	Rainbow Center, Casa Blanca (Site 1)	Nursing home, housing complex, junior/senior high school	541.2 kW	500 kW Single Axis Horizontal Tracking System	1	Caterpillar 350kW G3508 engine	1	79.0%	0.0%	21.0%	$4.03M	22.1	13.2
2	Southeast of Mesita Village (site 2)	Village load	1.0 MW	Fuhrlander 250 kW FL 250 Wind Turbine	3	Caterpillar 350kW G3508 engine	2	88.0%	11.0%	1.0%	$5.42M	10.8	9.7
3	Laguna Village, north of Transfer Station (Site 3)	Reservation, partial Reservation load, or power export	2.1 MW	Amonix 25 kW HCPV Array	40	Caterpillar 570kW G3512 90 TA engine	2	56.0%	13.0%	32.0%	$24.59M	21.9	15.1
4			5.1 MW	4 MW Single Axis Horizontal Tracking System	1	Caterpillar 570kW G3512 90 TA engine	2	36.0%	25.0%	39.0%	$42.2M	22.2	16.7
5	Paraje, near old high school (Site 5)	Village or partial village load	1.5 MW	1 MW Single Axis Horizontal Tracking System	1	Caterpillar 570kW G3512 90 TA engine	1	80.0%	20.0%	0.0%	$11.0M	19.4	13.1

*LCOE per Spec: LCOE per equipment as specified

*Optimized LCOE: LCOE per Homer Lowest Cost Optimization Process

Preliminary Project Cost Estimates: Observations

- Incentives will improve project LCOE results
- In the long term (10 - 20 years), electricity costs reduce dramatically due to full amortization of capital costs and low/no fuel costs
- Large-scale power export projects (e.g. – 50-60MW scale) do not appear to be viable at this time due to existing low-cost generating facilities in the region and limited resource needs of potential off-takers
- Reasons for considering renewable energy projects may not be cost-based alone, and may include:
  - Community values
  - Improved power quality/reliability
  - Energy independence/surety
  - Environmental stewardship

Project Assumptions

- HOMER model runs used the following assumptions

Relevant Variables, Parameters	Assumption or Value Used	Source or Basis of Assumption
2007 Peak Coincident Demand for Reservation, MW	4.845	T. Crooks Load Forecast
Village project period	Up to 20 years	Typical assumed project life; model runs inclue 10, 15, and 20 year cases
Gas engine/turbine operations:	75%	Typical assumption
Total assumed demand growth over project life	20%	Used for project scale at fatal flaw stage
Annual demand growth	8.30%	Annual average of 2000 - 2005 load profile from CDEC data
Total demand over project life @ 8.3% growth, MW	22.04	2000 - 2005 load profile from CDEC data
Single axis solar tracking system capital costs	$7,800/kW	Price quoted by APS June 2006, quantities < 1 MW. Includes BOS.
	$7,000/kW	Price quoted by APS June 2006, quantities > 1 MW. Includes BOS.
	$6,800/kW	Price quoted by APS June 2006, quantities 2-5 MW. Includes BOS.
Amonix HCPV array capital costs	$8,000/kW	Price quoted by APS June 2006, quantities < 1 MW. Includes BOS.
	$7,000/kW	Price quoted by APS June 2006, quantities > 1 MW. Includes BOS.

Project Assumptions

- HOMER model runs used the following assumptions

Relevant Variables, Parameters	Assumption or Value Used	Source or Basis of Assumption
Solar O&M costs	2¢/kWh	Quoted by APS June 2006
Wind turbine capital costs	Varies	Quoted by Fuhrlander June 2006
Gas engine capital costs	Varies	Per T. Crooks primary research
Capital equipment replacement costs	78%	Typical; assumes generating resource only, less power block or BOS
Annual Interest Rate	6.00%	Typical current value
Cost of natural gas	$6/MMBTU	Current average as of July 2006
Natural gas Lower Heating Value (LHV)	45 MegaJoules per kilogram (kg)	Typical industry value
Natural gas density	79 kg/m3	Typical industry value
Natural gas carbon content	67%	Typical industry value
Natural gas sulfur content	0.33%	Typical industry value

Recall that no financial incentives are yet included at this stage of analysis.

Next Steps

- Continue community education activities
- Gather community feedback on preliminary projects identified
- Further define selected projects and determine financial architecture, partnership structures, etc.
- Begin further wind site testing, as appropriate
- Complete detailed economic analyses of accepted projects
- Prepare development plan

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Pueblo of Laguna
DOE Renewable Energy Feasibility Study
Solar Project Feasibility Update

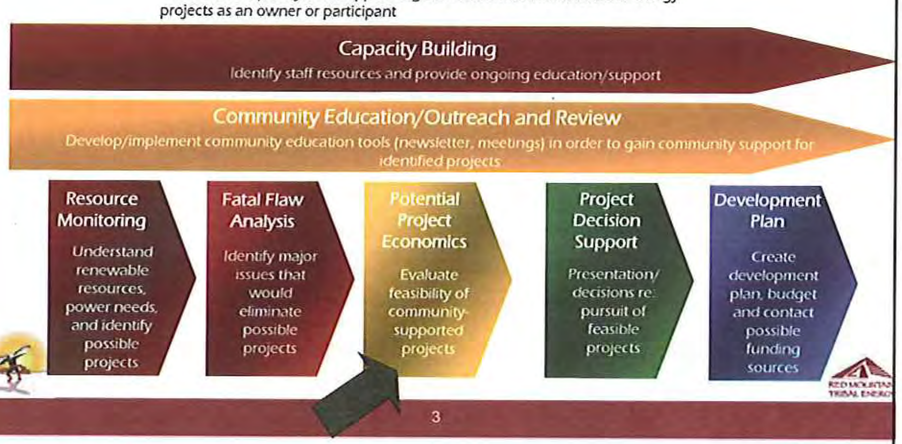
July 2007

Discussion Outline

- Project Scope/Progress to Date
- Initial Solar Project Feasibility Review
  - Laguna Solar Resource
    - ✓ PV
    - ✓ Concentrating Solar
  - Proposed Project Location
  - Solar Technology Options
  - Solar Project Concepts/Capital Cost Estimates
  - Project Development/Ownership Structure Options
  - Project Economics/PPA Indications
- Next Steps

Renewable Energy Feasibility Project Overview

Department of Energy Funded Study Project Objectives:
- Increase energy knowledge and capacity
- Improve quality and reliability of electric service
- Contribute to development of environmentally clean energy
- Provide data/analysis to support Laguna involvement in renewable energy projects as an owner or participant



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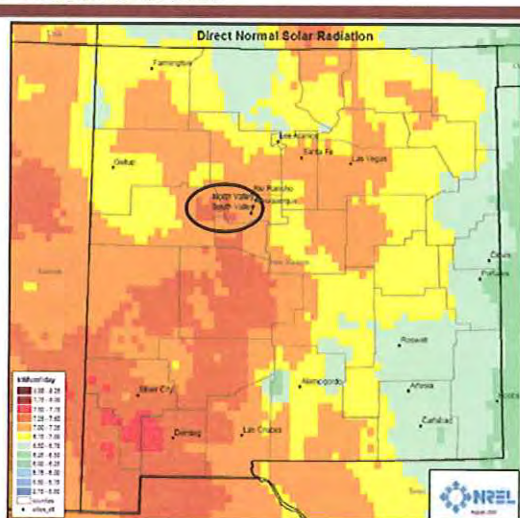
Site Concept/Site Selection Process

- Various community and large-scale project concepts and locations were identified throughout the study period and evaluated for fatal flaws
- Questionnaires developed for community input
- Combination of electric system analysis and renewable feasibility study contributed to identification of potential Mesita site
- Feasibility of solar project concepts being analyzed
  - PV vs. Concentrating Solar
  - Community Scale vs. Large Scale

4

Laguna PV Solar Resource: Direct Normal Solar Radiation

Solar resource, or "insolation", is measured in different ways. Flat plate collectors are used to measure insolation levels relevant for PV systems.



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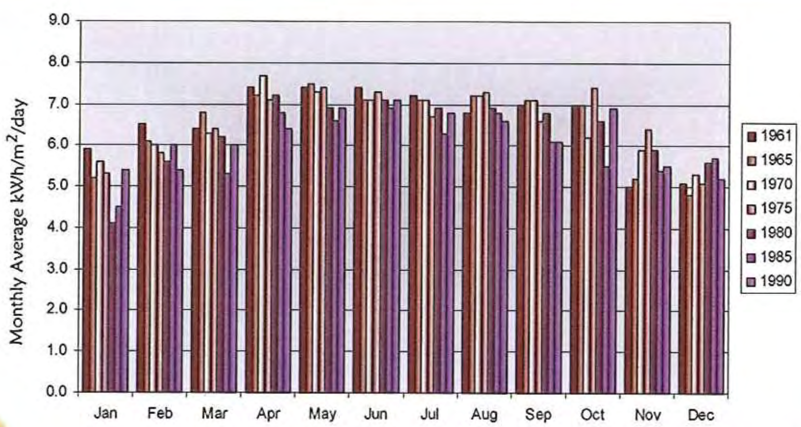
Laguna Solar Resource: Insolation for Flat-Plate Collector Facing South, Fixed Tilt

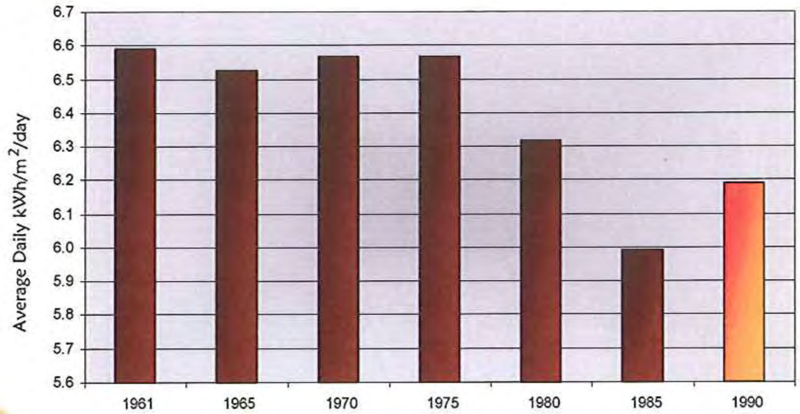


Annual Variation in Monthly Average kWh per Square Meter per Day for the Albuquerque Region, 1961 – 1990*

* Source: Red Mountain Tribal Energy, National Solar Radiation Database (NSRDB) Insolation Archive, 1961 -1990

6

Laguna Solar Resource: Insolation for Flat-Plate Collector Facing South, Fixed Tilt



Annual Average kWh per Square Meter per Day, by Year for the Albuquerque Region, 1961 – 1990*

* Source: Red Mountain Tribal Energy, National Solar Radiation Database (NSRDB) Insolation Archive, 1961 -1990

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Laguna Solar Resource: Concentrating Solar Power

Insolation relevant for CSP technology is measured with collectors that track the sun.

Source: National Renewable Energy Lab (NREL)

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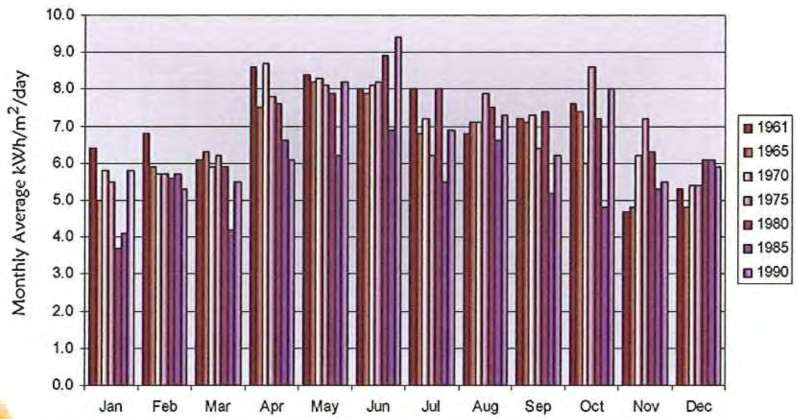
Laguna Solar Resource : Insolation for Two-Axis Tracking Concentrating Collector

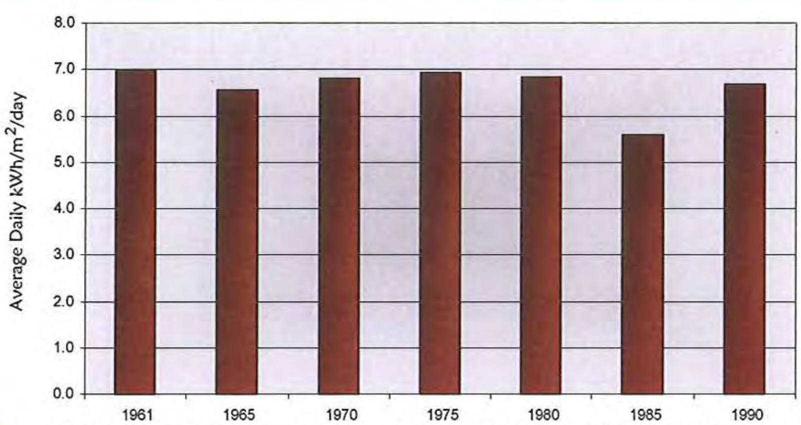


Annual Variation In Monthly Average kWh per Square Meter per Day for the Albuquerque Region, 1961 – 1990*

* Source: Red Mountain Tribal Energy, National Solar Radiation Database (NSRDB) Insolation Archive, 1961 -1990

9

Laguna Solar Resource: Insolation for Two-Axis Tracking Concentrating Collector



Annual Average kWh per Square Meter per Day, by Year for the Albuquerque Region, 1961 – 1990*

* Source: Red Mountain Tribal Energy, National Solar Radiation Database (NSRDB) Insolation Archive, 1961 -1990

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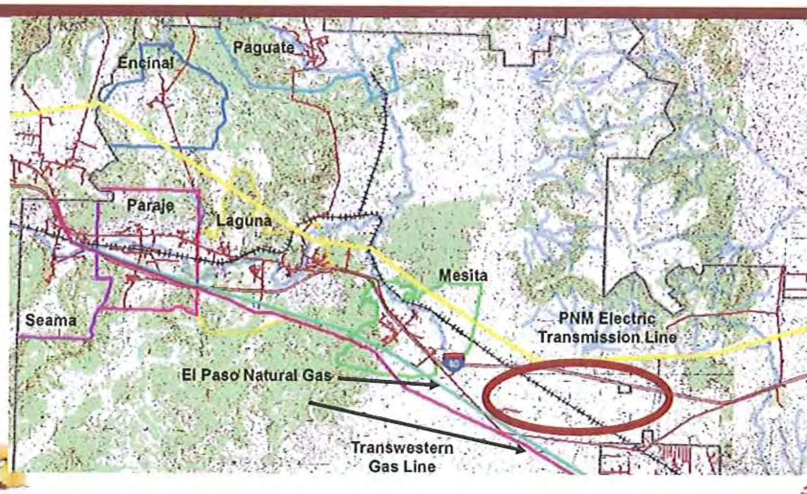
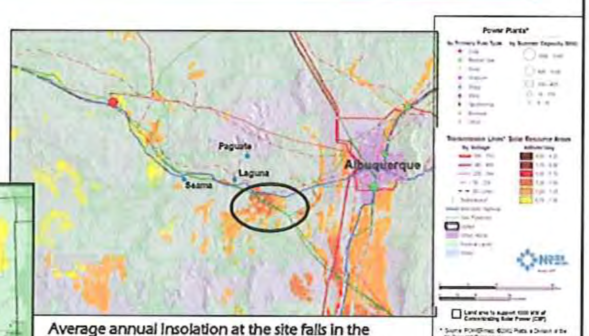
Possible Project Site

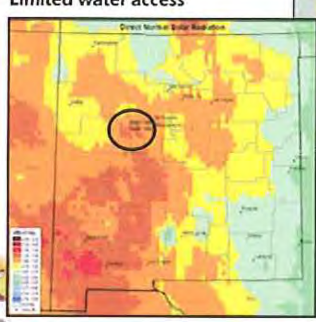


Resource Indications at Possible Project Site

- Insolation suitable for CSP or PV
- PNM 115 kV line within 1 mile of proposed site
- Natural gas access via PNM or interstate lines
- Limited water access



Average annual insolation at the site falls in the range of 7.25 – 7.5 kWh/m2/day – suitable for CSP applications.



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

Source: National Renewable Energy Lab (NREL)

Preliminary Site Assessment

- Site evaluated in late 2006
- No fatal flaws evident
- Anticipated community support for renewable projects – both small and large
- Some community interest in projects east of Mesita

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Solar Technology Options

- PV
- Concentrated Solar

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PV Technology Options

- Configurations
  - Fixed, flat plate
  - Single axis tracking
  - Dual axis tracking
- Many commercial applications, but usually on a smaller scale
  - Few projects over 1 MW

Concentrating Solar Technology Options


Power Tower

- Power Tower: Uses a circular field array of individually-tracking mirrors to focus sunlight onto a central receiver mounted on top of a tower, which produces steam to power a conventional turbine generator to produce electricity


Parabolic Trough

- Parabolic Trough: Uses trough-shaped mirrors to focus sunlight on thermally efficient receiver tubes that contain a heat transfer fluid; fluid is heated and pumped through a series of heat exchangers to produce superheated steam, which powers a conventional turbine generator to produce electricity


Dish-Engine

- Dish-Engine: Uses an array of dish-shaped mirrors to focus solar energy onto a receiver located at the focal point of the dish; fluid in the receiver is heated and used to generate electricity in a small engine or turbine attached to the receiver


HCPV

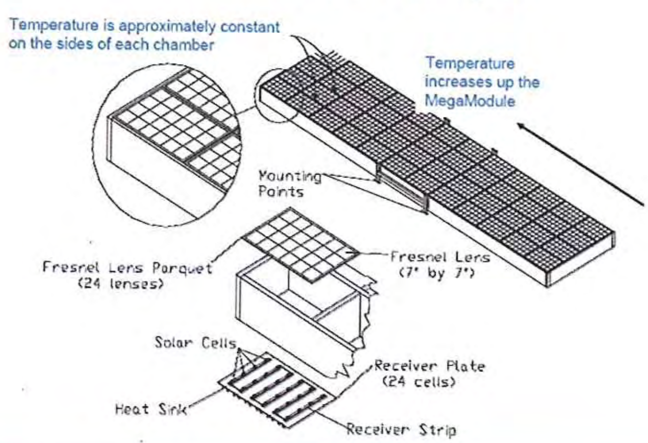
- High Concentration Photovoltaics (HCPV): Uses high efficiency PV cells with concentrating (Fresnel) lenses that multiply the sun's intensity, requiring hundreds of times less photovoltaic material to achieve the same energy output as PV cells without concentration

Concentrating Solar Technology Options

- Power Tower
  - Tested in CA for many years
  - No US commercial applications to date
  - Anticipated cost/efficiency improvements
- Parabolic Trough
  - 350 MW in commercial operation since 1990s
  - Water requirements pose a challenge
- Dish-Engine
  - No commercially operated systems to date
  - Cost improvements promised; not yet delivered
- HCPV
  - Field tested in AZ and NV for 15+ years
  - Small scale NV and AZ commercial operations
  - Anticipated cost/efficiency improvements
  - Major US manufacturer considering the technology

HCPV Technology

Thermal Analysis



PV vs. Concentrated Solar Comparison

Installation	Cost ($/Watt)
Single Axis Tracking PV	8.50
HCPV (Amonix)	4.90 – 5.20
HCPV - Future	3.00
Parabolic Trough (for comparison only)	4.00

Source: Arizona Public Service, 2006

In comparison, conventional generation costs are typically less than $2/Watt

Possible Solar Project Concepts

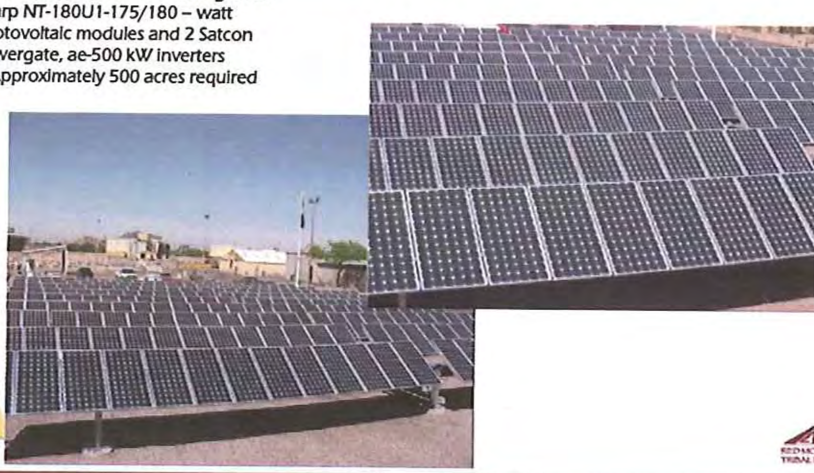
- Laguna Solar Project concepts under study
  - 3 MW community scale PV
    - ✓Single axis tracking
  - 50 MW large scale PV or HCPV
    - ✓Single axis tracking vs. high concentration PV
  - 100 MW large scale PV or HCPV
    - ✓Single axis tracking vs. high concentration PV

3 MW Single Axis Tracking PV

- 330 sections, consisting of 52 Sharp NT-180U1-175/180 – watt photovoltaic modules and 2 Satcon Powergate, ae-500 kW inverters
- Approximately 30 acres required

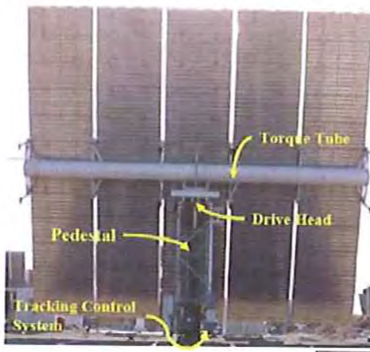
50 MW Large Scale PV

- 5500 sections, each consisting of 52 Sharp NT-180U1-175/180 – watt photovoltaic modules and 2 Satcon Powergate, ae-500 kW inverters
- Approximately 500 acres required



50 MW Large Scale HCPV

- 100 20-array 500 kW systems
- Each unit is 46' x 55'
- Approximately 530 acres required

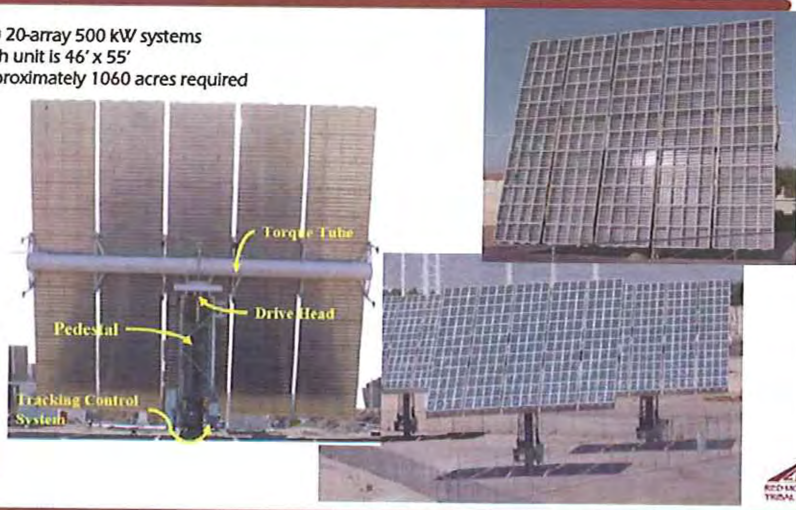


100 MW Large Scale PV

- 11000 sections, each consisting of 52 Sharp NT-180U1-175/180 – watt photovoltaic modules and 2 Satcon Powergate, ae-500 kW inverters
- Approximately 1000 acres required

100 MW Large Scale HCPV

- 200 20-array 500 kW systems
- Each unit is 46' x 55'
- Approximately 1060 acres required



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Laguna Solar Project Comparison

	Capital Cost (millions)	Acreage Required	Energy Production (million kWhs)	Levelized Cost of Energy ($.00 per kWh)
3 MW Single axis tracking PV	$26	30		
50 MW Single axis tracking PV	425	500		
50 MW HCPV	260	530		
100 MW Single axis tracking PV	850	1000		
100 MW HCPV	480	1060		

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Project Development/Ownership Options

- Community Scale
  - Developer owned/operated
  - Laguna owned/operated w/grant funding
- Large Scale
  - Developer owned/operated
  - Tribal/Tax Partner Joint Venture

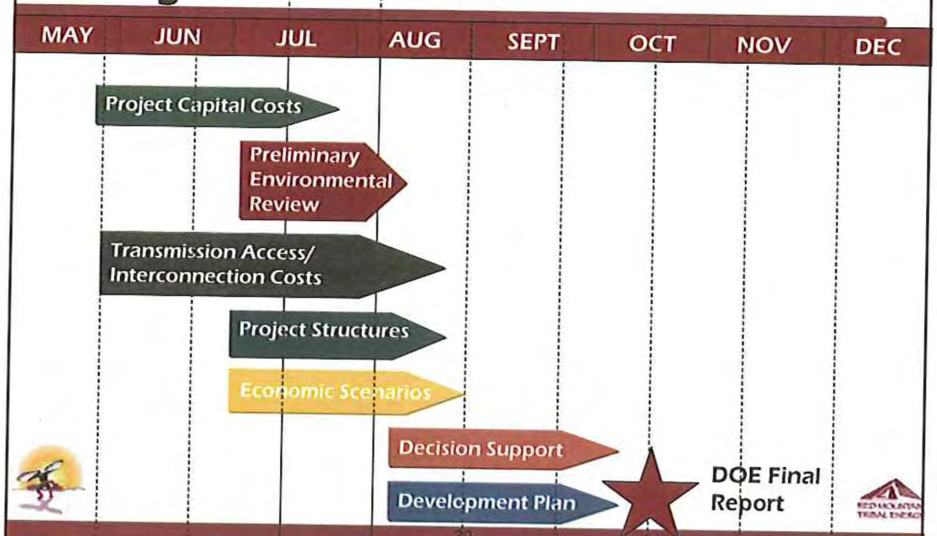
Project Economics/PPA Indications

- Community Scale
  - Laguna owned/operated w/grant funding likely to provide best economics
    - ✓ Grants reduce capital outlay
    - ✓ Net metered power
    - ✓ Sell RECs separately
- Large Scale
  - Tribal/Tax Partner Joint Venture likely to provide best economics
    - ✓ Tax partner takes advantage of tax incentives (ITC)
    - ✓ Sell power/RECs bundled
    - ✓ Sell power/RECs separately
    - ✓ Utilities vs. financial institutions

Renewable Energy Project Plan – May 2007

- Indicated Next Steps - May 2007
  - Distribute and analyze results from renewable energy questionnaires
  - Monitor wind at other sites
  - Develop feasibility study for a large-scale solar project east of Mesita
- Next Steps
  - Complete preliminary solar feasibility analysis
  - Decision support (presentation materials)
  - Development plan (steps, partners, funding options)

Project Schedule



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Pueblo of Laguna
Renewable Energy Development Plan

March 2008

Plan Outline

- Plan Components and Rationale
- Laguna Community Description Summary
- Community Member Services Plan
  - ✓ Community Member Solar Program
  - ✓ Community Center Solar Pilot Project
  - ✓ LIHEAP/Weatherization Coordination
  - ✓ Gross Receipts Tax Exemption Support
- Reservation-Scale Solar Plan
- Large-Scale Solar Plan

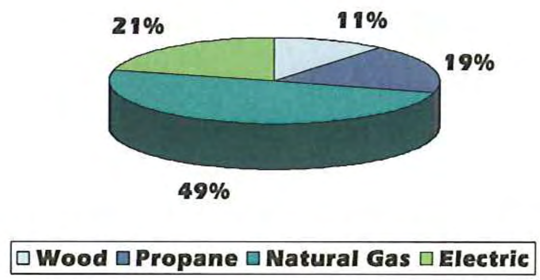
Laguna Renewable Energy Development Plan Purpose

- Provides a mechanism to economically empower the Laguna community
- Serve as a benchmark for progress in becoming energy self-sufficient
- Moves Laguna away from reliance on fossil fuels, which provides no community benefits
- Enhances livability for community members
- Promotes awareness of the need for community sustainability
- Allows Laguna the opportunity to take environmentally progressive action, and identifies Laguna as being more responsible and conscious about its impact on the earth

Laguna Target Community Summary

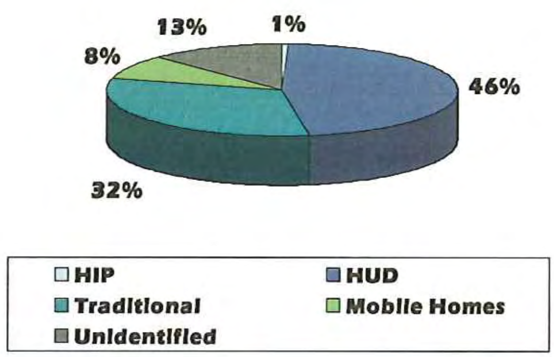
Laguna Target Community Demographics

Heating Assistance Customer Fuel Use



Laguna Target Community Housing Summary

Heating Assistance Customer Home Types



Laguna Target Community Household Annual Energy Use

- Average Laguna residential kWh/yr consumption for 2006 is approximately 6,230 kWh/yr
  - *Space heating typically 30% of total use*
  - *Water heating typically 20% of total use*
  - *Laguna has 1,294 residential household customers*

Total Consumption		Water Heating Use		Space Heating Use	
kWh/yr	Mbtu/yr	kWh/yr	Mbtu/yr	kWh/yr	Mbtu/yr
6,000.0	20.5	1,200.0	4.1	1,800.0	6.1
12,000.0	40.9	2,400.0	8.2	3,600.0	12.3
18,000.0	61.4	3,600.0	12.3	5,400.0	18.4

Community Member Services Plan: Community Member Solar Program

Community Member Solar Program Purpose

- Reduce Laguna member energy cost burden
  - Nearly 200 members eligible in 2006-7 heating season
- Improve reliability of energy services
- Promote use of renewable energy resources
  - Community input indicates support for use of renewables, and consistency with community values and traditions

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Community Member Solar Program Concept

- Laguna UA provides solar power generation, 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 provides equipment at significantly reduced cost, assuming grant funding is available
  - Purchase wholesale and act as distributor
  - Support member tax credit analysis
- Laguna UA bundles any applicable credits for community, for use in funding the program
  - White tags (energy conservation)
  - Carbon credit offsets
  - Renewable Energy Credits
- Laguna UA can provide education and training for community members or ongoing operations and maintenance support, as requested

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Community Member Solar Program: Solar PV Module Specified

- Kyocera KC175 GT
  - High efficiency multi-crystal
  - 175 watt, max dc power
  - 23.6V, max voltage
  - 7.42A, max current
  - 35.3 lbs module weight
  - 50.8" x 39.0" dimensions

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Community Member Solar Program: Residential Solar PV Array

1.05 kW PV Expandable System
- KACO 1501i 1500 watt inverter
- 120" rail kit mounting
- 600V dc disconnect
- Meter socket
- Permit pulling fee
- General parts and labor

Cost estimate: $10,333.52

*Sacred Power/LUZ Energy Corp cost estimate, including installation; Laguna UA distributor purchase/installation likely to be lower cost

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Community Member Solar Program: PV Array System Characteristics

- Assumptions made for 1.05 kW array
  - Temperature loss coefficient: .05% per degree C
  - 3% loss due to component mismatch
  - 4% loss due to dirt
  - 10% loss due to inverter efficiency
  - NOCT 47 C
- Estimated capacity factor
  - 25% (avg)
- Estimated dc power rating
  - .90 kW (avg)
- Estimated ac power rating
  - .75 kW (avg)
- Estimated energy production
  - 1939 kWh/yr (assume avg insolation of 6.4 hr/d peak sun)

Community Member Solar Program: PV Array Illustration

- 1 kW PV Array = (6) 175 W Panels

Community Member Solar Program: PV Array Energy Production

Flat Plate Collector PV Array	
Fixed Tilt, South Facing	
Albuquerque, NM; Lat: 35.05N; Long: 106.62W	
dc power, kW	1.05
temp coefficient	0.5%/C
loss, mismatch	3%
loss, dirt	4%
loss, inverter	10%
NOCT, celsius	47

Community Member Solar Program: PV Array Energy Production at Latitude +15 Degree Tilt

Month	Insolation	Avg Max Temp	Cell Temp	Array dc Power	Array ac Power	ac Energy
	kWh/m^2-day	C	C	kW	kW	kWh/mo
January	5.80	8.20	41.95	0.97	0.81	145.45
February	6.20	11.90	45.65	0.95	0.79	152.50
March	6.50	16.30	50.05	0.92	0.78	156.17
April	6.60	21.60	55.35	0.90	0.75	154.02
May	6.30	26.50	60.25	0.87	0.73	143.01
June	6.10	32.20	65.95	0.85	0.71	133.96
July	6.00	33.60	67.35	0.84	0.70	130.67
August	6.30	31.70	65.45	0.85	0.71	138.76
September	6.50	27.70	61.45	0.87	0.73	146.54
October	6.60	21.70	55.45	0.90	0.75	153.94
November	5.90	14.10	47.85	0.94	0.78	143.44
December	5.50	8.60	42.35	0.96	0.81	137.64
Average	6.2	21.2	54.93	0.90	0.75	144.67
			Total	kWh/yr	=	1880.77

Community Member Solar Program: PV Array Energy Production at Latitude -15 Degree Tilt

Month	Insolation	Avg Max Temp	Cell Temp	Array dc Power	Array ac Power	ac Energy
	kWh/m^2-day	C	C	kW	kW	kWh/mo
January	4.60	8.20	41.95	0.97	0.81	115.36
February	5.40	11.90	45.65	0.95	0.79	132.82
March	6.30	16.30	50.05	0.92	0.78	151.36
April	7.30	21.60	55.35	0.90	0.75	170.36
May	7.70	26.50	60.25	0.87	0.73	174.79
June	7.80	32.20	65.95	0.85	0.71	171.29
July	7.40	33.60	67.35	0.84	0.70	161.16
August	7.20	31.70	65.45	0.85	0.71	158.58
September	6.60	27.70	61.45	0.87	0.73	148.79
October	5.90	21.70	55.45	0.90	0.75	137.61
November	4.80	14.10	47.85	0.94	0.78	116.69
December	4.30	8.60	42.35	0.96	0.81	107.61
Average	6.3	21.2	54.93	0.90	0.75	145.54

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Community Member Solar Program: PV Array Energy Production at Latitude Tilt

Month	Insolation	Avg Max Temp	Cell Temp	Array dc Power	Array ac Power	ac Energy
	kWh/m^2-day	C	C	kW	kW	kWh/mo
January	5.30	8.20	41.95	0.97	0.81	132.91
February	6.00	11.90	45.65	0.95	0.79	147.58
March	6.50	16.30	50.05	0.92	0.78	156.17
April	7.20	21.60	55.35	0.90	0.75	168.03
May	7.20	26.50	60.25	0.87	0.73	163.44
June	7.10	32.20	65.95	0.85	0.71	155.92
July	6.90	33.60	67.35	0.84	0.70	150.27
August	6.90	31.70	65.45	0.85	0.71	151.97
September	6.80	27.70	61.45	0.87	0.73	153.30
October	6.50	21.70	55.45	0.90	0.75	151.61
November	5.50	14.10	47.85	0.94	0.78	133.71
December	5.00	8.60	42.35	0.96	0.81	125.13
Average	6.4	21.2	54.93	0.90	0.75	149.17
			Total	kWh/yr	=	1939.20

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Community Member Solar Program: PV Array Energy Production

PVWatts ..... **AC Energy & Cost Savings** ..... Cautions for Interpreting the Results

Station Identification	
Cell ID:	0197372
State:	New Mexico
Latitude:	35.0 ° N
Longitude:	107.3 ° W
PV System Specifications	
DC Rating:	1.05 kW
DC to AC Derate Factor:	0.753
AC Rating:	0.79 kW
Array Type:	Fixed Tilt
Array Tilt:	35.0 °
Array Azimuth:	180.0 °
Energy Specifications	
Cost of Electricity:	6.5 ¢/kWh

Results			
Month	Solar Radiation ($kWh/m^2/day$)	AC Energy (kWh)	Energy Value ($)
1	5.31	129	8.38
2	5.94	127	8.26
3	6.53	153	9.95
4	7.15	156	10.14
5	7.08	156	10.14
6	6.91	143	9.29
7	6.86	147	9.55
8	6.57	141	9.17
9	6.82	144	9.36
10	6.59	148	9.62
11	5.86	132	8.58
12	5.09	124	8.06
Year	6.39	1701	110.56

Community Member Solar Program: Solar Hot Water System

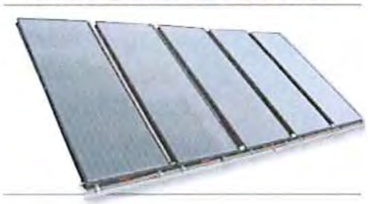
Heliodyne Helio-Pak HX PVC Domestic Hot Water System Components

- 3366 Gobi Collector, 26.8 sq ft
- Rack kit for 1 collector
- PV pump station
- Helix SS heat exchanger
- 40 Gas hot water heater
- Parts, labor, permit pulling fee

Cost estimate: $5,435.75

*Sacred Power/LUZ Energy Corp cost estimate; Laguna UA distributor purchase/installation likely to be lower cost

Gobi Solar Collector



Community Member Solar Program: Solar Hot Water System Characteristics

- Assumptions made for Gobi 3366
  - Clear sky with 6.4 h/d peak sun insolation
  - 40 gallon storage (sized for 2-person household)
  - Propane cost: $2.82/gallon (estimate from UA LIHEAP data)
  - Natural gas cost: $12.64/1000 CF (EIA 2007 New Mexico state avg)
  - Electricity cost: $0.0916/kWh (current CDEC residential rate)

Solar Hot Water System Energy Offset	
kwh/yr	Mbtu/yr
2,648.64	9.04

Annual Savings		
propane user $/yr	natural gas user $/yr	electricity user $/yr
280.05	110.83	242.62

Community Member Solar Program: Solarsheat Space Heating

1500G SolarSheat
Hot Air Collector With PV Assembly
- Ventilation duct and blower
- Vents and insulation
- General parts and labor

Cost estimate: $4,799.05
*Sacred Power/LUZ Energy Corp cost estimate; Laguna UA distributor purchase/installation likely to be lower cost

Community Member Solar Program: SolarSheat Space Heating

- SolarSheat SH1500G
  - Can be wall or roof mounted
  - 6 Mj SRCC rating for mildly cloudy day, category C
  - 6 kBtu per day output
  - Tempered glazed glass
  - 15.5 watts PV system
  - 71 CFM flowrate
  - .35 ton per year carbon dioxide reduction

Community Member Solar Program: SolarSheat Characteristics

- Assumptions:
  - 6 Mj SRCC rating for mildly cloudy day, category C
  - 6 kBtu output per day
  - Propane cost: $2.82/gallon (estimate from UA LIHEAP data)
  - Natural gas cost: $12.64/1000 CF (EIA 2007 New Mexico state avg)
  - Electricity cost: $0.0916/kWh (current CDEC residential rate)

Solar Space Heating Energy Offset	
kwh/yr	Mbtu/ yr
654.16	2.23

Annual Savings		
propane user	natural gas user	electricity user
$/yr	$/yr	$/yr
69.17	27.34	59.92

Community Member Solar Program: Energy Offset Components

- Solar PV system, solar hot water system, and SolarSheat space heating technologies combine for a total energy reduction of over 5,000 kWh/yr
- Energy offset components (estimated):
  - Hot Water Heating: 2,649 kWh/yr
  - Space Heating: 654 kWh/yr
  - PV Array: 1,726 kWh/yr

5,029 kWh/yr

Community Member Solar Program: Energy Offsets By Usage Type

total consumption		water heating (*)		net water heat energy need		space heating (**)		net space heat energy need	
KWh/yr	Mbtu/yr	KWh/yr	Mbtu/yr	KWh/yr	Mbtu/yr	KWh/yr	Mbtu/yr	KWh/yr	Mbtu/yr
6,000.0	20.5	1,200.0	4.1	-1,448.6	-4.9	1,800.0	6.1	1,145.8	3.9
12,000.0	40.9	2,400.0	8.2	-248.6	-0.9	3,600.0	12.3	2,945.8	10.1
18,000.0	61.4	3,600.0	12.3	951.4	3.2	5,400.0	18.4	4,745.8	16.2

(*) water heating assumed to be 20% of total household consumption
(**) space heating assumed to be 30% of total household consumption

- Important concepts from this table:
  - Water heating energy offset 100% for up to 12,000 kWh/yr energy consumption household
  - Space heating energy offset in range of 64-88% of total

Community Member Solar Program: Energy Cost Offset Comparison

			Annual Cost Offsets		
			Propane user	Natural Gas user	Electric user
Solar Tech	kwh/yr	Mbtu/yr	$/yr	$/yr	$/yr
Solar Hot Water	2,648.64	9.04	280.05	110.80	242.62
Solar Air	654.16	2.23	69.11	27.34	59.92
PV Array	1,701.00	5.80	112.19	112.19	155.81
TOTAL	5,003.80	17.07	461.35	250.33	458.35

*assume PV array performs according to PVWatts calculations, yielding 1701 kWh/yr per installed 1.05kW

- *Propane users achieve largest $ savings – estimated to be roughly $460 per year*
- *Electric users would save $458 per year and natural gas users would save $250 per year of their total household energy bills*

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Community Member Solar Program: Energy Offsets and Percent Savings

Annual Home Energy Use		Net Home Energy Need, Less Solar Energy Produced		Total Home Energy Reduction
kWh/yr	Mbtu/yr	kWh/yr	Mbtu/yr	%
6000	20.472	971.20	3.31	0.84
12000	40.944	6,971.20	23.79	0.42
18000	61.416	12,971.20	44.26	0.28

- Potential total energy reduction of 28-84% of total energy consumption per year, residential

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Community Member Solar Program: Overall Program Economics

	Annual Solar Energy Offset		Renewable Energy Production Incentive per household	Carbon Credits per household	Renewable Energy Credits	Total Annual Incentive Revenues for 150 households
	kwh/yr	CO2/yr	$/yr	$/yr	$/yr	$/yr
Solar Hot Water	2,649	1.50	$ 40	$ 8	n/a	$ 7,084
Solar Air	654	0.35	$ 10	$ 2	n/a	$ 1,734
PV Array	1,726	1.00	$ 26	$ 5	$ 112	$ 21,462
TOTAL	5,029		$ 75	$ 14	$ 112	$ 30,281

	Cost per unit	Tax credit - 30% w/ $2000 cap	Total Cost per unit	Total Laguna Costs
Solar Hot Water	$ 5,435	$ 1,631	$ 3,805	$ 570,675
Solar Air	$ 4,799	$ 1,440	$ 3,359	$ 503,895
PV Array	$ 10,000	$ 2,000	$ 8,000	$ 1,200,000
Total	$ 3,035,100			$ 2,274,570

Community Member Solar Program Rationale

- Laguna recognizes the need to ensure a vibrant and healthy quality of life for community members, including living conditions and housing needs, particularly elders and disadvantaged households
- Electrification provides basic quality of life, and can be addressed by Laguna in an environmentally conscious way
- Use of solar technology is cultural appropriate:
  - Aligns with Laguna values of respect and stewardship for the land and environment
  - Community member assistance aspects are consistent with Laguna elder care priorities

Community Member Solar Program Rationale

- Solar technologies are at various stages of development and feasibility for home and commercial use
- Solar energy exists as both an economy and community defining moment
- Laguna solar development provides recognition of the cleanliness and acceptability of solar technologies and promotes the use of renewable energy in tribal communities

Community Member Solar Program: Funding Plan

- Applicable Incentives Available
  - Personal Tax Credits – Federal/State
  - Corporate Tax Credits –Federal/State
  - REC sales
  - Potential carbon credits
  - Renewable production incentives
  - Other
- Grant Funding Targets
  - DOE Tribal Energy Program
  - NM EMNRD
  - USDA
  - Other

Community Member Services Plan: Community Center Pilot Solar Project

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Community Center Solar Pilot Project Concept

- Each of the villages would have the option to have solar equipment (PV panels, solar hot water heating, and solar heating) installed at the 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

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Community Center Solar Pilot Project Purpose

- Provide villages an opportunity to reduce their energy usage and costs, and free up funding to meet other community needs
- Through information available at the community centers, provide educational programs that help community members understand the benefits of renewable resources

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Community Center Solar Pilot Project: Encinal Community Center

- Encinal Village Community Center is approximately 30 feet by 40 feet in length and width and 1200 square feet in area
- Community Center is actively used and serves roughly 61 households
- Encinal's Community Center 2007 energy requirement is estimated to be 9000 kWh
- Community Center's location is free and clear from possible surrounding obstructions and shading issues and the building's roof has excellent access to the south

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Community Center Solar Pilot Project: Paraje Community Center

- Paraje Village Community Center is approximately 2500 square feet in area
- Community Center is not currently in use but would be serving roughly 211 households
- Paraje's Community Center currently has no energy requirement for 2007, but estimated to be 67,000 kWh/year
- Community Center's location is free and clear from possible surrounding obstructions and shading issues and the building's roof has excellent access to the south

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Community Center Solar Pilot Project: Paguate Community Center

- Paguate Community Center is approximately 65 feet by 30 feet in length and width and 2,000 square feet in area
- Community Center is actively used and serves roughly 192 households
- Paguate Community Center 2007 energy requirement is estimated to be 67,000 kWh/year
- Community Center's location is free and clear from possible surrounding obstructions and shading issues and the building's roof has excellent access to the south

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Community Center Solar Pilot Project: Seama Community Center

- Seama Village Community Center is approximately 55 feet by 20 feet in length and width and 1100 square feet in area
- Community Center is actively used and serves roughly 155 households
- Seama Community Center 2007 energy requirement is estimated to be 48,300 kWh/year
- Community Center's location gives the building's roof access to the south but there are potential shading issues due to a hill on the building's west side

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Community Center Solar Pilot Project: Mesita Community Center

- Village of Mesita has elected not to have solar PV equipment installed at their Community Center
- An alternative site has been designated as available for PV system installation

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Community Center Solar Pilot Project: Laguna Community/Recreation Center

- The Laguna Village Community Center is approximately 2500 square feet in area
- Community Center is actively used and serves roughly 429 households
- Laguna Community Center 2007 energy requirement is estimated to be 67,000 kWh/year
- Community Center's location is free and clear from possible surrounding obstructions and shading issues and the building's roof has excellent access to the south

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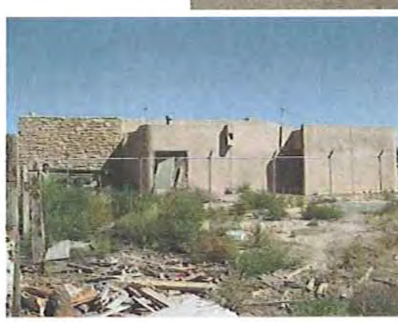
Community Center Solar Pilot Project: Laguna Village Community/Recreation Center

Laguna Village Community/Recreation Center

- Expansion/renovation
  - From 2,500 sq ft to 5,233 sq ft
- Estimated annual consumption
  - 6,6676 kWh/yr
  - Assumed to be considered Small Commercial
- Significant roof area for solar technologies



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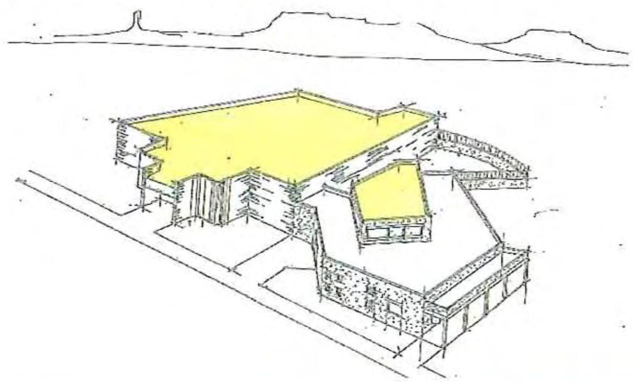
Community Center Solar Pilot Project: Laguna Community/Recreation Center Available Rooftop

Redesign For Laguna Village Community/Recreation Center

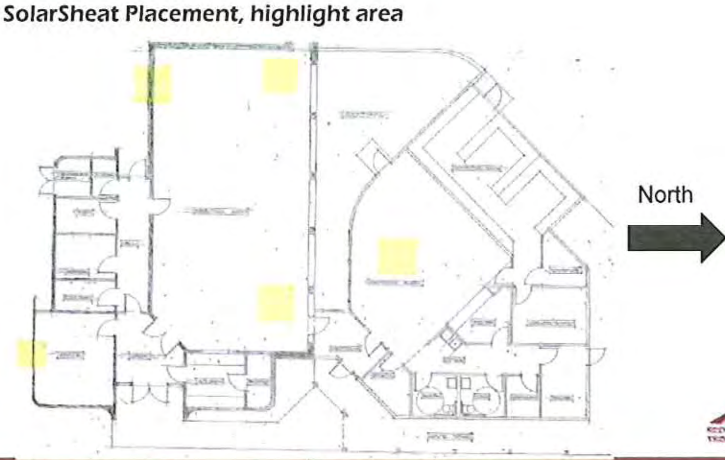
- Rooftop area available for solar PV, Solar Hot Water, SolarSheat heating
  - Highlighted area is approximately 2,000 sq ft



Community Center Solar Pilot Project: Laguna Community/Recreation Center SolarSheat Placement

Redesign Plan View

Possible SolarSheat Placement, highlight area



Community Center Solar Pilot Project: Overall Economics

				Annual Cost Offsets		
				Propane User	Natural Gas User	Electric User
Solar Tech	Units Installed	kWh/yr	Mbtu/yr	$/yr	$/yr	$/yr
SHW	2	5,297	18	560	222	485
Solar Air	6	3,925	13	415	164	360
*PV Array	10.15 kW, 58 modules	16,442	56	1,739	688	1,506
	TOTAL	25,664	88	2,714	1,074	2,351

*assume PV array performs according to PVWatts calculations, yielding 1701 kWh/yr per installed 1.05kW

Estimated annual energy reduction 62% of total energy consumption, kWh/yr

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Community Center Solar Pilot Project: WAPA PV Panel Concept

- Late in December 2007, WAPA made PV panels available to Tribes, which provided Laguna an opportunity to revise its plans to include these panels, as described below:
  - Laguna UA provides WAPA PV panels to each village for community center installation, as requested
  - Additional system costs covered by village or available grant funding
  - Laguna UA installs/coordinates installation of PV panels
  - Laguna UA bundles and sells Renewable Energy Credits and carbon offsets to cover its costs
  - Villages benefit from lower electric costs, due to reduced electric usage resulting from solar energy produced by the PV systems

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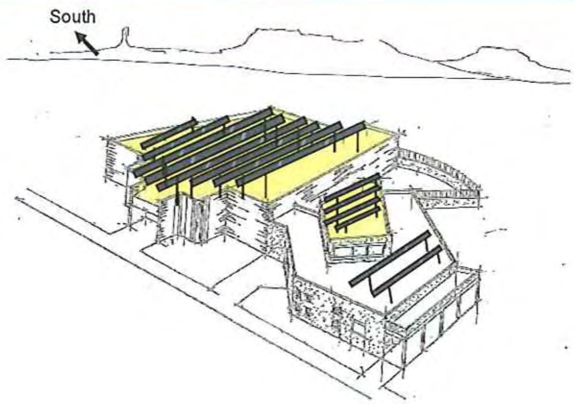
Community Center Solar Pilot Project: WAPA PV Panel Energy Production/Savings

Watts	# of panels	Area in square feet	kW	MWh	% load	Savings
43	257	2,223	11	15.3	23%	$ 1,530
50	251	1,568	13	17.3	26%	$ 1,730
110	399	5,098	44	60.4	23%	$ 6,040
	906		67	93		$9,300

Community Center Solar Pilot Project: Additional System Costs Required for Installation of WAPA PV Panels

System size, kW	5.5	8	10	11
Power generated, kWh	7,227	10,500	13,100	14,500
% of load provided by solar	11%	16%	20%	22%
Costs to install	$ 35,016	$ 45,391	$ 53,451	$ 58,681
# systems	12	8	6	6

Community Center Solar Pilot Project: Laguna Community Center Design using WAPA PV Panels



**Drawing is not to scale.

Community Center Solar Pilot Project: PV Panel Installation Training Available

- **New Mexico Solar Energy Association**
  www.nmsea.org
  5 -day $500
- **Solar Energy International (SEI)**
  http://www.solarenergy.org/about/index.html
  6-day to 10-day workshop - $950
  PV Lab – $1,100
- Debby Tewa, PV installer and trainer

Community Center Solar Pilot Project Rationale

- Community centers serve as general meeting places for various cultural, governmental, and social activities
- Community centers also anchor many social programs such as community elder meal programs, child after-school programs, and family celebrations
- Installing PV panels on community centers will create a series of dynamic and multi-dimensional concepts that support and influence Laguna villages at a number of levels:
  - Raise energy awareness for Laguna members
  - Elevate use of renewable energy for Laguna communities
- Project provides the Laguna UA an opportunity to support community development and member capacity building through energy education and cost-effective use of renewable resources
- Project provides the Laguna UA an opportunity to demonstrate its commitment to resourcefully serving community needs

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Community Member Services Plan: LIHEAP/Weatherization Coordination

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LIHEAP/Weatherization Coordination

- LIHEAP – Federal/state/UA funded coordinated effort; initial year completed
  - UA implemented the program due to lack of county customer outreach
  - UA served almost twice the amount of tribal members compared to the county in 2006
- Weatherization – Similar Laguna-coordinated effort possible to pursue program and funding for residents and tribal entities

RED MOUNTAIN TRIBAL ENERGY

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Low Income Housing Energy Assistance Program (LIHEAP)

- Conduct outreach activities and provide assistance to low income households in meeting their home energy costs, particularly those with the lowest incomes that pay a high proportion of household income for home energy
- Intervene in energy crisis situations
- Provide low-cost residential weatherization and other cost-effective energy-related home repair; and
- Plan, develop, and administer the State's program including leveraging programs

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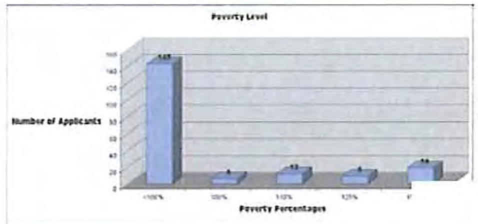
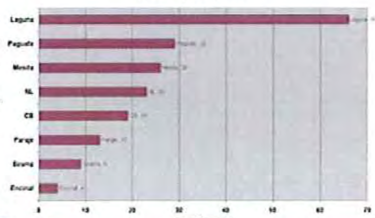
Prior Laguna LIHEAP Coordination

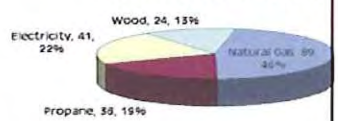
2006-2007 Laguna UA LIHEAP customer payment assistance coordination supported nearly 200 families, nearly double the number of families served in prior years



Applicants were overwhelmingly under the established poverty level



Applicant fuel sources reflected a balance of fuel types



Applicant locations were consistent with village populations

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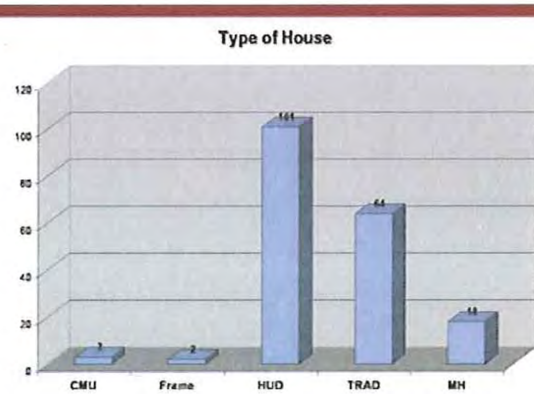
DOE Weatherization Coordination

The UA also plans to directly pursue DOE weatherization program funding and coordination in order to provide better access to member assistance



LIHEAP applicant home types indicated strong Laguna needs for improved access to weatherization program funding

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Why Weatherization?

- Heavy energy burden on low-income
  - Typically spend 14% of annual income on energy, compared with 3.5% for other households
- Low-income families often choose between heat and other necessities
- 28 million households currently eligible for Weatherization services—many are in Indian Country

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Weatherization Benefits

- Increases energy efficiency of the home
- Reduces energy costs year-round
- Provides long-term relief from expensive energy bills, not just bill paying
- Alleviates arrears, breaks destructive cycle of shut-offs and re-connections
- Breathes new life into marginal housing stock

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How Does Weatherization Work?

- Client applies for services
- Energy audit conducted; technicians identify energy-related problems
- List of cost-effective measures developed
- Energy efficiency measures installed
  - Measures more technically sophisticated since origins; building science widely practiced
  - Range of diagnostic tools used to identify and remediate energy problem
  - Test for health and safety hazards (e.g., carbon monoxide, gas leaks, potential for backdrafting)

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How Does Weatherization Work?

- Critical client education component undertaken
  - Ensure savings
  - Prevent health hazards
  - Prolong life of measures/equipment
  - Conducted before and after measures are installed
- Post-work inspection accomplished

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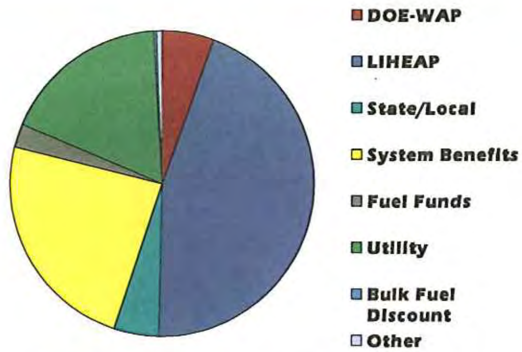
Energy Efficiency Measures: Base Load Reduction

- Electricity consumption can be reduced through lighting, refrigerator, or water heater measures,
- Range from low flow devices and CFL installations to refrigerator and HVAC system replacements
- Utility resources often used to supplement work for such measures as refrigerator and HVAC system replacement

Impacts of Weatherization

- Energy savings in the range of 30%, depending upon many variables
  - New evaluation in the planning stages
- DOE Central Region results range from 25-40% savings
  - On average, cost per weatherized house is $274
  - For every $1 invested in Weatherization return of $1.40 on average
  - For every $1 invested (by DOE), another $1.48 is "leveraged" from other funding sources such as federal, state, utility and private resources

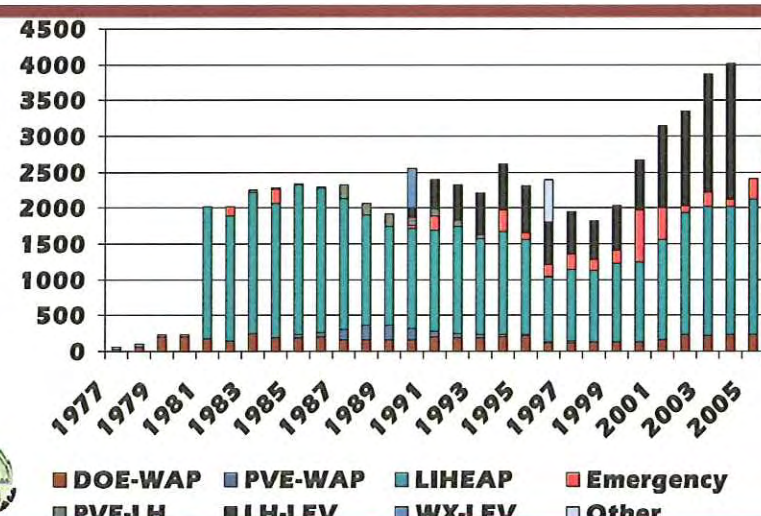
Low Income Energy Funding Sources



2004 - $4.1 Billion in Low-Income Funding

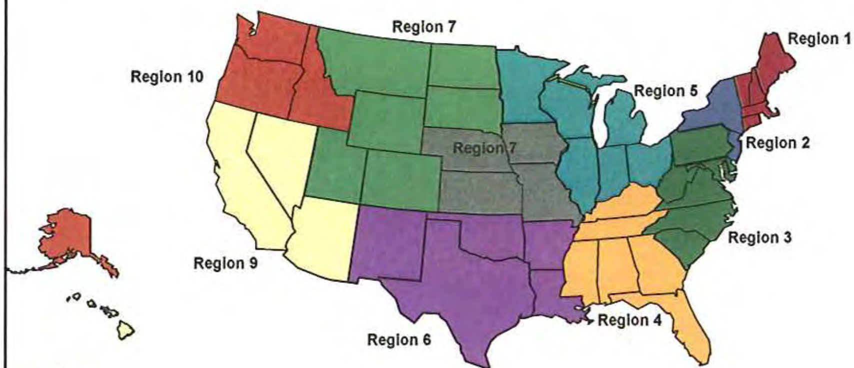
Source: www.liheap.ncat.org

Low Income Energy Funding History



Source: www.liheap.ncat.org

Funding Resource Regions



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Low-Income Energy Funds – Federal Region 6

Region 6:

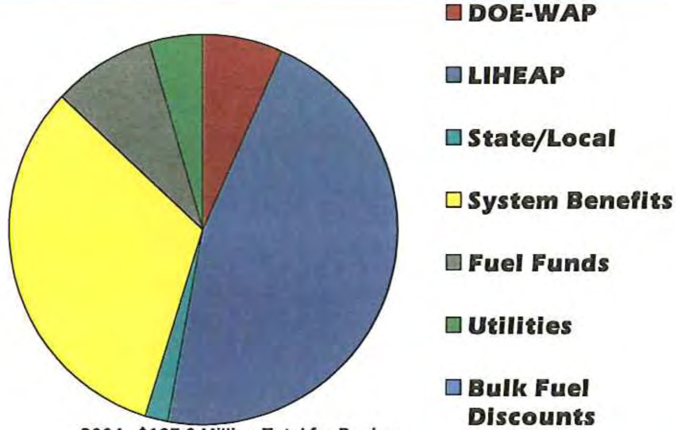
Arkansas

Louisiana

New Mexico

Oklahoma

Texas



2004 - $197.0 Million Total for Region

Tribes @ 4.0% - $7.9 Million

Tribes @ 8.0% - $15.9 Million

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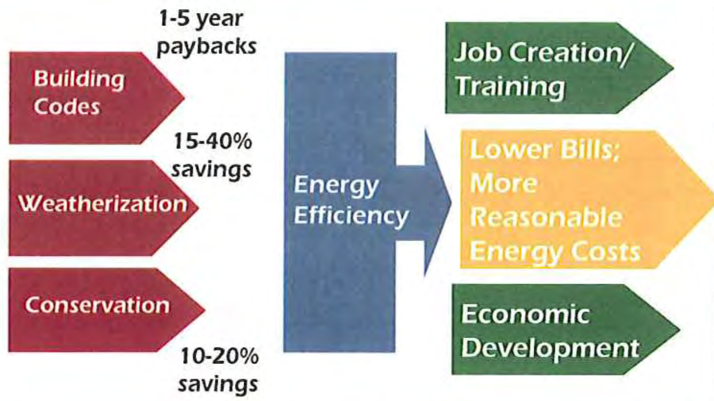
Value of Energy Efficiency

- Provides year-round, long-term relief from expensive energy bills
- Breathes new life into marginal housing stock



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Energy Related Funding Sources

- DOE – Weatherization Program
- HHS - LIHEAP
- Utilities - Various
- Private organizations -Various
- BIA-HIP
- HUD-NAHASDA
- Others

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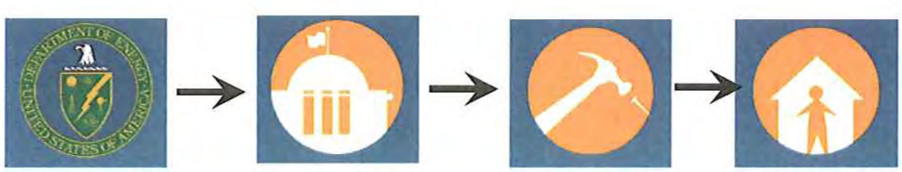
DOE Weatherization Program

- FY2008: $224MM
- Existed since 1976 (10 CFR Part 440 for DOE)
- Goal to reduce energy costs for low-income families, particularly elderly, disabled, and children, while ensuring health and safety
- Operates in every State, County, District of Columbia, and reservation
- Year-round services free to low-income eligible residents
- Direct Services
    - ✓ Advanced Energy Audit; Insulation
    - ✓ Blower Doors & other Diagnostic tools
    - ✓ Air Sealing & Duct Sealing; Windows & Doors
    - ✓ Heating & Cooling systems
    - ✓ Water Heaters
    - ✓ AC and Warm Climate Weatherization Measures
    - ✓ Electrical Appliances and Weatherization Base Load Measures
- Training & Technical Assistance

DOE - Weatherization Funds Flow



Department of Energy HQ/ 6 Regional Offices → 50 State Energy Offices/ DC/Tribal Organizations → Over 970 Local Agencies → Low-Income Americans

DOE-WAP Fund Distribution Factors

- F-3 Residential Energy Expenditures by Low-Income Households in each state
  - Approximation of financial burden energy use places on low-income households
  - Approximation necessary due to lack of state-specific data on residential energy expenditures by low-income households

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DOE-WAP Fund Distribution Factors

- F-3 Residential Energy Expenditures by Low-Income Households in each state
  - Approximation of financial burden energy use places on low-income households
  - Approximation necessary due to lack of state-specific data on residential energy expenditures by low-income households

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Grantees and Subgrantees

- DOE funds "grantees"
  - Most are state offices
  - Two are tribes
- Grantees fund "subgrantees"
  - Community action agencies
  - Special purpose agencies
  - Units of local government
  - Tribes
- Subgrantees have opportunities to participate in State, Regional, and National-level training and technical assistance

2004-5 DOE Weatherization Services Provided

CENTRAL REGION WEATHERIZATION PROGRAM - PROGRAM YEAR 04-05

State	FY 04 DOE Allocation (PY 04-05)	State Receives Non-DOE Funds?	TOTAL Number of Units Completed	TOTAL Number of People Assisted with Grant Funds	Number of Native Americans Assisted with Grant Funds	% Assisted - Native American
Colorado	$5,479,996	Yes	4,082	10,088	143	1.42%
Kansas	$2,530,561	Yes	1,413	2,630	33	1.25%
Louisiana	$1,731,371	No	1,127	1,640	2	0.12%
Montana	$2,519,458	Yes	1,354	2,447	553	22.60%
Nebraska	$2,494,014	No	595	1,472	74	5.03%
New Mexico	$1,723,006	Yes	869	1,703	172	10.10%
North Dakota	$2,496,970	No	803	1,437	217	15.10%
Oklahoma	$2,591,542	No	915	2,059	187	9.08%
South Dakota	$1,916,788	No	1,049	988	180	18.22%
Texas	$5,575,530	Yes	1,822	4,212	6	0.14%
Utah	$2,077,161	No	830	2,417	143	5.92%
Wyoming	$1,174,532	No	539	1,072	43	4.01%
TOTAL - 12 STATES	$32,310,929		15,398	32,165	1,753	5.45%

Find Information/Apply for Services

- Contact current local provider in your area
- Obtain contact list or Name of State Program Manager
- View Weatherization websites:
  - http://www.eere.energy.gov/weatherization/
  - http://www.waptac.org/
- Contact DOE's Regional Weatherization Project Manager
  - Central Region – Rob DeSoto

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Getting Access to Direct Funding

- What the current federal regulations (10 CFR 440) pertaining to processes for applying for direct grants -
  - 10 CFR 440.11 Native Americans
  - (1) Low-income members of an Indian Tribe must present to the Support (Regional) Office Director, a case of not receiving benefits equivalent to assistance provided to other low-income persons in a State

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Getting Access to Direct Funding

- (2) The low-income members of such tribe would be better served by means of a grant made directly to provide such assistance
- The Director reviews, and can make a determination for direct funding, in which case he reserves funding not less than 100 percent, or more than 150%, an amount which bears the same ratio of Native Americans under this determination, to the population of all low-income persons in the State.

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Other Options

- For Providing Weatherization services:
  - 10 CFR 440.12 State Application
  - (5) A recommendation that a Tribal organization be treated as a local applicant eligible to submit an application pursuant to 440.14 (b) (becoming a "Subgrantee")

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HHS - LIHEAP

- Tribes can apply for funding/administer programs
- Leveraging awards
- Tribal Reach awards
  - To minimize the health and safety risks that result from high energy burdens on low-income Americans, prevent homelessness as a result of inability to pay energy bills, increase the efficiency of energy usage by low income families and target energy assistance to individuals who are most in need
  - Implementation and evaluation of energy efficiency education services that meet quality standards established by the Secretary in consultation with the Secretary of Energy, and have the potential for being replicable model designs for other programs
- 148 Tribes and Tribal agencies
  - Tribes eligible households as a % of state eligible households
- Section 2604(d)(1) of the LIHEAP statute authorizes the U.S. Department of Health and Human Services to award direct LIHEAP allotments to Indian tribes and tribal organizations

HUD - NAHASDA

- Native American Housing Assistance and Self-Determination Program
  - Indian Housing Block Grant
  - Loan Guarantees
- Tribally Administered

BIA-HIP

- Home Improvement Grants
- Available to low-income members
- Awards ~ $2000

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Community Member Services Plan: Gross Receipts Tax Exemption Support

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Community Member Services Plan: State Taxes on Gas & Electric Bills

NM Gross Receipts Taxes are by law not applicable to enrolled members of Tribes living on reservations in NM

TITLE 3: TAXATION

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Community Member Services Plan: State Taxes on Gas & Electric Bills

Many Laguna members had not applied for exemption from the gross receipts (sales) tax; up to 3 years of taxes can be refunded to customers

BILLING DETAILS

BASIC SERVICES

NON-BASIC SERVICES

TOTAL NONBASIC CHARGES:

SALES TAX

TOTAL BASIC CHARGES

ACCOUNT SUMMARY

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Community Member Services Plan: State Taxes on Gas & Electric Bills

Laguna UA staff prepared information for customers to help them request assistance, and to help them understand their options re: exemption

Renewable Energy Equipment Program

	Yes	No
1. I am interested in reducing my reliance on dirty fossil fuels	☐	☐
2. I would be interested in information about renewable energy options for my home, such as PV panels and solar hot water heating	☐	☐
3. I would like assistance in purchasing and installing renewable energy equipment for my home	☐	☐
4. I would like assistance in financing renewable energy equipment for my home	☐	☐
5. I would like Laguna Pueblo to utilize renewable energy for its facilities	☐	☐
6. I would like my village to utilize renewable energy for the community center	☐	☐

General Comments and Suggestions:

Contact Thelma Antonio at 552-9957 for more information

Laguna Utility Authority Energy Services Survey

General Energy Service Questions

	Yes	No
1. I am satisfied with my current energy provider's service	☐	☐
2. I am satisfied with my current energy costs	☐	☐
3. My current energy provider's programs meet my needs	☐	☐
4. I am in favor of Laguna-controlled utility services	☐	☐
5. I would like to have the 6.552% state sales tax removed from my energy provider's bills and receive a refund for the maximum amount available	☐	☐

General Comments and Suggestions:

Community Member Services Plan: State Taxes on Gas & Electric Bills

Laguna UA staff prepared information for customers to help them request assistance, and to help them understand their options re: exemption

PUEBLO OF LAGUNA SALES TAX EXEMPTION CERTIFICATION

For use only by an enrolled member of an Indian Tribe who resides within the boundaries of the Pueblo of Laguna and thereby claims that no gross receipts (sales) tax can be levied on the provision of gas or electric services.

Utility Company	Account Number
Type or print full name	Social Security Number
Mailing Address	City, State, Zip
Census Number	Indian Tribe

☐ I declare that I am Native American living on the Pueblo of Laguna reservation.

☐ I request a refund of the prior sales taxes paid in the maximum amount allowable.

Member Signature

Date

Signature Tribal Pueblo Official

Date

Reservation-Scale Solar Project

Reservation-Scale Solar Project Concept

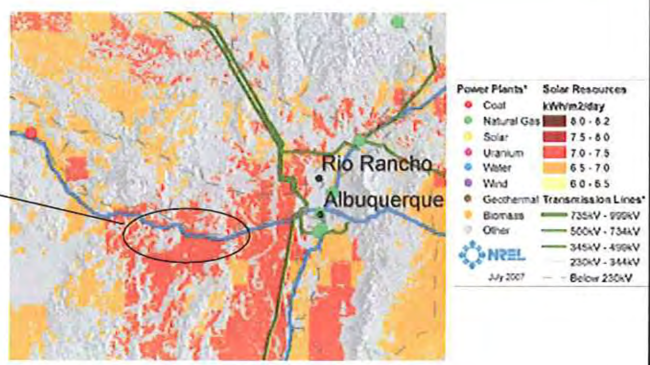
- Laguna could develop and ultimately own (after 5-7 years) a reservation-scale (2 MW) concentrating solar plant, which would help meet peak usage on its system
  - ✓ Grant funding would be needed to fund initial development costs
  - ✓ Laguna would partner with a financial institution that provided 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)

Reservation-Scale Solar Project Purpose

- Allow Laguna to leverage its resources (insolation) and provide peak period power to the Laguna electric system, which could lower overall power supply costs
- Generate power at prices acceptable to utilities needing peak power and renewable energy credits, using all available incentives
- Provide Laguna an ownership position and partnership payouts for the 20-year life of the project
- Create several jobs for Laguna members during construction and operation of the project

Reservation-Scale Solar Project: Applicable Laguna Solar Resources

Possible Laguna solar project sites



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

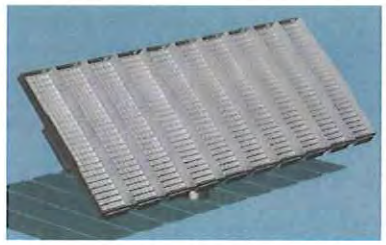
Reservation-Scale Solar Project: Solar Technology

EMCORE is an Albuquerque, NM-based firm that developed and manufactures a state-of-the-art dual-axis concentrating PV system suitable for a Laguna reservation-scale project

Features and Characteristics

The EMCORE CPV array (patent pending) is designed to deliver 25 kW peak DC power for unattended operation in either grid-tied or off-grid applications. The heart of the system is the EMCORE manufactured ultra high efficiency Multi-Junction (MJ) solar cell, leveraged from our leading Spacecraft Power technology. The system is designed for 500X concentration, using Fresnel optics and a secondary optical reflector.

The EMCORE CPV array is configured with ten (10) modular 2.5 kW sub-arrays, each containing 182 MJ solar cell receivers. A reliable structure provides safe operation in all conditions, and an extremely accurate 2-axis tracking element maintains focus on the sun, allowing for maximum power output. The array was designed for ease of assembly, installation and maintenance.



Reservation-Scale Solar Project: Possible Laguna Community Solar Project Locations

Proposed project would require roughly 13 acres of flat land near 3-phase electric distribution system lines, with minimal water required

Reservation-Scale Solar Project: Potential Power Purchasers

- PNM
  - Has sufficient renewable resources to comply with 6% RPS for 2008-9
  - Considering two additional renewable resources
    - ✓ Large-scale central station solar facility (100-200 MW)
    - ✓ Expansion of customer-owned PV REC program to apply to systems > 10kW
  - Expected to issue an RFP for small scale renewables in early 2008
- Continental Divide Electric Cooperative
  - Current RPS requires cooperatives to have 5% renewable supplied power by 2015

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Reservation-Scale Solar Project: Funding Requirements

Funding Requirements

- $14 million in capital costs
  - Turnkey equipment and construction for 2 MW of concentrating PV
  - System interconnection costs
- $500,000 in development costs
  - Detailed feasibility analyses
  - Environmental reviews
  - Project coordination
  - Financing studies
  - Power purchase negotiations
  - Project interconnection studies

Funding Sources

- Development costs - grant funding (DOE, USDA), investor funding

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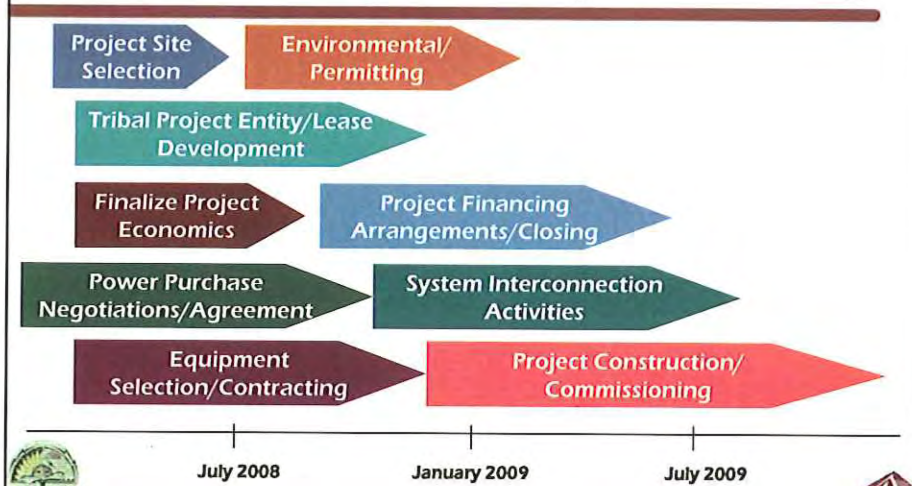
Reservation-Scale Solar Project: Possible Project Development Steps and Timing



Reservation-Scale Solar Project: Project Rationale

- 2 MW concentrating PV solar project would leverage Laguna solar resources (insolation) and provide peak period power to the Laguna electric system
- Using all available incentives, project power could be generated within a reasonable price range for the peak power and renewable energy credits needed by NM utilities
- Power for the project would not require interconnection through a new substation, but would boost power quality at its interconnection point
- Laguna could develop the project on its own, and benefit from an ownership position and partnership payouts for the life of the project

Large-Scale Solar Project

Large-Scale Solar Project Concept

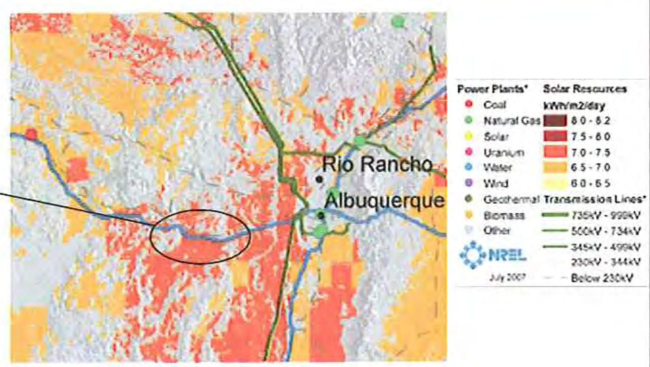
- Laguna could work with a development partner to develop, and ultimately (after 5-7 years) own and operate a large-scale (100 MW) concentrating solar plant, which would provide power to the grid to help New Mexico utilities meet their renewable energy requirements
  - Development partner would fund 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

Large-Scale Solar Project Purpose

- Allow Laguna to leverage its resources (insolation) and provide peak period power to the NM grid
- Generate power at prices acceptable to utilities needing peak power and renewable energy credits through utilization of all available incentives
- Provide Laguna an opportunity to benefit from an ownership position and significant partnership payouts for the 20-year life of the project
- Create manufacturing positions, as well as construction and operations and maintenance positions for Laguna members

Large-Scale Solar Project: Applicable Laguna Solar Resources

Possible Laguna solar project site



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

Large-Scale Solar Project: Solar Technology

EMCORE is an Albuquerque, NM based firm that developed and manufactures a state-of-the-art 2-axis concentrating PV system suitable for a Laguna reservation-scale project

Features and Characteristics

The EMCORE CPV array (patent pending) is designed to deliver 25 kW peak DC power for unattended operation in either grid-tied or off-grid applications. The heart of the system is the EMCORE manufactured ultra high efficiency Multi-Junction (MJ) solar cell, leveraged from our leading Spacecraft Power technology. The system is designed for 500X concentration, using Fresnel optics and a secondary optical reflector.

The EMCORE CPV array is configured with ten (10) modular 2.5 kW sub-arrays, each containing 192 MJ solar cell receivers. A reliable structure provides safe operation in all conditions, and an extremely accurate 2-axis tracking element maintains focus on the sun, allowing for maximum power output. The array was designed for ease of assembly, installation and maintenance.

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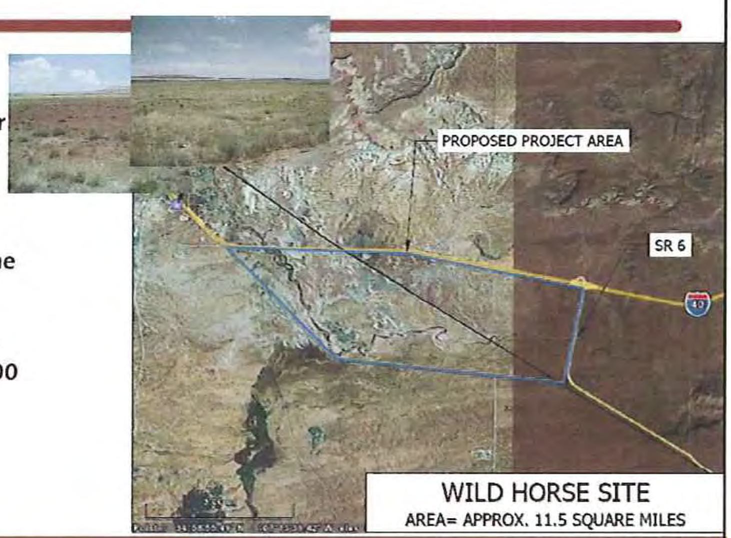
Large - Scale Solar Project: Proposed Site

This proposed large-scale solar project site has strong solar resources, is close to a transmission line and is a large, flat area; 650 acres would be needed for a 100 MW project



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Large-Scale Solar Project: Potential Power Purchasers

- PNM
  - Has sufficient renewable resources to comply with 6% RPS for 2008-9
  - PNM solar solicitation expected in early 2008
    - ✓ RPS requirements/solar set aside requires PNM to acquire roughly 200 MW of solar by 2011
  - Is considering expansion of customer-owned PV REC program to apply to systems > 10kW
  - Expected to issue an RFP for small scale renewables in early 2008
- Continental Divide Electric Cooperative
  - Current RPS requires cooperatives to have 5% renewable supplied power by 2015

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Large-Scale Solar Project: Funding Requirements

Funding Requirements

- $340-560 million in capital costs
  - Turnkey equipment and construction for 100 MW of concentrating PV
  - System interconnection costs
- $14 million in development costs
  - Detailed feasibility analysis
  - Environmental reviews
  - Full-time project coordination
  - Financing studies
  - Power purchase negotiations
  - Project interconnection studies

Funding Sources

- Development costs - grant funding (DOE, USDA), investor funding

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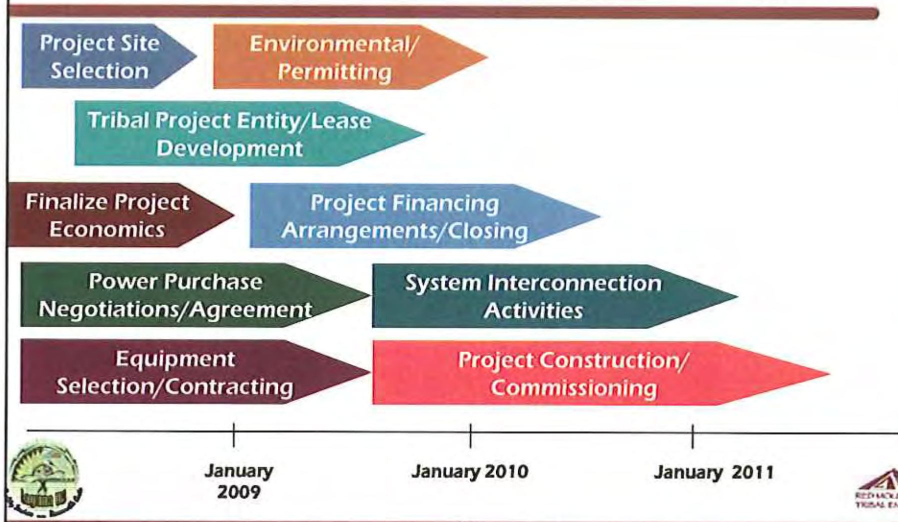
Large-Scale Solar Project: Possible Project Development Steps and Timing



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Large-Scale Solar Project Next Steps

- Pursue community and Council approval for project development
  - Identify site specifics
  - Begin environmental, cultural reviews
- Begin discussions with large-scale solar developers
  - Several large-scale solar developers have expressed interest in working with Laguna
  - Solar technology providers also interested in Laguna potential sites
- Establish contact with potential power purchasers
  - Utilities
  - Financial entities
- Begin discussions with technology providers
  - EMCORE
  - Other CPV technology providers

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Large-Scale Solar Project Rationale

- Laguna brings many advantages to a solar project partnership which can help ensure project success
- Location is close to market and transmission lines (115 kV)
- Laguna solar resources and nearby natural gas lines
- Time to market could be short, as permitting process could be accelerated with Tribal leadership support for energy development
- High potential for manufacturing/component integration facilities
- Available incentives and financing considerations can reduce levelized costs of energy
  - 30% Investment Tax Credit for solar equipment
  - New Market Tax Credits (39%) available for similar projects
  - Renewable Energy Credits from tribal lands worth 2x for certain power purchasers
  - Low-interest loan/loan guarantees/Clean Renewable Energy Bonds

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Contact Information

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Resources and Places to Find Further Information:

- California Energy Commission: http://www.energy.ca.gov/distgen/index.html
- http://www.naturalgas.org/overview/uses_electrical.asp
- http://www.fuelingthefuture.org/contents/NaturalGasPowersUp.asp
- http://epa.gov/cleanenergy/natgas.htm
- Multiple gas generating equipment vendors

For further information, contact:

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Pueblo of Laguna
Renewable Energy
Feasibility Study

Firming Renewable Generation with Natural Gas: A Technology Brief

Inside: learn more about –

- *What kinds of gas turbines are available?*
- *What do gas turbines look like?*
- *Are gas turbines suitable to firm renewable energy projects that serve facilities, villages or the reservation?*
- *How much land is required?*
- *What does gas-fired generation cost?*
- *What are the benefits and considerations associated with gas-fired generation?*

About Gas-Fired Generation

The Pueblo of Laguna Renewable Energy Feasibility Study is currently underway. The community's perspective and input is critical to the success of the study. This pamphlet is designed to provide basic information about some of the gas-firming technologies that may be considered.

What kinds of gas turbines are available?

Microturbines are small combustion turbines that produce between 25 kW and 500 kW of power. Microturbines were derived from turbocharger technologies found in large trucks or the turbines in aircraft auxiliary power units.

Reciprocating engines convert the energy contained in a fuel into mechanical power. This mechanical power is used to turn a shaft in the engine. A generator is attached to the engine to convert the rotational motion into power.

Combustion turbines have three main components: Compressor, where incoming air is compressed to a high pressure; Combustor where fuel is burned, producing high-pressure, high-velocity gas, and a Turbine, where energy is extracted from the high-pressure, high-velocity gas flowing from the combustion chamber.

What do gas turbines look like?

Gas turbines vary in size and appearance. The photos below, clockwise from left, are examples of the turbines listed above.

Reciprocating Engine

Microturbine

Combustion Turbine

Are gas turbines suitable to firm renewable energy projects that serve facilities, villages, or the reservation?

In order for renewable energy projects to supply all or part of the electricity demand in any of the Pueblo's six villages, they must be sized to match the demand. Laguna's villages vary in size and electricity requirements. Because wind or solar projects only generate electricity when the wind is blowing or the sun in shining, they are known as "intermittent resources" and cannot supply steady amounts of electricity at all hours of the day.

In some cases, batteries are used to store the power so that it can be used later. In other situations, natural gas-fired generating facilities are used to "firm" the renewable energy facilities. Since wind or solar projects can supply a portion of the power needs, it would take many pieces of equipment to supply a 100kW demand with wind alone. It is generally not cost effective to install that much equipment without another generating source to supply power when the wind isn't blowing, or the sun isn't shining. Renewable energy facilities, such as wind turbines, and solar arrays are generally sized to optimize the economics of a blended power supply.

How much land is required?

Gas turbines need very little land to construct and operate. A key requirements for natural gas generation is for the gas distribution line to be in close proximity to the project, in order to be economic.

Space requirements for gas generation are measured in feet, rather than acres. For example, a 1.2 MW Solar Saturn 20 gas turbine generator set is approximately 23 feet long and 6 feet wide. A 6.1 MW Caterpillar GCM34 reciprocating gas engine generator set is 40 feet wide, and 11 feet wide.

What does gas-fired generation cost?

The cost of generating electricity with natural gas varies with a number of factors, including the cost of natural gas, proximity to gas distribution lines, efficiency of selected equipment, availability of incentives (tax credits, rebates), and the economies of scale that may be achieved through higher volume equipment purchases.

Gas-fired generation has become very well accepted in the last few decades, and is one of the most economic, cleanest and most flexible to operate. While changing gas prices impact the cost per kilowatt-hour (kWh) of electricity produced, gas-fired generation is likely to be an economical choice for facility, village and reservation needs.

What are the benefits and considerations associated with gas-fired generation?

Environmental, cultural, economic benefits

- Dispatchable
- Reliable
- High efficiencies
- Low emissions
- Proven technology

Trade-offs

- Fuel supply cost risks

Resources and Places to Find Further Information:

- National Renewable Energy Laboratory (NREL), Solar Power Center: http://www.nrel.gov/solar/
- Sacred Power: http://www.sacredpowercorp.com/
- Solar Electric Power Association: http://www.solarelectricpower.org/
- New Mexico Energy, Minerals & Natural Resources Division Solar Energy: http://www.emnrd.state.nm.us/EMNRD/ecmd/Solar/Solar.htm

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Pueblo of Laguna
Renewable Energy
Feasibility Study

Generating Electricity From the Sun: A Technology Brief

Inside: learn more about –

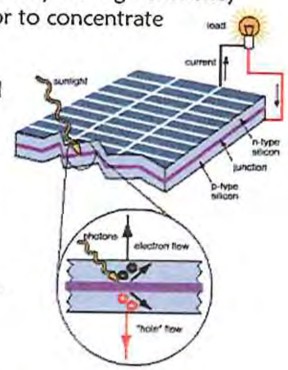
- *How do solar energy systems work?*
- *What do solar facilities look like?*
- *What types of solar technologies would be suitable to serve facilities, villages, or the Reservation?*
- *How much land or space is required?*
- *What does solar generation cost?*
- *What are the benefits and considerations associated with solar generation?*

About Solar Generation

The Pueblo of Laguna Renewable Energy Feasibility Study is currently underway. The community's perspective and input is critical to the success of the study. This pamphlet is designed to provide basic information about some of the renewable generation technologies that may be considered.

How do solar energy systems work?

Solar energy systems use the sun's energy either for direct conversion to electricity via high efficiency photovoltaic (PV) cells, or to concentrate the sun's energy.



"Concentrators" are used to produce electric power by using lenses or mirrors to efficiently convert the sun's energy either into high-temperature heat to drive turbines or engines, or directly into electricity.

What do solar facilities look like?

Solar technologies vary greatly in size and configuration, depending on the technology chosen and its application. The photos show examples that could supply homes and large scale systems.

A 500kW ground-mounted system

A 25kW dish-engine

1kW hybrid with dual tracking

What types of solar technologies would be suitable to serve facilities, villages, or the Reservation?

Solar generation technologies fall into two basic categories: (1) Photovoltaic (PV) systems that directly convert sunlight to electricity, and (2) Concentrating Solar Power (CSP) systems that concentrate sunlight to create high-temperature heat or to intensify sunlight onto PV arrays. Generally, the following types of solar technologies are used for:

Type of Installation	Typical Solar Technologies Deployed
Homes & small businesses	☐ Fixed flat plate, roof-mounted PV ☐ Fixed or tiled flat plate PV, roof or ground-mounted ☐ Hybrid PV systems with propane, wind, or battery back-up
Commercial-scale buildings	☐ Fixed or tiled flat plate PV, roof or ground-mounted ☐ Flat plate PV with single or dual axis tracking ☐ Hybrid PV systems with propane, wind, or battery back-up
Village-scale applications	☐ Large flat plate PV with single or dual axis tracking ☐ Large-scale HCPV (High Concentration PV) systems ☐ Dish-engine CSP systems
Reservation-scale	☐ Large-scale HCPV (High Concentration PV) systems ☐ Dish-engine CSP systems ☐ Parabolic trough systems

How much land or space is required?

Spacing requirements for solar technologies also vary significantly. Roof-mounted PV arrays require only the footprint of the modules themselves, often on the order of 30-40 square feet for typical residential installations. Ground-mounted modules require 1.5 to 2 times array size for titled installations, and additional spacing for tracking systems. The largest utility-scale CSP systems require as much as 5 – 10 acres per Megawatt of generating capacity.

What does solar generation cost?

The cost of generating solar electricity varies with a number of factors, including the strength of the solar resource, the applicable technology and its efficiency, availability of incentives (tax credits, rebates), and the economies of scale that may be achieved through higher volume equipment purchases.

In general, the more energy produced by a solar system, the less its levelized cost of energy (¢/kilowatt-hour) will be. CSP technologies tend to have among the highest efficiencies and lower initial capital costs because of their larger scale, and can produce electricity today in the range of 15¢/kilowatt-hour. PV systems are among the most rapidly improving technologies and are expected to achieve lower energy costs in the near future. With current technologies, PV systems can generate electricity in the range of 20¢ - 25¢/kilowatt-hour.

What are the benefits and considerations associated with solar generation?

Environmental, cultural, economic benefits

- ☐ Low operating costs
- ☐ No fuel supply/cost risks
- ☐ No cooling water required
- ☐ No wastes, no emissions
- ☐ Good load following capability

Trade-offs

- ☐ High first costs
- ☐ Non-dispatchable

Resources and Places to Find Further Information:

- National Renewable Energy Laboratory (NREL), National Wind Technology Center: http://www.nrel.gov/wind/animation.html
- American Wind Energy Association (AWEA): http://www.awea.org/faq/tutorial/wwt_basics.html
- California Energy Commission: http://www.energyquest.ca.gov/story/chapter16.html
- National Wind Coordinating Committee: http://www.nationalwind.org/

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Pueblo of Laguna
Renewable Energy
Feasibility Study

Generating Electricity with Wind: A Technology Brief

Inside: learn more about –

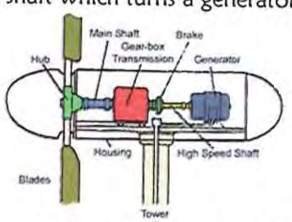
- *What is a wind turbine and how does it work?*
- *What do wind turbines look like?*
- *Are wind turbines suitable to serve facilities, villages or the reservation?*
- *How much land is required?*
- *What does wind generation cost?*
- *What are the benefits and considerations associated with wind generation?*

About Wind Generation

The Pueblo of Laguna Renewable Energy Feasibility Study is currently underway. The community's perspective and input is critical to the success of the study. This pamphlet is designed to provide basic information about some of the renewable generation technologies that may be considered.

What is a wind turbine and how does it work?

A wind turbine works just like a fan, but in the opposite direction. Instead of using electricity to make air flow, wind turbines use the wind's energy to make electricity. The blades of the turbine are attached to a hub that is mounted on a turning shaft. The shaft goes through a gear transmission box where the turning speed is increased. The transmission is attached to a high speed shaft which turns a generator that makes electricity.



What do wind turbines look like?

Wind turbines vary in size and appearance. The photos below, clockwise from left, are examples of turbines that could supply a home, a school, and a large utility wind farm.

100 kilowatt turbine

10 kilowatt turbine

2 Megawatt turbines

Are wind turbines suitable to serve facilities, villages, or the reservation?

Yes. In order for wind energy to supply all or part of the electricity demand in any of the Pueblo's six villages, wind turbines must be sized to match the demand. Laguna's villages vary in size and electricity requirements. Because these turbines only generate electricity when the wind is blowing, they are known as "intermittent resources" and cannot supply steady amounts of electricity at all hours of the day.

Experts generally estimate that a wind turbine can reliably supply between 5% and 20% as much energy as a "firm" generating resource (such as a gas turbine or diesel generator). It might take as many as five to twenty 100kW turbines to supply a 100kW demand with wind alone. It is generally not cost effective to place that many turbines without another generating source to supply power when the wind isn't blowing, and wind turbines are generally sized to optimize the economics of a blended power supply.

How much land is required?

Wind turbines need very little land to construct and operate, but do require sufficient space to prevent interference caused by "downdrafts" of adjacent wind turbines when multiple turbines are placed. Rule of thumb land requirements for various applications are:

- Residential & remote applications: 1 acre/turbine
- Commercial facility-scale: 1-10 acres/turbine
- Village-scale applications: 5-100 acres/turbine
- Reservation-scale generation: ≥ 100 acres/turbine

What does wind generation cost?

The cost of generating electricity with wind turbines varies with a number of factors, including the strength of the wind resource, size and efficiency of selected turbines, availability of incentives (tax credits, rebates), and the economies of scale that may be achieved through higher volume equipment purchases.

Wind energy has become one of the most economical renewable resources to date, and larger scale wind farms generate electricity for as little as 3¢ - 4¢ per kilowatt-hour (kWh). In areas where smaller turbines are best suited, the cost of wind-generated electricity may be as high as 15¢ - 20¢ per kWh. Capital costs also vary by size of turbine.

What are the benefits and considerations associated with wind generation?

Environmental, cultural, economic benefits

- Low operating costs
- No fuel supply/cost risks
- No cooling water required
- No wastes, no emissions

Trade-offs

- High capital costs
- Non-dispatchable

Pueblo of Laguna Utility Authority

Renewable Energy Feasibility Study

Community Meeting
June 2006

Laguna's DOE-Funded Renewable Energy Feasibility Study is Underway

Laguna study includes two continual phases, and five project phases in sequence

All seven project phases should be completed by December 2006

Laguna's Study Evaluated the Potential for Wind, Solar, Biomass, Geothermal and Gas Hybrid Projects


2 MW Wind Turbines


Gas-Fired Microturbines

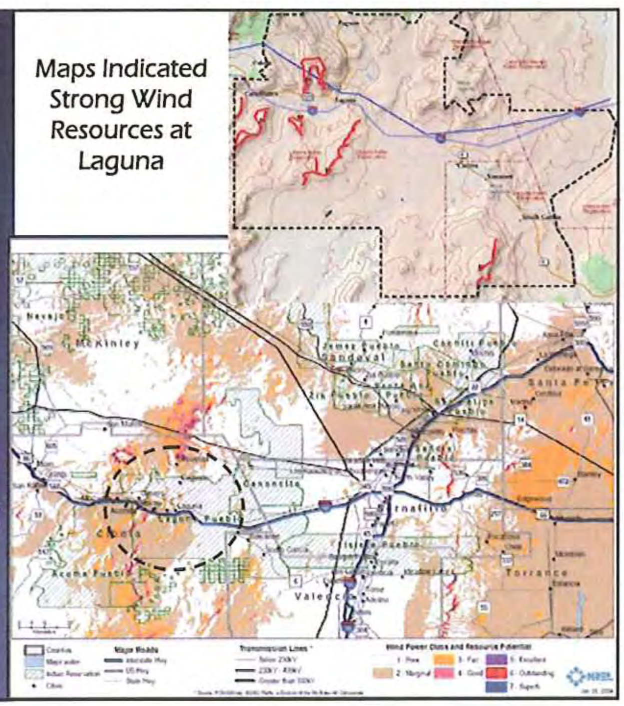
25 kW Tracking Concentrator


100 MW Geothermal Plant

5 kW PV Array

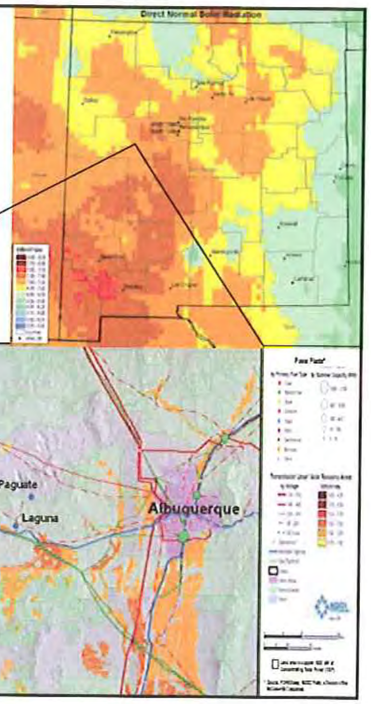
Laguna Renewable Resources Include Wind, Solar, and Geothermal Plus Natural Gas Access

Maps Indicated Strong Wind Resources at Laguna



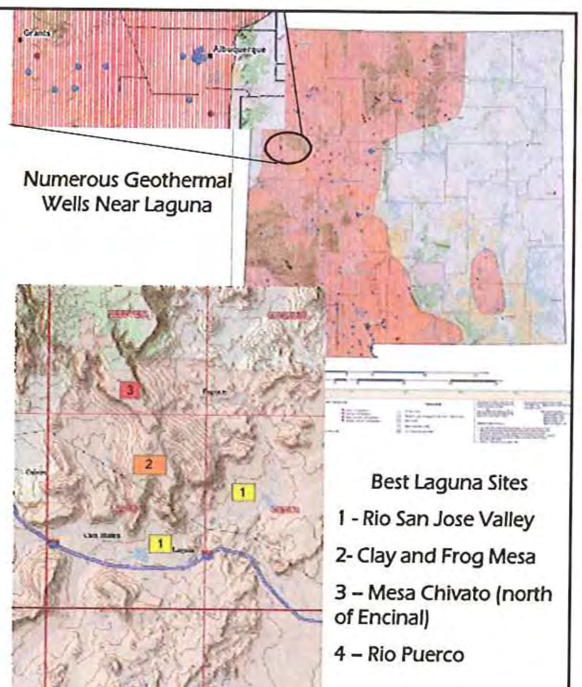
Laguna Renewable Resources Include Wind, Solar, and Geothermal Plus Natural Gas Access

Laguna Solar Resources are Well-Suited for Most Solar Technologies



Laguna Renewable Resources Include Wind, Solar, and Geothermal Plus Natural Gas Access

Numerous Geothermal Wells Near Laguna



Best Laguna Sites

1 - Rio San Jose Valley

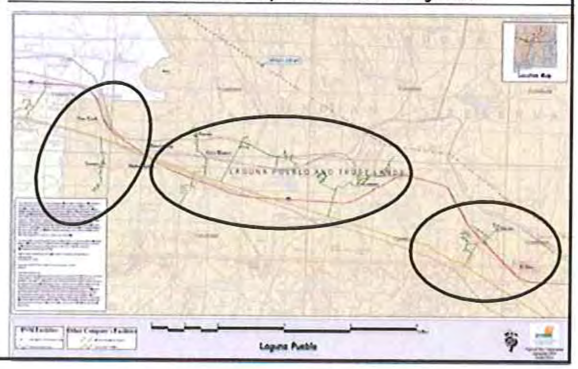
2- Clay and Frog Mesa

3 – Mesa Chivato (north of Encinal)

4 – Rio Puerco

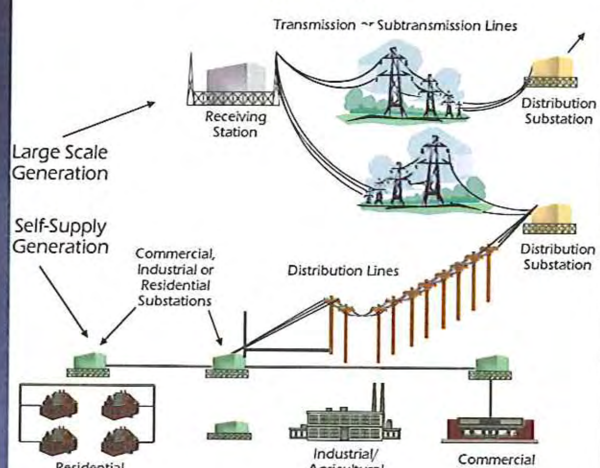
Laguna Renewable Resources Include Wind, Solar, and Geothermal Plus Natural Gas Access

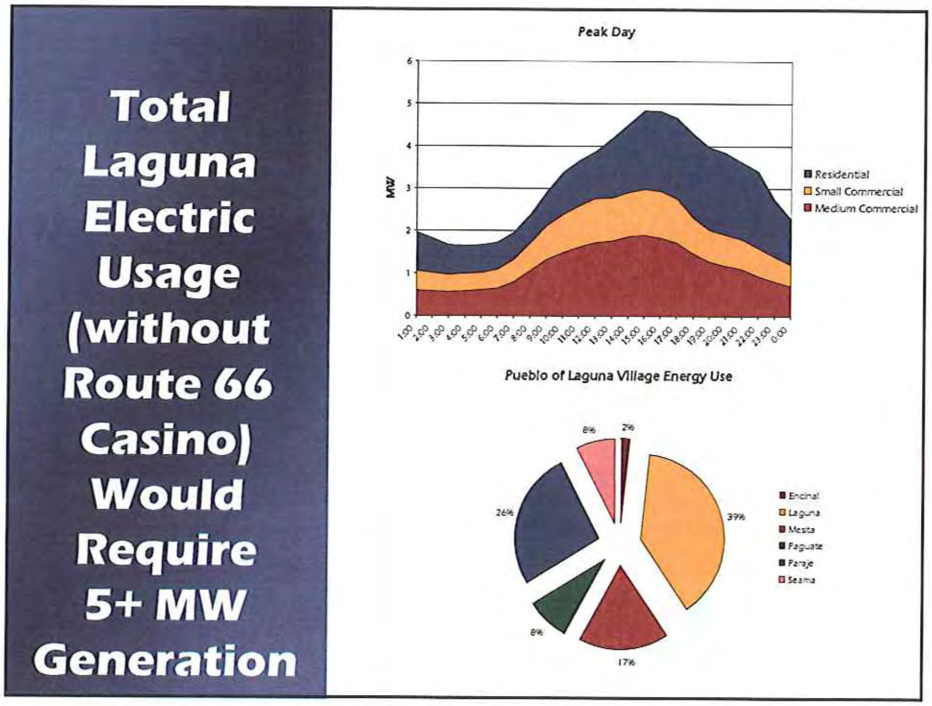
Laguna Has Good Access to Natural Gas Transmission and/or Distribution Systems

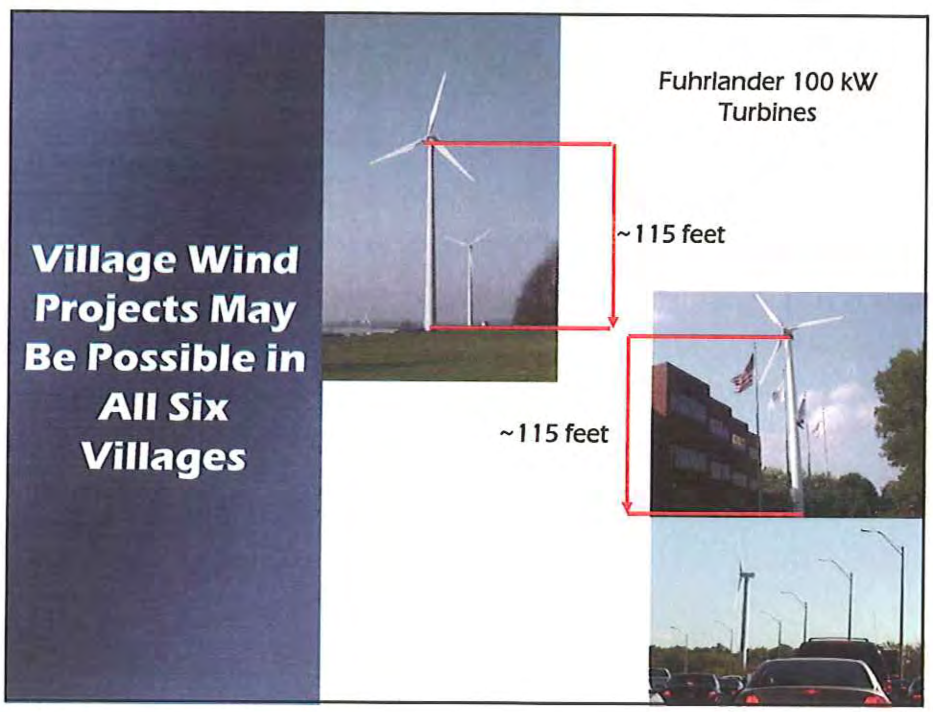


Renewable Energy Could Serve Facility, Village or Total Reservation Electric Needs

CDEC Distribution and PNM Transmission Lines Cross Laguna Allowing Generation for Self-Supply or Sales to Grid




Total Laguna Electric Usage (without Route 66 Casino) Would Require 5+ MW Generation
Peak Day
MW
0
1
2
3
4
5
6
1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 0:00
Residential
Small Commercial
Medium Commercial
Pueblo of Laguna Village Energy Use
8%
2%
26%
39%
8%
17%
Encinal
Laguna
Mesita
Paguate
Paraje
Seama


Village Wind Projects May Be Possible in All Six Villages
Fuhrlander 100 kW Turbines
~115 feet
~115 feet

Village Solar Projects May Be Possible in All Six Villages

25kW Tracking Concentrator

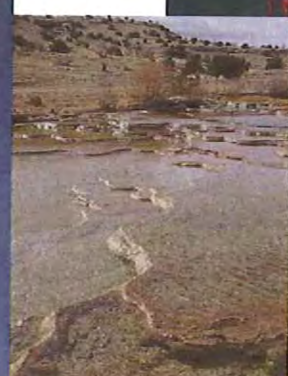
Multiple Pieces Required to Supply Even the Smallest Village Needs

45 feet x 55 feet

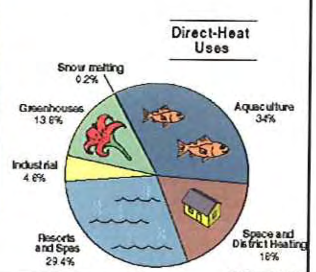
3 foot x 8 foot PV Arrays

1 MW per 1.5 – 2 acres Parabolic Trough Field

Geothermal Projects May Be Possible near Laguna and Rio Puerco

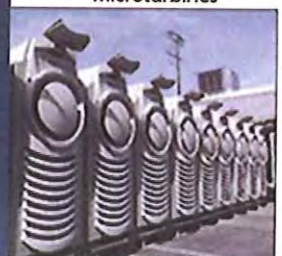


Laguna Has Several Options for Heating or Industrial Use



Natural Gas Projects May Be Possible in Laguna, Seama, Paraje, Mesita and Rio Puerco

Microturbines



Combustion Turbine

Reciprocating Engine

Reservation-Scale+ Projects May Be Possible with Laguna Wind, Solar, and Natural Gas Resources

Fuhrlander 2 MW Turbines

GE 1.5 MW Turbine

25 kW Tracking Concentrator

25 kW Stirling Dish Engine System

1 MW per 1.5 – 2 acre Parabolic Trough Field

350 MW Gas-Fired Generation

Renewable Technologies Have Different Characteristics and Costs

- Capacity Factor
- Installation Costs
- Levelized Costs of Energy
- Intermittency

Renewable Energy Generation Has Numerous Benefits

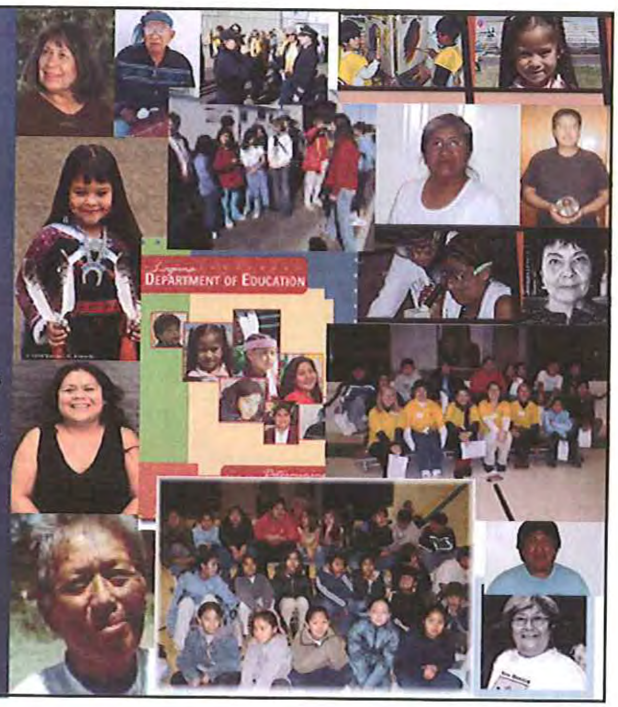
- Low Emissions
- Level Lifetime Operating Costs
- Improving Economics for Renewable Generation
- Many Proven Renewable Technologies
- Numerous Incentives Available for Renewable Projects

Key Laguna Considerations are the Cultural and Environmental Impact of Projects, Installation Cost, and Cost of Electricity Produced

Technology Comparisons

Type of Resource	Installed System Cost ($/kW)	1 MW Equivalent	Capacity Factor	Key Issues
Wind	1,200	Less than 1 Turbine	Class 4 wind 30%	Intermittency
Solar Thermal	3,000 – 4,000	1 acre e.g. Walmart store	22-25%, up to 90% with storage	High Capital Cost
Solar PV - Commercial	6,500	10 acres	14-20%	High Capital Cost
Geothermal	2,000-2,500	15-20klbs	90%	High initial costs; resource could deplete
Natural Gas	500-1,000		75+%	Permitting; some emissions

Community Input is Requested to Help Focus on the Projects that Best Fit Laguna



Pueblo of Laguna
Renewable Energy Project Options

Your input is invited.

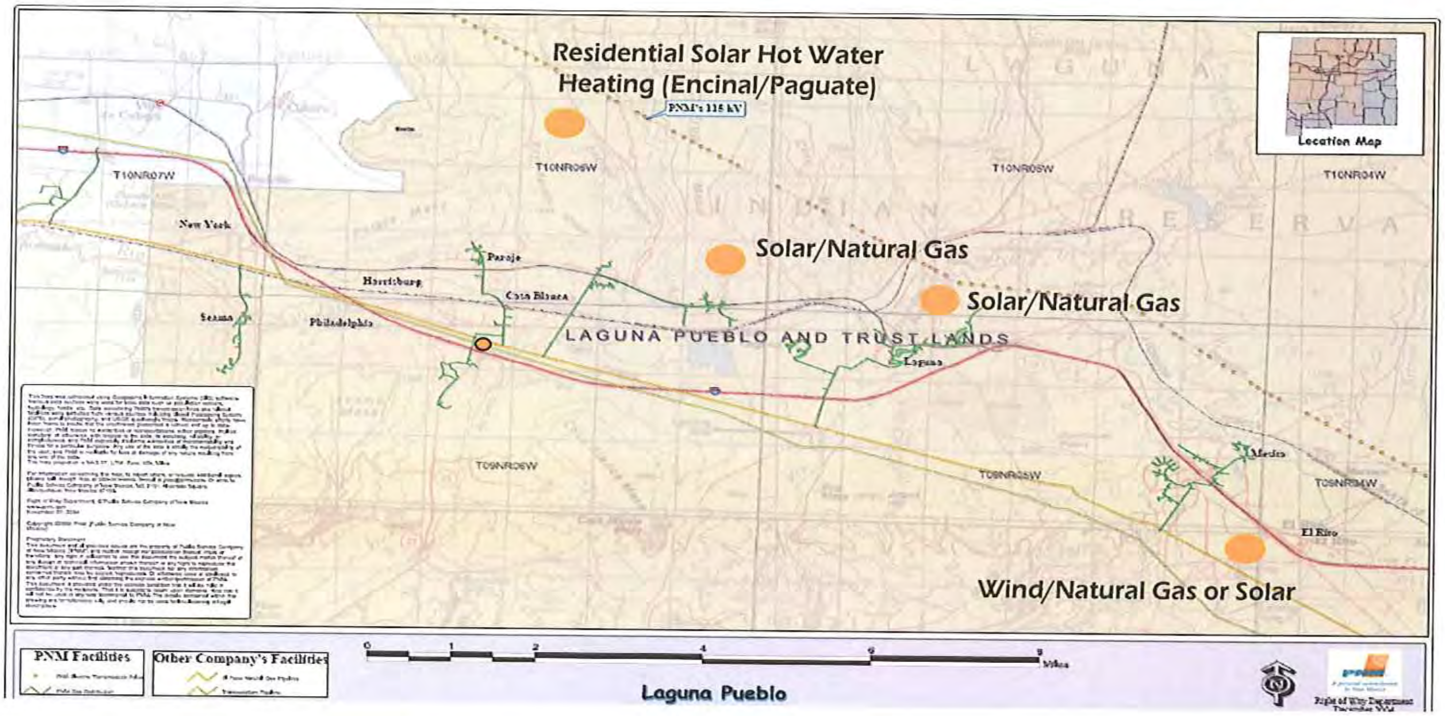
Background

Renewable energy resources – those that can be renewed by nature and can provide clean sources of electricity generation, are abundant in the Southwestern U.S. The Pueblo of Laguna's lands are blessed with many such sources, 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.

The Pueblo of Laguna Renewable Energy Feasibility Study has been underway since December 2005. The study, funded by the U.S. Department of Energy ("DOE") and managed by the Pueblo of Laguna Utility Authority, was undertaken to identify, evaluate, and plan the development of renewable energy generation projects that could potentially be built on Tribal lands. The community's perspective and input is critical to the success of the study. This material is designed to provide basic information about some renewable energy project options that have been identified as part of the study, and to gather perspective about your preferences, ideas, concerns, and any other input you would like to offer about the potential projects. Because the projects can only achieve the desired benefit if they succeed in meeting the community's needs and goals, your perspective is vital.

Project Overview

The map below reflects several Renewable Energy Project Options identified by the project team. We have additional project information on the following pages, and included a sheet requesting your input.



Pueblo of Laguna
Renewable Energy Project Options

Project Descriptions

Project Type: Wind/Natural Gas Backup
Location: Southeast of Mesita Village

Wind: 250 kW Fuhrlander Turbine

Backup Generation: Caterpillar Diesel/ Natural Gas Engines

Project Type: Solar or Solar/Natural Gas Backup
Location: Laguna Village, north of Transfer Station or Southeast of Mesita Village

Solar: Single Axis Tracker PV (Photovoltaic)

Solar: HCPV (High Concentration Photovoltaic)

Backup Generation: Caterpillar Diesel/ Natural Gas Engines

Project Type: Solar Electric or Hot Water Heating
Location: Any residence, community center or commercial building

Pueblo of Laguna Renewable Energy Project
Community Input Questionnaire

Instructions for Completion

This material is designed to provide basic information about some renewable energy project options that have been identified as part of Laguna's DOE-funded renewable energy study. Because the projects can only achieve the desired benefit if they succeed in meeting the community's needs and goals, your perspective is vital. Please help us by providing your comments, concerns and questions about the potential renewable energy projects.

Community Input Questionnaire

What is your feeling about renewable energy?

What is your feeling about solar and wind power generation?

Have you had any experience with renewable energy power generation?

Yes No

If yes, please describe:

Do you feel that there is a need for renewable energy power generation within the Pueblo of Laguna? Yes No

Please explain:

Do you feel that the Pueblo of Laguna produce power to sell to others outside of Laguna? Yes No

Please explain:

Pueblo of Laguna Renewable Energy Project
Community Input Questionnaire

Community Input Questionnaire, Continued

How do you feel about renewable energy projects at the proposed sites?

Do you have a preference as to which project should be developed?

Would you like additional information on any particular project?

What results would you like to see for Laguna from a renewable energy project?

Do you have any additional questions or comments?

What To Do With Your Completed Questionnaire

Please return completed surveys to:

Thelma Antonio, Energy Program Coordinator
Pueblo of Laguna Utility Authority
PO Box 517
Casa Blanca, NM 87007

505 246-4271 or 505 246-4277

Please add you contact information here if you would like additional information:

____
____
____
____

Project Updates

- Study Update: Project Identification Meeting
- POLUA Board of Directors: Status Report
- POLUA Board and Entity Update
- DOE Program Review October 2006
- DOE Tribal Energy Program Review October 2007

RED MOUNTAIN TRIBAL ENERGY

RED MOUNTAIN ENERGY PARTNERS

Pueblo of Laguna
Renewable Energy Feasibility Study

Study Update
Project Identification Meeting

March 2006

Meeting Agenda

- Introductions
- Project Background – Ken Garcia, Dave Melton, Harry Antonio
- Project Overview/Schedule – Carolyn Stewart
- Laguna Renewable Resources – Kate Maracas
- Natural Gas Access/Issues – Tracey LeBeau
- Energy Use Profile – Edward Samson, Kate Maracas
- Laguna Project Considerations – All
- Next Steps – Carolyn Stewart

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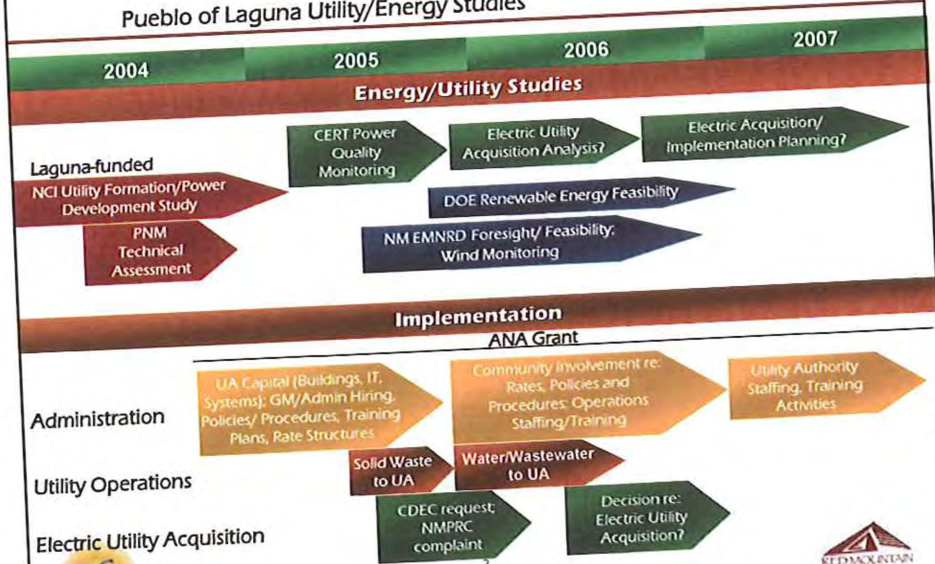
Project Background

- Utility Authority Formation – 1980s-2005
- Utility Formation and Power Development Study - 2004-2005
  - Utility Organization, Implementation
  - Electric System Issues, Alternatives
  - Power Development Potential
- Multiple Grant Applications
  - ANA – Utility Implementation (awarded)
  - USDA – Electric System Acquisition/Improvements
  - DOE – Electric System Negotiations
  - DOE – Renewable Energy Feasibility (awarded)
  - DOI – Renewable Energy Feasibility (underway)
  - NM – Wind Feasibility (awarded)
- Foresight Energy Wind Development Agreement – May 2005
- Utility Authority Operations Begin – August 2005
- DOE Feasibility Study – Now Underway

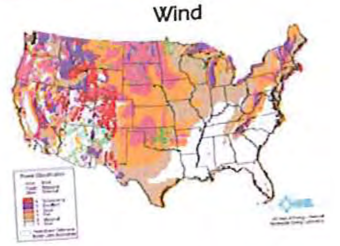
Pueblo of Laguna Utility/Energy Studies



Regional Renewable Resources Support Energy Project Development

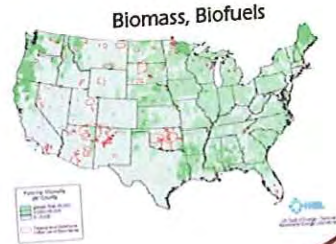
Concentrating Solar Power (CSP)

Wind



Geothermal

Biomass, Biofuels



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Renewable Energy Feasibility Study Purpose/Objectives

- Increase energy knowledge and capacity
- Improve quality and reliability of electric service
- Contribute to development of environmentally clean energy
- Provide data/analysis to support Laguna involvement in renewable energy projects as an owner or participant

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Renewable Energy Feasibility Study Scope

- Capacity Building
  - Identify staff resources and provide ongoing education/support
- Community Education/Outreach
  - Develop/implement community education tools (newsletter, meetings) in order to gain community support for identified projects
- Resource Monitoring
  - Understand renewable resources, needs, and identify possible projects
- Fatal Flaw Analysis
  - Identify significant issues for possible projects
- Potential Project Economics
  - Evaluate feasibility of community-supported projects
- Project Decision Support
  - Support presentation/decisions re: feasible projects
- Development Plan
  - Create development plan, budget and possible funding sources

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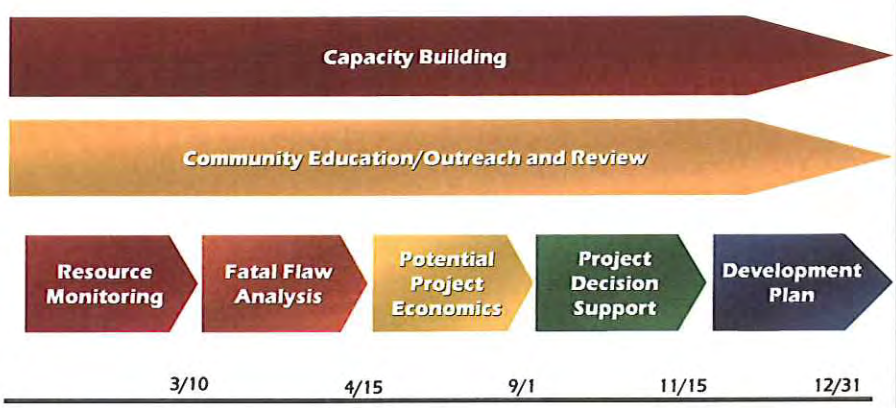
Renewable Energy Feasibility Study Project Overview/Schedule



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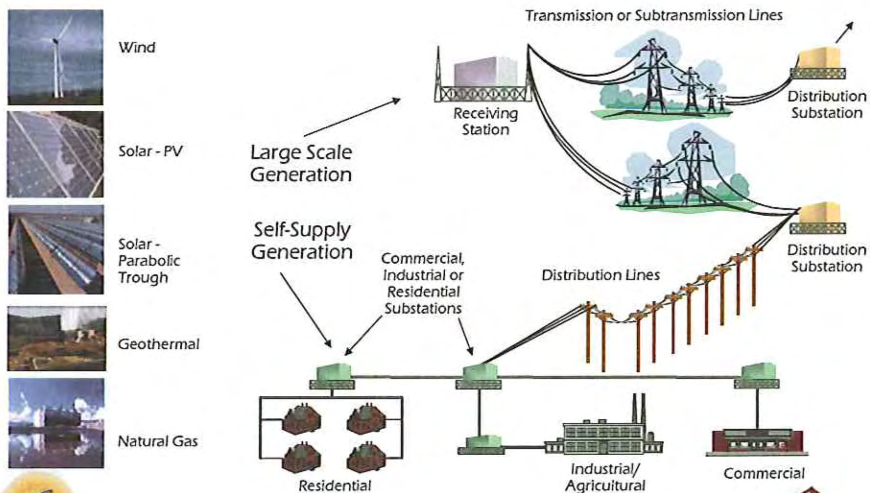
Large Scale vs. Self-Supply Generation

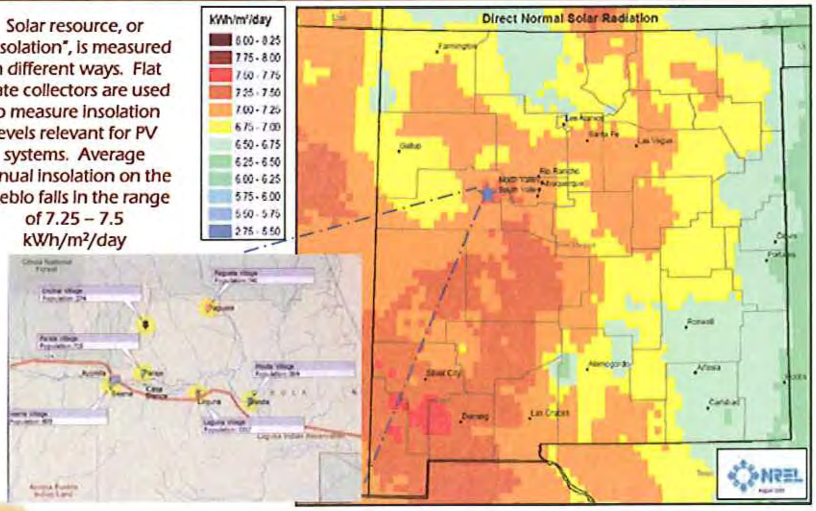


Laguna Renewable Resources Assessed

- Solar
- Wind
- Biomass
- Geothermal

Laguna Solar Resource - Direct Normal Solar Radiation

Solar resource, or "insolation", is measured in different ways. Flat plate collectors are used to measure insolation levels relevant for PV systems. Average annual insolation on the Pueblo falls in the range of 7.25 – 7.5 kWh/m²/day



Source: National Renewable Energy Lab (NREL)

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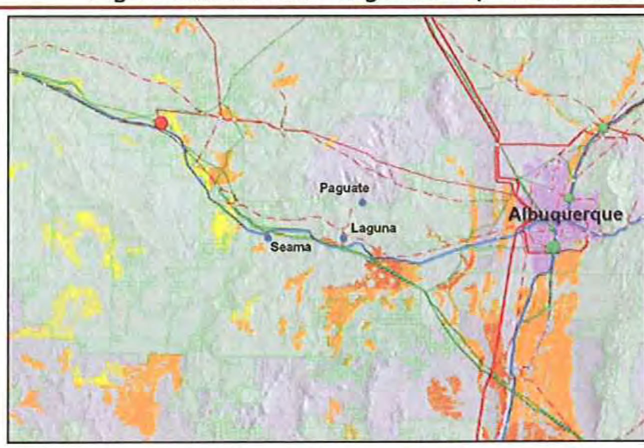
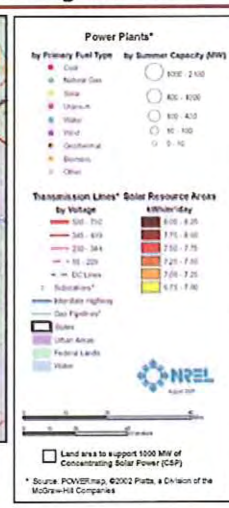
Laguna Solar Resource - Regional Prospects for Concentrating Solar Power





Insolation relevant for CSP technology is measured with collectors that track the sun. Parts of the Pueblo have concentrator insolation levels in the range of 7.25 – 7.5 kWh/m²/day, well within the range suitable for large-scale solar projects

Source: National Renewable Energy Lab (NREL)

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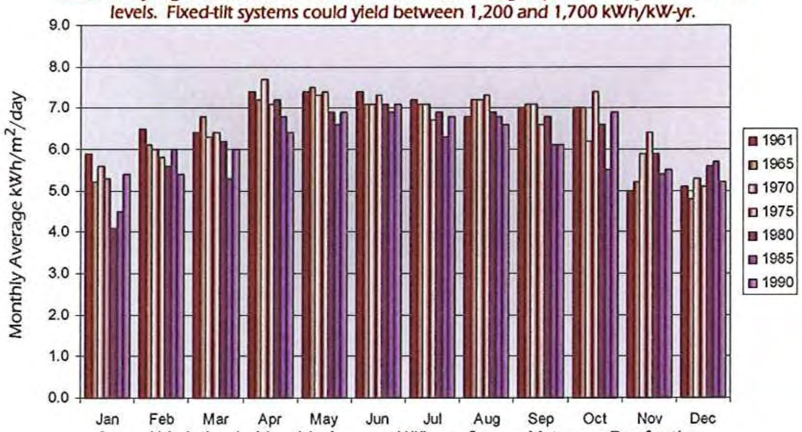
Laguna Solar Resource - Insolation for Flat-Plate Collector Facing South, Fixed Tilt at Latitude

Surface measurements taken over a thirty-year period in the Albuquerque area indicate consistently high insolation levels. Photovoltaic technologies perform very well at these levels. Fixed-tilt systems could yield between 1,200 and 1,700 kWh/kW-yr.



Annual Variation In Monthly Average kWh per Square Meter per Day for the Albuquerque Region, 1961 – 1990*

* Source: Red Mountain Energy Partners, National Solar Radiation Database (NSRDB) Insolation Archive, 1961-1990

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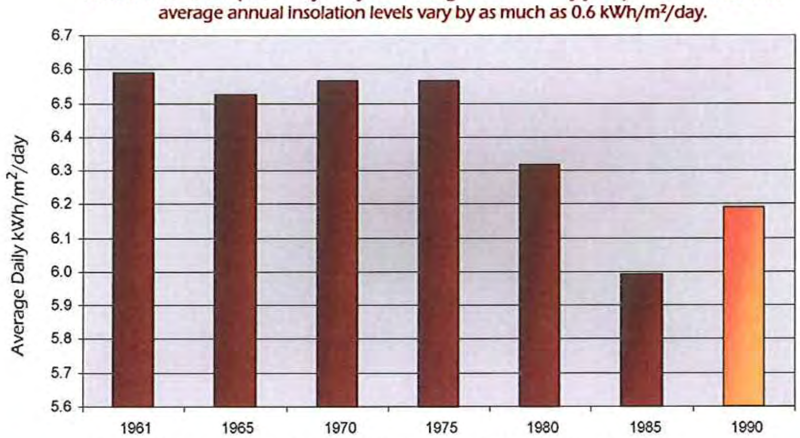
Laguna Solar Resource - Insolation for Flat-Plate Collector Facing South, Fixed Tilt at Latitude

Measurements sampled every five years during the same thirty-year period illustrate that average annual insolation levels vary by as much as 0.6 kWh/m²/day.



Annual Average kWh per Square Meter per Day, by Year for the Albuquerque Region, 1961 – 1990*

* Source: Red Mountain Energy Partners, National Solar Radiation Database (NSRDB) Insolation Archive, 1961-1990

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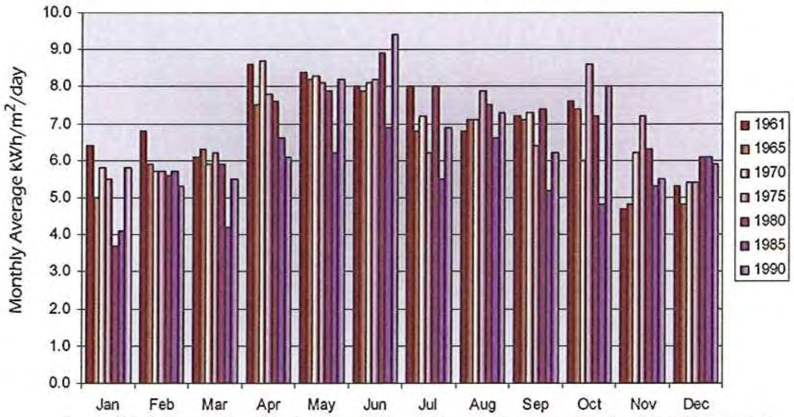
Laguna Solar Resource - Insolation for Two-Axis Tracking Concentrating Collector

Thirty-year measurements for tracking concentrators also indicate consistently high insolation levels. CSP systems could yield over 2,000 kWh/kW-yr at these levels.



Annual Variation In Monthly Average kWh per Square Meter per Day for the Albuquerque Region, 1961 - 1990*

* Source: Red Mountain Energy Partners, National Solar Radiation Database (NSRDB) Insolation Archive, 1961 -1990

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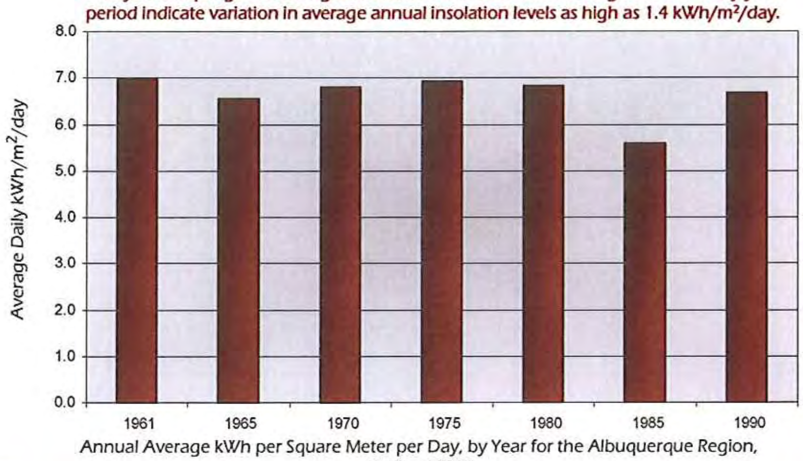
Laguna Solar Resource - Insolation for Two-Axis Tracking Concentrating Collector

Five-year samplings of tracking concentrator measurements during the same thirty-year period indicate variation in average annual insolation levels as high as 1.4 kWh/m²/day.



Annual Average kWh per Square Meter per Day, by Year for the Albuquerque Region, 1961 - 1990*

* Source: Red Mountain Energy Partners, National Solar Radiation Database (NSRDB) Insolation Archive, 1961 -1990

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Solar Energy Technology Options: Residential & Commercial Solar Systems


Thin film BIPV


Polycrystalline silicon


Multi-junction cells


Single & dual axis tracking

- Photovoltaic (PV) Modules
  - Vary in composition and feedstock materials
    - "Thin-film" cells make use of ultra-thin photovoltaic material deposited on an inexpensive material such as glass or plastic; both efficiency and cost are comparatively low
    - Silicon cells can have different molecular "crystal" structures (polycrystalline, homogeneous, or amorphous); proportional trade-off between cost of manufacturing and energy conversion efficiency
    - Cells can be made of other compound semiconductors (Gallium Arsenide, Indium Phosphide, etc.); generally higher cost & efficiency
    - "Multi-junction" cells make greater use of the sun's energy by layering different materials that have higher response to varying portions of the light spectrum; higher performance allows for use of less semiconductor material

Cost	Output	Market Maturity
$	+	+++
$$	++	+++++
$$$	+++	++
$$$	+++++	+

  - Vary by structure
    - Fixed, flat-plate: may be horizontal, fixed tilt, or Building Integrated PV (BIPV)
    - Single-axis tracking: uses mechanical tracking to follow the sun's most intense angle of incidence
    - Two-axis tracking: uses mechanical tracking to follow the sun's most intense angle in two directions; higher efficiency than single-axis

Solar systems can be distributed for direct on-site energy use, or deployed for large-scale power generation.

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Solar Energy Technology Options: Large-Scale Solar Systems


Power Tower


Parabolic Trough


Dish-Engine


HCPV

Large-scale systems for central-station generation typically* use Concentrating Solar Power (CSP) Technologies. CSP:

- Produces electric power by using lenses or mirrors to convert sun's energy into high-temperature heat to drive turbines or engines, or directly into electricity via high-efficiency PV cells
- Consists of two major subsystems: (1) solar radiation collection/concentration component, and (2) energy conversion component
- Can be sized for distributed generation (10-35 kilowatts) or central grid-connected applications (up to several hundred Megawatts)
- Can be readily "hybridized" with fossil fuel and in some cases adapted to utilize thermal storage; hybridization and thermal storage enable dispatchability of generated power and operation during periods when solar energy is not available, thus enhancing the economic value of the electricity produced and reducing its average cost
- Four Primary CSP Technologies are:
  - Power Tower
  - Parabolic Trough
  - Dish-Engine
  - High Concentration Photovoltaics (HCPV)

Large-scale solar systems tend to use concentrator assemblies to increase the sun's thermal or optical intensity.

** Central station plants on the order of 5-10 MW have also used conventional PV modules.*

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Solar Energy Technology Options: Large-Scale Solar Systems


Power Tower


Parabolic Trough


Dish-Engine


HCPV

- Primary CSP Technologies
  - Power Tower
    - Uses a circular field array of heliostats (large individually-tracking mirrors) to focus sunlight onto a central receiver mounted on top of a tower, which produces steam to power a conventional turbine generator to produce electricity
  - Parabolic Trough
    - Uses parabolic trough-shaped mirrors to focus sunlight on thermally efficient receiver tubes that contain a heat transfer fluid; fluid is heated and pumped through a series of heat exchangers to produce superheated steam, which powers a conventional turbine generator to produce electricity
    - Nine trough systems between 14 and 80 MW, built in the mid to late 1980's, are currently generating 354 MW in Southern California
  - Dish-Engine
    - Uses an array of parabolic dish-shaped mirrors (stretched membrane or flat glass facets) to focus solar energy onto a receiver located at the focal point of the dish; fluid in the receiver is heated and used to generate electricity in a small engine or turbine attached to the receiver
  - High Concentration Photovoltaics (HCPV)
    - Uses high efficiency PV cells with concentrating (Fresnel) lenses that multiply the sun's intensity, requiring hundreds of times less photovoltaic material to achieve the same energy output as PV cells without concentration

Solar Energy Technology Options: Comparisons of Cost and Performance

Examination of kWh delivered per dollar expended is useful in considering technology investment decisions. Some solar technologies may have lower first-costs, but also much lower performance, and thus longer payback periods.

Installation	Cost ($/Watt)	Performance (kWh/kW-yr)	kWh/$
Fixed – Horizontal	5.25	1,250	4.75
Fixed – Latitude	5.25	1,630	6.20
Tracking – Horizontal	5.50	2,350	8.55
Tracking – Latitude	6.50	2,450	8.25
HCPV	6.00	2,030	6.75
Parabolic Trough	4.00	2,000	10.00
HCPV - Future	3.00	2,400	16.00
Dish/Turbine - Future	2.50	2,400	19.20

Source: Arizona Public Service, 2005. Data reflects insolation levels specific to Arizona.

Technology Fit with Laguna Solar Resource - PV Alternatives

Screening Criteria

	Match with Insolation Needs	Technology Maturity	Market Maturity	Reliability	Intermittency (Operational Concerns)	Output Efficiency, %	Installed Capital Cost	Renewable Portfolio Standard (RPS) Efficacy	Effective Load Carrying Capability (ELCC)
Metric	Strong match = ■■■■	High maturity = ■■■■	High maturity = ■■■■	High reliability = ■■■■	Low capacity factor (high intermittence) = ■	High efficiency = ■■■■	High installed capital cost = ■	High efficacy = ■■■■	High ELCC = ■■■■
Polycrystalline Silicon, Fixed-Tilt PV Modules	■■■■	■■■□	■■	■■■	■■	■	■		■■
Polycrystalline Silicon, Fixed-Horizontal PV Modules	■■■■	■■■□	■■	■■■	■■	■	■		■■
Thin-Film, BIPV	■■■■	■■	■■	■■	■■	□	■■		■□
Single-Axis Tracking Silicon PV Modules	■■■■	■■■	■	■■■	■■	■■	□	■■	■■■
Dual-Axis Tracking Silicon PV Modules	■■■■	■■■	■	■■■	■■	■■	□	■■	■■■■
Nano-technologies	■■■■	■			■■	■■■			

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Technology Fit with Laguna Solar Resource - CSP Alternatives

Screening Criteria

	Match with Insolation Needs	Technology Maturity	Market Maturity	Reliability	Intermittency (Operational Concerns)	Output Efficiency, %	Installed Capital Cost	Renewable Portfolio Standard (RPS) Efficacy	Effective Load Carrying Capability (ELCC)
Metric or Weighting Coefficient	Strong match = ■■■■	High maturity = ■■■■	High maturity = ■■■■	High reliability = ■■■■	Low capacity factor (high intermittence) = ■	High efficiency = ■■■■	High installed capital cost = ■	High efficacy = ■■■■	High ELCC = ■■■■
High Concentration PV (HCPV), Silicon	■■■■	■□	■	■■■	■■	■■	■	■■■■	■■■■
HCPV, Multi-Junction PV Cells	■■■■	■□	■	■■	■■	■■■■	■	■■■■	■■■■
Dish-Engine Systems	■■■■	■■■	■■?	■■	■■	■■■	■■■■	■■■■	■■■■
Dish-Turbine with Storage	■■■■				■■	■■■■	□	■■■■	■■■■
Parabolic Trough	■■■■	■■■■	■■	■■■■	■■	■■■	■■■	■■■■	■■■
Power Tower	■■■■	■■	□	■■	■■	■■■	■	■■■■	■■■■

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Technology Fit with Laguna Solar Resource

Observations

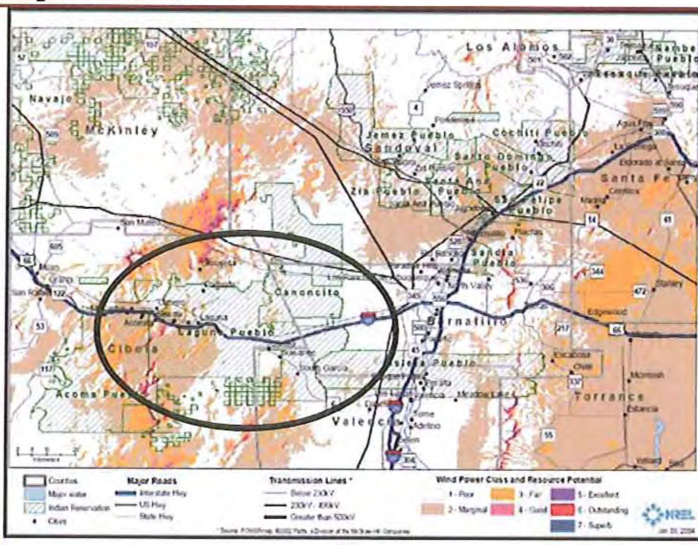
- Technology selections for any project should be weighed against considerations specific to the Tribe's needs and objectives
  - Insolation levels in and around the Pueblo appear to be well-suited for most solar technologies
  - Large scale systems are a better fit if RPS Efficacy, and sales of Renewable Energy Credits (RECs) are a goal
  - For distributed generation applications, ELCC is an important criterion in determining a system's payback period
  - Output efficiency and installed capital costs must be examined by pro forma analysis to understand the true costs and revenue potential of produced energy
  - Intermittency and operational concerns are relevant to both distributed (on and off-grid) and centralized projects

Technology Fit with Laguna Solar Resource (continued)

Observations

- Insolation levels in and around the Pueblo villages well-suited to support distributed and centralized photovoltaic applications
- Cooler temperatures in the high-desert region yield higher operating efficiency for photovoltaics
- Insolation appears to be sufficient for larger scale CSP technologies, but actual site measurements required to support project investment decisions
  - Project economics for installations in even higher insolation areas highly dependent upon financing, project structure, enabling incentives, etc.
  - Annual kWh produced and sold will make or break project profitability, and thus accurate resource characterization is critical
  - Technology advances and volumetric deployments expected to bring capital costs down in the next several years

Laguna Wind Resource



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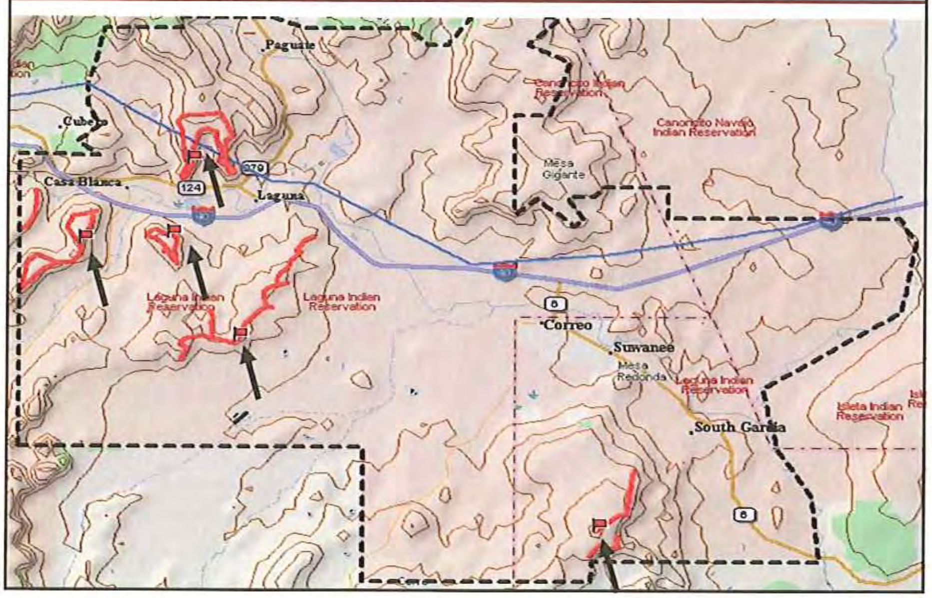
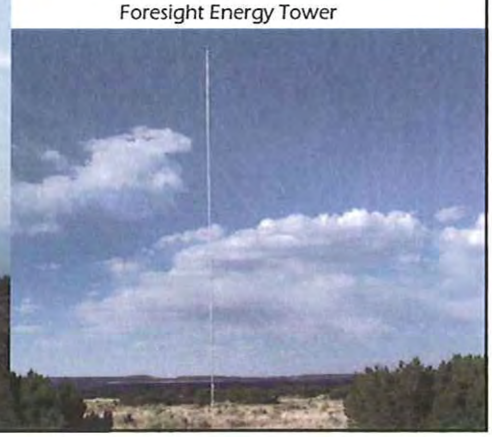
Initial Laguna Wind Testing Sites



Laguna Anemometry Installed July 2005

Lucero Mesa – 20 meter NREL tower

Seama Mesa – 50 meter Foresight Energy Tower



Laguna Wind Resource

- Six months of data gathered
- Initial indications that wind resource is lower than expected at sites monitored
  - Data gathered during the lower wind season
  - One year's data is needed for full evaluation
- Wind monitoring equipment could be moved to other possible sites
  - No sites remaining of those originally identified
  - New sites would need to be identified

Wind Technology

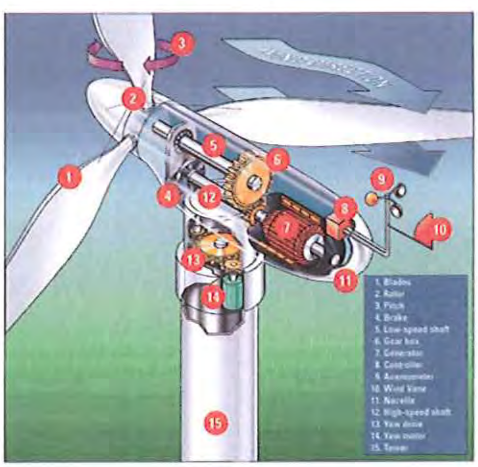
Bergey 10 kW Turbine

GE 1.5 MW Turbines

GE 3.6 MW Off-Shore Turbines

- Wind
  - Requires project-specific resource characterization: anemometry, terrain analysis, meteorology, etc. for feasibility analysis or pre-development
  - Turbines: range in size from 5 kW to 6 MW (offshore)
  - Large turbines require about ¼ acre of land each
  - Capital costs range roughly from ~ $800/kW (small refurbished turbine) to $1,300/kW
    - Purchase quantities are relevant
  - Sizing considerations: available wind speed, power needs, siting constraints, availability of turbines
  - Design considerations: efficiency investment tradeoffs, VAR compensation, etc.
  - Procurement & Construction considerations: economies of scale for quantity, purchases, crane deployment, etc.
  - Operational considerations: intermittency, numerous operational concerns
  - 1-3 years to develop
  - 40-50 personnel needed during construction for ≥ 100 MW
  - 5-7 personnel needed for operation

Wind Technology



Source: Alliant Energy

- Two general types of wind turbines
  - Horizontal – most common for modern applications
  - Vertical – rotor is mounted on a vertical axis; less efficient
- Wind turns the blades, which spin a shaft that connects to a generator and makes electricity
- Gears connect the low-speed shaft to the high-speed shaft and increase the rotational speeds from about 30 to 60 rotations per minute (rpm) to about 1200 to 1500 rpm, the rotational speed required by most generators to produce electricity
- Yaw drive is used to keep the rotor facing into the wind as the wind direction changes; downwind turbines don't require a yaw drive; wind blows the rotor downwind
- Large turbines range in size from 50 kilowatts to as high as 6 Megawatts
- Single small turbines - below 50 kilowatts - are used for homes, telecommunications dishes, or water pumping

Source: NREL National Wind Technology Center

Wind Technology Overview

Advantages	Challenges
• One of the lowest cost renewable resources • Wind power market (permitting, project developers, financing, equipment supply and service) is at comparable level of maturity to broad power market • In good wind regimes, economics approach competitiveness with conventional power generation; elevated gas prices and incentives increase cost-effectiveness • Only uses ~5% of affected land area – remainder can continue to be used for grazing, crops, etc.	• US market development is strongly dependent on the Federal PTC periodically renewed by Congress • Intermittent resource difficult to schedule within existing wholesale markets • Class 4 - 6 wind resources are very localized • Land availability in high wind areas is often limited or costly • T&D systems are often weakest in remote areas where wind resource are best – upgrades often needed to transport power to load centers • Avian mortality can be an issue if located in migration paths; larger turbines used today have low rotational speed (<18 rpm), so avian deaths are less of an issue; bat mortality has also become a concern

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General Wind Project Economics

40 MW Wind Project		
Project Size (kW)		40,000
Capital Cost ($/kW)	$	1,000
Incentive		0.0%
Capital cost after incentive	$	-
Electric Interconnection Costs	$	900,000
Development/Financing Costs	$	2,000,000
Other Costs	$	250,000
Total Project Cost	$	43,150,000
Capital Cost Amortization (yrs)		14
kWh/Yr		106,320,000
Production Cost ($/kWh)	$	0.0551
O&M Cost ($/kWh)	$	0.0050
Other	$	-
ALL-IN COST/kWh	**$**	**0.0601**

RED MOUNTAIN ENERGY PARTNERS

Foresight Development Agreement - Summary of Timeline and Activities

Foresight Responsibilities

Phase I

- Identify potential sites, install met testing equipment, collect data 6 - 12 mos
- Apply for state, federal, and other grants
- Prepare technical report describing conditions for each tested site
- Deliver report within 13 months after installation of met tower
- Move towers to alternative sites, if needed, up to 9 months into the term

Phase II

- Physical and cultural evaluation of proposed site(s)
- Prepare detailed financial projections
- Discuss equity participation agmts
- Execute Power Purchase Agreements
- Prepare Interim Development Report
- Commence land payment option of $25,000 per year upon execution of an Easement Agreement for site

Phase III

- Continue land option payments
- Finalize PPAs for the Project's output
- Finalize project sale to new owner or oversee financing and construction of facility
- Finalize financing of Project, utilizing a minimum 50% project debt, or provide notice that lead equity investor will contribute up to 100% of capital costs

Months After Agreement Execution: 1 ... 16 ... 22 ... 40 ... 58

Laguna Responsibilities

Phase I

- Provide/assist access to potential project sites for monitoring equipment
- Assist in applying for federal, state, and other grant applications, and administering funds
- If Foresight concludes wind resource is adequate, and provides evidence of ability to commit additional $250,000 for development, Parties extend Agreement. If not, Foresight delivers all data and reports to Laguna; Agreement will expire

Phase II

- Seek tribal approval to execute Grant of Easement with BIA
- Allow Foresight to undertake legally permissible activities on sites selected
- Administer grant funds and assist Foresight to develop and market Project
- Parties enter into long-term Easement Agreement for project site.
- Primary Agreement: payments for greater of 1) $2,500 per MW of turbine capacity/yr, escalated by 5% each five years; or 2) 3% of Gross Operating Proceeds during Operating Period

Phase III

- Execute Equity Agreement w/option for up to 20% equity or provide Laguna annual cash payment of $50,000
- Execute Post Operating Period Agreement; owner responsible for removing equipment/restoring land to original condition or transferring 100% ownership to Laguna. PPA extension extends Easement Agreement and increases Royalty Payments to greater of $5000 per MW/year, or 5% of Project's Gross Operating Proceeds

RED MOUNTAIN ENERGY PARTNERS

Laguna Biomass Resource

- Organic material available on a renewable or recurring basis:
  - Forest-related materials
  - Agricultural-related materials
  - Animal waste
  - Solid woody waste materials
  - Crops and trees planted for the purpose of being used to produce energy
  - Landfill gas, wastewater treatment gas, and biosolids
  - Segregated municipal solid waste ("MSW"), excluding tires, medical and hazardous waste

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RED MOUNTAIN ENERGY PARTNERS

Laguna Biomass Resource

- Forest – Adequate resources, with over 150,000 acres of forest; no existing logging infrastructure/forest management activity
- Agriculture: Extremely limited to non-existent; agriculture limited to small family plots of corn, chile, alfalfa and assorted vegetables. No discernible residue stream
- Animal wastes: Non-existent. No confined animal operations (dairy, feedlot, poultry)
- Landfill gas: Non-existent. Several abandoned landfills. Contents "burned" before backfill, not lined nor monitored. Gas production likely to be low because of small size/capacity and low rainfall in region
- 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

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Laguna Biomass Resource

- Municipal solid waste: 940 households; handled by Utility Authority
  - Delivered to transfer station and then to Albuquerque landfill
  - Not likely enough tonnage to warrant consideration of MSW
- Transfer station: Modest amount of woody biomass from local C&D is ground up for free use by anyone

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Biomass Technology

BIOMASS FEEDSTOCK

Wood Waste
MSW
Agricultural Crops
Agricultural Residues
Animal Wastes

→

CONVERSION PROCESSES

Gasification
Fermentation
Acid Hydrolysis
Hydro-thermal liquefaction
Combustion
Co-firing

→

USES

Transportation Fuels
- Ethanol
- Biodiesel
- Biocrude Oil

Electricity

Heat

Products
- Oils
- Plastics
- Solvents
- Chemical Intermediates
- Adhesives
- Dyes, Pigments, and Ink
- Detergents
- Etc.

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Biomass Technology

Resource		Conversion Option	Technology Type
Solid Biomass	• Wood • Wood Waste • Agricultural Residues • Bagasse • Food Processing Residues • Animal Wastes • Municipal Solid Waste (MSW) • Energy Crops	Direct Combustion	Biomass-only Rankine (steam) Cycle
			Co-firing Rankine Cycle (primarily coal)
		Gasification	Biomass-only Rankine Cycle
			Biomass-only GT/IGCC
			Biomass-only IC Engine (ICE)
			Co-firing (coal or NG Rankine, IGCC, CCGT)
			Co-gasification of Biomass and Coal
		Liquefaction (Pyrolysis)	Biomass-only (Rankine, GT, ICE)
			Co-firing (Rankine, GT/GTCC, ICE)
Gaseous Biomass (biogas)	• Landfill Gas • Methane From Waste, Wastewater Treatment	Direct Combustion/ Conversion	Biomass-only Rankine Cycle
			Biomass-only GT, GTCC, ICE
			Biomass-only Fuel Cell

Note: GT = gas turbine, GTCC = gas turbine combined cycle; IGCC = integrated gasification combined cycle, ICE = internal combustion engine

Source: Navigant Consulting, Inc.

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Biomass Technology Overview

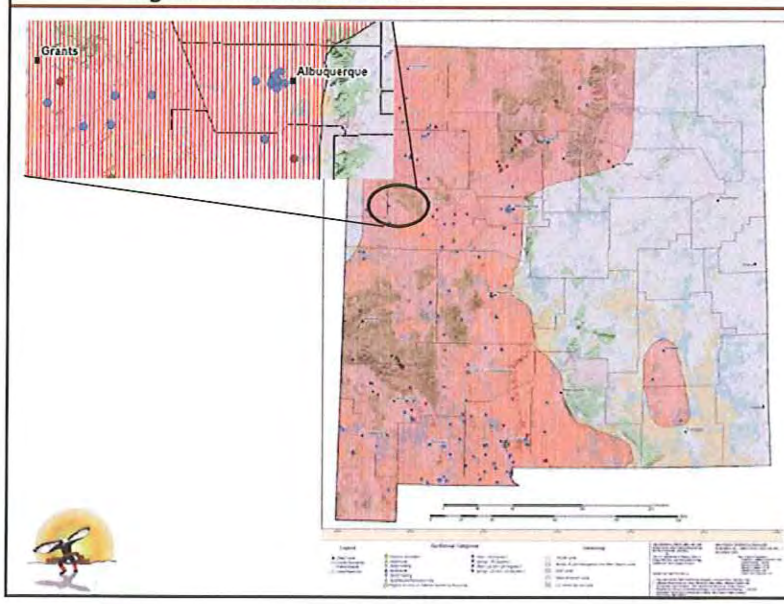
Direct Solid Biomass Combustion and Gasification

Advantages	Challenges
• Biomass combustion is proven technology • Dispatchable, high capacity-factor • Creates additional economic value for agriculture or biomass-based industries (energy cost savings via cogeneration, or revenue from sale of biomass residues to power plants) • Adds more capacity to the overall power supply mix (vs. co-firing at existing fossil plants, which only displaces existing capacity) • Avoids or reduces cost of disposal (waste = fuel) • Biomass gasification combined cycle promises higher efficiency and lower emissions relative to biomass combustion – should be easier to permit than direct combustion	• High capital costs ($1,500-2,500/kW, depending on size, higher for distributed applications) • Combustion has low efficiency (20-25%) (lower for distributed applications) • Requires long-term biomass fuel supply at reasonable price to avoid risk of stranded investment • Limited incentives relative to other major renewable technologies • Can be difficult to site due to emission concerns • For distributed systems a lack of business models to address ownership and operation, since site owners may not have the interest in owning and operating a power plant • Biomass gasification combined cycle is not commercially proven and progress has been slow

Laguna Biomass Considerations

- Buildings / processes with high thermal loads and high load factors
  - Larger facilities, typically over 50,000 square feet
  - Important to capture economies of scale
- Buildings with existing boilers and circulating hot water or steam systems
  - Hot water systems preferred, as state laws generally require personnel with special certification for operation of a steam system
- Current condition and age of existing boilers
  - New or well-maintained boilers are rarely candidates for retrofit
- Future construction plans
  - Stand-alone project more difficult to economically justify
  - Identify construction plans that include expansion or renovation of HVAC system
- Comparative fuel economics
  - Compare delivered price of biomass energy to the current fuel costs

Laguna Geothermal Resource



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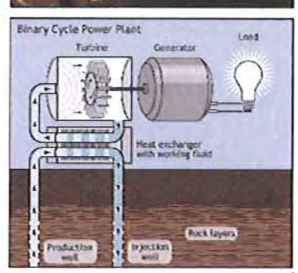
Large-Scale Geothermal Technology

Geothermal power has an established track record, with the US and Philippines accounting for 50% of the installed capacity.

- **Dry steam** plants use hydrothermal fluids that are primarily steam. The steam goes directly to a turbine, which drives a generator that produces electricity. These resources are the least common
- Hydrothermal fluids above 360F can be used in **flash steam** plants to make electricity. Fluid is sprayed into a tank held at a much lower pressure than the fluid, causing some of the fluid to rapidly vaporize, or "flash." The vapor then drives a turbine, which drives a generator.
- **Binary** plants use fluids below 400F. Heat from the geothermal fluid is used to boil a low-boiling point fluid, which then drives the turbines. These resources are the most common.

The Geysers dry steam plant in California.



Source: US DOE, Office of Energy Efficiency and Renewable Energy.

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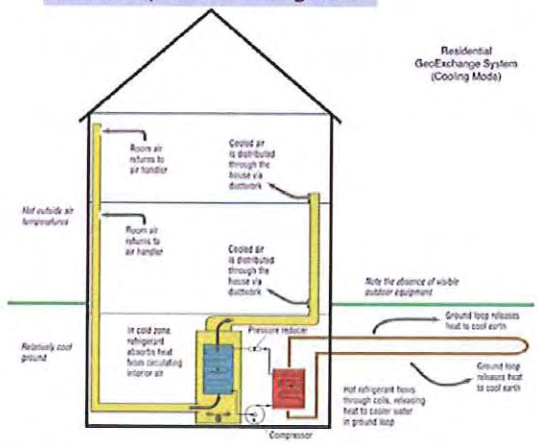
Residential and Commercial-Scale Geothermal Technology

Summer Operation: Cooling Mode



- Geothermal Heat Pumps:
  - Work through a series of plastic polyethylene (PE) pipe buried in the yard, known as the ground loop heat exchanger; connects to a highly efficient water-source heat pump unit located indoors
  - Extract stored solar heat from the Earth, exchanging as the seasons change
  - Most efficient heating and cooling systems available
  - Much quieter than conventional equipment, require no outdoor equipment to maintain

Source: Geothermal Heat Pump Consortium

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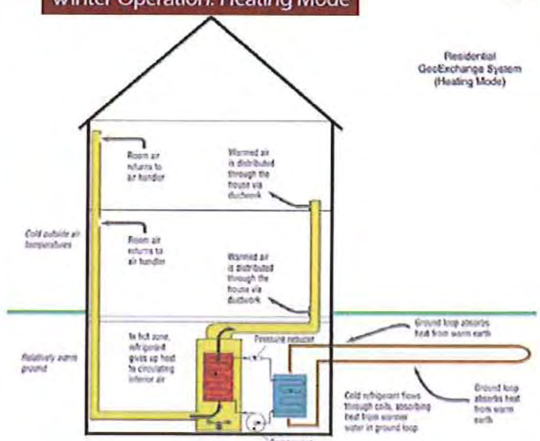
Residential and Commercial-Scale Geothermal Technology

Winter Operation: Heating Mode



- Geothermal Heat Pumps:
  - Lower electricity demand by approximately 1 kW per ton of capacity
  - Generate no onsite emissions and have lowest emissions among all heating and cooling technologies
  - Save 30 to 70% in the heating mode and 20 to 50% in the cooling mode, compared to conventional systems

Source: Geothermal Heat Pump Consortium

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Geothermal Technology Overview

Good geothermal resources combined with other factors such as low land requirements, high availability and few technical risks are the main drivers.

Advantages	Challenges
• At good resource sites, the technology is very cost competitive relative to conventional power sources • Less land requirement than coal and nuclear plants (e.g., entire geothermal field uses only 1-8 acres/MW vs. 5-10 acres/MW for nuclear and 19 acres/MW for coal) • Low emissions, if any, for steam and flash plants, mostly water vapor (CO_2 emissions only 5% of equivalent fossil fuel power plant emissions) • No gaseous emissions for binary plants that adopt the closed-loop system • High availability (90-98%) • Few technical risks – based on proven power cycle technology	• High levels of capital investment for exploration and development (~30% of overall project cost) — These costs are relatively risky, since exploration is not always successful. • Some emission of hydrogen sulfide, radon, methane and ammonia • Well productivity can decrease as much as 5-10% per year requiring construction of new wells • Greater O&M costs than some other renewable energy technologies • Less availability of economically feasible resource sites near transmission lines

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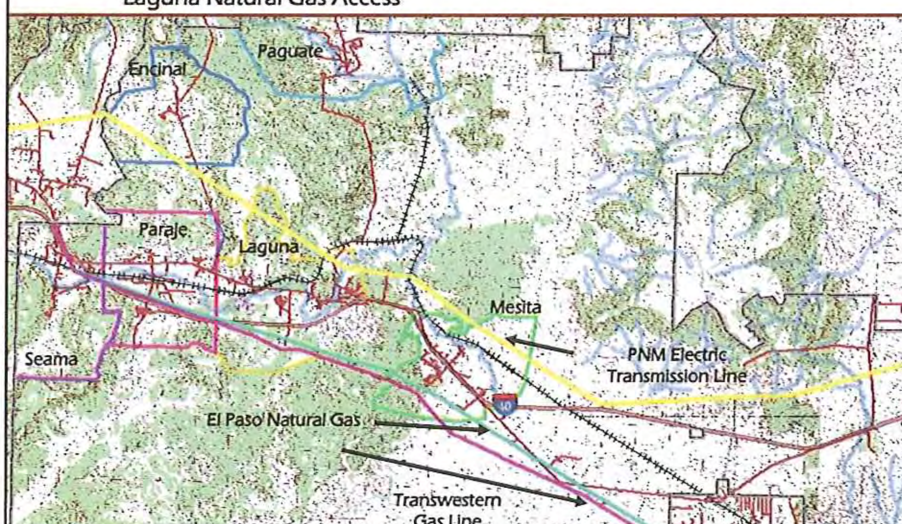
Laguna Natural Gas Access



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Laguna Natural Gas Access

- Excellent access to two high-pressure interstate pipelines
  - El Paso Natural Gas
  - Transwestern
- Access via PNM gas distribution system
  - Laguna
  - Mesita
  - Seama
  - Paraje

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RED MOUNTAIN ENERGY PARTNERS

Laguna Natural Gas Opportunities

- "Firm" a renewable resource w/natural gas generation
  - Large scale
  - Small scale
- Operate gas distribution operations
  - Provide retail distribution services on reservation
  - Poise to provide gas services on reservation to serve current and attract potential commercial, industrial customers
  - Potentially provide wholesale gas to gas-fired reservation project

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RED MOUNTAIN ENERGY PARTNERS

Laguna Natural Gas Considerations

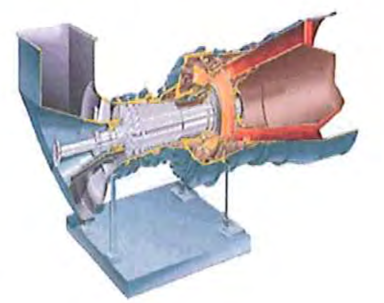
- Energy project development
  - Project location/cost of project laterals
  - Cost and process of interconnection
- Natural gas distribution operations
  - Cost of distribution lines/project laterals
    - Distance/terrain are a challenge
- Potential to attract new businesses
- Pipeline capacity
  - Previously a major issue
- Gas supply
  - Gas cost risk
  - Tribal supply arrangement
  - Hedging options

Natural Gas – Combined Cycle Cogeneration

- Small Combined Cycle / Cogeneration
  - Combined Cycle with steam export for industrial or commercial use
  - More fuel efficient and cost effective than separate power and heating/cooling plants
  - Capacity from 10 to 100 megawatts
  - Requires 5 to 20 acres of land
  - Requires 2 to 5 years to develop and construct
  - Capital cost between $50 million and $100 million
  - Up to 100 jobs during construction, about 20 jobs during operation

Natural Gas - Simple Cycle

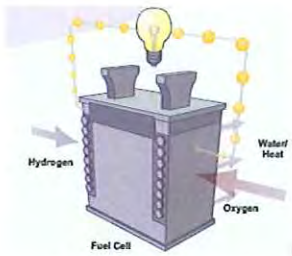
- Combustion Turbine or Reciprocating Engine only
- Lower capital cost, but lower fuel efficiency
- Appropriate for summer peak operation
- Capacity from 20 to 100 megawatts
- Requires 5 to 20 acres of land
- Requires 1 to 3 years to develop and construct
- Capital cost between $10 million and $50 million
- Up to 50 jobs during construction, about 10 during operation



General Gas Turbine Combined Cycle Plant Economics

200 MW CCGT		
Project Size (MW)		200
Capital Cost ($/MW)	$	800,000
Electric Interconnection Costs	$	1,000,000
Ancillary Equipment Costs	$	1,000,000
Fuel Infrastructure Costs	$	2,000,000
Fuel Cost ($/MMBtu)	$	5.00
Heat Rate (Btu/MWh)		7.5
Total Project Cost	$	164,000,000
Capital Cost Amort (yrs)		15
Annual Capital	$	24,079,175
MWh/Yr at 80% LF		1,401,600
Production Cost ($/MWh)	$	17.1798
O&M Cost ($/MWh)	$	5.0000
Fuel Cost ($/MWh)	$	37.5000
ALL-IN COST/MWh	**$**	**59.6798**

Fuel Cell Technology



Oxygen enters a fuel cell membrane from the atmosphere, while its hydrogen source may come from natural gas, or renewable energy-based water electrolysis

- Convert the chemical energy of a fuel and an oxidant directly into electrical energy and heat using electrochemical processes
- The simplest type, a Proton Exchange Membrane Fuel Cell (PEMFC), combines hydrogen fuel with oxygen from the air to produce electricity, water, and heat. Consists of:
  - an anode (a negative electrode that repels electrons),
  - an electrolyte in the center, and
  - a cathode (a positive electrode that attracts electrons)
- Hydrogen gives up electrons at the anode, and recombines with the hydrogen ions (the protons) and oxygen at the cathode to form water
- As hydrogen flows into the fuel cell anode, a catalyst, often a platinum coating on the anode, helps to separate the gas into protons (hydrogen ions) and electrons
- Electricity results from free electrons liberated from hydrogen at the anode flowing through an external electrical circuit before recombining with hydrogen ions and oxygen at the cathode to produce water
- Individual fuel cells can be combined in series into a fuel cell "stack" to achieve the desired voltage

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Source: U.S. Fuel Cell Council, 2006

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Fuel Cell Technology

	Proton Exchange Membrane Fuel Cell (PEM)	Alkaline Fuel Cell (AFC)	Phosphoric Acid Fuel Cell (PAFC)	Molten Carbonate Fuel Cell (MCFC)	Solid Oxide Fuel Cell (SOFC)
Electrical System Efficiency (%,LHV)	35-50	50-60	40	45-65	50-70
Typical Size (kW)	Residential: 1-10/ Commercial: 75-250	25-100	200	250 multi-megawatt	Residential: 3–10 Commercial: ~250
Cost per kW (US$)			4,250		
Some Applications					
Commercial Buildings	YES	YES	YES	YES	YES
Cogeneration	YES	YES	YES	YES	YES
Residential	YES	YES			YES
Utility Power			YES	YES	YES
Distributed Power	YES	YES	YES	YES	YES
Utility Repowering			YES	YES	YES
Vehicles	YES	YES	YES		

Source: U.S. Fuel Cell Council, 2006

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Fuel Cell Technology

Stationary fuel cell units, used for small power needs and back-up generation are the most mature fuel cell application

Advantages	Challenges
• High energy conversion efficiency – may range from 40 to 60% based on lower heating value (LHV) of the fuel • Good part load characteristics; quick response to load changes • Modular design and flexibility of size • Easily sited due to low environmental signature; no gaseous, solid or noise emissions • Suitable for cogeneration – heat rejected from some fuel cell types such as the Molten Carbonate and Solid Oxide fuel cells is at sufficiently high temperature for process heat • Can be constructed in a wide range of electrical output, from less than a kW to sizes in excess of a MW	• Sensitivity to certain contaminants that may be present in the fuel such as sulfur and chlorides • High capital costs; currently on the order of \$4,500/kW with research targeted toward a \$400/kW price point • Lack of the field data on endurance/reliability • Fuel entering the cell must be gaseous and in some cases, must be hydrogen which leads to the requirement of a fuel pre-processor, or "reformer" – in some types fuel is processed outside (externally reformed) or inside (internally reformed)

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Fuel Cell Applications

2 UTC Fuel Cells 200 kW natural gas units installed on 4th floor of Conde Nast Building at 4 Times Square, New York

Plug Power 5kW unit

Ballard 259 kW natural gas unit; utilizes cogeneration incorporating an absorption chiller for air-conditioning

Fuel Cell Energy 250 kW unit

- An electrochemical energy conversion device that combines hydrogen and oxygen to produce pure water plus energy
- Range in size from kilowatts to megawatts
- Currently capital costs are ~ \$4,500/kW; research is targeted toward a price point of \$400/kW or less
- Can be run on a wide variety of fuels; when run on pure hydrogen fuel generated by renewable energy sources, fuel cells produce no carbon or other toxic emissions
- Several main types of fuel cells exist, characterized by their "electrolytes", which are solids or liquids that provide a transport mechanism between positive and negative electrodes
- Stationary fuel cell units are the most mature application; used for backup power, power for remote locations, stand-alone power plants, distributed generation, and co-generation
- Approximately 600 systems that produce 10 kilowatts or more have been built and operated worldwide to date, most fueled by natural gas
- Types of fuel cells:
  - Polymer Electrolyte Membrane (PEM) Fuel
  - Alkaline Fuel Cells
  - Phosphoric Acid Fuel Cells
  - Molten Carbonate Fuel Cells
  - Solid Oxide Fuel Cells

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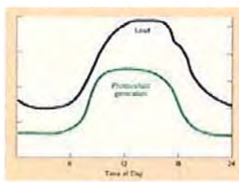
Purpose of Energy Profiling

- Identification of fit between energy demand and potential generation options
  - Best-fit generation options have high correlation between daily energy use profile and the generating resource's daily energy production profile
- Identification of energy management opportunities
  - Energy efficiency, conservation, demand management
  - Implications for operational flexibility:
    - Time-of-use patterns
    - "Coincident" usage patterns to avoid demand charge threshold
    - Real-time consumption information



Example of a photovoltaic production profile and a typical demand profile

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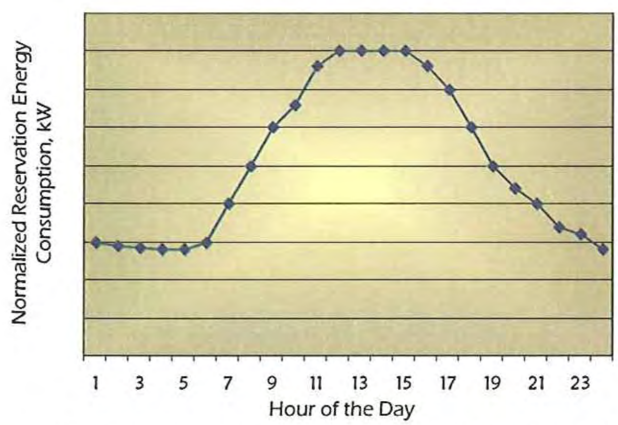
Laguna Energy Profile

Energy profile depicts a very typical pattern of daily energy use



Average Daily Energy Consumption, Reservation-wide, Based Upon Existing Generalized Analysis

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Building an Energy Use Profile

- Update existing Energy Profile
  - Preliminary, generalized annual load profile
  - Updates to existing profile required
    - Some information incomplete
    - New construction to date will be added via housing stocks database
- Validate existing profile through meter data and utility billings
  - Data gathering underway; additional requests to utilities needed
  - Validation will reflect better representation of actual Reservation electricity load and forecast

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Efforts Underway

- Data requests for 2004/2005 utility billings and/or energy ledgers
- Requests to utility providers for detailed data
  - Meter types by facility
  - Demand or "interval" data, where available
  - Applicable electricity tariffs (rate schedules)
  - Requests must be made or approved by Tribal customers
- Update of facility and dwelling inventory via analysis of housing stock database
- Discussions with facility/energy managers
- Reconstruction of energy profile with actual data

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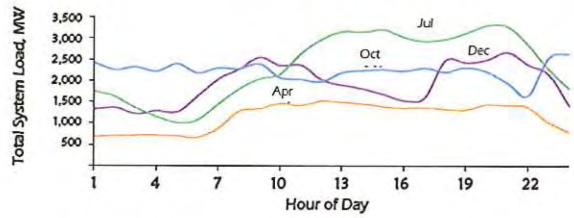
System Electric Load vs. Generation

- The tariff, or "rate schedule", sets price charged for electricity consumed, based upon customer information and energy demand
  - Total system load, driven by customer energy demand, varies hourly and seasonally
  - Generating capacity must be maintained to serve *peak* demand



–Illustrative–
Typical pattern for a southwestern U.S. utility with summer peak load

Typical daily electrical utility system load varies by season.

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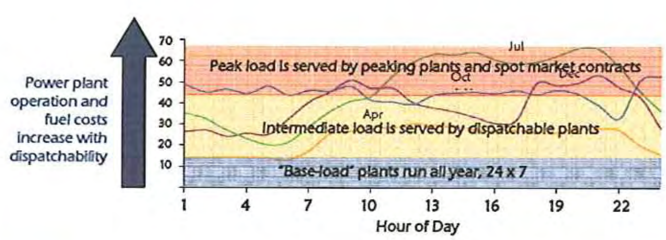
System Electric Load vs. Generation

- Cost of generating electricity varies hourly and seasonally, due to need to dispatch more expensive plants during peak demand periods
- Utilities recover their capital costs required to maintain sufficient peak generating capacity through "facility charges", also known as capacity charge, or *demand charge*
- Utilities also recover the production costs of more expensive electricity by using "time-of-use" rates



–Illustrative–
Typical pattern for a southwestern U.S. utility with summer peak load

Energy costs also vary both hourly and by season.

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Laguna Energy Project Considerations

- Renewable Resources
  - Wind
  - Solar
  - Biomass
  - Geothermal
- Technology cost effectiveness
- Natural gas complement
- Laguna needs vs. available resource
- Large scale vs. self-supply
- Siting/permitting
- Joint tribal project

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Renewable Resource "Benchmark" Traits

Type of Resource	Measurement	Typical Values	1 MW Equivalent
Wind	Wind Speed (Density)	Class 4-7 15.7+ mph	Less than 1 Turbine
Solar PV	Solar Insolation	Capacity Factor Watts/m2	1 acre e.g. Walmart store
Solar Thermal	Solar Insolation	Capacity Factor Watts/m2	10 acres
Solid Biomass	Heat/Water Content	5000-7000 Btu/lb	1 Dry Ton/Hr
Biogas	Methane Content	LFG: 50% Methane Dairy: 60% Methane	1 MM tons WIP; 1000 cattle
Geothermal (Flash/Direct Steam)	Steam Temperature, Pressure and Quantity	>350F 100 psi	15-20klbs
Small Hydro	Head (ft) Flow(cu.ft/sec)	Wide range	33 ft @ 500 cu.ft/sec

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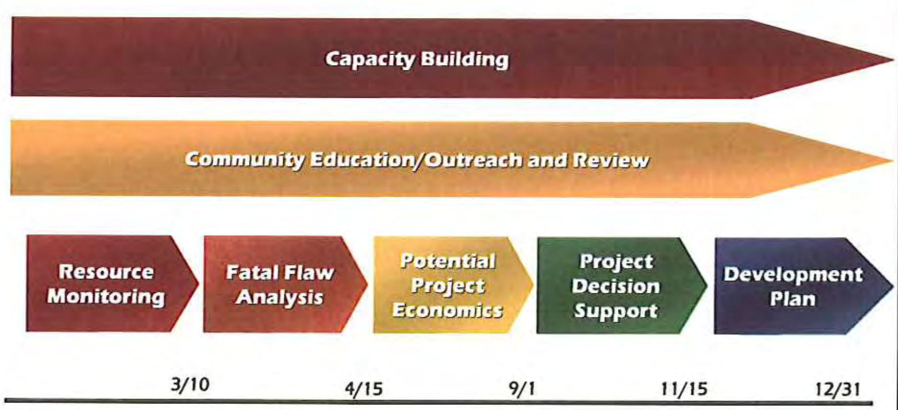
Renewable Resource "Benchmark" Traits

Type of Resource	System Size	Installed System Cost ($/kW)	O&M Costs (¢/kWh)	Capacity Factor	Key Issues
Wind	Each Turbine: 650-2500 kW	1,200	0.5	Class 4 wind 30%	Intermittency
Solar Thermal	25kW – 300 MW	3,000 – 4,000	0.03-0.04	22-25%, up to 90% with storage	High Capital Cost
Solar PV - Commercial	250-1000 kW	6,500	0.8	14-20%	High Capital Cost
Solid Biomass	15 kW-100 MW	1,500-2,000	1.5 (+fuel)	85%	Emissions
Biogas	5 MW	1,200-1,500	1.5-2.0 (+fuel)	85%	Air quality; gas collection system
Geothermal	50 MW+	2,000-2,500	1.0-1.5	90%	Upfront costs such as drilling an exploration; resource could deplete
Small Hydro	1-5 MW	3,500-4,500	0.5	45-65%	Permitting; High Capital Cost

Renewable Energy Feasibility Study Project Overview/Schedule



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ENERGY PARTNERS

Pueblo of Laguna
Utility Authority Board of Directors
Status Report

May 2006

Discussion Topics

1. Overview of DOE Renewable Energy Study/Status
2. Status of DOI MAPS Grant Application for Renewable Energy Feasibility Study
3. CDEC System Issues Update
4. Possible DOI Electric System Proposal
5. Possible Economic Development Administration (EDA) Grant Opportunity

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Background Information

- Utility Authority Formation – 1980s-2005
- Utility Formation and Power Development Study - 2004-2005
  - Utility Organization, Implementation
  - Electric System Issues, Alternatives
  - Power Development Potential
- Multiple Grant Applications
  - ANA – Utility Implementation (awarded)
  - USDA – Electric System Acquisition/Improvements
  - DOE – Electric System Negotiations
  - DOE – Renewable Energy Feasibility (awarded)
  - DOI – Renewable Energy Feasibility
  - NM – Wind Feasibility (awarded)
- Foresight Energy Wind Development Agreement – May 2005
- Utility Authority Operations Begin – August 2005
- DOE Feasibility Study – Now Underway

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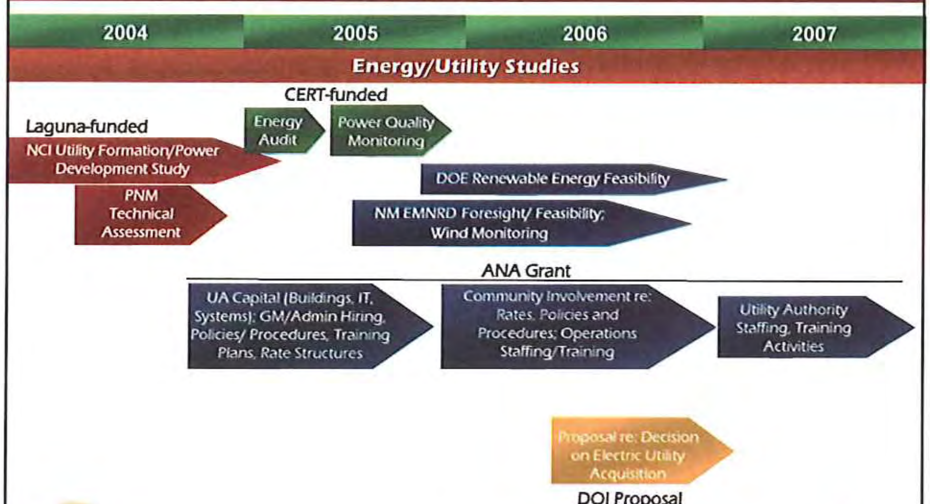
RED MOUNTAIN ENERGY PARTNERS

Pueblo of Laguna Utility/Energy Studies



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RED MOUNTAIN ENERGY PARTNERS

Renewable Energy Feasibility Study Objectives and Work Effort

Project Objectives:

- Increase energy knowledge and capacity
- Improve quality and reliability of electric service
- Contribute to development of environmentally clean energy
- Provide data/analysis to support Laguna involvement in renewable energy projects as an owner or participant

Capacity Building

Identify staff resources and provide ongoing education/support

Community Education/Outreach and Review

Develop/implement community education tools (newsletter, meetings) in order to gain community support for identified projects

Resource Monitoring

Understand renewable resources, power needs, and identify possible projects

Fatal Flaw Analysis

Identify major issues that would eliminate possible projects

Potential Project Economics

Evaluate feasibility of community-supported projects

Project Decision Support

Presentation/ decisions re: pursuit of feasible projects

Development Plan

Create development plan, budget and contact possible funding sources

Laguna Capacity Building

- Recruit/identify/support energy management intern
  - Job description developed and posted
  - Applicants interviewed
  - Thelma Antonio hired; April 9 start date
- Red Mountain Energy provided interim project management support

Laguna Community Outreach

- Newsletter concept developed
- Newsletter article scheme developed
  - Lead topic for each edition
  - Regular articles on utility related topics
  - Schedule developed
  - First edition completed and distributed
  - Second edition underway
- Community meeting concepts developed
  - Series of village and combined meetings
  - Initial meeting now scheduled May 17


Laguna Utility Service News

Laguna Utility Authority Formed

Employees Transition to Utility

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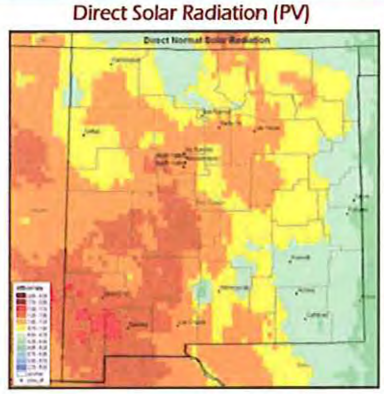
Laguna Solar Resource

Concentrating Solar Power

Insolation relevant for Concentrating Solar Power technology is measured with collectors that track the sun. Parts of the Pueblo have concentrator insolation levels in the range of 7.25 – 7.5 kWh/m²/day, well within the range suitable for large-scale solar projects

Direct Solar Radiation (PV)



Flat plate collectors are used to measure insolation levels relevant for PV systems. Average annual insolation on the Pueblo falls in the range of 7.25 – 7.5 kWh/m2/day

Source: National Renewable Energy Lab (NREL)

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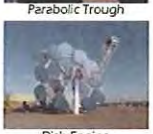
RED MOUNTAIN ENERGY PARTNERS

Laguna Solar Options

Concentrating Solar Power

Power Tower

Parabolic Trough



Dish-Engine

HCPV

Photovoltaics

- Solar resource is strong, and would support distributed and centralized photovoltaic applications
- Combination of strong resource and cooler temperatures at Laguna improve operating efficiency and economics

Concentrating Solar Power

- Solar resource appears to be strong for larger scale CSP technologies; actual site measurements required to support project investment decisions
  - Project economics depend on financing, project structure, enabling incentives, etc.
  - Annual kWh produced and sold will make or break project profitability; accurate resource measurement is critical
  - Technology advances and increasing volumes expected to continue to bring capital costs down

Photovoltaics

Thin film BIPV

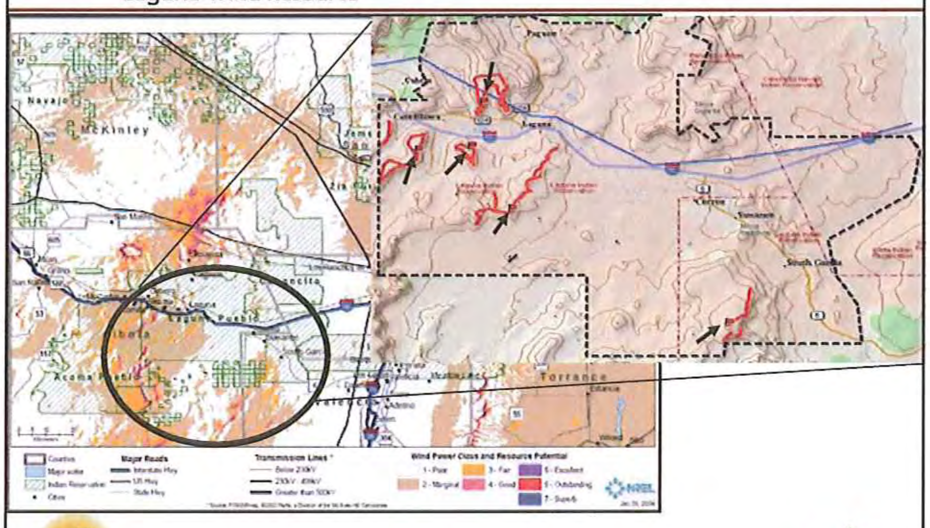
Polycrystalline silicon

Multi-junction cells

Single & dual axis tracking

RED MOUNTAIN ENERGY PARTNERS

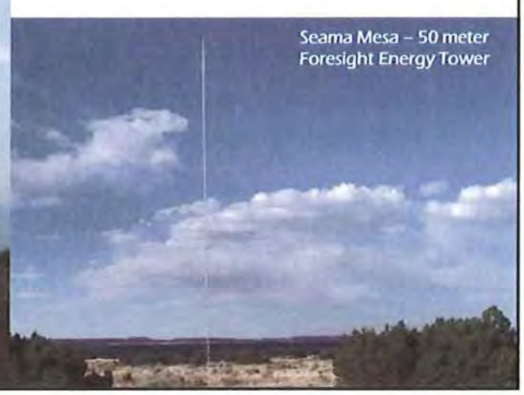
Laguna Wind Resource



RED MOUNTAIN ENERGY PARTNERS

Laguna Wind Resource

Results to Date:
- Initial indications that wind resource is lower than expected
  - Data gathered during the lower wind season
  - One year's data needed for full evaluation
- Wind monitoring equipment could be moved to other possible sites
  - No sites remaining of those originally identified
  - New sites would need to be identified



Foresight Development Agreement - Summary of Timeline and Activities

Foresight Responsibilities

Phase I

- Identify potential sites, install met testing equipment, collect data 6 - 12 mos
- Apply for state, federal, and other grants
- Prepare technical report describing conditions for each tested site
- Deliver report within 13 months after installation of met tower
- Move towers to alternative sites, if needed, up to 9 months into the term

Phase II

- Physical and cultural evaluation of proposed site(s)
- Prepare detailed financial projections
- Discuss equity participation agmts
- Execute Power Purchase Agreements
- Prepare Interim Development Report
- Commence land payment option of $25,000 per year upon execution of an Easement Agreement for site

Phase III

- Continue land option payments
- Finalize PPAs for the Project's output
- Finalize project sale to new owner or oversee financing and construction of facility
- Finalize financing of Project, utilizing a minimum 50% project debt, or provide notice that lead equity investor will contribute up to 100% of capital costs

Months After Agreement Execution

1 … 16 … 22 … 46 …

Laguna Responsibilities

- Provide/assist access to potential project sites for monitoring equipment
- Assist in applying for federal, state, and other grant applications, and administering funds
- If Foresight concludes wind resource is adequate, and provides evidence of ability to commit additional $250,000 for development, Parties extend Agreement. If not, Foresight delivers all data and reports to Laguna; Agreement will expire

- Seek tribal approval to execute Grant of Easement with BIA
- Allow Foresight to undertake legally permissible activities on sites selected
- Administer grant funds and assist Foresight to develop and market Project
- Parties enter into long-term Easement Agreement for project site.
- Primary Agreement: payments for greater of 1) $2,500 per MW of turbine capacity/yr, escalated by 5% each five years; or 2) 3% of Gross Operating Proceeds during Operating Period

- Execute Equity Agreement w/option for up to 20% equity or provide Laguna annual cash payment of $50,000
- Execute Post Operating Period Agreement; owner responsible for removing equipment/restoring land to original condition or transferring 100% ownership to Laguna. PPA extension extends Easement Agreement and increases Royalty Payments to greater of $5000 per MW/year, or 5% of Project's Gross Operating Proceeds

RED MOUNTAIN ENERGY PARTNERS

Laguna Wind Options

- Wait for Foresight Energy report due early August
- Potential for Foresight to end agreement, based on interim results
  - Per Foresight Development Agreement, Laguna would be free to pursue other wind development opportunities (small scale or large scale)
  - If community supported concept of wind generation, consider large-scale development at other sites
    - Further testing to determine if other sites could be viable
- If Foresight continues agreement, Laguna could still pursue village-specific projects

GE 1.5 MW Turbines
(large scale)

Bergey 10 kW Turbine
(small scale)

Laguna Biomass Resource

- **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

Laguna Biomass Options

- No obvious opportunities, given limited resources
- High interest in use of salt cedar
- Best options:
  - Focus on resources for buildings / processes with high thermal loads and high load factors
    - Larger facilities, typically over 50,000 square feet
    - Buildings with older existing boilers and circulating hot water or steam systems
  - Consider for future construction that includes expansion or renovation of HVAC system

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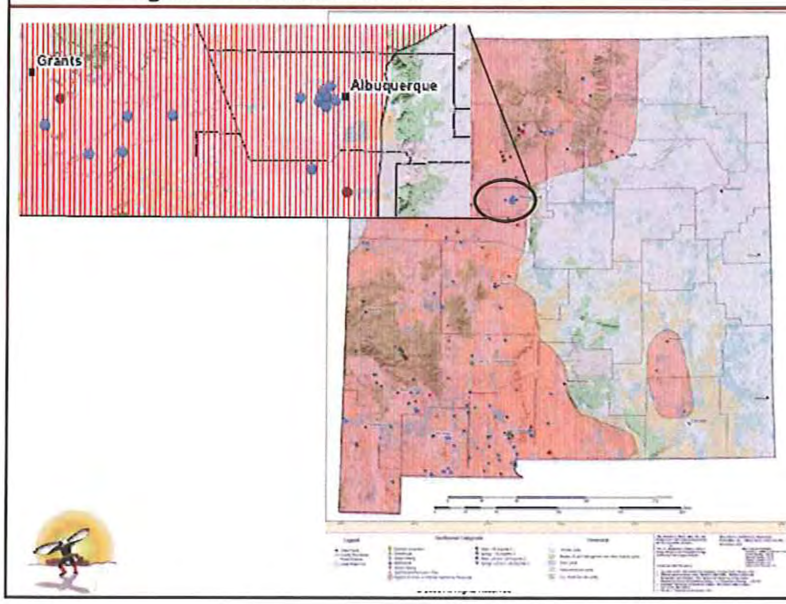
Laguna Geothermal Resource



Laguna Geothermal Resource

- 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

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RED MOUNTAIN ENERGY PARTNERS

Laguna Geothermal Options

- Potential 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

USDOE

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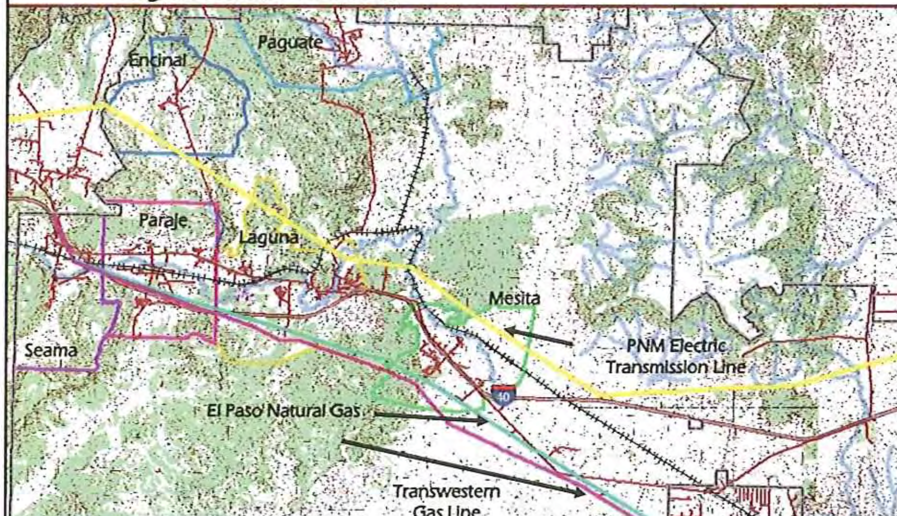
RED MOUNTAIN ENERGY PARTNERS

Laguna Natural Gas Access



RED MOUNTAIN ENERGY PARTNERS

Pueblo of Laguna Natural Gas Line Access

- Interstate pipelines on Laguna provide interconnection potential for very high-volume natural gas use
  - TransWestern Pipeline
  - El Paso Natural Gas Pipeline
- PNM transmission/distribution system service on portions of Laguna provides access for industrial. commercial, government and residential access

RED MOUNTAIN ENERGY PARTNERS

Laguna Natural Gas Options

- Large scale gas-fired generation
  - Meet reservation load, plus sales to grid
  - Consideration of economies of scale in relation to possible interconnection and pipeline lateral costs
- "Firm" a renewable resource w/natural gas generation
  - Large scale
  - Small scale
- Village-scale microturbine
- Facility location
  - Turbine or CHP
- Gas distribution operations

Large scale combined cycle/combined heat/power plant

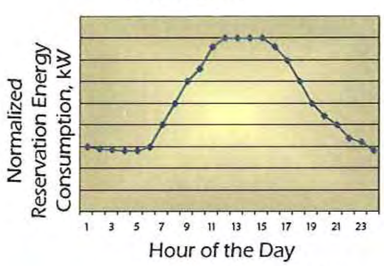
Combustion turbine or recip engine

Microturbine

Fuel cell

Laguna Electric Load Assessment

- Usage
  - Reservation
  - Villages
  - Major entities
- Profile
  - Time of use
  - Level of use



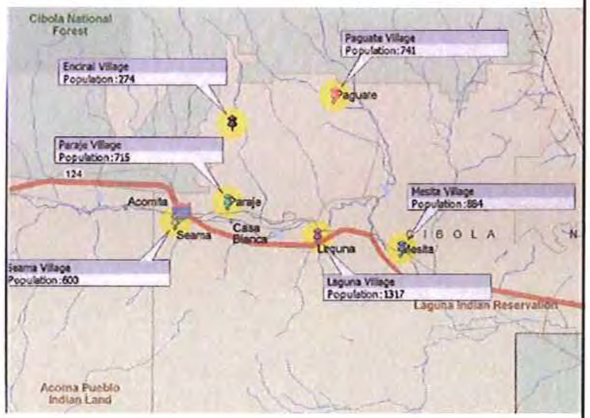
Average Daily Energy Consumption, Reservation-wide, Based Upon Existing Generalized Analysis

- Purposes/uses of electric load assessment:
  - Identify "fit" between energy demand and potential generation options
    - High correlation between daily energy use profile and energy production profile of generating resource
  - Identification of energy management opportunities
    - Energy efficiency, conservation, demand management
  - Identify impacts on operational flexibility
    - Time-of-use patterns (certain hours)
    - "Coincident" usage (all at once) patterns to avoid demand charge
    - Real-time consumption information

Laguna Potential Project Identification

Match between:

- Resource available
  - Equipment types
- Electric usage/type of use
  - Provide a portion or all of power supply
- High-level project economics
- Community considerations
  - Cultural fit
  - Environmental impact
  - Footprint
  - Views
  - Power cost impact



Project Identification - Renewable Resource Comparisons

Type of Resource	System Size	Measurement	Capacity Factor	Installed System Cost ($/kW)	1 MW Equivalent
Wind	Each Turbine: 650-2500 kW	Wind Speed (Density)	Class 4 wind 30%	1,200	Less than 1 Turbine
Solar Thermal	25kW – 300 MW	Solar Insolation	22-25%, up to 90% with storage	3,000 – 4,000	10 acres acre e.g. Walmart store
Solar PV - Commercial	250-1000 kW	Solar Insolation	14-20%	6,500	1 acre (Walmart)
Solid Biomass	15 kW-100 MW	Heat/Water Content	85%	1,500-2,000	1 Dry Ton/Hr
Biogas	5 MW	Methane Content	85%	1,200-1,500	1 MM tons WIP; 1000 cattle
Geothermal	50 MW+	Steam Temperature, Pressure and Quantity	90%	2,000-2,500	15-20klbs
Small Hydro	1-5 MW	Head (ft) Flow(cu.ft/sec)	45-65%	3,500-4,500	33 ft @ 500 cu.ft/sec

Renewable Energy Feasibility Study Objectives and Work Effort

Project Objectives:
- Increase energy knowledge and capacity
- Improve quality and reliability of electric service
- Contribute to development of environmentally clean energy
- Provide data/analysis to support Laguna involvement in renewable energy projects as an owner or participant

Capacity Building
Identify staff resources and provide ongoing education/support

Community Education/Outreach and Review
Develop/implement community education tools (newsletter, meetings) in order to gain community support for identified projects

Resource Monitoring — Understand renewable resources, power needs, and identify possible projects

Fatal Flaw Analysis — Identify major issues that would eliminate possible projects

Potential Project Economics — Evaluate feasibility of community-supported projects

Project Decision Support — Presentation/decisions re: pursuit of feasible projects

Development Plan — Create development plan, budget and contact possible funding sources

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RED MOUNTAIN ENERGY PARTNERS

Discussion Topics

1. Overview of DOE Renewable Energy Study/Status
2. Status of DOI MAPS Grant Application for Renewable Energy Feasibility Study
3. CDEC System Issues Update
4. DOI Electric System Proposal
5. Economic Development Administration Grant Opportunity

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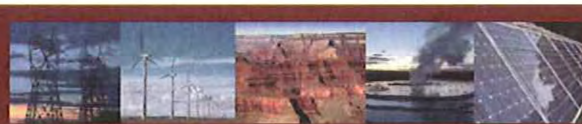
RED MOUNTAIN ENERGY PARTNERS

RED MOUNTAIN ENERGY PARTNERS



Pueblo of Laguna
Renewable Energy Feasibility Study

Utility Authority Board and Entity Update

July 2006

Discussion Outline

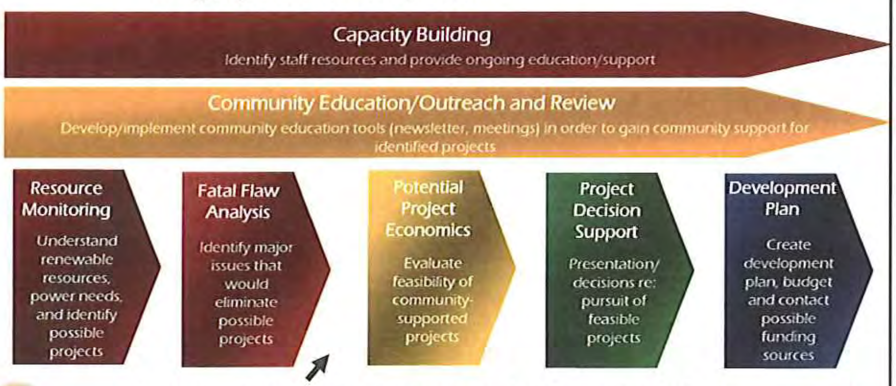
1. Project Background
2. Observations and Conclusions to Date
3. Project Options and Possible Locations
4. Anticipated Project Benefits
5. Reactions, Questions and Input
6. Next Steps

Project Background

Renewable Energy Feasibility Study

Department of Energy Funded Study Project Objectives:

- Increase energy knowledge and capacity
- Improve quality and reliability of electric service
- Contribute to development of environmentally clean energy
- Provide data/analysis to support Laguna involvement in renewable energy projects as an owner or participant



Currently Finishing Fatal Flaw Analysis of Potential Projects

2

Observations and Conclusions to Date

Renewable Resources/Natural Gas

- Wind
  - Waiting for final anemometry results
  - Preliminary results indicate small project potential, but likely not adequate for large wind project (Class 4 or better)
- Solar
  - Strong solar resource; appears adequate for photovoltaic or concentrating solar applications
- Geothermal
  - Power generation not likely; other business uses indicated
- Biomass
  - Resource still unknown; waiting to review forest resource assessment

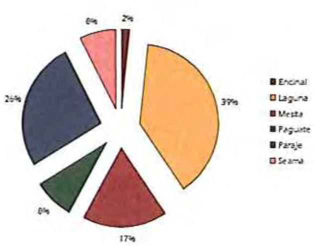
- Natural gas
  - Good access to gas transmission and distribution in most locations
  - Available for firming or backup

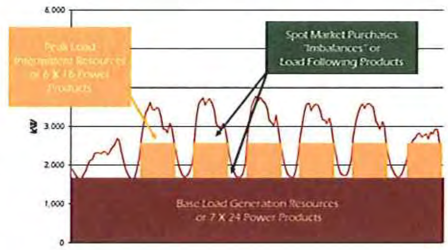
3

Electric Usage

- Majority of energy demand is nonresidential; 66% in Laguna and Paraje
  - Peak demand is approximately 5 MW; varies up to 3.2 MW in a day
  - Resources required to serve the total reservation electric demand:
    - 1.6 MW base load supply (7 X 24) (57%)
    - 1.9 MW intermediate (6 X 16) (28% includes solar/wind)
    - 1.6 MW load following (spot market purchases)

Pueblo of Laguna Village Energy Use





Project Considerations

- Laguna renewable projects considered generate intermittent power
  - Solar
  - Wind
- Customers assumed to have continued connection to electric grid
  - Projects would not meet 100% of needs
- Purpose of gas-fired generation would be to firm a renewable resource
- Project could generate adequate power to meet a portion or all of specific electric needs
  - Reservation+
  - Village
  - Entity/facility

Community Input

- Visual impacts may not be acceptable for village-specific projects
- Anticipate better support for facility or reservation-wide projects in areas with limited visibility
- Improved likelihood of success if projects were located in existing industrial or commercial areas
- Best wind resources, and minimal visual impacts will be off mesas currently being monitored

- Further input needed from community
    - Multiple methods (Laguna newspaper, UA newsletter, additional village/reservation-wide meetings) to provide education, seek input

Project Options

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

Note: All projects could be configured as natural gas or renewable only, rather than a hybrid arrangement; renewable-only projects would provide intermittent power

Possible Project Locations

Site 1 Project Options – Rainbow Center/Jr Sr High School

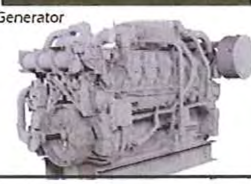
20 25 kW Tracking Concentrators

+ 288 kW Caterpillar Gas Generator

788 kW projects

2 250 kW Fuhrlander Wind Turbines

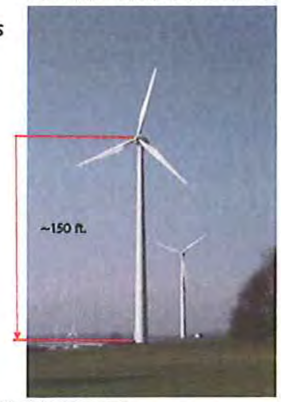
+ 288 kW Caterpillar Gas Generator



Site 2 Project Options –Southeast of Mesita

40 25 kW Tracking Concentrators

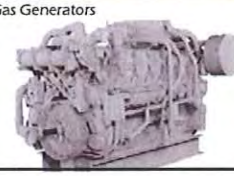
3 250 kW Fuhrlander Wind Turbines



1.57 MW projects

+ 288 kW Caterpillar Gas Generator

+ 2 288 kW Caterpillar Gas Generators



Site 3 Project Options – Laguna, north of Transfer Station

40 25 kW Tracking Concentrators

2.14 MW project

+ 2 570 kW Caterpillar Gas Generator

Site 4 Project Options – Rio Puerco, near Rt. 66 Casino

40 25 kW Tracking Concentrators

2.14 MW project

+ 2 570 kW Caterpillar Gas Generators

Site 5 Project Options – Paraje, near old high school

40 25 kW Tracking Concentrators

1.57 MW project

+ 570 kW Caterpillar Gas Generator

Multiple Sites

50+ MW Gas-Fired Generation Plant

Power Markets/Buyers

- Power markets/buyers
  - New Mexico utilities
    - Investor Owned (4)
    - Public Power (7)
    - Electric Cooperatives (18)
- Drivers for power purchases from POLUA generation projects:
  - Renewable Portfolio Standard (RPS) compliance
  - Competitive power prices
  - PNM interest in green power and associated Renewable Energy Certificates (RECs) from non-wind projects

Preliminary Environmental Review

- Sites under consideration have been/adjacent to properties previously impacted by some activity (i.e. development, grazing, agriculture, access roads, etc.)
- All sites appear clear of any immediate cultural or historical fatal flaws
- Washes present at sites #1 and #5, but sites flexible re: mitigation
  - Dry washes; no apparent endangered species issues
- Multiple sites available allow for protection of "view sheds"
- Additional transmission/distribution ROWs yet to be reviewed
- Alternative sites must be identified under any Environmental Assessment
- FONSI (finding of no significant impact) may not be considered, since proposed projects are a "change in use"

Transmission/Interconnection

- Transmission
  - Previous studies indicate 60 MW of capacity available for power export via PNM 115 kV transmission line
    - Projects involving facility-scale, village-scale, or partial village-scale loads are likely to require some distribution line upgrades
- Interconnection
  - Interconnection for large projects could occur at the Paguate Substation or new substation being considered
  - Interconnection at other project sites will require additional equipment to coordinate system protection schemes (fuse cut-outs, breakers, relays)

Renewable Generation

Wind
- Environmental, cultural, economic benefits
  - Low operating costs
  - No fuel supply/cost risks
  - No cooling water required
  - No wastes, no emissions
- Trade-Offs
  - High capital costs
  - Non-dispatchable

Solar
- Environmental, cultural, economic benefits
  - Low operating costs
  - No fuel supply/cost risks
  - No cooling water required
  - No wastes, no emissions
  - Good load following characteristics
- Trade-Offs
  - High capital costs
  - Non-dispatchable

Gas-Fired Generation

Microturbines
- Environmental, cultural, economic benefits
  - Small number of moving parts
  - Low emissions
  - Long maintenance intervals
  - Compact
  - Dispatchable
  - Can utilize waste fuels
  - Good efficiencies w/cogeneration
- Trade-offs
  - Low fuel to electric efficiencies
  - Loss of power output/efficiency with higher ambient temperatures

Reciprocating Engines
- Environmental, cultural, economic benefits
  - Low capital costs
  - Good efficiencies
  - Quick startup
  - Fuel flexibility
  - High reliability
  - Low natural gas pressure required
- Trade-offs
  - Emissions
  - Noisy
  - Frequent maintenance intervals

Combustion Turbines
- Environmental, cultural, economic benefits
  - High efficiency, low cost
  - Wide range of power outputs
  - Can produce high temperature steam
  - Well-established channels
  - High power to weight ratio
  - Proven reliability/availability
- Trade-offs
  - Reduced efficiencies at part load
  - Sensitive to ambient conditions
  - Cost/efficiency not as good in small systems

Community/Entity Benefits from Renewable Energy

Benefits
- Environmental benefits
- No wastes, no emissions
- Greater power reliability
- No fuel cost risk
- Can be firmed with gas
- Minimal water requirements
- Low operating costs
- Proven technology

Disadvantages
- High capital costs
- Continued reliance on grid power unless firmed with gas

Reactions, Questions and Input

- Project types
- Locations
- Entity interests in specific facility projects

Next Steps

- Continue community education activities
- Continue to analyze most probable project(s) and locations
- Complete technical and financial analyses of probable projects
- Prepare development plan

Further Information

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Pueblo of Laguna Utility Authority

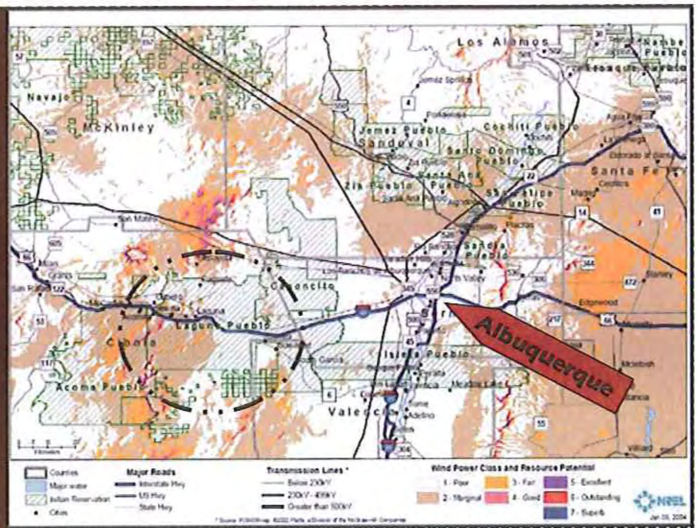
Renewable Energy Feasibility Study

DOE Program Review

October 2006

Project Location: Pueblo of Laguna

Location in New Mexico



Pueblo of Laguna: 533,000 acres
44 miles west of Albuquerque

Laguna Pueblo Villages

Enrollment
8,000

Laguna
Paguate
Seama
Paraje
Encinal
Mesita

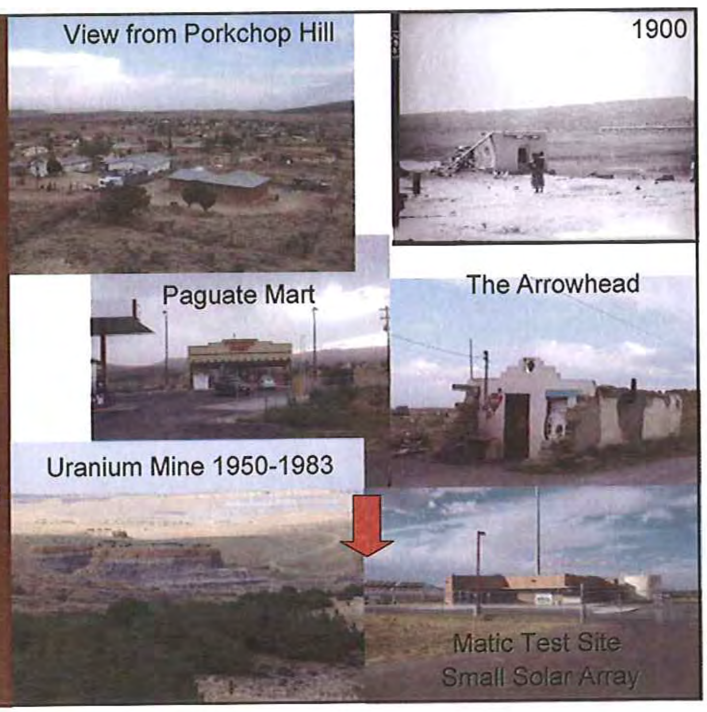
KA-WAIKAH (Lake People)

Laguna:
Main Village

Sept. 19 - St. Joseph Feast Day

Paguate:
Northern Village

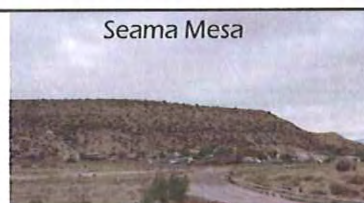
September 25 -
St. Elizabeth Feast Day



Paraje: Near West Village

Seama: Near West Village

July 26: St. Anne Feast Day



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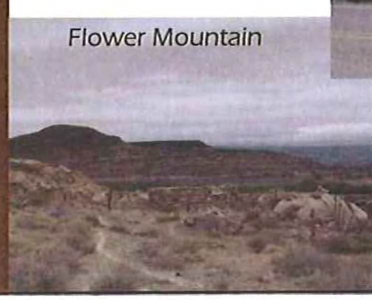
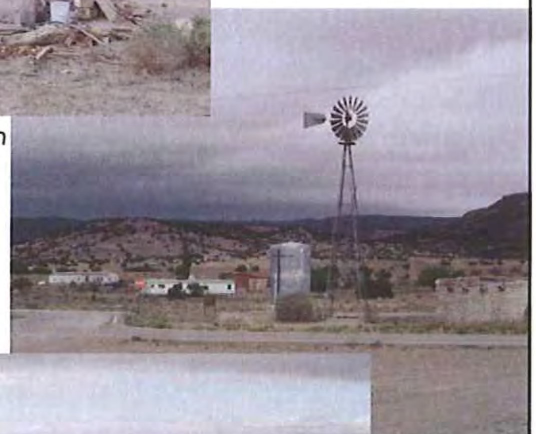


Encinal: Smallest Village

September 8 – ?? Feast Day

Encinal Springs

White Springs

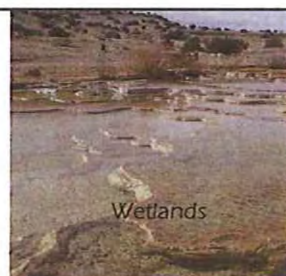


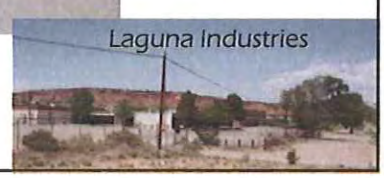
Water Canyon

Water Shed

Mesita: East Village

August 15th - St. Augustine Feast Day





Project focuses on community involvement in addition to technical studies

Project Objectives

- Assess feasibility of renewable energy generation projects
- Build on Pueblo interest in renewable energy focused on wind, solar and biomass resources
  - Prior projects included solar facilities at Majors Ranch and Laguna Industries
- Consider options to leverage nearby gas pipelines to develop a "hybrid" project, providing "firm" power
- Encourage community involvement and participation through education
- Expand on previously completed work
  - Utility formation and development
  - Energy self-sufficiency options
  - Integration of energy management with economic development
- Support energy capacity building

Project is being led by Utility Authority personnel

Project Participants

Tribal and Staff Participants:

- Pueblo of Laguna Utility Authority and Board of Directors
- Pueblo of Laguna Tribal Council and Staff Officers
- Pueblo of Laguna Villages
- Pueblo of Laguna Entities/Facility Managers

Project Consultant:

- Red Mountain Energy Partners

Project Scope

Study includes seven phases – two continual and five in sequence

Energy Coordinator position established to provide capacity building opportunity

Utility Authority Newsletter established to provide community education


Laguna Utility Service News

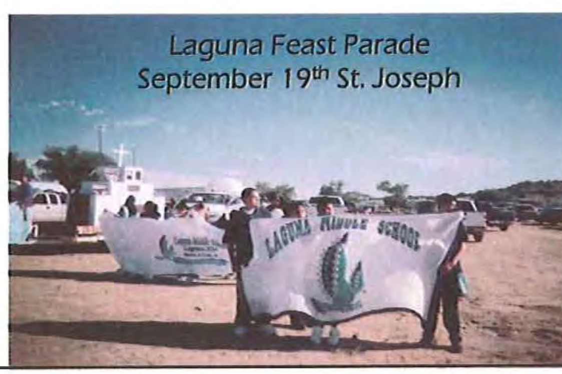
What is Renewable Energy?

Solar Power: Photovoltaics (PV)

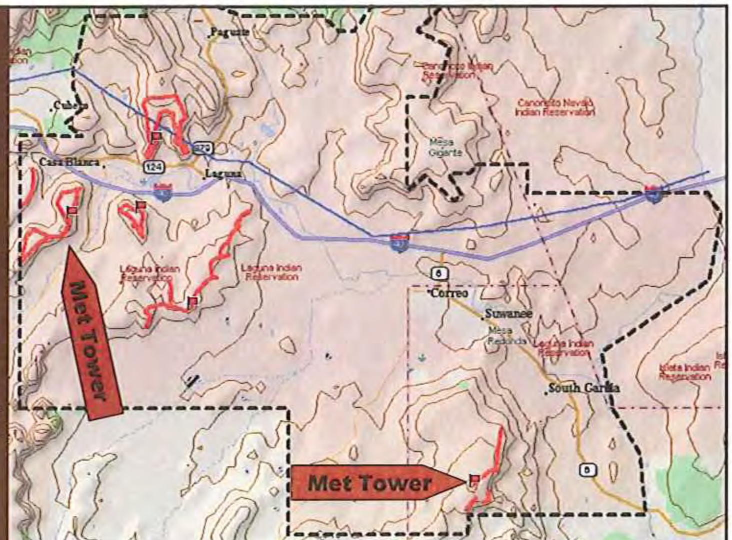
Middle School and Utility Authority Partnership:

Mentorship
RE Curriculum
Science Fair
Campus Project

Laguna Middle School selected Energy as the theme for 2006/2007 Science Fair

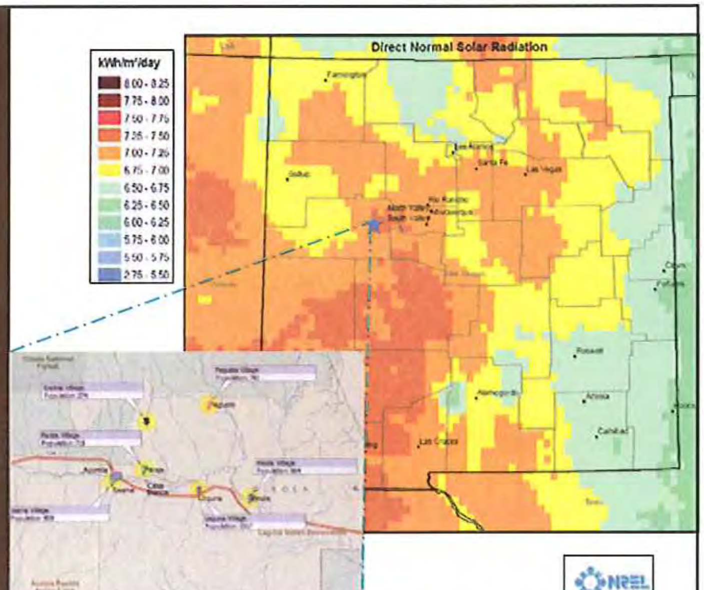


Maps indicated potential wind resource at Laguna



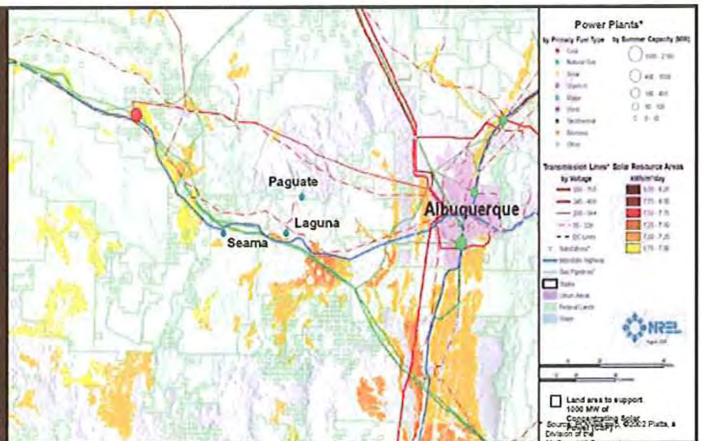
One year of data has not confirmed the anticipated resource at selected sites to support large-scale wind development

Solar resource at Laguna appears adequate to support PV



Laguna average annual insolation falls in the range of 7.25 – 7.5 $kWh/m^2/day$

Solar resource at Laguna appears adequate to support Concentrating Solar Power



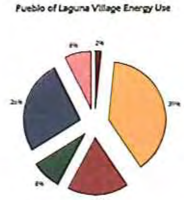
Portions of the reservation have concentrator insolation levels in the range of 7.25 – 7.5 kWh/m^2/day, well within the range suitable for large-scale solar projects

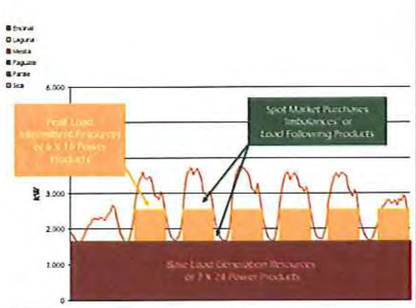
Electric usage requirements were forecasted by village and reservation

Preliminary Load Study Results

Majority of energy demand is nonresidential; 66% in Laguna and Paraje

- Peak demand approximately 5 MW; varies up to 3.2 MW in a day
- Resources required to serve the total reservation electric demand:
  - 1.6 MW base load supply (7 X 24) (57%)
  - 1.9 MW intermediate (6 X 16) (28% includes solar/wind)
  - 1.6 MW load following (spot market purchases)





Seven potential project sites were identified to meet a range of village and reservation needs

Initial Project Sites Identified

Multiple wind project options were considered at identified sites

Initial Wind Project Configurations

Village or Reservation Application	Peak Demand (kW)	Annual Usage (kWh)	Load Factor	Possible Project Configurations (All Grid-Supplemented)	Peak Power (kW)	Projected Capacity Factor	Projected Annual kWh	Initial Capital Cost [1]
Laguna Industries Generation	544	1,620,000	34.0%	Two Fuhrlander 250 kW Turbines [2]	500	21.14%	871,507	$1.25M - $1.75M
Encinal Village-Scale Generation	102	393,023	44.0%	One Fuhrlander 100 kW Turbine	100	24.2%	225,223	$250k - $300k
Laguna Village-Scale Generation	2,083	9,207,437	50.5%	One GE 1.5 MW Turbine	1,500	20.6%	3,059,491	$2.0M - $2.25M
Mesita Village-Scale Generation	949	4,073,652	49.0%	One Fuhrlander 600 kW Turbine [2]	600		1,000,000	$950k - $1M
Paguate Village-Scale Generation	472	1,953,873	47.3%	Two Fuhrlander 250 kW Turbines [2]	500	21.14%	871,507	$1.25M - $1.75M
Paraje Village-Scale Generation	1,392	6,206,168	50.9%	One GE 1.5 MW Turbine	1,500	20.6%	3,059,491	$2.0M - $2.25M
Seama Village-Scale Generation	427	1,783,999	47.7%	Two Fuhrlander 250 kW Turbines [2]	500	21.14%	871,507	$1.25M - $1.75M
Laguna Reservation-Scale Generation	5,426	23,618,151	49.7%	Four GE 1.5 MW Turbines	6,000	20.6%	12,237,964	$8M - $9M
Power Export to Grid	6MW	N/A	N/A	Forty GE 1.5 MW Turbines	6MW	120.6%	122,379,640	$75M - $85M

Initial wind project capital costs identified ranged from $250,000 to $85 million

Multiple solar project options were considered at identified sites

Initial Solar Project Configurations

Village or Reservation Application	Peak Demand (kW)	Annual Usage (kWh)	Load Factor	Possible Project Configurations (All Grid-Supplemented)	Peak Power (kW)	Expected Capacity Factor	Projected Annual kWh	Initial Capital Cost [1]
Laguna Industries Generation	544	1,620,000	34.0%	Twenty 25 kW Dish-Engine Modules	500kW	25%	1.1 GWh	$2.5M
Encinal Village-Scale Generation	102	393,023	44.0%	Four 25 kW Amonix HCPV [2] arrays	100kW	23%	203,000	$600k
Laguna Village-Scale Generation	2,083	9,207,437	50.5%	Parabolic Trough	2MW	25%	4.4 GWh	$8M
Mesita Village-Scale Generation	949	4,073,652	49.0%	Parabolic Trough	1MW	25%	2.2 GWh	$4M
Paguate Village-Scale Generation	472	1,953,873	47.3%	Twenty 25 kW Dish-Engine Modules	500kW	25%	1.1 GWh	$2.5M
Paraje Village-Scale Generation	1,392	6,206,168	50.9%	Parabolic Trough	1MW	25%	2.2 GWh	$4M
Seama Village-Scale Generation	427	1,783,999	47.7%	Sixteen 25 kW Amonix HCPV [2] arrays	400kW	23%	812,000	$2.4M
Laguna Reservation-Scale Generation	5,426	23,618,151	49.7%	Parabolic Trough	5MW	25%	10.9 GWh	$20M
Power Export to Grid	60 MW	N/A	N/A	Parabolic Trough	Sized to project need	25%	132 GWh	$240M

Initial solar project capital costs identified ranged from $600,000 to $240 million

Initial Community Input

Findings From Community Meetings

- Visual impacts may not be acceptable for village-specific projects
- Better support for facility or reservation-wide projects in areas with limited visibility
- Improved likelihood of success if projects were located in existing industrial or commercial areas
- Best wind resources, and minimal visual impacts will be off mesas currently being monitored
- Further input needed from community
- Suggest multiple venues (Laguna newspaper, UA newsletter, additional village/reservation-wide meetings) to provide education, seek input

Preliminary environmental findings did not eliminate any sites

Preliminary Findings

- Sites under consideration adjacent to properties previously impacted by some activity (i.e. development, grazing, agriculture, access roads, etc.)
- All sites appear clear of any immediate cultural or historical fatal flaws
- Washes present at sites #1 and #5, but sites flexible re: mitigation
  - Dry washes; no apparent endangered species issues
- Multiple sites available allow for protection of "view sheds"
- Additional transmission/distribution ROWs yet to be reviewed
- Alternative sites must be identified under any Environmental Assessment
- FONSI (finding of no significant impact) may not be considered, since proposed projects are a "change in use"

Preliminary cost estimates utilized "HOMER" modeling approach

Modeling Considerations

- 2-3 potential configurations from each proposed project site
- Cost analysis utilized:
  - Load profiles, escalated through 2027
  - Solar and wind resource for Laguna
    - Wind data derived from preliminary anemometry results
    - Solar data extracted from National Solar Radiation Database for Albuquerque Region, 1961-1990
- A minimum renewable generating component was required
- HOMER optimizes project design and seeks least cost on the basis of:
  - Overall Net Present Value for the life of the project
  - Levelized Cost Of Energy ("LCOE")
  - Optimal contributions of grid-supplied energy and renewable and/or fossil generating resources
- *No incentives are factored in fatal flaw analysis; LCOE results expected to improve once incentives are considered*

Initial Levelized Cost of Energy (LCOE) estimates ranged from 9.7 to 16.7 cents per kWh without incentives or alternate funding

Summary of Initial Project Sites and Configurations

Case #	Site Description	Load Served	Proposed Project Scale	Grid-Parallel Project Scenarios: Generating Resource #1	Qty	Generating Resource #2	Qty	Optimum Sizes: Grid kW	Gen1 kW	Gen2 kW	Expected Project Net Present Value	LCOE* per Spec ¢/kWh	Optimized LCOE* ¢/kWh
1	Rainbow Center, Casa Blanca (Site 1)	Nursing home, housing complex, junior/senior high school	541.2 kW	500 kW Single Axis Horizontal Tracking System	1	Caterpillar 350kW G3508 engine	1	79.0%	0.0%	21.0%	$4.03M	22.1	13.2
2	Southeast of Mesita Village (site 2)	Village load	1.0 MW	Fuhrlander 250 kW FL 250 Wind Turbine	3	Caterpillar 350kW G3508 engine	2	88.0%	11.0%	1.0%	$5.42M	10.8	9.7
3	Laguna Village, north of Transfer Station (Site 3)	Reservation, partial Reservation load, or power export	2.1 MW	Amonix 25 kW HCPV Array	40	Caterpillar 570kW G3512 90 TA engine	2	56.0%	13.0%	32.0%	$24.69M	21.9	16.1
4			5.1 MW	4 MW Single Axis Horizontal Tracking System	1	Caterpillar 570kW G3512 90 TA engine	2	36.0%	25.0%	39.0%	$42.2M	22.2	16.7
5	Paraje, near old high school (Site 5)	Village or partial village load	1.5 MW	1 MW Single Axis Horizontal Tracking System	1	Caterpillar 570kW G3512 90 TA engine	1	80.0%	20.0%	0.0%	$11.0M	19.4	13.1

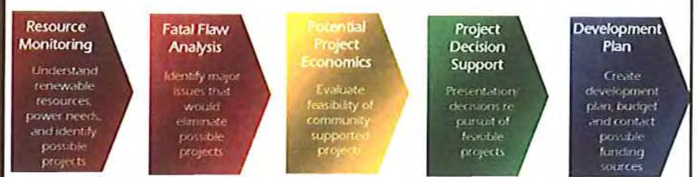
LCOE considerations put initial cost estimates results into perspective

LCOE Considerations

- Incentives will improve project LCOE results
- Project power costs reduce dramatically in long-term due to full amortization of capital costs and low/no fuel costs
- Large-scale power export projects (e.g. – 50-60MW scale) do not appear to be viable at this time due to existing low-cost generating facilities in the region and limited resource needs of potential off-takers
- Reasons for considering renewable energy projects may not be cost-based alone, and may include:
  - Community values
  - Improved power quality/reliability
  - Energy independence/surety
  - Environmental stewardship

Next steps will center around community/ stakeholder involvement, project economics, decision support and preparation of a development plan

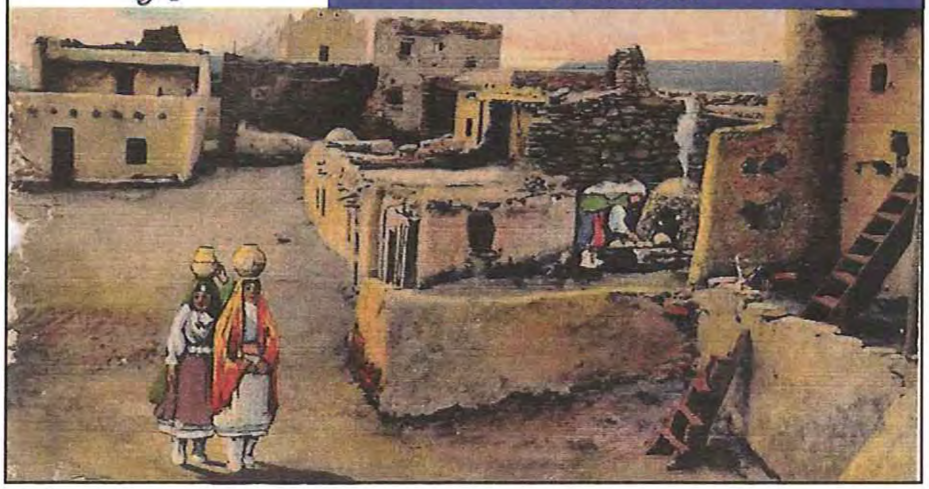
Next Steps



- Continue community education activities
- Gather community feedback on preliminary projects identified
- Further define selected projects and determine financial architecture, partnership structures, etc.
- Begin further wind site testing, as appropriate
- Complete detailed economic analyses of accepted projects
- Prepare development plan

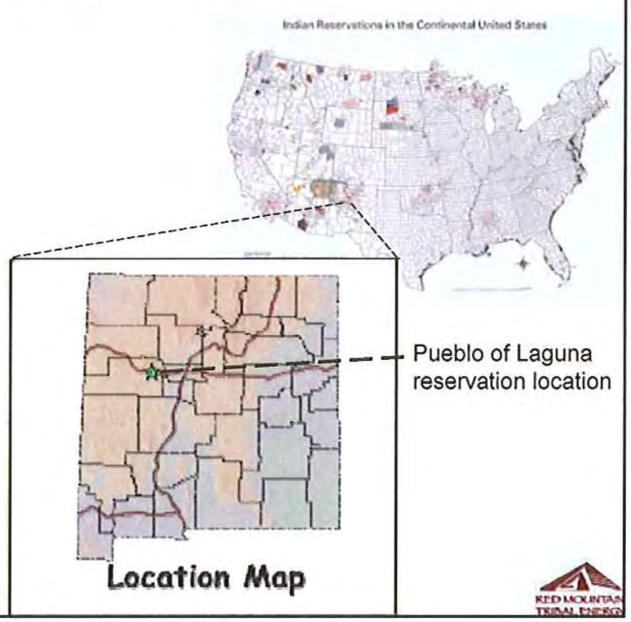
Pueblo of Laguna Utility Authority Renewable Energy Feasibility Study

DOE Tribal Energy Program Review
October 2007

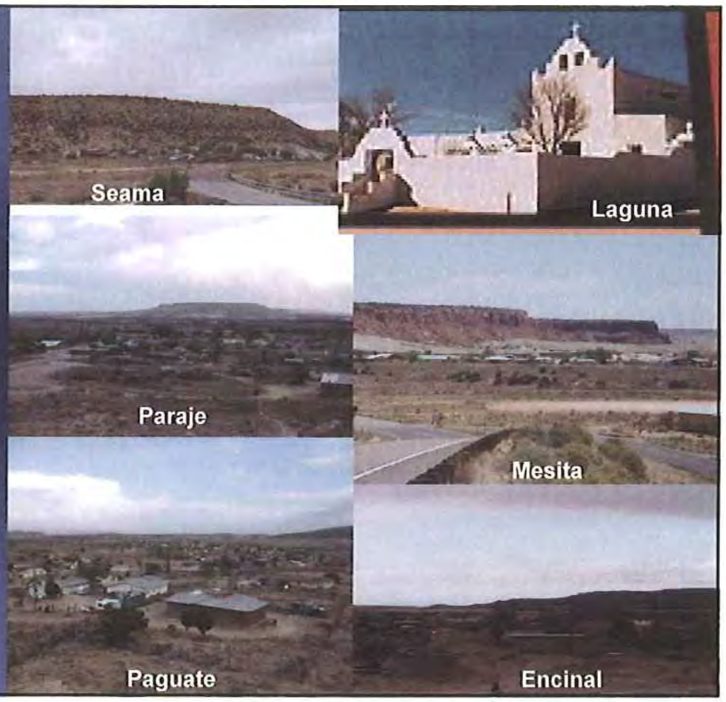


Pueblo of Laguna Reservation

Pueblo of Laguna lands in West Central New Mexico cover more than 533,000 acres



Six villages in Laguna with varying interests and needs have significant impact on Laguna decisions



Feasibility project focused heavily on Capacity Building and Community Outreach to ensure Laguna has ability to implement its plans

Project Steps and Objectives

Study Objectives:
- Increase energy knowledge and capacity
- Improve quality and reliability of electric service
- Contribute to development of environmentally clean energy
- Provide data/analysis to support Laguna involvement in renewable energy projects as an owner or participant

Project is being led by Laguna UA personnel, with technical support provided by Red Mountain Tribal Energy

Project Participants

- **Tribal and Staff Participants:**
  - Pueblo of Laguna Utility Authority and Board of Directors
  - Pueblo of Laguna Tribal Council and Staff Officers
  - Pueblo of Laguna Villages
  - Pueblo of Laguna Entities/Facility Managers
- **Project Consultant:**
  - Red Mountain Tribal Energy

Focus of 2007 effort was to engage the community and narrow the list of potential renewable projects for more in-depth evaluation

Laguna Renewable Projects Evaluated in 2007

- Commercial-scale wind (Foresight Energy)
- Solar project focus
  - Community-scale hybrid solar/natural gas
  - Small and large-scale single axis tracking PV and HCPV
  - Community Solar program

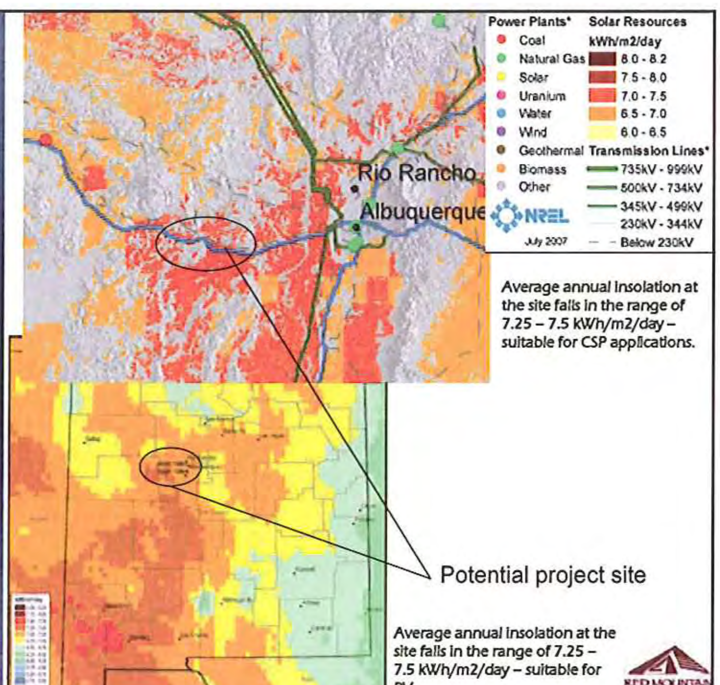
Wind resources monitored at two locations; one year of data did not confirm the potential for a commercial scale project

Wind Resource Monitoring and Feasibility

- Data suggests sites have wind resources of 2+ to 3 PNL wind class
  - Seama Mesa
    - Close proximity to transmission lines & I-40
    - No known cultural/historical concerns
    - 60 MW project req. $3.25 million in access & tie-in costs
  - Lucero Mesa
    - Large area able to accommodate larger project
    - + Remote location, no view shed concerns, but far from transmission lines & access
    - 90 MW project would req. $6.3 million in access & tie-in costs

RED MOUNTAIN TRIBAL ENERGY

Laguna solar resources appear excellent for both PV and CSP projects



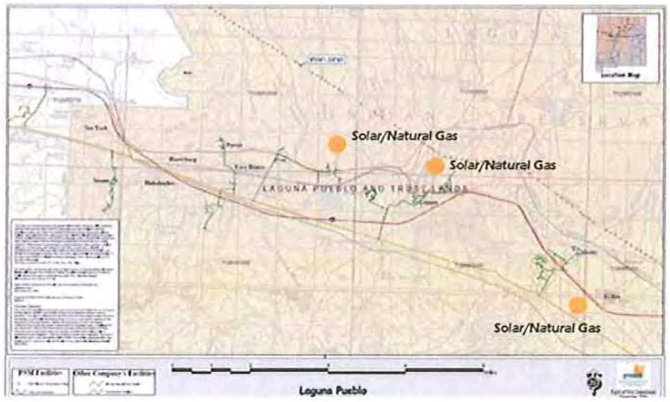
Average annual insolation at the site falls in the range of 7.25 – 7.5 kWh/m2/day – suitable for CSP applications.

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

RED MOUNTAIN TRIBAL ENERGY

Multiple community projects appear feasible; economics are dependent on technology costs and availability of grant funding

Possible Laguna Community Solar/Gas Project Locations



A hybrid solar/natural gas project could produce enough power to meet Laguna reservation needs, but without grant funding, would result in too high a power cost

Laguna Community-Scale Solar/Gas Project Economics

Project Size	Solar Component	Cost per KW	Natural Gas Component	Cost per kW	Total Capital Cost	Optimized LCOE estimate
5.1 MW	4 MW Single Axis Tracking System	$6,800	Caterpillar 570kW G3512 90 TA engine (2 units)	$1,263	$42.2 million	16.7 cents per kWh (36% solar; 25% gas; 39% grid)

Source: Red Mountain 8/06 analysis

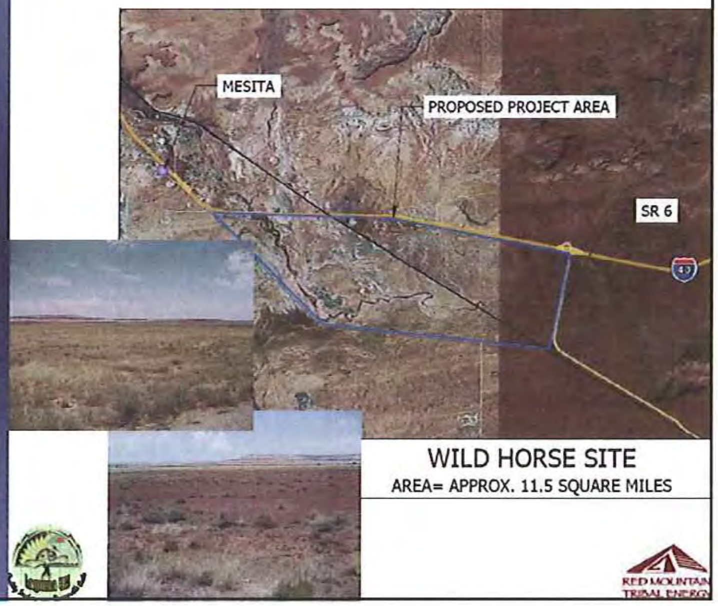
4 MW Single Axis Tracking System

+

+ 2 570 kW Caterpillar Gas Generators

Proposed Wild Horse Site

Proposed large-scale solar project site has excellent insolation, close proximity to transmission line and large, flat available area

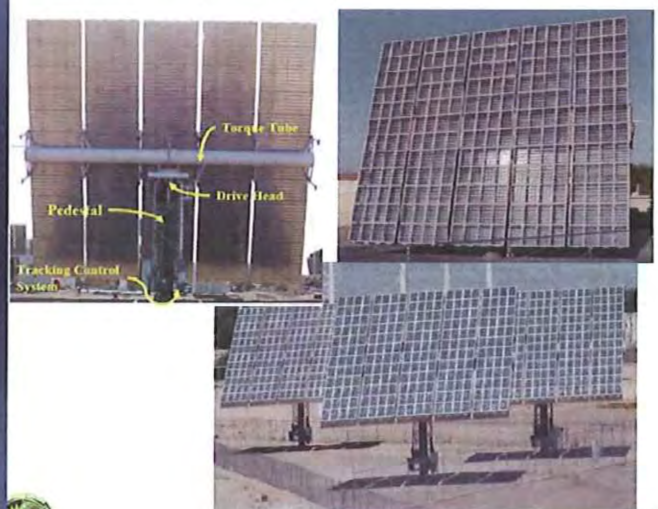


3, 50, 100 MW Single Axis Tracking PV Projects Evaluated

Limited water availability suggests single axis PV would be appropriate technology for a large-scale Laguna solar project

50,100 MW Large Scale HCPV Projects Evaluated

Laguna's limited water resource and excellent CSP insolation also suggests potential for High Concentration PV (HCPV)



Laguna Solar Project Economic Considerations

Scale of Laguna project and available technology/ costs suggest different ownership approaches

- Laguna Community Scale Solar/Gas Energy Project
  - **Laguna owned/operated w/grant funding likely to provide best economics**
    - Grant funding could reduce capital outlay
    - Net metered power/use as self-generation
    - RECs sold separately
- Laguna Large Scale Solar Energy Project
  - **Developer/Tax Partner Joint Venture likely to provide best economics**
    - Tax partner can take advantage of tax incentives (ITC)
    - Project could sell power/RECs bundled or separately
    - Utility or developer could partner with Laguna

Laguna renewable resources allowed for multiple projects to be evaluated; with current technology cost/ performance indications, 100 MW HCPV appears most viable

Laguna Solar Project Comparison

	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

RED MOUNTAIN TRIBAL ENERGY

Technology/ cost improvements indicate increasing competitive position of HCPV

PV vs. Concentrating Solar Capital Cost Comparison

Installation	Cost ($/Watt)
Single Axis Tracking PV	8.50
HCPV (Amonix)	5.00 – 7.00
HCPV - Future	3.00
Parabolic Trough (for comparison only)	4.00

Source: Arizona Public Service

RED MOUNTAIN TRIBAL ENERGY

Laguna Solar Project Partnership Considerations

Numerous advantages of a Laguna solar project partnership suggest competitive power pricing

- Location
  - Proximity to market, transmission lines (115 kV)
- Resources
  - Excellent PV and CSP solar resource
  - Nearby natural gas lines
- Time to market
  - Permitting process could be accelerated
  - Tribal leadership support for energy development
- Manufacturing/component integration facilities
  - Business incentives
  - Workforce development
  - NM Alternative Energy Product Manufacturers Tax Credit for businesses
  - Solar Energy Gross Receipts Tax Deduction for businesses
- Incentives and financing considerations
  - Low-interest loan/loan guarantees/Clean Renewable Energy Bonds
  - NM solar set aside; RECs from tribal lands worth 2x for certain power purchasers

Laguna Solar Project Next Steps

Laguna is working on next steps for both large-scale and community scale solar and solar/ hybrid projects

- Large Scale
  - PNM solar solicitation expected by year end 2007, early 2008
    - RPS requirements/solar set aside requires roughly 200 MW of solar by 2011
  - Laguna beginning to make project developer contacts
  - Technology providers also interested in Laguna potential
- Community Scale
  - Need to identify and pursue potential capital funding sources, pending community needs

Renewable Energy education efforts have been a consistent focus; community input indicates strong community support for Renewable Energy projects

Laguna Community Outreach

UA Newsletter highlighted Renewable Energy education in several issues

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

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

Renewable Energy Input

"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"

Renewable Energy Input

"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."

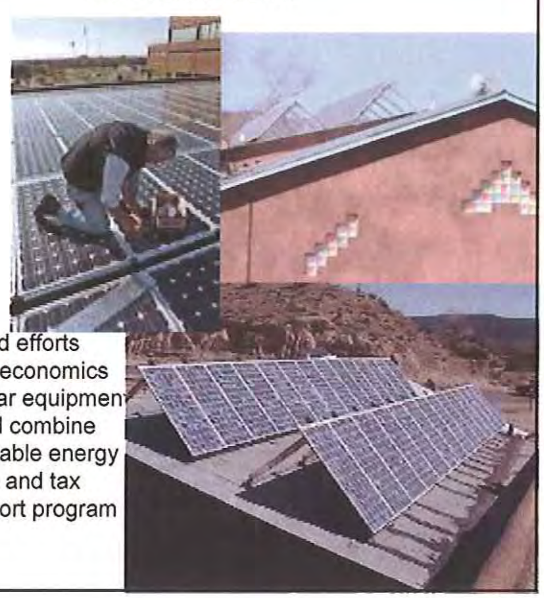
"I believe it is a wonderful idea. We need it to help our future generations"

"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."

Laguna Community Solar program being studied is intended to assist economically disadvantaged /elderly lower their energy bills as well as support community renewable energy acceptance

Community Solar Program Evaluation



UA-coordinated efforts could improve economics of member solar equipment installation and combine value of renewable energy credits (RECs) and tax credits to support program

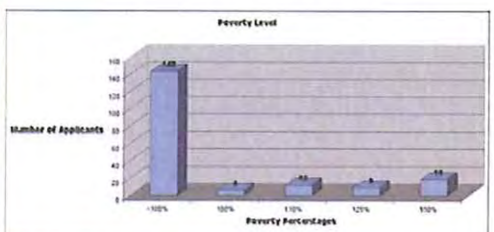
Initial efforts are focused on installing equipment at six community centers and several homes to serve as a pilot for a broader Community Solar program

Laguna Community Solar Program

- Purpose to aid elderly/disadvantaged members
- UA program concept
  - Purchase solar/PV equipment locally
  - Fund purchases via bundled REC sales + tax credits available
  - Leverage any other grants/incentives available to UA
  - Make available to low-income households
    - 161 customers already approved for payment assistance
  - UA arranges net metering with utility
    - Meter runs backwards when sun is shining
    - Customer bill credit would need to be negotiated with CDEC

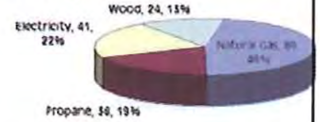
Laguna UA energy personnel also coordinate access to LIHEAP funding; twice as many members served as in prior years

Laguna Community Energy Assistance

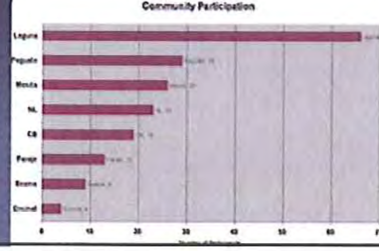


Applicants were overwhelmingly under the established poverty level

Energy Source



Applicant fuel sources reflect the use of multiple fuel types



Applicant locations were consistent with village populations

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