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Feasibility Analysis
Renewable Energy Potential in New Mexico Indian Pueblos Case Study

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ABSTRACT

The United States' continued dependence on imported petroleum is one of the gravest national and economic security risks. In order to break this habit, the U.S. must develop more alternative sources of energy. Some of America's most efficient and powerful solar and wind resources reside on lands granted to Native American tribes. Therefore, it is suggested that America's government, private sector companies, public utilities, and universities partner with Native American Tribes to create a "win-win" situation via renewable energy solutions. This study focuses on educating, specifically, A New Mexican Native American Pueblo, the Ohkay Owingeh Tribe, on renewable energy technologies –solar and wind.

To begin, solar and wind energy, and its history, are examined to provide an analysis of where the industry stands today. The study also explores the U.S. Department of Energy's (DOE) Tribal Energy Program, which plays an integral role in the assessment and establishment of solar and wind energy devices on tribal lands including examples from the Bureau of Indian Affairs (BIA)/Sherman Indian School in California and the Sioux Indian Tribe in South Dakota. Based on these examples, an analysis is given for the tribe, including a discussion of the funding and legal challenges. The feasibility study concludes with a theoretical plan for the Ohkay Owingeh tribe with steps on how to implement photovoltaic and wind technologies on their land.

Note. This is a not an official project of the Ohkay Owingeh Tribe.

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Note: this is a working paper for analytical and educational purposes only. It is not an official document of New Mexico or the Ohkay Owingeh Tribe.

1. Introduction

"Other than nuclear proliferation and weapons of mass destruction, there is no greater threat to the security of the United States and our economic security than our continuing dependence of imported petroleum," stated Frederick Smith, the FedEx Corporation's CEO and the Energy Security Leadership Council's co-chairman (Talley 1). Sixty percent of America's oil was imported from foreign producers in 2006 as petroleum represented the leading fuel source consumed by Americans, powering their vehicles and utilities. Furthermore, 78 percent of America's energy production – specifically 71 trillion British thermal units (BTUs) – was generated from burning fossil fuels in 2006 (Plunkett Research 22). With oil's record close of $125 per barrel on Friday, May 9, 2008, Americans need to follow Smith's lead by developing and using alternative fuel sources in their backyards – the sunlight and wind.

The radiation from one minute of sunlight has the potential to meet global energy requirements for one year, according to MMA Renewable Ventures. The total amount of solar energy produced in the U.S. equaled approximately 70 billion British thermal units (BTUs) in 2006, while comprising approximately 1 percent of America's energy consumption (Plunkett Research 22). The U.S. has failed to capitalize upon its real estate in the southwest – "250,000 square miles of land" that is ideal for solar power plants (Zweibel 64). Like solar energy, wind energy shares similar characteristics – an abundant, cheap, and under-utilized renewable energy source. Although 258 billion BTUs of wind energy were generated in 2006, wind energy represented 3.8 percent of the nation's energy intake (Plunkett Research 22). While the current wind energy infrastructure can power 1 million-plus homes, the U.S. has lagged behind Germany and other leading nations that generate 10 to 25 percent of their respective electricity from the wind (AWEA 1).

Some of America's most efficient and powerful solar and wind resources reside on lands granted to Native American tribes. Native Wind, a lobbying organization, estimates that tribal lands have approximately 535 billion kilowatt-hours of potential wind energy. According to the U.S. Census Bureau, 4.3 million Native Americans live within the U.S., comprising 1.5 percent of the total population. Although 71 percent of Native Americans complete high school, their participation in the workforce and median salary are lower than the national average. 66 percent of working Native American men earn an annual salary of $28,900, undercutting the national average by $8,200; 57 percent of the working Native American women earn $4,400 less than the national average, or $22,800. Regardless of gender, Native Americans are also "less likely" to hold managerial and professional roles, leading to a poverty rate that is twice the national standard (Ogunwole 8-10, 12).

By partnering with Native American tribes, America's government, private sector companies, public utilities, and universities can create a "win-win" situation via renewable energy solutions. The refinement and deployment of renewable energy sources requires teamwork in order to make environmentally friendly technologies viable, while yielding social benefits. For example, the installation of renewable energy systems on tribal lands would provide Native American tribes with reliable and sustainable sources of electricity. These renewable energy farms would also drive the creation of jobs in Native American communities, enabling families to rise above the national poverty line. As a complementary product of renewable energy projects, carbon offsets and renewable energy credits would act as an additional revenue stream for Native American tribes. The additional revenue from these green tags could be re-invested in further developing Native American communities. While Native Americans benefit from renewable energy farms, America would also reduce its dependence on foreign petroleum, while decreasing its carbon footprint. By working with Native American tribes to develop feasible renewable energy solutions, America would lead the world to a "green" future.

2. Background Information

The purpose of this feasibility study focuses on an educational study of renewable energy potential in New Mexico. It focuses on a theoretical potential of educating one tribe about the specific commercial and other opportunities. The case study tailors renewable energy technologies – specifically solar and wind – for potential for Ohkay Owingeh Tribe. The study explores possible uses of solar and wind energy on tribal lands, including a discussion of funding and legal challenges. The feasibility study concludes with a theoretical action plan for the Ohkay Owingeh tribe.

For this student research project, the author focused on the Ohkay Owingeh Tribe to provide a specific case study for examination. ***Note: this is not an official document of the Tribe or any members of it.*** The tribe has 2,800 members and 5,000 residents on its reservation located north of Espanola, in Northern New Mexico. Formerly known as San Juan Pueblo, these Native Americans trace history before 1598 when Spain colonized New Mexico, establishing their capitol on tribal lands. Today, the Ohkay Owingeh's reservation features a bison park, fishing at the San Juan Lake, the Ohkay Casino Resort, Ohkay Sporting Clays Club, Oke Oweenge Craft Cooperative, and a regional airport; the airport primarily serves employees and visitors of Los Alamos National Laboratories. The Tsay Corporation directs the majority of the Ohkay Owingeh tribe's economic development (Ohkay Owingeh 1).

According to the U.S. Census Bureau, the Ohkay Owingeh's population is evenly divided between men and women; the majority of the population is between 25 and 54 years old. Only 30 percent of the population has at least a high school education, so most members are confined in low and lower wage jobs. 76 percent of tribe households' have annual incomes between $15,000 and $49,999. The largest population segment is in the $15,000 to $24,999 income range. 81 percent of these families use gas to heat their homes. Up to 28 percent of tribal families live below the national poverty line; up to 42 percent of individuals live in poverty (San Juan Pueblo 1-4). Therefore, bringing opportunities to these low income areas is challenging, but efforts for energy self-sufficiency, particularly that create jobs or economic savings are welcome.

3. Solar and Wind Energy Technology

Although Bell Labs introduced the first solar cell in 1954, solar technology continues to struggle to gain acceptance as an effective and reliable source of electricity. The major types of solar technology include concentrating solar power and photovoltaics. Concentrating solar power is as an umbrella for three designs – dish, solar thermal, and solar updraft towers – for large scale utility applications. As an alternative to conventional power, concentrating solar's advantage lies within its ability to meet peak demand. (Plunkett Research 3-5).

Dish Technology in California's Mojave Desert
Source: Stirling Energy Systems

Concentrating solar power dish technology resembles a satellite dish broadcasting television. It has a base to change dish position. Stirling Energy System, a leader in dish technology, lines its dish's 38 foot diameter with flat mirrors that capture and re-focus sunlight into a small area. The thermal receiver absorbs sunlight, heating hydrogen in a continuous cycle. Hydrogen fuels an engine, turning a generator to produce electricity. Each dish costs approximately $25,000.

Like dish technology, solar thermal positions long mirrors to reflect sunlight onto pipes containing fluid, like oil. The mirrors transfer solar energy into heat as sunlight heats fluid, passing through a heat exchanger to generate steam. Turbines then produce electricity. Nine U.S. power plants utilize solar thermal technology to produce 354 megawatts of electricity. Energy storage is needed to reap greatest potential. Pipes could be extended to insulated storage basins containing molten salt, which would absorb the heat. Such captured heat could then be used to produce energy at night (Zweibel 69).

Small Scale, Working Prototype of Solar Updraft Tower in Manzanares, Spain
Source: EnviroMission Ltd.

Unlike dish and solar thermal technology, solar updraft towers use convection to generate electricity. The tower's base functions as a greenhouse, capturing sunlight to heat the air. Through convection, air is forced upwards to scale the tower. Air's movement creates wind, propelling generators making electricity. Like dish technology, solar updraft towers, though proven technology, are prototypes. Financing remains an obstacle to construction and operation on a larger scale. There are plans for EnviroMission Ltd.'s to erect a 50 megawatt solar tower in Australia (Plunkett Research 4-5).

While concentrating solar power technology has limited success to date, Bell Labs' solar cells – the forerunners to today's photovoltaics – touch various aspects of our daily lives. Photovoltaics power heat pumps in commercial buildings and homes, and illuminate backyard patios and highways. When these panels absorb sunlight, solar energy energizes electrons to migrate from one semiconductor layer to another. A junction is at the intersection of these two semiconductors with slightly different electrons. This creates pressure, or voltage, to move electrons across the junction, generating electricity (Photoelectric Effect 1). Multiple panels together form a module; an array is many modules together. Through wiring, arrays can deliver power to transformers supporting the electrical grid (Zweibel 68).

While different technologies compete for sunlight, wind plants are powered by an underlying technology that is scalable to meet customer specific needs – windmills. The kinetic or moving energy of the blades is converted into rotary motion via the rotor. This motion turns the generator, creating electricity (How a Small Wind Electric System Works 1). America's wind farms generated 16,818 megawatts of electricity in 2007, according to the American Wind Energy Association.

4. Historical Examples – Renewable Energy Efforts on Tribal Lands

The U.S. Department of Energy's (DOE) Tribal Energy Program plays an involved role in the assessment and establishment of solar and wind energy devices on tribal lands. This federal program financed the installation of a 30 kilowatt, hybrid photovoltaic system in the Bureau of Indian Affairs (BIA) / Sherman Indian School in Riverside, California. The school's hybrid system included batteries, inverters, and software to provide maximum power during peak demand. By wiring the photovoltaic panels to a battery, the absorbed solar energy charged the battery, which stored the electrical energy to deliver power to school's grid.

BIA/Sherman Indian School's Hybrid Photovoltaic System
Source: DOE

The battery boosted the photovoltaic modules' reliability by providing electricity regardless of weather conditions and the time of day. An inverter was connected to the battery and load, converting the direct current of the photovoltaic panels and battery to the alternating current required to power appliances, computers, lights, and telephones. The inverter enabled the hybrid solar plant to be linked to the school's electrical grid, powering local facilities. While 15 Native American employees were educated in the installation and maintenance of the photovoltaic system, students also monitored the hybrid solar plant in science classes via a computer. Prior to the photovoltaic system's installation, the BIA / Sherman Indian School paid more than $450,000 in utility bills. Coupled with incremental improvements in managing school energy efficiency, the hybrid system led to a 40 percent decrease in energy utilization, slashing operating costs (Council 4; DOE's Energy Savings 1-2).

The DOE offered a grant to the BIA / Fort Apache Agency for an off grid wind system. Located on 1.7 million acres in the forests of Arizona's White Mountains, the Fort Apache Reservation was bypassed by utilities' transmission lines and relied solely upon photovoltaic panels for electricity. However, these solar modules were unable to generate enough electricity to satisfy the reservation's peak demand; cloudy and rainy days also rendered their photovoltaic panels powerless. With DOE's assistance, Fort Apache planned to install five wind turbines on the reservation, supplementing the capacity and reliability of its photovoltaic modules (Council 5).

The Navajo Nation also identified training as a critical success factor in the long term operation of renewable energy projects. As such, Native American Photovoltaics, Inc., was created as a non-profit joint venture between Energy Photovoltaics, Inc., and the Navajo Nation's Dilkon and Teesto Chapters in August, 1999. The joint venture served two purposes – to electrify 10,000 to 25,000 homes on the Navajo Reservation and create jobs in high unemployment areas.

By August 2002, Native American Photovoltaics installed 20 1.2 kilowatt hybrid photovoltaic systems, including battery storage and inverters, and a 4 kilowatt photovoltaic system for the Seba Dalkai School. Due to the intensive labor of the business, Native American Photovoltaics added jobs to the Navajo

economy from a service-oriented business model. Native American Photovoltaics provided customers with consulting services to assess needs and determine appropriate size of hybrid power. After installing solar systems, the joint venture's employees maintained and serviced power generating units, overcoming previous pitfalls that caused the technology to be ineffective (Nat Am Photovoltaics 1-4; Navajo Nation 1-4).

Native American Photovoltaics' Systems
Source: DOE

The DOE contributed $210,000 to Navajo renewable energy efforts; Native American Photovoltaics and the tribe raised $171,000. The entity recognized DOE's role. "None of these successes would have been possible without the initial investment of the Department of Energy" (Nat Am Photovoltaics 2). DOE subsidies enabled the joint venture to accomplish its financing model – "a reasonable monthly payment covers system installation and service costs" (Navajo Nation 1).

Native American Photovoltaics became a sustainable business because customers could afford to pay $2,000 down payment and $150 monthly payments. The joint venture is currently seeking more funding – specifically credit lines and grants. With $4 million in additional capital, the project plans to install 50,000 more systems on remote Navajo homes over the next decade. Project leaders would like to expand into solar lighting as well as solar heating and water pumps, while developing manufacturing capability of its own photovoltaic panels. Their goal is annual manufacturing output of 5 megawatts (Native American Photovoltaics 1-4; Navajo Nation 1-4).

Media attention surrounded the Rosebud Sioux's renewable energy projects on its tribal lands in South Dakota. This tribe pioneered wind turbine efforts on tribal lands overcoming funding barriers. In 1995, the Rosebud Casino, Tribal Utility Commission, and the Rosebud tribe installed anemometers to measure the speed and quality of the wind. 18 months of wind data documented average wind speed of 17.9 mph. The tribe received a cooperative grant from DOE; halving cost of installing a commercial grade turbine.

750 KW NEG Micon Wind Turbines
Source: DOE

The tribe also secured "the first U.S. Department of Agriculture Rural Utilities Service loan" by collaborating with Distributed Generation, Inc., and Intertribal Council on Utility Policy (Rosebud 1). Vermont's NativeEnergy, a financing and marketing entity, purchased the wind turbine renewable energy credits before construction began. The company sold the credits to Ben & Jerry's, the Dave Matthews Band, and others interested in the credits. Because transmission lines were unable to differentiate between

"green" and traditional sources of electricity, these organizations bought NativeEnergy's credits to support alternative energy (The Economist 56; NativeEnergy 5; Rosebud 1).

The tribe's attorney, Bob Gough, noted, "NativeEnergy's funding was 25 percent of the turbine's cost. Their additional revenue for renewable energy credits, paid up front to the project once it achieved commercial operation, was a valuable component of the overall project financing and helped make it possible for the Rosebud Sioux Tribe to make the final decision to move ahead." (NativeEnergy 6).

As a result of this financing package, a 750 kilowatt NEG Micon commercial grade wind turbine was installed near the casino complex February, 2003. It generates 750 kilowatts of electricity at wind speeds of 31 miles per hour (mph). It became the first Native American-owned turbine to be connected to the electrical grid. Excess electricity was sold to surrounding communities, including Ellsworth Air Force Base in Rapid City, South Dakota, via transmission lines of Nebraska Public Power, and the Western Area Power Administration (Rosebud 1-2). The success of the NEG Micon wind turbine spurred development and impending installation of another wind turbine rated to produce 30 megawatts of electricity within the Rosebud Sioux Reservation. A local utility has expressed interest in purchasing electrical output and renewable energy credits (NativeEnergy 6).

5. Analysis

The Okhay Owingeh Tribe could explore the implementation of photovoltaic and wind technologies on its reservation because these proven technologies are more cost-effective and reliable than the various experimental types of concentrating solar power. Photovoltaic and wind turbine technologies minimize the risk from a technological perspective, while maximizing the positive impact on the community. These technologies can be customized and packaged together to construct hybrid renewable systems to meet the needs of the tribe.

CHART 1: COMPARING RENEWABLE ENERGY TECHNOLOGIES

Technology	Concentrating Solar Dish	Concentrating Solar Thermal	Concentrating Solar Updraft Tower	Photovoltaics	Wind
Ease of installation	No	No	No	Yes	Yes
Scalability	Yes	Yes	No	Yes	Yes
Add storage (e.g., battery)	No	Yes (Developing Tech.)	No	Yes	Yes (Developing Tech.)
Transmission backbone	Direct current	Direct current	Direct current	Direct current	Alternating or direct current
Water required	No	No	No	No	No
Efficiency	-	-	-	10%	65% - 75%

Price	$25,000	-	-	$0.21 per kWh - $0.50 per kWh	$0.65 per kWh - $0.85 per kWh
Price after incentives	-	-	-	$0.19 per kWh - $0.35 per kWh	$0.05 per kWh - $0.07 per kWh
Energy payback	-	-	-	1 – 4 years	3 – 8 months
Future cost volatility	-	-	-	Hedged	Hedged
Number of jobs created	7.24 per MW	7.24 per MW	7.24 per MW	7.24 per MW	2.77 per MW

Sources: AWEA Association, DOE, DSIRE Database, Native Wind, Plunkett Research Ltd., and Solarbuzz.com

Based on DOE National Renewable Energy Laboratory maps of potential solar and wind energy, the tribe is situated in a renewable energy rich environment. The Ohkay Owingeh Reservation receives approximately 5 to 6 kilowatt hours per squared meter of sunlight daily, and a 200 kilowatt transmission line runs through the lands. The tribe could explore potential integration of photovoltaic systems to power New Mexico's electrical grid. For tribal members located more than quarter mile from transmission lines, remote photovoltaic systems are cost effective for these homes, based upon the Navajo case study. Such photovoltaic systems have potential to reduce heating and energy needs for tribal members, assisting in reduced costs that could lead to rises in income.

The Ohkay Owingeh Reservation only has "marginal" wind speeds in most areas for remote, or off the grid, turbines. As member of the Eight Northern Indian Pueblos Council, Inc., the tribe has the opportunity to collaborate with neighboring tribes with "outstanding" resources for utility grade wind farms. According to the DOE National Renewable Energy Laboratory, the Nambe Pueblo, Pojoaque Pueblo, Santa Clara Pueblo, Taos Pueblo, and Tesuque Pueblo tribes are in higher quality wind and speed areas. On these lands, wind power density is 600 to 800 watts per square meter; speed is 17.9 to 19.7 miles per hour.

6. Funding Challenges

As highlighted by the historical examples of renewable energy farms on tribal lands, funding represents a significant barrier to tribes' adoption of environmentally friendly technology. Native Americans do not have the same access to financial capital as other Americans with to a long history of being underserved by financial institutions. According to a study commissioned by the U.S. Treasury Department, Native Americans and financial institutions share a mutual distrust due to cultural differences. Due to limited financial knowledge, Native American's experience higher costs and rejection rates for loans. For example, 65 percent of Native American respondents to the U.S. Treasury Department's survey indicated that it is "difficult" or "impossible" to be approved for a home mortgage. Furthermore, Native Americans often lack good credit history and live far from financial institutions, often more than 30 miles away. Without cultivating relationships, bankers are wary of such transactions and lack understanding of tribal government, including laws and operations. Bank regulations are a hurdle to financing in Indian Country as tribal lands are hard to qualify for collateral (Report 2-6).

In order to overcome these challenges, Native Americans need to take advantage of the available financial incentives to support their renewable energy efforts; the appendix's guide to these financial incentives serves as the foundation for the following recommendation. To construct renewable energy farms on its reservation, tribes needs to draw upon capital from diverse sources – DOE, U.S. Treasury Department, renewable energy credits, tax credits, and socially motivated investment funds.

The tribe belongs to the Eight Northern Indian Pueblos Council, Inc., (ENIPC) a non profit corporation dedicated to serving 10,000 tribal members via economic development, educational, and social service programs. This is a vehicle for economic development for the tribe and tribal members. The ENIPC's competitive advantage lies within its association with the Office of Environmental Technical Assistance (OETA), which specializes in grant writing and management. The ENIPC would use these grants to fund start up businesses and tribal entities like the Ohkay Owingeh's Tsay Corporation to support tribal member efforts starting renewable energy projects.

Any project will need capital. Clean tech has been the hottest area for investment in the U.S. In the first half of 2007, Plunkett Research Ltd. reported capital invested in green technology totaled $1.1 billion. Energy security, global warming, and the volatility in oil prices drove venture capitalists to invest in a growing alternative energy sector. Even though green manufacturers are unable to meet customers' orders for photovoltaic panels and wind turbines, sales have grown. Photovoltaic module revenues increased from $5 billion in 2003 to $11 billion in 2005, a compounded annual growth rate of 81 percent. Revenues have more than doubled for turbines, from $8 billion in 2004 to $19.5 billion in 2006. With the market for solar panels and wind turbines projected to reach $69.3 billion and $60.8 billion, respectively, by 2016, investors are forecasted to increase their stakes in green technology by 20 to 30 percent annually (MMA Renewable Ventures; Plunkett Research 20).

By investing in such projects, investors benefit from a "win-win" situation. They receive tax breaks on their investments via efforts like new markets tax credits. Other private sector organizations would also reap rewards of renewable energy investing. Like the Rosebud Sioux, a tribe or a corporation could work with companies like Native Energy to market and sell renewable energy credits generated via solar and wind farms on tribal lands.

There are also a number of socially responsible investors (SRI) also called socially motivated investors. These range from individuals to institutions. While the capital amounts from these institutions are typically small (under $1 million), so cannot be relied upon to fully capitalize a project, they are attractive sources as there is a strong mission fit for such projects. The best resources are the Social Investor Forum www.socialinvest.org and Community Investing Center, www.communityinvest.org.

Foundations have also supported similar efforts with grants, but also with soft loans known as 'program related investments' or PRIs and 'mission related investments' or MRIs. While these are logical and attractive sources, there are negatives. There is extensive competition for foundation dollars, the economic climate will lead to fewer dollars, and few foundations consistently do PRIs /MRIs. More information can be found at Ford Foundation, F.B. Heron, and others who do have experience through the PRI Makers Network website.

7. Legal Challenges

Regulation is an unknown variable, or "x-factor" in this sector, even more so for operations on tribal lands. While states are prohibited from taxing tribes and members conducting business on reservations,

non-Native corporations are liable for appropriate taxes while working in Indian Country. If a tribe is interested in connecting renewable energy farms with an electrical grid, public utility companies might require state inspection to connect to transmission lines. The tribe will have to consider Uniform Building Codes and building inspectors for project construction; which results in increased (but necessary) project costs (State Legal Issues 1).

For companies and individuals partnering with Native corporations or tribes on renewable energy projects, these stakeholders will have to understand legal disputes under tribal law (Tribal Issues 1). If the Okhay Owingeh Tribe secures federal contracts or funding, U.S. government mandates unemployment and worker compensation packages, overriding tribal law. And, tribes will needs to work with the Environmental Protection Agency, Archaeological Resource Protection Act, National Historic Preservation Act, and the Native American Graves Protection and Repatriation Act on tribal lands. Certain actions, including ascertainment of leases and "rights of way" on tribal lands, for renewable energy projects require approval or permission from federal agencies (Federal Issues 1).

8. Potential Action Plan for Native American Tribes, including Ohkay Owingeh

1. Develop a vision of the future for the tribe and reservation, including solar and wind energy solutions that are customized to fit the tribal members' needs.
2. Identify tribal champions who can lead through a long process
3. Form relationships based on trust with strategic partners, such as attorneys, the DOE, engineering firms, other tribes, private sector corporations, venture capital funds, and U.S. federal agencies.
4. Work with the tribe's strategic partners to assess the various solar and wind energy technologies for the reservation.
5. Identify financing sources to put together a total package. Partners can assist with this process.
6. Plan installation of renewable energy solutions on tribal land, starting with site selection. Based on the Mesa Redonda case study lessons, the following analyses are valuable:
    a. Archaeological reconnaissance and cultural resources
    b. Avian risk assessment
    c. Biological resource screening
    d. Geotechnical site characterization
    e. Thermal screening analysis
    f. Design of the renewable energy system: on the grid vs. off the grid construction
    g. Economic analysis
7. Meet with tribal stakeholders and strategic partners to evaluate project feasibility.

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Appendix

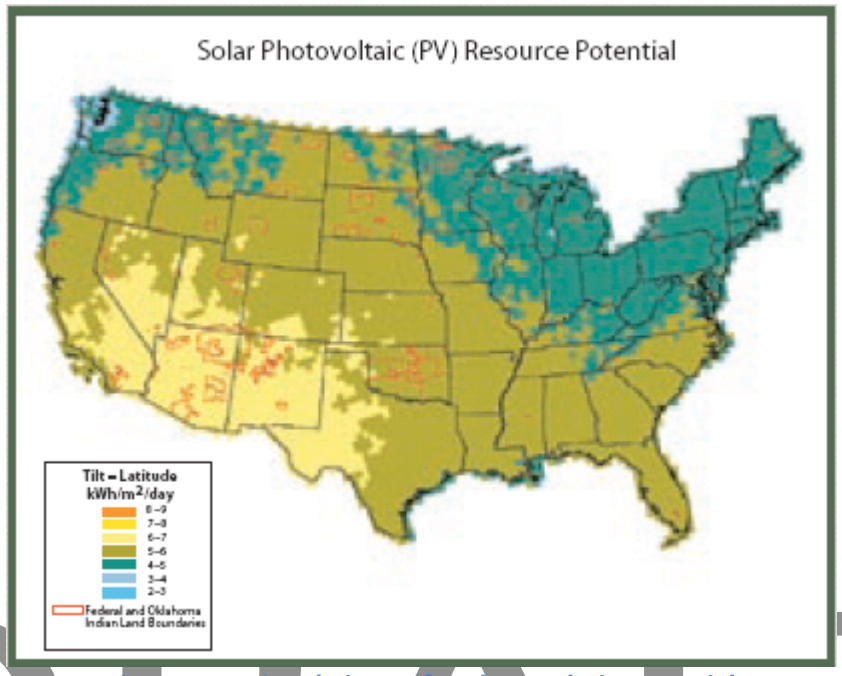

Figure 1: National Picture for Photovoltaic Potential
Source: DOE

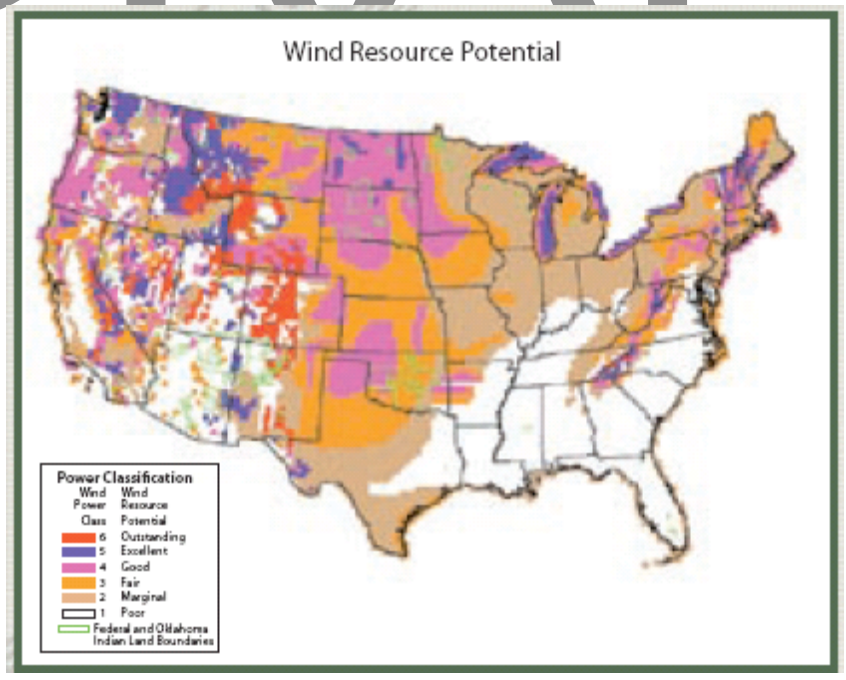

Figure 2: National Picture for Wind Energy
Source: DOE

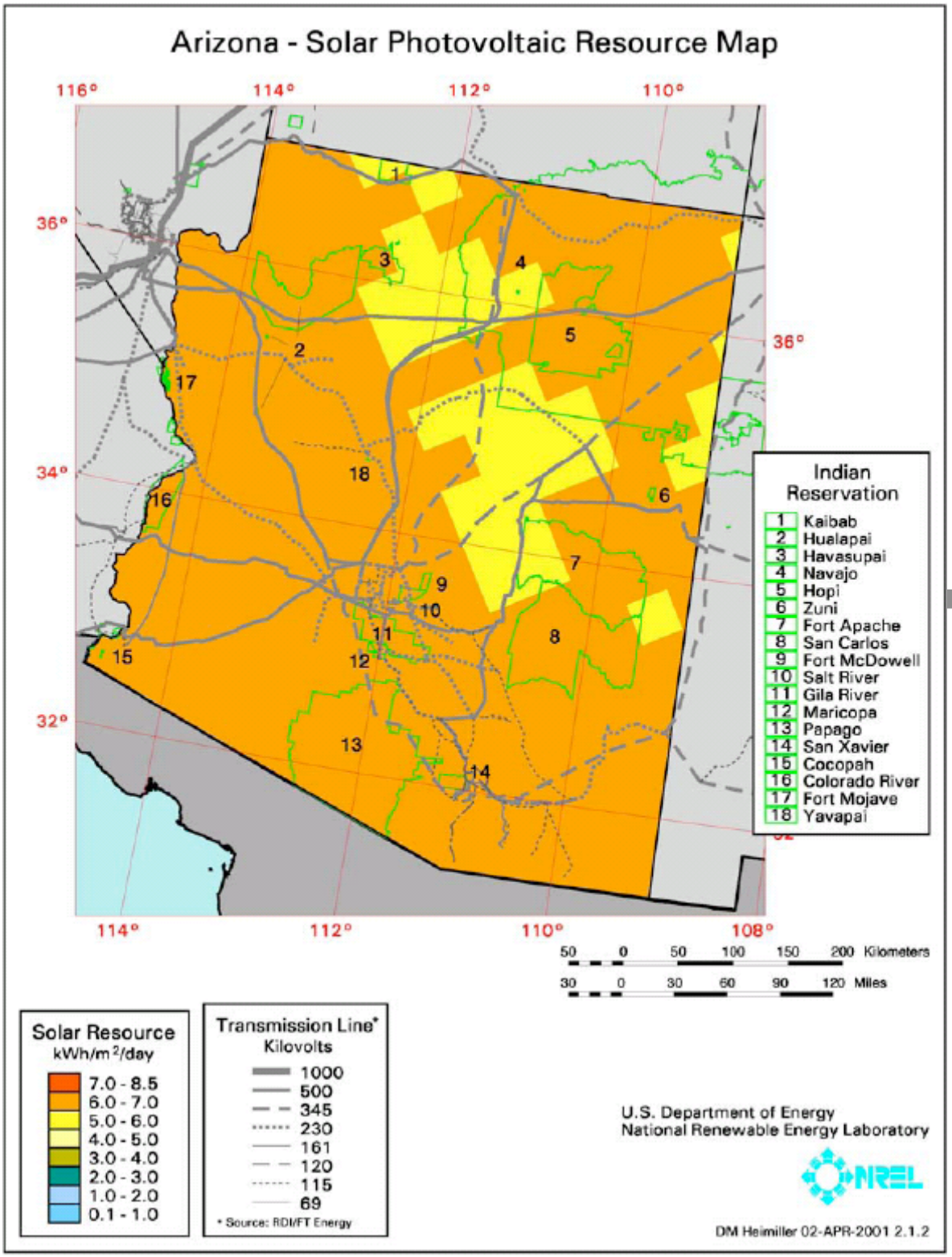

Figure 3: Arizona's Photovoltaic Potential
Source: http://www.wrapair.org/forums/ap2/projects/tribal_renew/TribalRE-AppC-RenewableEnergyResourceMaps.pdf

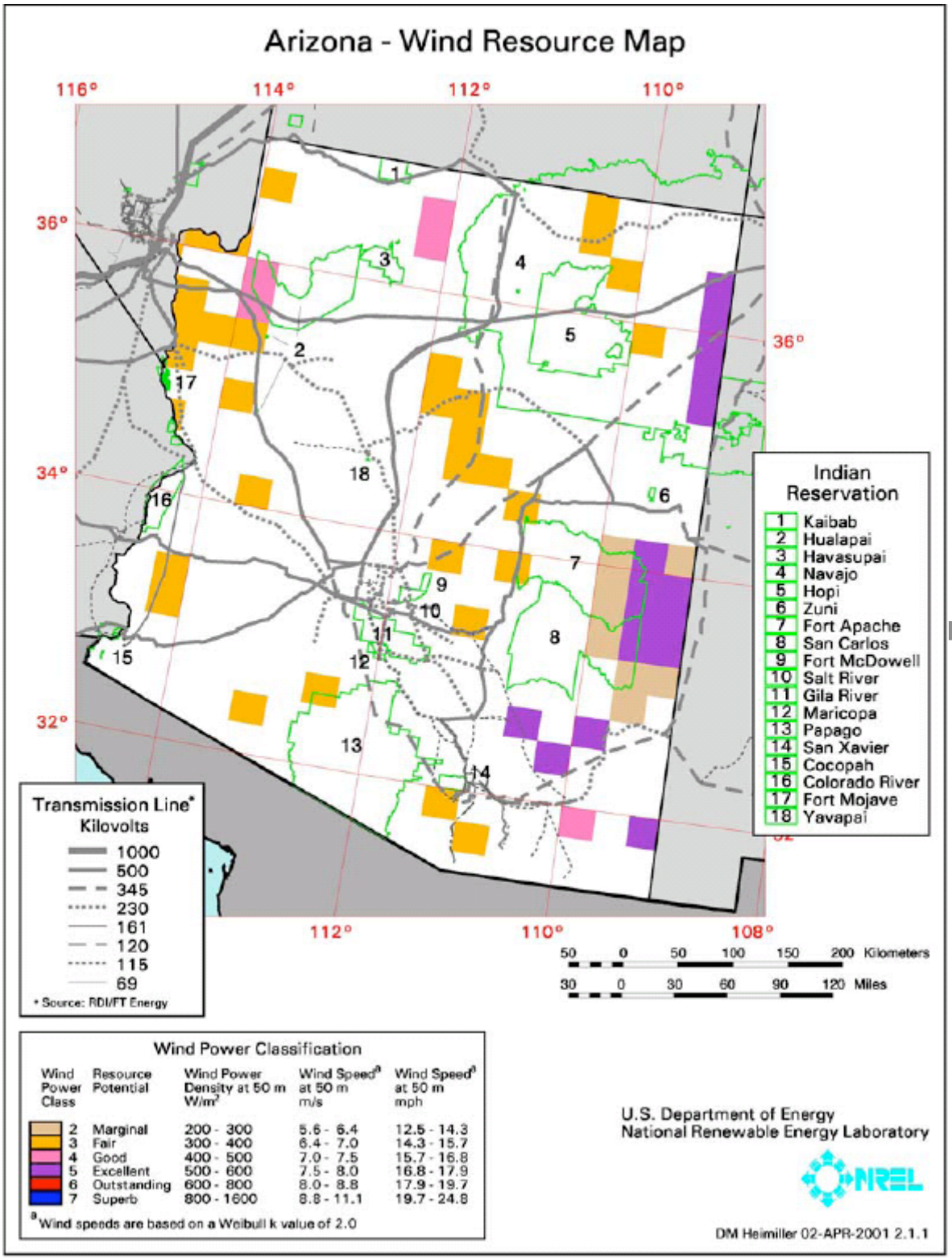

Figure 4: Arizona's Wind Potential

Source: http://www.wrapair.org/forums/ap2/projects/tribal_renew/TribalRE-AppC-RenewableEnergyResourceMaps.pdf

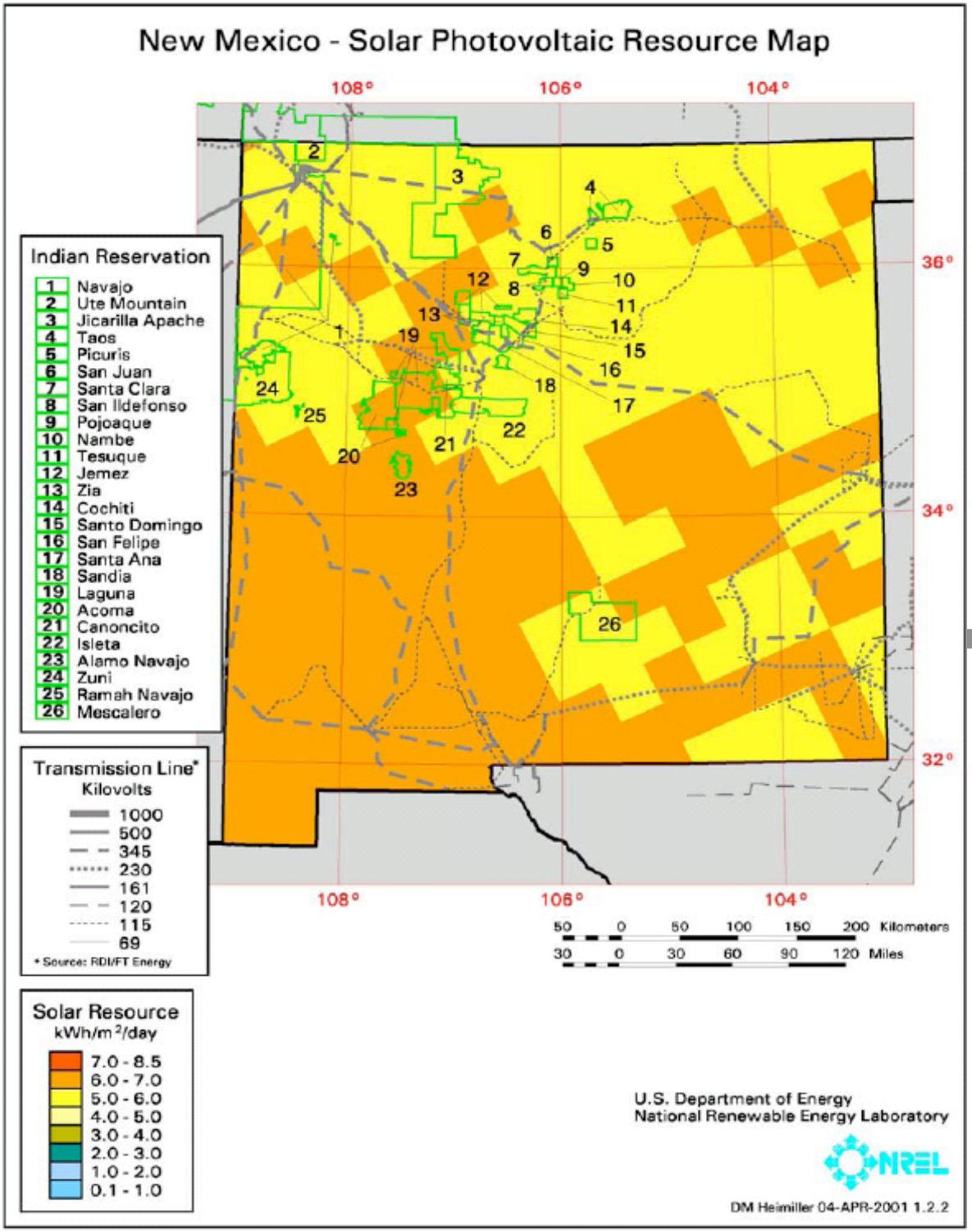

Figure 5: New Mexico's Photovoltaic Potential
Source: http://www.wrapair.org/forums/ap2/projects/tribal_renew/TribalRE-AppC-RenewableEnergyResourceMaps.pdf

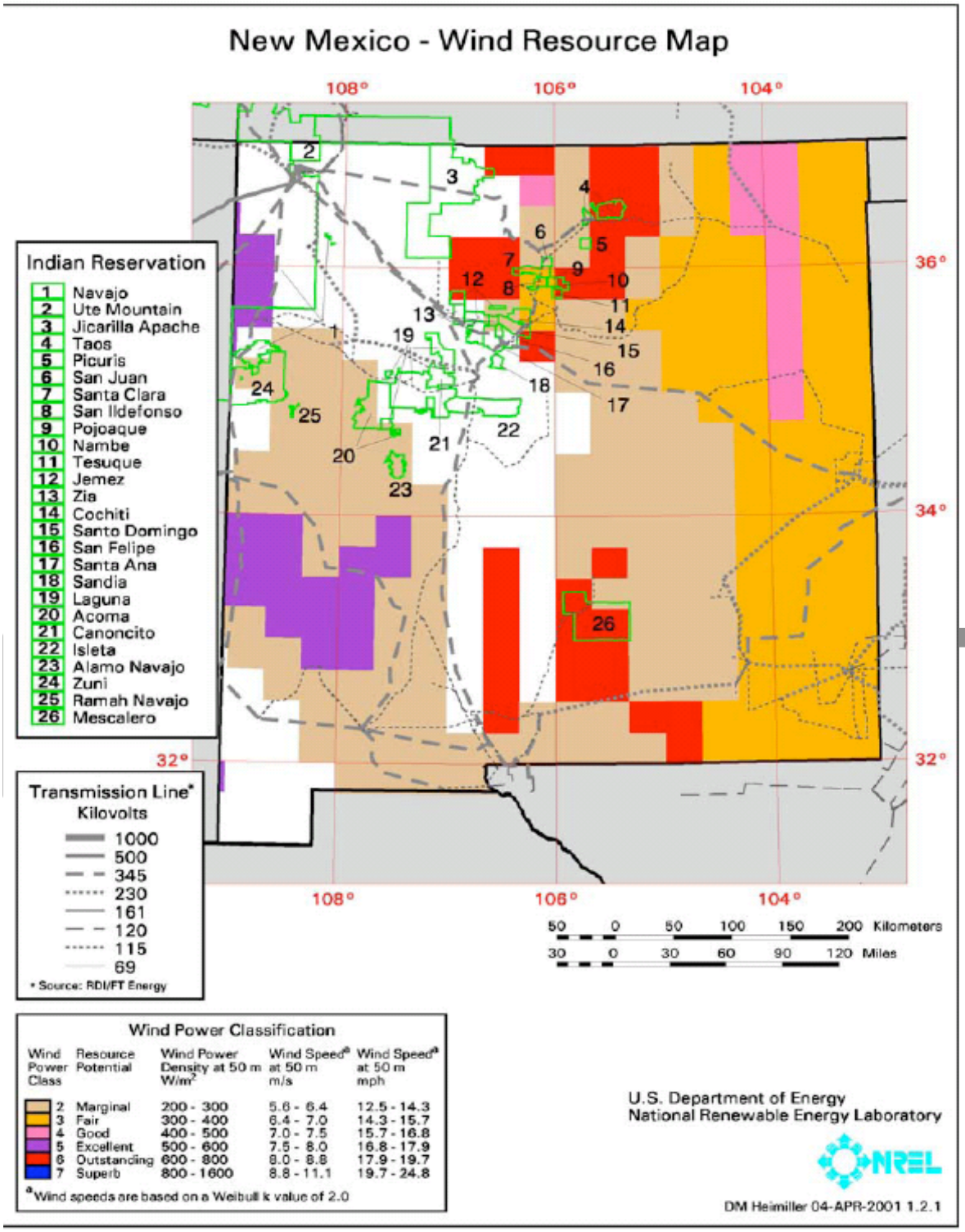

Figure 6: New Mexico's Wind Potential
Source: http://www.wrapair.org/forums/ap2/projects/tribal_renew/TribalRE-AppC-RenewableEnergyResourceMaps.pdf

Table A-1: Theoretical Pro-Forma Income Statement (Based First Solar Inc. data)

Income Statement	2007	2006
Production Capacity	308MW	75MW
Net sales	503,976	134,974
Operation cost	252,573	80,730
Gross profit (loss)	251,403	54,244
Research and development	15,107	6,361
Selling, general and administrative	82,248	33,348
Production start-up	16,867	11,725
Operating income (loss)	137,181	2,810
Foreign currency gain (loss)	1,881	5,544
Interest income	20,413	2,648
Interest expense, net	(2,294)	(1,023)
Other (expense) income	(1,219)	(799)
Income tax benefit	2,392	(5,206)
Profit/(Loss)	**158,354**	**3,974**

Table A-2: Theoretical Pro-Forma Balance Statement (Based on First Solar Inc. data)

Balance Sheet	2007	2006
Cash and cash equivalents	404,264	308,092
Accounts receivable, net	18,165	27,123
Inventories	40,204	16,510
Property, plant and equipment, net	430,104	178,868
Total assets	1,371,312	578,510
Total liabilities	274,045	116,844
Accrued collection and recycling liabilities	13,079	3,724
Current debt	39,309	19,650
Long-term debt	68,856	61,047
Total stockholders' equity	1,097,267	411,440

Table A-3: Theoretical Pro-Forma Cash Flow Statement (Based on First Solar Inc. data)

Cash Flow	2007	2006
Net cash provided by (used in) operating activities	205,951	5,040
Net cash used in investing activities	(547,250)	(43,832)
Net cash provided by financing activities	430,421	51,663
Effect of exchange rates on cash flows	7,050	385
Net increase in cash and cash equivalents	96,172	13,256

A Guide to Financial Incentives for Renewable Energy Farms

Federal Tax Credits for Solar and/or Wind Energy Farm

- Renewable Energy Production Incentive Program (REPI) (Expires 2026)
    - The United States government pays nonprofit electrical cooperatives, Native Corporations, and tribal governments 1.5 cents per kilowatt hour for electricity generated via renewable energy facilities like solar farms.
        - These organizations must sell their electricity to an individual or another organization.
        - The financial incentive applies for the first ten years of the renewable energy facility's operation.
    - The REPI program is dependent upon the United States federal government's budget in any fiscal year.
        - In the case that the REPI program cannot pay the entire financial incentive to qualified organizations, the funds are allocated based on the type of renewable energy facility that produces electricity. 60 percent of the funds is dedicated to "closed-loop biomass technologies," geothermal, ocean, solar, and wind energy facilities, while other technologies like fuel cells receive the remaining money.
    - To qualify for the REPI program (including the availability of funds), please contact Christine Carter, U.S. Department of Energy, Golden Field Office, 1617 Cole Blvd., Golden, CO 80401-3393. Her e-mail address is: christine.carter@go.doe.gov.
- Residential (including multi-family dwelling) Energy Conversation Subsidy Exclusion
    - Individuals may apply for 100 percent refund for any subsidy or rebate from a public utility for energy conservation efforts.
    - If an individual or household participates in a public utility's energy conservation program, any rebates – including credits or rate reductions – are nontaxable.
    - The installation of a solar energy system needs to decrease a household's consumption of electricity and/or natural gas "or improve the management of energy demand."
    - To qualify for this tax credit, speak with an attorney specializing in taxes.

Arizona Tax Credits for Solar and/or Wind Energy Farm

- Non-residential Solar and Wind Corporate or Personal Tax Credit (Expires December 31, 2012)
    - Individuals, Native Corporations, nonprofit organizations, and tribal governments may apply for a rebate that equals 10 percent of the cost to install renewable energy technologies, including solar energy devices and wind generator systems, in commercial and industrial settings.
        - Solar energy devices are systems that provide cooling, electrical power, heating, mechanical power, and/or "solar daylighting." These devices are active or passive that collect, store, and/or transfer electrical energy.
        - Third parties that construct and/or install the renewable energy systems are eligible for this tax credit.
        - For any fiscal year, the maximum rebate is $25,000 for a building and $50,000 in total credits.
    - To qualify for this tax credit, the individual or organization needs to file an application with Arizona's Department of Commerce (ADOC). After reviewing the application, ADOC issues an initial certification to qualifying individuals or organizations. Once the

renewable energy installation is finished, ADOC distributes a credit certificate to the qualifying individuals or organizations, including Arizona's Department of Revenue.
    - ADOC is limited to issuing $1 million in tax credits annually.
- Residential Solar and Wind Energy Systems Tax Credits
    - An individual may apply for tax credit – 25 percent of the installation cost for solar and/or wind energy devices in a residence in Arizona. The tax credit cannot exceed $1,000 in a year.
    - To qualify for this tax credit, the solar and/or wind energy devices must meet all performance and safety requirements. Additionally, collectors, heat exchangers, and storage units need to have a minimum of a 2 year warranty, while other equipment is subject to a minimum of a 1 year warranty. The individual must apply for the tax credit in the same year of the devices' installation.
        - For more information, please contact Debby Tewa, Arizona Department of Commerce, Energy Office, 1700 West Washington Avenue, Suite 220, Phoenix, Arizona 85007. Contact: deboraht@azcommerce.com, 602-771-1241 phone.
- Solar Energy Property Tax Exemption
    - Any individual or organization may apply for a property tax exemption – specifically 100 percent of the increased value of solar energy devices for "on-site consumption."
    - For more information, please contact the Tax Assistance department of Arizona's Department of Revenue at 602-255-3381.

New Mexico Tax Credits for Solar and/or Wind Energy Farm

- Renewable Energy Production Tax Credit
    - New Mexico provides a personal income tax credit between 1 cent per kilowatt hour and 2.7 cents per kilowatt hour to organizations generating electricity from solar and/or wind farms. The credit applies to the first ten years of wind generators' operation – specifically 400,000 megawatt hours of electricity created annually; the credit for solar farms is limited to the first 200,000 megawatt hours of electricity produced annually. The solar and wind farms need to be installed and generate at least 1 megawatt hour of capacity before January 2018. New Mexico limits corporate and personal income tax credits for renewable energy projects to 2.5 megawatt hours of annual production of electricity.
    - To qualify for this tax credit, new renewable energy systems are required to meet certain performance and safety standards; New Mexico's Energy, Minerals and Natural Resources Department needs to certify any generators. Follow the hyperlink for the tax credit claim form and instructions: www.tax.state.nm.us/forms/year03/rpd41227.pdf
        - For more information, please contact Michael McDiarmid, P.E., New Mexico Energy, Minerals and Natural Resources Department, Energy Conservation and Management Division, 1220 South Saint Francis Drive, Santa Fe, New Mexico 87505. Mr. McDiarmid's e-mail address is mmcdiarmid@state.nm.us, and his phone number is 505-476-3319.
- Solar Market Development Tax Credit (Expires December 31, 2015)
    - New Mexico's solar market development personal income tax credit is designed to supplement the federal solar income tax credits; these federal and state tax credits are limited to a total of 30 percent of renewable energy systems' purchase and installation expenses or $9,000.

  - To qualify for this tax credit, New Mexico's Energy, Minerals and Natural Resources Department needs to certify the renewable energy systems, which must comply with the Solar Rating and Certification Corporation's (SRCC) rules.
    - For more information, please contact Ryan Helton, New Mexico Energy, Minerals and Natural Resources Department, Energy Conservation and Management Divison, 1220 South Saint Francis Drive, Sante Fe, New Mexico 87505. Mr. Helton's e-mail address is ryan.helton@state.nm.us, and 505-476-3318 is his phone number.
- Sustainable Building Corporate or Personal Tax Credit
  - New Mexico provides corporate and personal tax credits for sustainable commercial and residential buildings. These tax credits are dependent upon the building's size in square feet and rating level according to the US Green Building Council. 30 cents per square foot and $6.25 per square foot represents the range of tax credits for sustainable commercial buildings, while sustainable homes are eligible for tax credits between $3.00 per square foot and $6.85 per square foot.
  - To qualify for these tax credits, individuals and organizations need to register and achieve a minimum rating of LEED Silver by US Green Building Council for sustainable buildings. Build Green NM Gold and Energy Star Manufactured Home also represent minimum certifications for sustainable homes.
    - New Mexico's Energy, Minerals and Natural Resources Department grants the building's owner a certificate of eligibility; this department issues a total of $10 million in certificates of eligibility that are equally divided between commercial buildings and residential buildings in a year.
    - The taxpayer then applies for this tax credit with New Mexico's Taxation and Revenue Department upon the review of his/her certificate of eligibility.
    - If the individual or organization has applied for a solar market development tax credit for a photovoltaic or solar thermal system, the taxpayer cannot receive this tax credit.
    - For more information, please contact Susie Marbury, New Mexico Energy, Minerals and Natural Resources Department, Energy Conservation and Management Divison, 1220 South Saint Francis Drive, Sante Fe, New Mexico 87505. Ms. Marbury's e-mail address is susie.marbury@state.nm.us, and her phone number is 505-476-3254.

***Source**:* 2007 NC State University's DSIRE: Database of State Incentives for Renewables and Energy. <www.dsireusa.org>.

New Market Tax Credits for Renewable Energy Projects

- Administered by the U.S. Treasury Department's Community Development Financial Institutions (CDFI) Fund, the new market tax credits are designed for individuals and private sector corporations that invest in approved community development entities (CDEs) and CDFIs. By investing in the debt or equity of certified CDEs or CDFIs, the CDFI Fund issues these taxpayers federal income tax credits over seven years. For the first 3 years, the taxpayers receive 5 percent of their total investment in tax credits, while these credits increase to 6 percent of the total investment in the remaining 4 years. Over the respective life of CDEs, these firms are allowed to issue a total of $19.5 billion in new market tax credits for equity investments.
  - In order to qualify for these tax credits, investors cannot withdraw their investment from the qualified CDEs or CDFIs over the seven year period. Furthermore, the CDEs

and CDFIs must use the proceeds of the taxpayers' investments to develop underserved, low income communities.

- The following counties in Arizona have census tracts that qualify as low income communities – Apache, Cochise, Gila, Graham, La Paz, Navajo, Santa Cruz, and Yavapai. Caltrong, Chaves, Cibola, Curry, Eddy, Grant, Guadalupe, Hildalgo, Lea, Lincoln, Luna, McKinley, Mora, Oter, Rio Arriba, Roosevelt, San Juan Miguel, Sierra, Socorro, Taos, and Torrance counties contain census tracts labeled as low income communities in New Mexico.
- To become a certified CDE, the mission behind this corporation or partnership is to develop low income communities via investment capital. For accountability purposes, the organization's advisory board must include representatives from the low income communities it serves. The potential CDE must file two applications – a CDE certification and a new market tax credit allocation form. Each year these applications are posted on the CDFI Fund's website in mid-October with a postmark deadline in mid-December; decisions are announced in mid-March.
- In order to qualify as a CDFI, this domestic legal entity must offer development and financial services to its low income clientele that are considered "high risk" by major financial institutions. Some of the financial services include brokering mortgages for first-time homeowners, underwriting the bonds for community buildings, and providing commercial loans for small businesses. Community development banks, credit unions, savings and loans associations, and venture capital funds catering to low income communities are eligible for CDFI certification. A potential CDFI needs to file two applications – a CDFI certification and a new market tax credit allocation form. The CDFI Fund makes these applications available on their website each year in mid-October; mid-December marks the applications' postmark deadline, while the CDFI Fund announces its decisions in mid-March.
- For more information on the CDE and CDFI certification process, please contact Michelle Dickens, Management Analyst, at 202-622-8959; Darnita Campbell, Program Assistant at 202-622-9091; and Star Wilbraham, Financial and Program Analyst at 202-622-2550.

Native American CDFI Assistance (NACA) Program

- The NACA program is sponsored by the U.S. Treasury Department's Community Development Financial Institutions (CDFI) Fund, providing support for Native CDFIs, including their subsidiaries (also known as "sponsored entities"), and "emerging" Native CDFIs. Native CDFIs, potential Native CDFIs, and "sponsored entities" are specialized CDFIs, serving a common target market; 50 percent of their respective programs meet the needs of Native American communities. Native CDFIs are eligible to apply for financial and technical assistance grants as well as new market tax credits. Potential CDFIs, including "sponsored entities," are limited to technical assistance grants.
  - $2 million is the maximum financial assistance grant distributed in the form of deposits, equity investments, or loans; this grant must be used for financing capital, loan loss reserves, and operations. Additionally, the grant must be matched with similar funds from non-federal entities; these CDFIs need to maintain a leverage ratio of 20:1 – $20 from non-federal organizations to $1 from the grant. The financial assistance grant enables Native CDFIs to showcase their ability to effectively function as a financial services firm, offering "affordable and appropriate financial products and services that positively impact their communities."

- The maximum technical assistance grant totals $100,000, which earmarked for developing Native CDFIs' staff and technology capabilities.
- Established and potential Native CDFIs, including their sponsored subsidiaries, are required to complete two applications – a certification form and a NACA program application. Each year these applications are posted on the CDFI Fund's website in mid-October with a postmark deadline in mid-December; decisions are announced in mid-March.
  - For certification purposes, "emerging" Native CDFIs need to develop a plan and time frame to become CDFI-approved, while "sponsored entities" represent "separate legal entities" desiring CDFI-certification.
- In 2008, the CDFI Fund is trying to secure $3.5 million for the funding of the NACA program.

***Source**:* 2008 United States Department of Treasury's Community Development Financial Institution Fund. <www.cdfifund.gov/index.asp>.

Carbon Credits

- Companies purchase carbon credits, also known as carbon offsets, as a low cost alternative to reducing their carbon footprint or output. These carbon credits enable these companies to continue releasing carbon dioxide into the environment, while funding renewable energy projects around the globe. 1 carbon credit, or verified emission reduction, represents a decrease of 1 metric ton of greenhouse gas emissions below a "business as usual" baseline with an average price between $16 and $24. Without the revenue stream of carbon credits, these renewable energy projects would not be feasible as a result of financial and operational constraints. For example, some solar and wind energy farms would be unable to sell their electricity at competitive prices when compared to conventional power sources. In order to qualify for carbon credits, the performance of renewable energy projects is audited, verifying and certifying their ability to cut carbon emission.
  - The 2007 global market for carbon credits was approximately $27.86 billion; Western companies and governments accounted for approximately 6 percent of the market, or $1.6 billion.
  - The United Nations Framework Convention on Climate Change's (UNFCCC) Clean Development Mechanism issued between $1.2 and $1.8 billion carbon credits.
  - 3Degrees and NativeEnergy are the major providers of carbon offsets in the United States.

***Sources**:*

Bail, Jeffrey. "U.N. Effort to Curtail Emissions in Turmoil." The Wall Street Journal. April 12, '08, page A1.

NativeEnergy – FAQs. <www.nativeenergy.com/pages/faq_s/15.php>.

3Degrees – VERs. <www.3degreesinc.com/products/carbon_offset>.

Renewable Energy Certificates

- Renewable energy certificates (RECs) are the proper name for "green tags," which closely resemble carbon offsets. Renewable energy sources like solar and wind farms produce 2 services – electricity and RECs. Every kilowatt-hour or megawatt-hour of electricity generated by these renewable energy sources is accompanied by 1 REC. These alternative energy providers have the option to sell their electricity and RECs in a 2-for-1 package to utility companies. These providers can also sell these products separately to different customers by selling the electricity to utility companies and the RECs to individuals and organizations. By purchasing RECs, companies and individuals possess the legal right of purchasing electricity from renewable energy sources.
    - For each megawatt-hour or kilowatt-hour of electricity provided via alternative energy sources, a REC theoretically decreases the need for another megawatt-hour or kilowatt-hour of electricity from traditional generation techniques like coal burning power plants.
    - Like carbon offsets, firms like 3Degrees and NativeEnergy have engineered RECs that finance renewable energy projects. The additional revenue stream from RECs makes these renewable energy projects more viable and sustainable in light of competition from convention power sources.

***Sources**:*

NativeEnergy. <www.nativeenergy.com/filebin/popups/recs.html>.

3Degrees <www.3degreesinc.com/products/recs>.