ARIZONA WIND AND SOLAR STATUS REPORT 2013

Cara Corbinmeyer, Robert Douglass, Karin Wadsack

NORTHERN ARIZONA UNIVERSITY

Institute for Sustainable Energy Solutions

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Overview of Arizona Wind and Solar Status Report 2013

This report details utility-scale renewable energy projects on Arizona's public, private, Native American, and military land. Utility-scale is defined as all projects greater than one megawatt. For each county, Native American tribe, and military jurisdiction, details are presented on the size, technology, and status of projects. For areas where there haven't been any utility scale developments, we outline the priorities for renewable energy development and in some cases highlight smaller-scale installations. This information was gathered through direct contact with government employees, tribal members, and online searches. Here are some of our major findings:

- There are 1,460 megawatts (MW) of utility-scale renewable energy operating and under construction in Arizona: 1,137 MW of solar; 288 MW of wind; and 35 MW of biomass/biogas energy.
- Maricopa County leads the counties in solar development with 566 MW of projects completed or under construction.
- The Dry Lake wind farm in Navajo County is the largest wind farm in Arizona with 127 MW capacity.
- There have not been any utility-scale renewable energy projects on tribal lands, yet there have been a number of smaller scale projects, feasibility studies, and other pre-development work toward utility-scale installations.
- Each branch of the military has internal goals for increasing the percentage of renewable energy it uses. Only a few projects have been realized thus far.

This report begins with a general introduction to renewable energy development in Arizona, a summary of market trends, updates on regulatory issues, and a discussion of the environmental impacts of renewable energy development. Additional sections include technological descriptions of the differing renewable energy generators, modeling of economic impacts from renewable energy development, resource maps, installed capacity maps, and appendices that include additional resources and links to permitting guidelines.

Throughout the report, projects are defined as either proposed, under development, under construction, or operating. **Proposed projects** have been proposed to the public by developers through press releases or presentations to government institutions. Projects that are **under development** are going through the permitting process and/or seeking additional funding or developers. Proposed and under development projects may or may not ever be realized. **Under construction** means the projects have broken ground and are in the process of being built. Finally, **operating** projects have been completed and are currently generating and selling electricity.

For each jurisdiction detailed in the report, the population, size and median household income is provided. This information was found through The United States Census Bureau and demographic analysis done by Northern Arizona University and The Arizona Rural Policy Institute. The area of the state of Arizona is 113,594 square miles, and the median household income statewide is $50,256.

Introduction

Background. In 2013, was among the top producers of electricity from renewable sources in the United States, most notably from solar. The state's Renewable Energy Standard and Tariff (REST), established in 2006, fostered demand for renewable energy projects; a number of large, longer-term projects were completed; and the successful completion of earlier wind and solar projects facilitated new developments. For its electricity generation statewide, however, Arizona continues to rely largely on coal, natural gas, and nuclear power.

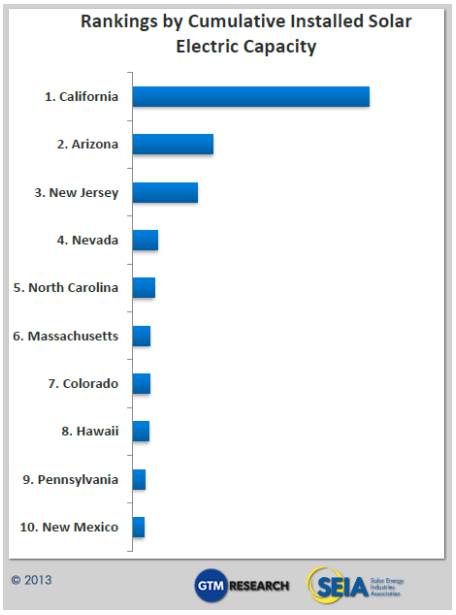


Figure 1. State Ranking by Solar Capacity. Source: SEIA and GTM 2013

This report is an update to the 2009 and 2011 Arizona Wind and Solar Status Reports, conducted by Northern Arizona University's Landsward Institute and Institute for Sustainable Energy Solutions. Building on past reports, this work attempts to track and map all utility-scale renewable energy projects throughout the state. Our 2013 research found that the total utility-scale installed and under construction capacity stands at 1,137 MW for solar and 288 MW for wind. An additional 7,133 MW (solar and wind combined) have been proposed or are under development statewide, yet may never be completed.

Trends in Wind & Solar. Solar development has outpaced the development of wind for a number of reasons. Clearly, there are abundant solar resources in Arizona, which are stronger and more reliable year-round than the state's wind resources. This fact, along with policy incentives provided at the state and local level, has turned Arizona into a hub for solar energy innovation and development. National and foreign companies have been drawn to Arizona to pursue research, manufacturing, and project development. Net metering has supported strong growth for solar distributed generation (DG) for Arizona's residential and commercial buildings. These factors have propagated over 100 significant manufacturing, development, and construction companies[1] in the region whose work is focused at least in part on renewable energy technology or development. Undeveloped, relatively flat land ideal for solar development is abundant and comparably inexpensive in Arizona. Furthermore, some farmers are finding it economical to sell or lease their farm land, with associated water rights, to solar developers. Many state policymakers, including the Governor, recognize the potential economic benefits of becoming a renewable energy development hub. For all these reasons, Arizona has become a leader in solar development.

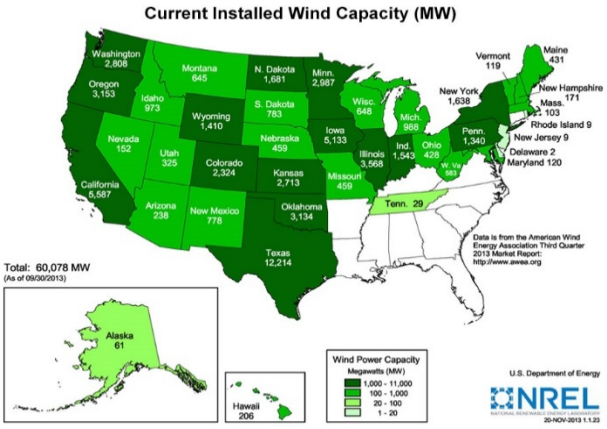


Figure 2. US Map of Total Installed Wind Capacity. Source: National Renewable Energy Lab, 2013

[1] See http://www.azcommerce.com/industries/renewable-energy

In contrast, wind energy development has grown more slowly. Arizona's wind resource is not as strong or consistent as that in neighbor states. Some aspects of the permitting process for wind farms are more complicated and can take longer due to the fact that wind farms might cross several permitting jurisdictions, in addition to general concerns over avian and bat populations, visual impacts, and proximity to populations. Statewide wind modeling efforts, collaboration by environmental protection agencies at different jurisdictional levels, and the establishment of policies, guidelines, ordinances, and other guiding documents are all factors that help to accelerate the development of wind projects in Arizona.

Notable Solar Projects. There are a number of notable concentrated solar power (CSP) and photovoltaic (PV) projects that came online in 2013. The Solana Generating Station in Maricopa County, completed in October 2013, is a CSP parabolic trough with generating capacity of 280 MW and storage capability to allow it to produce electricity into the night. APS will purchase 100 percent of the electricity produced. The Agua Caliente Solar Project located outside of Yuma is currently under construction and will be the world's largest PV plant connected to the grid when completed, with capacity to generate 290 MW. This is being developed by First Solar, a Tempe-based manufacturer and developer of solar energy.

Notable Wind Projects. The Dry Lake I and II, Western Wind, and Perrin Ranch wind farms are the three operational wind farms in Arizona. In addition, the Red Horse 2 wind farm is under construction. These have a total generation capacity of 287 MW. Another 1 MW turbine is located on the Fort Huachuca Army Base. There are other projects that are approved or under development across the state. For example, the Bureau of Land Management (BLM) is moving forward to approve[2] the Mojave County Wind Farm, which will consist of as many as 243 turbines with 500 MW of total generating capacity.

Other Renewable Energy Projects. Arizona also utilizes other renewable energy sources. Biomass and biogas have potential throughout the state. Geothermal has potential, but to a lesser extent because the geothermal wells are at a lower heat than needed for electricity production. Nevertheless, there have been some direct geothermal applications for aquaculture, heating systems, and farming. There are two biomass plants and two biogas plants in the state. The Snowflake biomass power plant is the largest in the state with operational capacity of 25 MW. After a brief closure in 2013, the plant is set to restart soon after being sold to Novo Power LLC. A 2.8 MW biogas facility is operating in the city of Glendale and is powered by the methane captured from the landfill. Another biogas plant that is being proposed in Glendale by Vieste Energy and Abengoa, a Spanish renewable energy company, would utilize waste-to-energy technology. This plant would gasify 180,000 tons of trash annually to produce 350 tons of gas a day to be burned to generate 15 MW of electricity.

Permitting. All renewable energy development projects must comply with applicable state, federal, and tribal laws, and with the guidance or regulations of the governing bodies having jurisdiction in the area of development. The state has 15 counties with differing or nonexistent rules for wind and solar development, and also is home to nearly two dozen federally recognized Native American tribes. The checkerboard layout of Arizona land means that there are often differing permitting processes for different projects across the state, and some projects must obtain multiple permits from different jurisdictions. As an example during Phase I the Dry Lake Wind Farm developer obtained Conditional Use and construction permits from Navajo County, a Right of Way from the State Land Department, and a Right of Way from the Bureau of Land Management. References to permitting guidelines are provided in an appendix to this report.

[2] http://www.doi.gov/news/pressreleases/secretary-jewell-announces-approval-of-major-wind-energy-project-on-public-lands-in-arizona.cfm

Native American Communities. To date, there have not been any utility scale renewable energy projects constructed on tribal lands in Arizona. Several tribes have performed resource assessments and other feasibility work for utility-scale wind and solar development, including the Hualapai Tribe, Navajo Nation, Hopi Tribe and Fort Mojave tribe. Developers and tribes have been working for many years to address challenges with permitting, land ownership, and project ownership arrangements. There are a number of smaller scale projects, from solar street-lighting to facility-scale renewable energy systems, installed in tribal communities across Arizona. Many of these provide renewable energy in places where there is no grid connection or where the renewable backup power contributes significantly to reliability of power or reduction in energy costs for tribal governments.

Market Trends. The cost of solar and wind installations continues to fall. The Department of Energy's (DOE) 2012 Wind Technologies Market Report[3] indicated the cost of a wind farm installation, including turbine and installation, balance of plant costs, and any substation and interconnection costs, was around $1,940/kW in 2012; a $300/kW reduction since 2009/2010. According the Solar Energy Industries Association (SEIA) the cost of solar installations also continues to decrease. Utility-scale solar system prices averaged around $2,070 per kW, yet the costs vary widely depending on technology, location, and other factors on a project-by-project basis. These costs, along with operations and maintenance costs, capacity factors, development costs, transportation costs, siting and permit requirements, and construction costs and market conditions affect the Power Purchasing Agreement (PPA) pricing – the price at which wind and solar developers sell their electricity to utility companies. In 2012, the west had the highest average PPA price for wind in the country, at $50 - $90 per MWh, whereas the national average was $40 per MWh.

Regulatory uncertainty has affected market stability in Arizona and the US as a whole. The Production Tax Credit (PTC), a 2.3 cent / kWh federal income tax credit, was due to expire in 2012, but was extended to the end of 2013, allowing all projects beginning in 2013 to collect on this tax incentive. The lack of long-term stability for this incentive creates uncertainty for the industry over time. The Business Energy Investment Tax Credit (ITC) provides tax breaks for up to 30% of the costs of installing solar, small scale wind, and other renewable energy technologies. The ITC has fueled growth in the solar sector, but will decrease significantly in 2017, which creates uncertainty, but also provides some time to build economies of scale, enhance efficiency, and plan for a market without the credit.

Renewable Energy Standard. Since 2006, the Arizona Corporation Commission (ACC) has enforced the Renewable Energy Standard and Tariff (REST). The REST mandates that investor-owned utility companies, and electric co-ops serving more than half of their retail customers in Arizona, generate 15% of their electricity from renewable sources by 2025. The required renewable energy generated as a percentage of total produced electricity increases incrementally each year. Out of the REST mandate for each year, 30% must be met by distributed generation (DG) sources. In 2013, the standard was set at 4%, and increases to 4.5% during 2014. To meet the standard, the utility companies must retain or obtain renewable energy credits (RECS) to represent the renewable energy attributes of eligible projects. The increasing percentage of this and other neighboring states' standards creates demand for continued development of renewable energy in the region. As of the 2012 compliance reports, the major Arizona utility companies have been meeting the REST requirements. APS had reported that 5.3% of total electricity retail sales came from renewables and exceeded the residential and nonresidential DG by 131% and 206% respectively. TEP reported similar figures; 5.2% of total retail electricity sales from renewables and 118% of residential and 205% nonresidential of the standard has been met.

Net-metering and Deregulation. In 2013, two major issues in electricity market regulation were addressed by the ACC. First they opened a discussion docket on the topic of electricity market deregulation. A deregulated electricity market would create competition among utilities, by allowing consumers to select which company provides their

[3] http://emp.lbl.gov/publications/2012-wind-technologies-market-report

electricity. This could have pushed electricity prices down as consumers sought out the cheapest options, or allowed consumers to choose providers based on other criteria such as who has the largest mix of renewables. The ACC docket accepted comments on deregulation's potential impact from all interested parties. The ACC ultimately voted not to pursue deregulation at this time, maintaining the current utility service structure in Arizona. The second debate concerned net-metering. Arizona Public Service (APS) submitted a proposal for the ACC to amend the net-metering and distributed energy policy. APS asserted that because the costs of maintaining transmission and distribution systems are included in the cost of kWh that customers purchase, infrastructure and other fixed costs are shifted from those with distributed energy systems to other consumers.

To right this perceived wrong, APS proposed adding a monthly charge of $50-$100 to homes with DG installations. This could have had a crippling effect on rooftop solar and other distributed energy generating markets in Arizona, as they would have been made less economically feasible. The ACC rejected the large fees, instead opting for a $0.70 fee per month for each kW of DG capacity that the customer had on site.

Environmental Issues. A number of environmental costs and benefits are weighed in decisions made regarding renewable energy development. Most renewables do not emit any CO2, the leading cause of climate change, during the production of electricity. For a kWh of renewable energy that is produced in place of natural gas and coal, respectively, 1.2 lbs. or 2.2 lbs. of CO2 emissions are avoided. Thus, a 5 MW solar PV installation with a 20% capacity factor (average for Arizona), displaces 19.3 million lbs. of CO2 that would have otherwise been released into atmosphere if the electricity were generated from coal. Also, avoiding the need for coal or natural gas also mitigates the environmental damages associated with coal mining and hydraulic fracturing.

There are environmental concerns related to the manufacturing, construction, and operation of renewable energy facilities as well. In the southwest in particular, the use of and planning for water resources is extremely important. Wind and solar PV use almost no water in their operation, while CSP technologies continue to use steam generators and thus water for plant cooling. Renewable energy technologies also impact certain wildlife species. The habitat areas of Desert Tortoises, an endangered species, and other desert animals and plants, are subject to destruction, damage or fragmentation by large-scale solar developments. A number of avian and bat species, including the federally protected Golden Eagle, are put at risk by wind plants being developed in areas where they roost or migrate. Increased awareness of risk, through pre-construction monitoring, and mitigation practices during and after construction, have been put in place to minimize these environmental costs.

Renewable Energy Technologies

Photovoltaic (PV) solar panels convert sunlight directly into electricity. The solar panels are made up of a number of solar cells that contain the photovoltaic materials. These systems have no moving parts, which distinguishes them from other renewable technologies. Instead, the photons from sunlight are captured within the solar cells, which excite electrons to generate an electric current. The lower costs, compactness, and low maintenance make solar PV systems one of the most widely dispersed renewable energy technologies.

Concentrated Solar Power (CSP) uses the thermal energy from the sun to generate electricity. This typically involves heating a substance that powers an electricity-producing steam generator. There are three main types of CSP designs: parabolic troughs, parabolic dishes, and power towers.

Parabolic Trough systems consist of many parabola-shaped mirrors that direct heat from sunlight toward tubes full of flowing fluid or steam. This fluid reaches an industrial steam generator to produce electricity. With storage capacity for the heated substance, this technology has the potential to produce electricity when the sun goes down.

Parabolic Dish systems are mirrored dishes that look similar to a satellite dish. They reflect the sunlight to central points in front of each dish, where the heat is transferred to a liquid or gas. The heated fluid or gas then powers a generator to create electricity. Sterling engine designs used to generate electricity beneficial due to their size and the fact that they use no water. Each parabolic dish's generating capacity ranges from 10 kW to 25 kW.

Power Towers consist of a multitude of moving mirrors surrounding a large tower. The mirrors focus the solar heat toward a center point at the top of the tower where either molten salt or water is heated and cycled down to a generator to produce electricity. Molten salt can be stored, allowing for the production of electricity after the sun goes down.

Wind Turbines use the kinetic energy from the wind to generate electricity. There are variations in size and design but they function similarly. The wind causes the blades and rotor to spin, which drives gears that powers a generator within the turbine and generates electricity. The most widely used turbines have a horizontal axis and can be up to 500 feet high.

Geothermal Electricity Production taps into the natural heat generated in the earth's crust. There are a number of designs to utilize the heat in order to produce steam. This steam is then captured at geothermal power plants to power thermal generators and produce electricity.

Biomass Electricity Generation produces electricity by burning any raw or processed organic plant matter. This technology essentially uses the same process as a coal or natural gas plant but instead burns biomass. It is considered renewable if the biomass source continues to grow back.

Biogas Electricity Generation is electricity generated from gases produced by organic material. Gas is produced from organic matter, agricultural waste, aquatic plants, vegetative waste, and wood waste or animal and human waste through anaerobic digestion, oxidization, or gasification. The resulting gas, similar to natural gas, is burned to produce steam and power a generator to create electricity.

Hydroelectric Generation captures energy from the flow of water. Water is stored behind a dam in a reservoir, then passes through an enclosed area where it turns a turbine that generates electricity. Hydroelectricity has been utilized for many years.

Jobs and Economic Development Impact (JEDI) Modeling Summary

Economic Impacts

The development of wind and solar power plants creates jobs, increases direct local spending on products and services for the plant, and increases indirect spending by those who receive wages or payments due to the plant's operation. The plants also provide a stream of property tax, right-of-way, or other land payment revenue to the state, county, tribe or federal agency having land jurisdiction, as well as to any private entity whose land makes up part of the project's footprint.

The JEDI model

These positive economic impacts can be quantified using the Jobs and Economic Development Impacts model[4] developed by the National Renewable Energy Laboratory. This model is an input-output model, developed using data gathered from industry interviews, surveys of local businesses, and economic multipliers derived from the Minnesota-based IMPLAN group's accounting software and state files. The model can be used to estimate economic impacts at the state or county level. For the purposes of this report, the model was run at the state level.

Basics of economic impacts and input-output modeling

The statewide economic impacts of renewable energy projects are directly related to the relative costs of the project development materials and processes, and their availability in the state. If there is a component or service for the construction or maintenance of the plant available in Arizona, the model assumes that it is used, whether this is actually the case or not. Thus, if the equipment for a concentrating solar plant costs more than an equivalent-size wind plant, then the total project cost is higher, and to the extent that materials for the plant are available in Arizona, the economic impact on the state is greater. The same is true for the labor involved in plant construction and maintenance. In addition, the land use expenses, such as lease arrangements, property taxes, and rights-of-way are included as default values in the model, and generally are higher for plants that use more of the actual surface area of the project boundary.

The model quantifies construction-phase and operation-phase impacts. Jobs, earnings, and output are distributed across three categories:

- Project Development and Onsite Labor Impacts: refers to the actual work and financial transactions related to the renewable energy project development, construction and operation onsite at the plant. Example: the job and paycheck of a road grader or wind turbine technician at a wind plant.
- Local Revenue and Supply Chain Impacts: refers to additional work or spending that takes place in the local area or in the supply chain statewide for the actual development, construction, or operation of the plant. Example: the purchase of local legal services or construction supplies from a firm in the state where a solar plant is built.
- Induced Impacts: refers to the work or revenue resulting from local expenditures made by those individuals whose jobs are supported by the onsite or supply chain impacts. Example: part of the employment, wages, and revenue at a theater where wind plant workers take their families out for movies and popcorn.

Jobs refers to the full-time-equivalent employment (calculated in job-years) caused by the development phase or aspect of the project in question.

Earnings is a dollar figure representing the wages, salaries, and benefits paid to the workers in the jobs.

[4] See http://www.nrel.gov/analysis/jedi/about_jedi.html

Output refers to economic activity or the value of production in the state being analyzed. This dollar figure includes earnings, as well as the other revenue that results from the spending related to the project (purchases of equipment, materials and services).

Impacts of renewable energy development in Arizona

Arizona currently has 288 MW of wind capacity, 868 MW of solar PV capacity, and 286 MW of CSP capacity operating or under construction. The economic impacts of the construction and operation of these power plants are illustrated in the following figures and tables.

These job impacts, calculated using the JEDI model, include on-site jobs, jobs in the supply chain related to the project development or operation, and indirect jobs created by the additional employment on-site and in the supply chain.

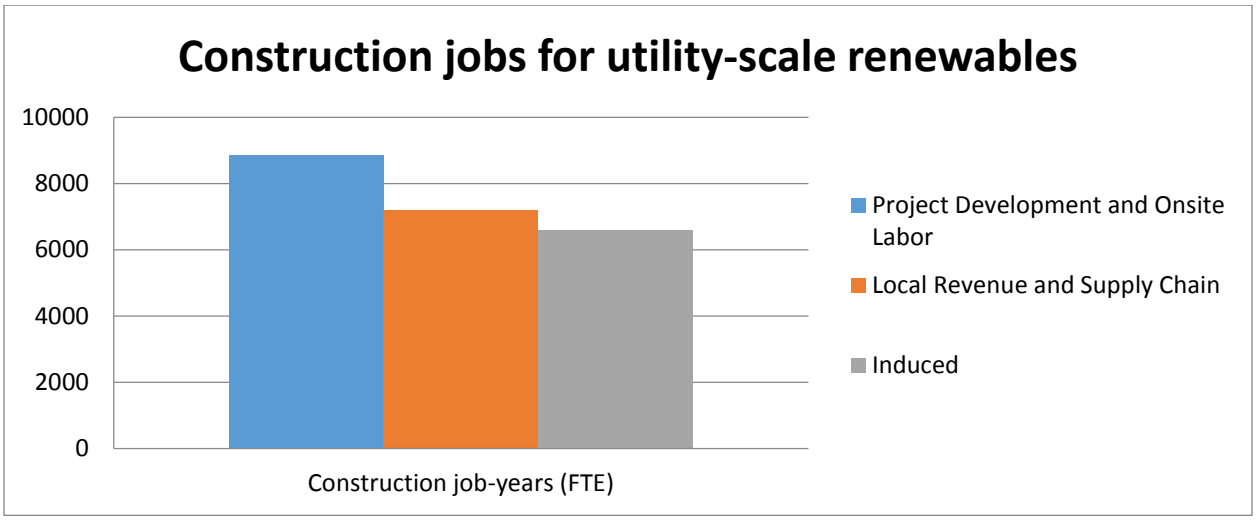


Figure 3. Total FTE construction-phase jobs created by all renewable energy projects built or under construction in Arizona.

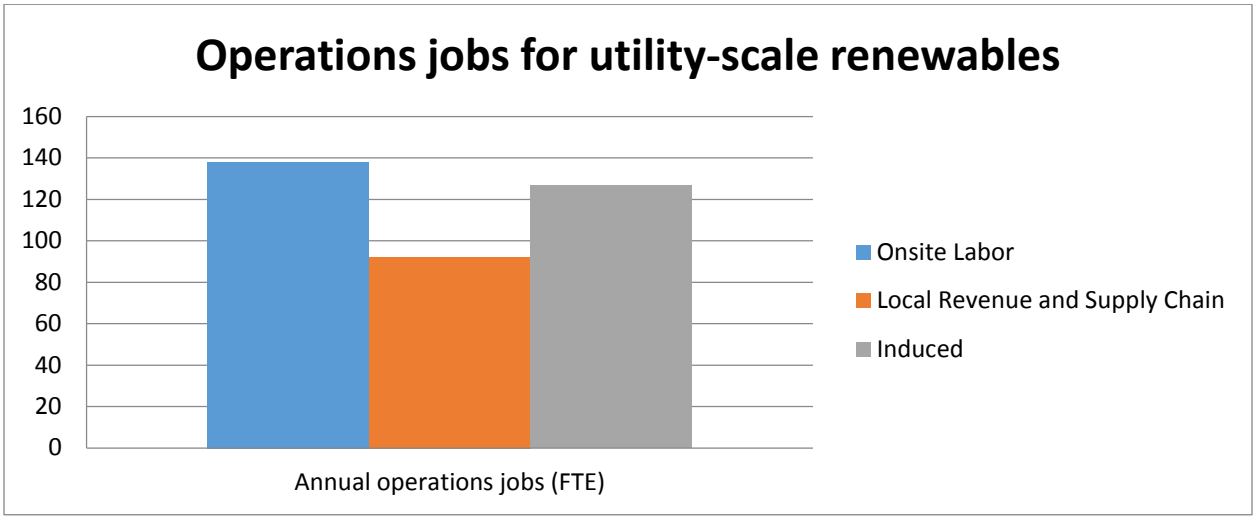


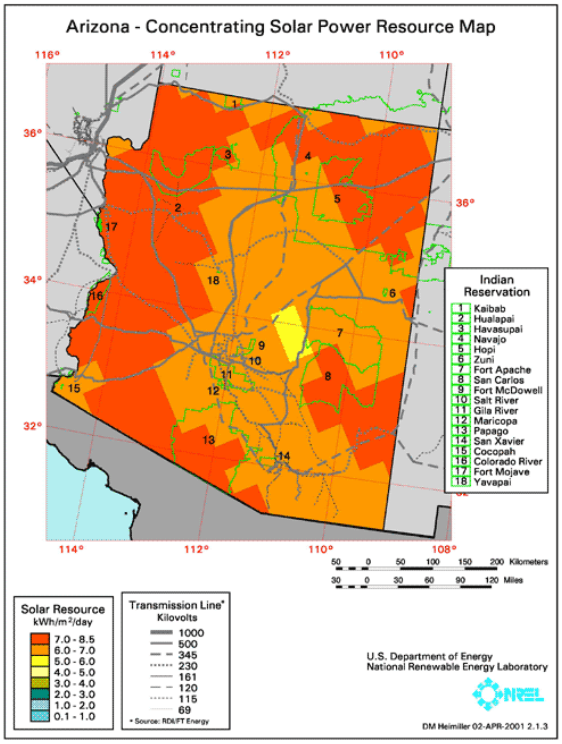
Figure 4. Total FTE operations jobs created by all renewable energy capacity operating or under construction in Arizona.

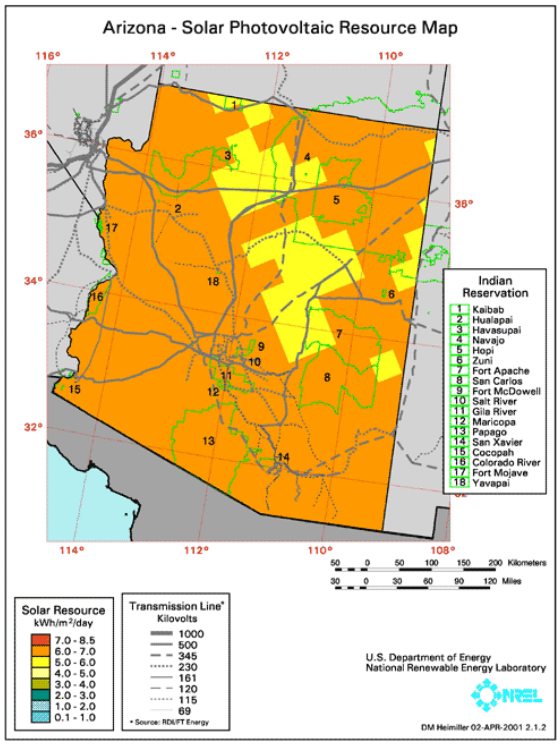
Model validation

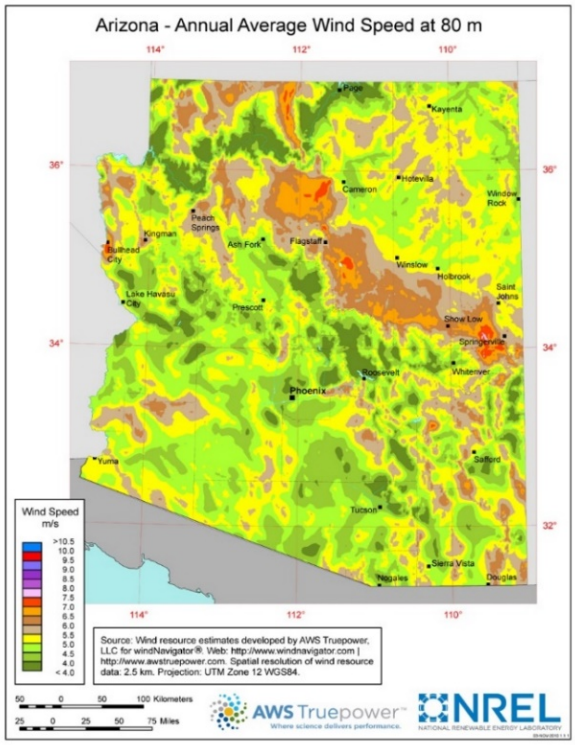
Because the model assumes that any service needed by the project is provided in-state if it is available in-state, it tends to over-estimate the economic impacts of technologies that do have manufacturing and other supply chain companies in the state. The actual reported economic impacts of several Arizona renewable energy power plants are listed below.

- Solana Generating Station, a 280-MW CSP plant with molten-salt energy storage in Maricopa County, built by Abengoa Solar, reported that during construction the project created 1500 direct jobs, and that there are 85 full time workers employed to operate the plant.
- Agua Caliente Solar, a 250-MW solar PV plant (290 planned at construction completion) in Yuma County, built by FirstSolar, employed 400 workers for four years during construction of all project phases.
- Dry Lake I, the first 63-MW phase of two wind plants in Navajo County developed by Iberdrola Renewables, reported a peak of 200 jobs during construction and 5 permanent on-site positions.
- Perrin Ranch, a 99-MW wind plant in Coconino County built by NextEra Energy, reported a peak of 200 construction jobs and 6 permanent positions on-site.

Arizona Wind and Solar Resource Maps





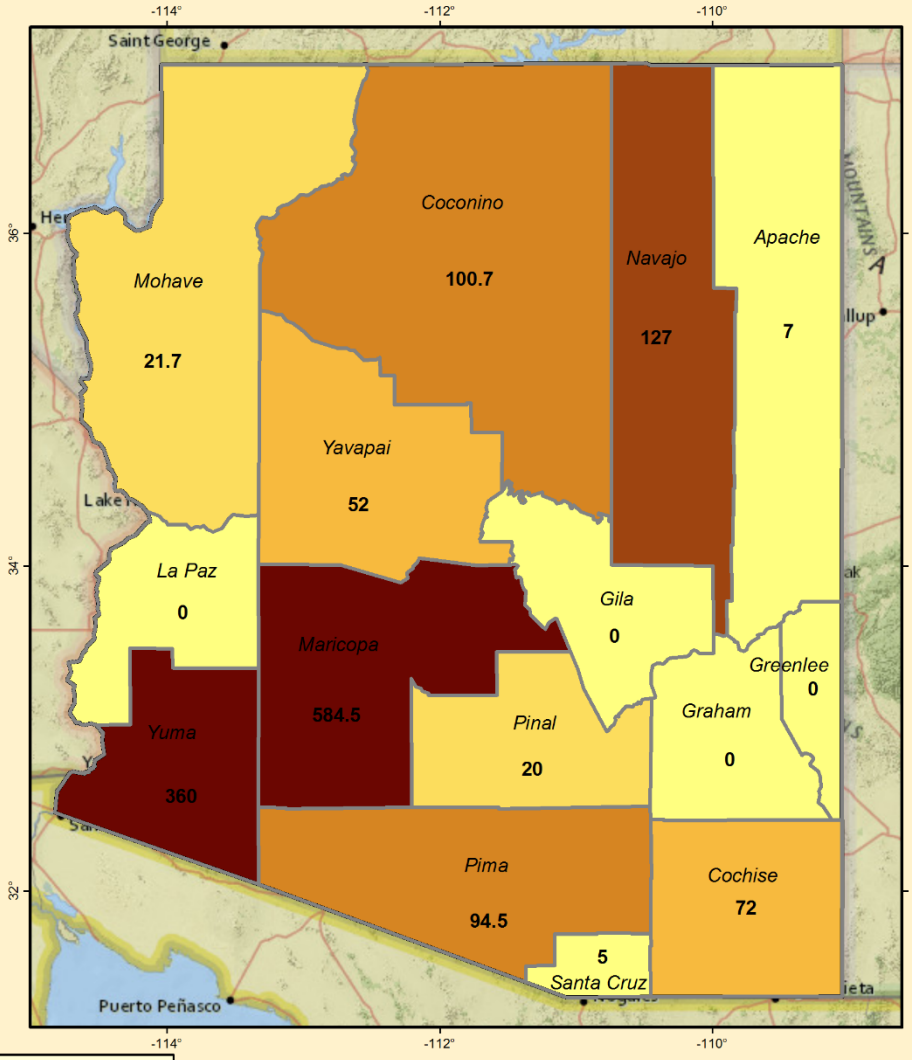


Source for Maps: National Renewable Energy Laboratory

Installed and Proposed Capacity Maps (Counties)

Arizona Total Wind & Solar Capacity (2013)

includes
Operating and under construction



Solar & wind megawatts

By County

- 0.0 - 7.0
- 7.1 - 21.7
- 21.8 - 72.0
- 72.1 - 100.7
- 100.8 - 127.0
- 127.1 - 584.5

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0 25 50 100 Miles

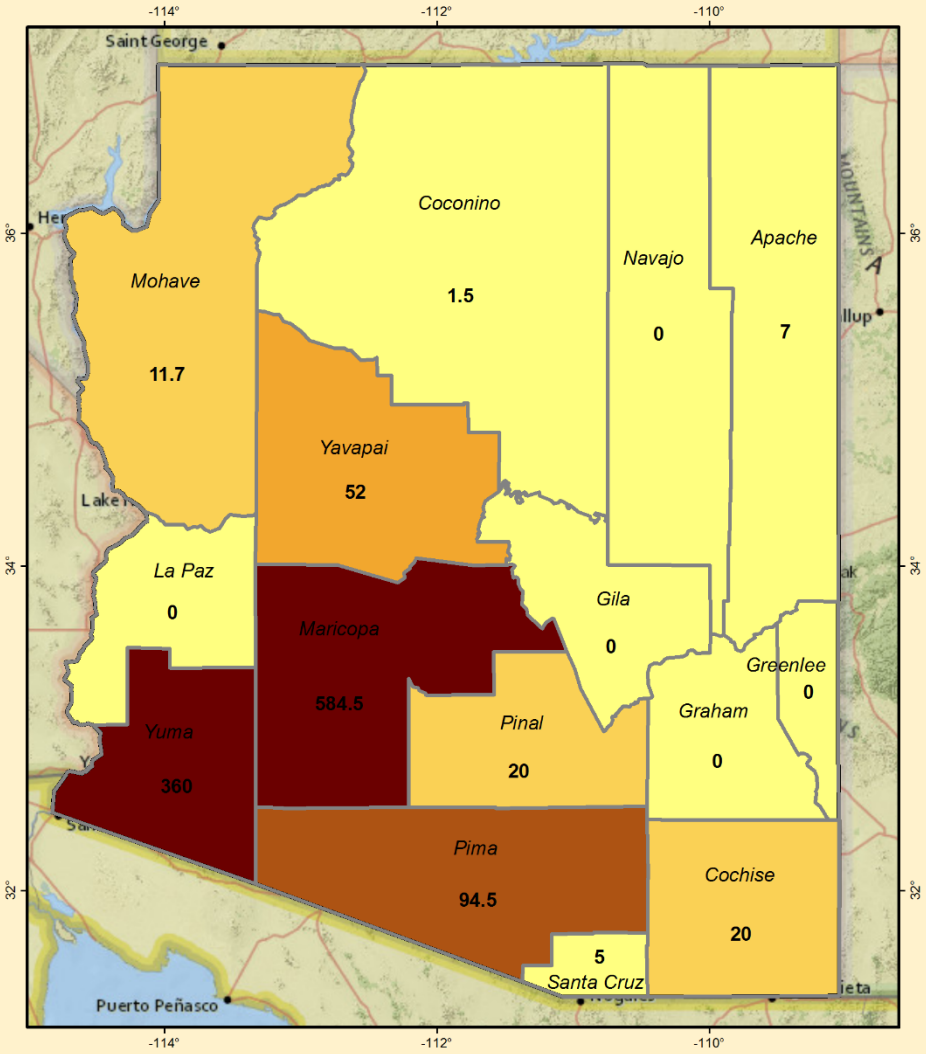
N

Last revision: 28 March 2014

DISCLAIMER: This map and the data it contains may not be comprehensive or complete and was made with the best available information. Please refer to the ISES Arizona Wind and Solar Status Report (2013)

Arizona Total Solar Capacity (2013)

includes
Operating and under construction



Solar megawatts
By County
- 0.0 - 7.0
- 7.1 - 20.0
- 20.1 - 52.0
- 52.1 - 94.5
- 94.6 - 584.5

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0 25 50 100 Miles

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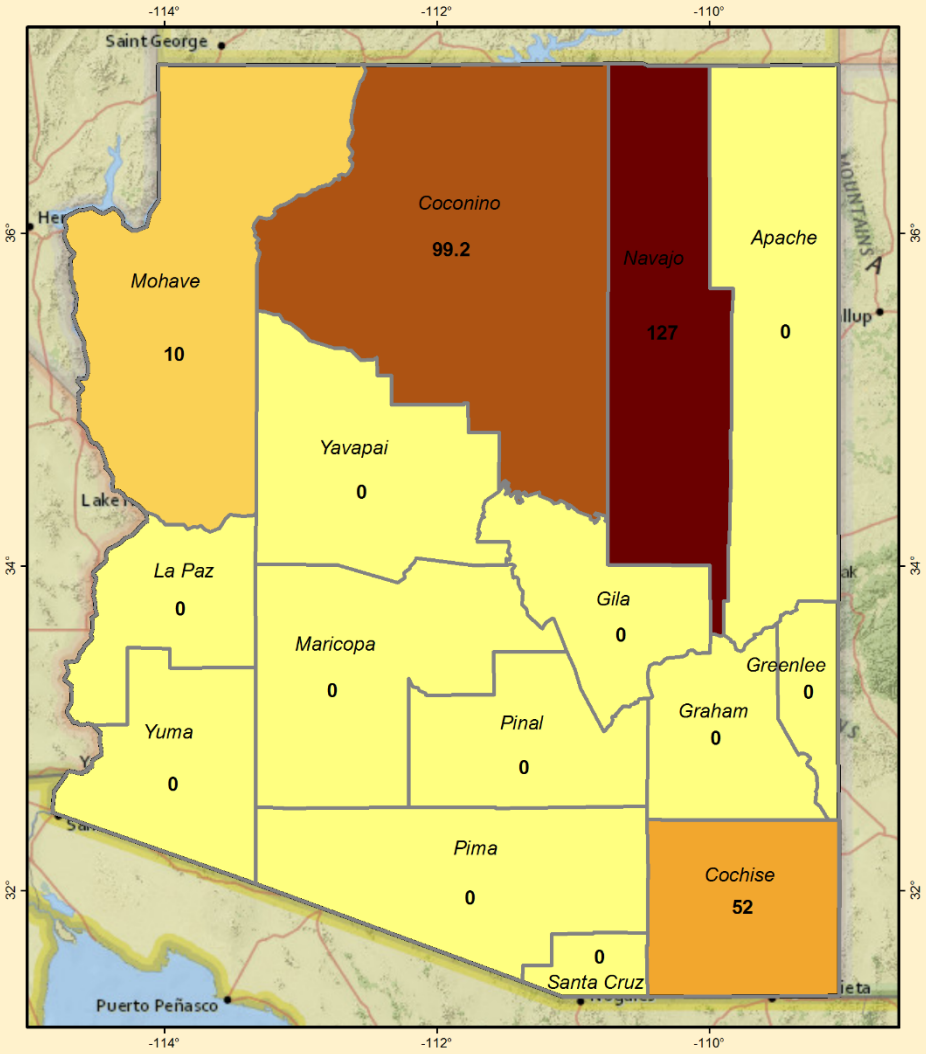
Arizona Total Wind Capacity (2013)

includes
Operating and under construction



Wind megawatts
By County
- 0.0
- 0.1 - 10.0
- 10.1 - 52.0
- 52.1 - 99.2
- 99.3 - 127.0

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0 25 50 100 Miles

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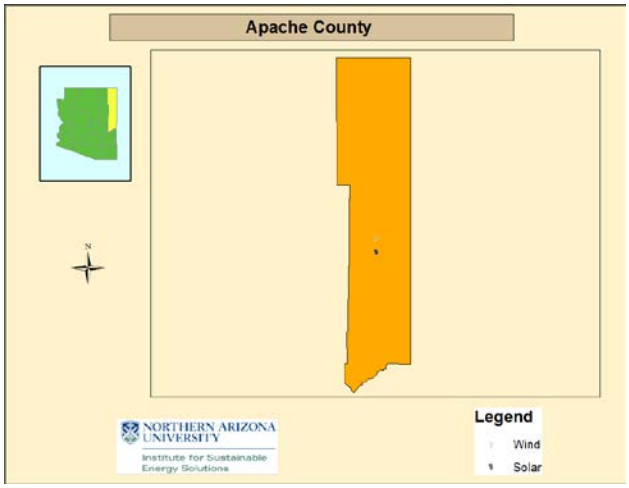
Apache County

Population: 73,195

Size: 11,197 sq. mi.

Median Household Income: $31,011



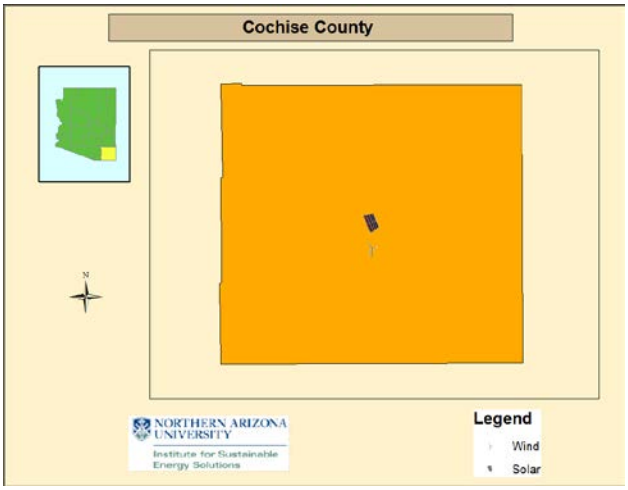
Solar Project Name	Design	Megawatts	Acreage	Stage of Development	Developer	Purchaser of electricity
Springerville Generating Station	PV	7	64	Operating	Global Solar Energy	Tucson Electric Power
Total Proposed or Under Development		**0**				
Total Under Construction or Operating		**7**				

Cochise County

Population: 132,088

Size: 6,165 sq. mi.

Median Household Income: $45,906



Solar Project Name	Design	Megawatts	Acreage	Stage of Development	Developer	Purchaser of electricity
Fort Huachuca	PV	20		Under Construction		
San Simon	PV	1.2	5	Under Development	Sulphur Springs Valley Electric Cooperative	
Total Proposed or Under Development		**1.2**				
Total Under Construction or Operating		**20**				

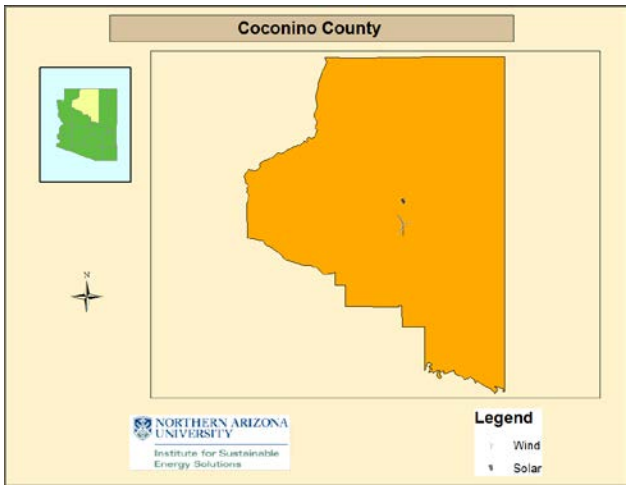
Wind Project Name	Megawatts	Acreage	Stage of Development	Developer	Purchaser of electricity
Fort Huachuca	1		Operating	US Army	
Red Horse 2 Wind	51	220	Under Construction	Red Horse 2, LLC and Torch Renewable Energy, LLC	TEP
Total Proposed or Under Development	**0**				
Total Under Construction or Operating	**52**				

Coconino County

Population: 136,011

Size: 18,618 sq. mi.

Median Household Income: $49,615



Solar Project Name	Design	Megawatts	Acreage	Stage of Development	Developer	Purchaser of electricity
APS Community Power Project	PV	1.5		Operating	APS	APS
Total Proposed or Under Development		**0**				
Total Under Construction or Operating		**1.5**				

Wind Project Name	Megawatts	Acreage	Stage of Development	Developer	Purchaser of electricity
Perrin Ranch	99.2	22,000*	Operating	NextEra	APS
Total Proposed or Under Development	0				
Total Under Construction or Operating	**99.2**				

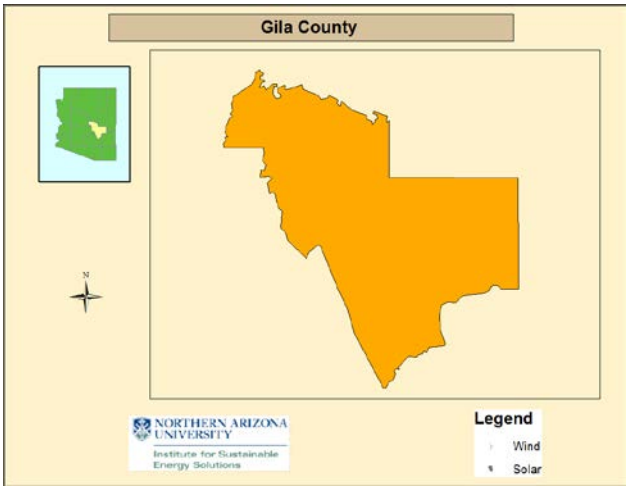
*This includes the entire project boundary which is not completely covered in turbines, allowing for multipurpose use.

Gila County

Population: 53,144

Size: 4,757 sq. mi.

Median Household Income: $37,905



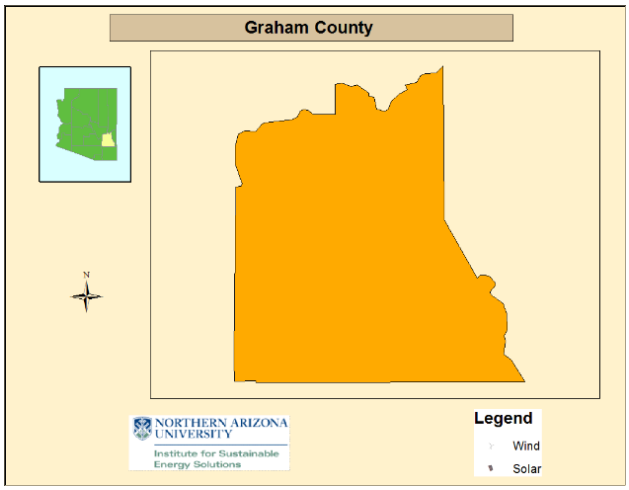
There are no projects at this time in Gila County.

Graham County

Population: 8,700

Size: 292.08 sq. mi.

Median Household Income: $32,255



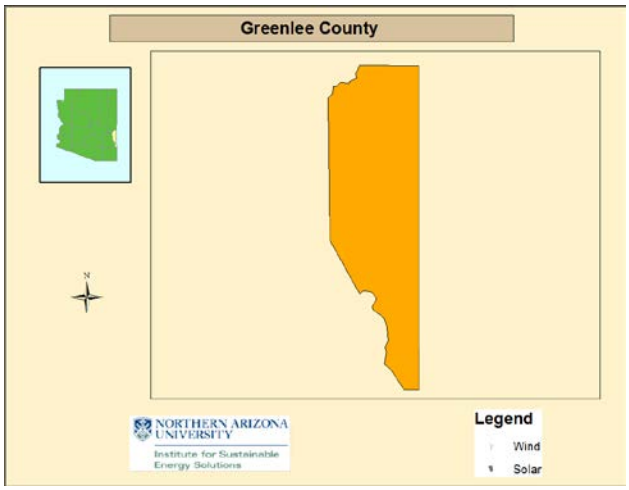
There are no projects at this time in Graham County.

Greenlee County

Population: 8,802

Size: 1,184.13 sq. mi.

Median Household Income: $49,390



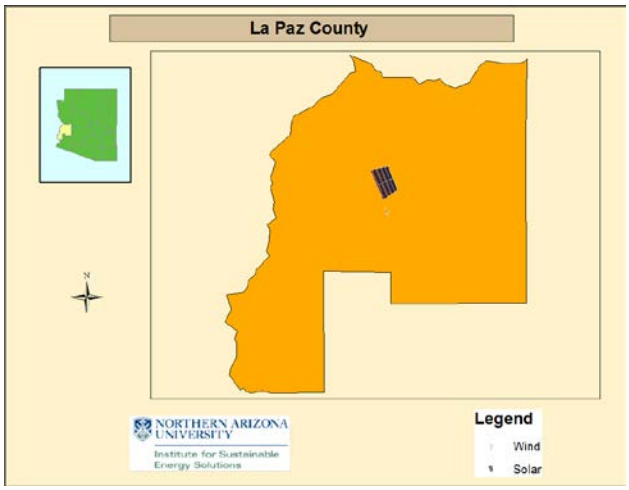
There are no projects at this time in Greenlee County.

La Paz County

Population: 20,281

Size: 4,499.63 sq. mi.

Median Household Income: $32,220



Solar Project Name	Design	Megawatts	Acreage	Stage of Development	Developer	Purchaser of electricity
Horizon	CSP Trough	250	8,812	Proposed	Horizon Wind Energy, LLC.	
Little Horn	CSP Trough	1,000	12,000*	Proposed	SunPower Corp.	
Quartzsite Solar Energy Project	CSP Tower	100	1,450	Under Development	Solar Reserve	
La Paz Solar Tower	Solar Tower	200		Under Development	EnviroMission	Southern California Public Power Authority
Total Proposed or Under Development		**1,550**				
Total Under Construction or Operating		**0**				

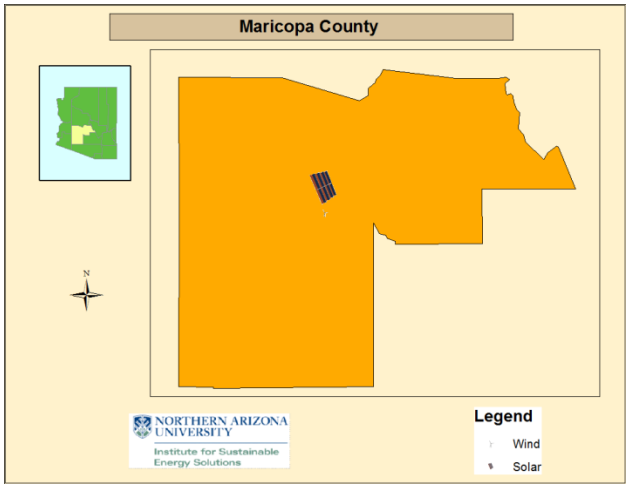
*This figure reflects acreage applied for through the BLM, not the actual footprint of the project.

Maricopa County

Population: 3,942,169

Size: 9,200 sq. mi.

Median Household income: $55,099



Solar Project Name	Design	Megawatts	Acreage	Stage of Development	Developer	Purchaser of electricity
ASU Solar Array	PV	23.5		Operating		
Arlington Valley Solar Energy Project	PV	125	1,433	Under Development	Arlington Valley Solar Energy, LLC	
Arlington Valley Solar Project II	PV	125	1,160	Under Development	Arlington Valley Solar Energy, LLC	
Phase 1 of Arlington Valley Solar Project II	PV	19*		Operating	AVSE, LLC	
Badger 1 Solar Farm	PV	15	172	Under Development	Juwi Solar Inc.	APS
Cotton Center	PV	18	145	Operating	Solon	APS
Crossroads Solar Energy Project	CSP Tower	150		Under Development	Solar Reserve	
Gila Bend	PV	500	6,000	Proposed	First Solar	
Gila Bend Solar Power Plant	PV	32	400	Under Construction	Solar Reserve	APS
Gillespie 1	PV	20		Under Construction	Recurrent Energy	
Horizon Aguila	CSP Trough	250	11,534	Proposed	First Solar	
Hyder Valley Solar Energy Project	CSP Trough	325	4,500	Under Development	Iberdrola	

Solar Project Name	Design	Megawatts	Acreage	Stage of Development	Developer	Purchaser of Electricity
Maricopa Solar Park	PV	300	1,730	Under Development	Marisol Energy II, LLC	
Mesquite Solar 1	PV	150	920	Operating	Sempra U.S. Gas & Power	PG&E
Mesquite Solar Additional Phases	PV	550		Proposed	Sempra U.S. Gas & Power	
Paloma Solar Plant	PV	17		Operating	First Solar	APS
Queen Creek Solar	PV	25	135	Operating	Juwi Solar Inc.	SRP
Solana Generating Station	CSP Trough	280	1,920	Operating	Abengoa	APS
Sonoran Solar Energy Project	PV	300	2,013	Under Development	Boulevard Associates, LLC	
Sun Streams Solar Farm	PV	150		Under Development	Element Power	
Total Proposed or Under Development		**2,790**				
Total Under Construction or Operating		**584.5**				

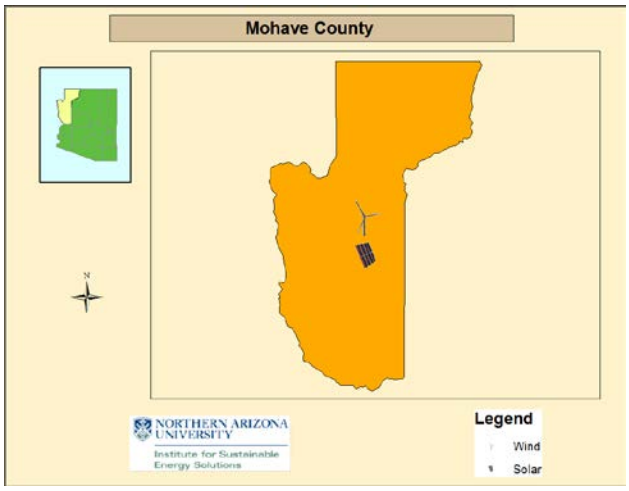
*The 19 mw are included in the overall 125 mw of Arlington Valley Solar Project II.

Mohave County

Population: 203,334

Size: 13,311 sq. mi.

Median Household Income: $40,573



Solar Project Name	Design	Megawatts	Acreage	Stage of Development	Developer	Purchaser of electricity
Black Mountain Solar	PV	10		Operating	Duke Energy	UniSource Energy Service
Hualapai Valley Solar Project	CSP Trough	340	4,000	Under Development	Mohave Sun Power	Western Area Power Administration
Kingman Project	CSP Trough	200		Under Development	Albiasa Corp.	
La Senita Elementary	PV	1.2		Operating	Unisource	
Western Wind Energy Project	PV	.5	10	Operating	Western Wind Energy	
Total Proposed or Under Development		**540**				
Total Under Construction or Operating		**11.7**				

Wind Project Name	Megawatts	Acreage	Stage of Development	Developer	Purchaser of electricity
Dolan Springs			Testing	Pacific Wind Development, LLC	
Five Star 1			Testing	Five Star Energy Systems, LLC	
Five Star 2			Testing	Five Star Energy Systems, LLC	

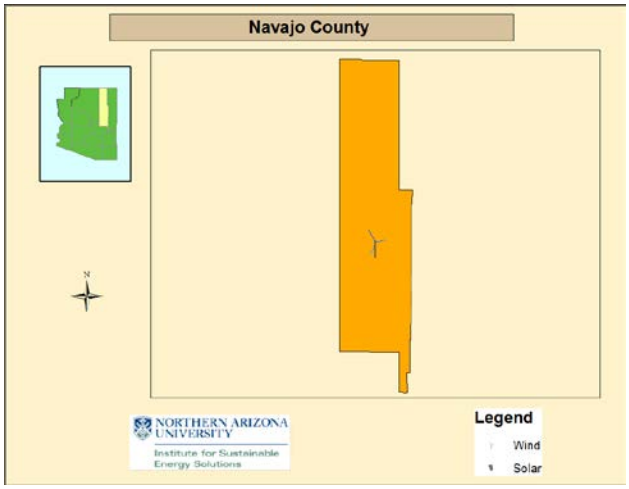
Wind Project Name	Megawatts	Acreage	Stage of Development	Developer	Purchaser of electricity
Mohave County Wind Farm	Up to 500		Under Development	BP Wind Energy North America	
Western Wind Energy Project	10		Operating	Western Wind Energy	
Total Proposed or Under Development	**Up to 500**				
Total Under Construction or Operating	**10**				

Navajo County

Population: 107,094

Size: 9,950 sq. mi.

Median Household Income: $38,975



There are no solar projects in Navajo County at this time.

Wind Project Name	Megawatts	Acreage	Stage of Development	Developer	Purchaser of electricity
Dry Lake Wind Farm	127	6,000*	Operating	Iberdrola	SRP
Total Proposed or Under Development	**0**				
Total Under Construction or Operating	**127**				

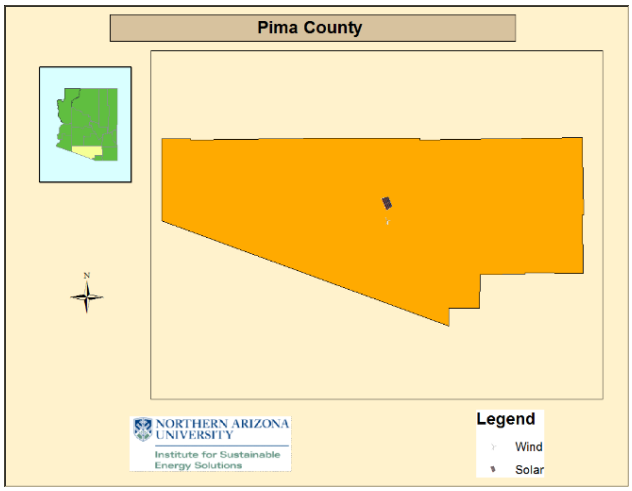
*Turbines cover less than two percent of the total acreage.

Pima County

Population: 992,394

Size: 9,187 sq. mi.

Median Household Income: $46,341



There are no wind projects in Pima County at this time.

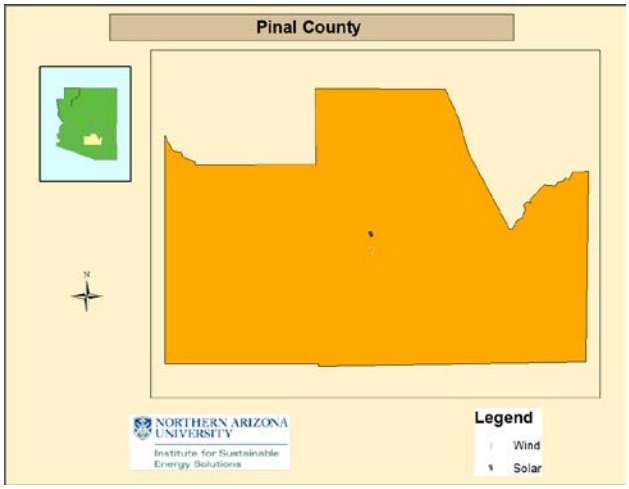
Solar Project Name	Design	Megawatts	Acreage	Stage of Development	Developer	Purchaser of electricity
Ajo Solar	PV	5		Operating	Duke Energy	APS
Avra Valley Solar Project	PV	25	200	Operating	NRG Solar; First Solar	TEP
Bright Tucson	PV	2		Under Development	TEP	TEP
Davis-Monthan AFB	PV	14.5		Operating		
Davis-Monthan AFB – Soaring Heights Community	PV	6		Operating		
Gato Montes, U of A	PV	6	38.5	Operating	Duke Energy	TEP
Pima County Wastewater Reclamation Solar Plant	PV	1		Operating		
Roger Road	PV	1		Operating		
Prairie Fire	PV	5		Operating	Solon	TEP
Saguaro Solar Power Plant	CSP Trough	1	16	Operating	Solargenix	APS
TEP's Sundt Boost Project	Compact Linear Fresnel Reflector	5		Operating		TEP
Tucson Solar	PV	25	305	Operating	SunEdison	TEP
Total Proposed or Under Development		**2**				
Total Under Construction or Operating		**94.5**				

Pinal County

Population: 387,365

Size: 5,365 sq. mi.

Median Household Income: $51,212



Solar Project Name	Design	Megawatts	Acreage	Stage of Development	Developer	Purchaser of electricity
Copper Crossing Solar Ranch	PV	20	144	Operating	Iberdrola	SRP
Total Proposed or Under Development		**0**				
Total Under Construction or Operating		**20**				

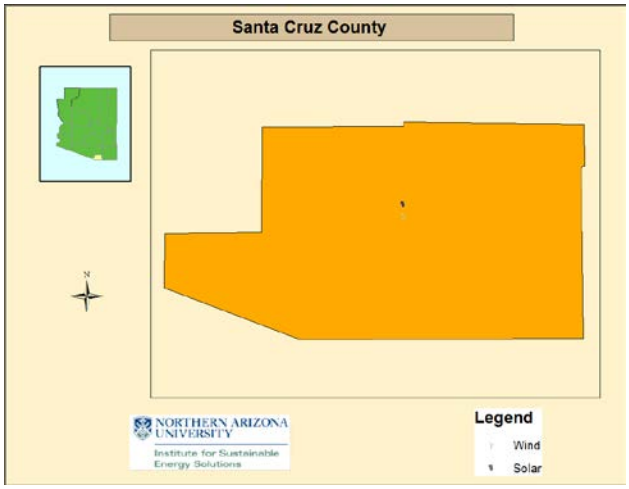
Wind Project Name	Megawatts	Acreage	Stage of Development	Developer	Purchaser of electricity
Kearny			Testing	Grayback Wind, LLC	
Total Proposed or Under Development					
Total Under Construction or Operating					

Santa Cruz County

Population: 266,776

Size: 445 sq. mi.

Median Household Income: $66,030



Solar Project Name	Design	Megawatts	Acreage	Stage of Development	Developer	Purchaser of electricity
Rio Rico	PV	5	37	Under Construction	UNS Energy Corp.	Unisource Energy Services
Total Proposed or Under Development		**0**				
Total Under Construction or Operating		**5**				

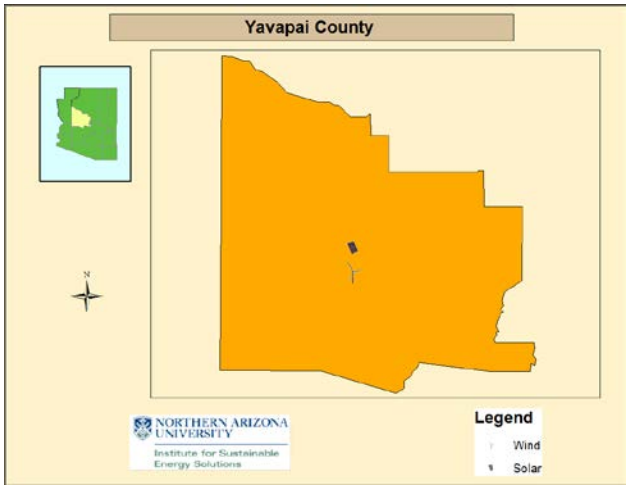
There are no wind projects in Santa Cruz County at this time.

Yavapai County

Population: 212,637

Size: 8,123 sq. mi.

Median Household Income: $44,084



Solar Project Name	Design	Megawatts	Acreage	Stage of Development	Developer	Purchaser of electricity
Bagdad Solar	PV	15	127	Operating	Duke Energy	APS
Chino Valley Solar Plant	PV	20	160	Operating	SunEdison	APS
Prescott Airport Solar Power Plant	PV	2		Operating		APS
Prescott Solar Plant	PV	10		Operating	SunEdison	APS
Prescott Solar Power Plant	PV	3		Operating	APS	APS
Prescott Valley Tank Farm	PV	2		Operating	Smart Energy Capitol	Prescott Valley
Total Proposed or Under Development		**0**				
Total Under Construction or Operating		**52**				

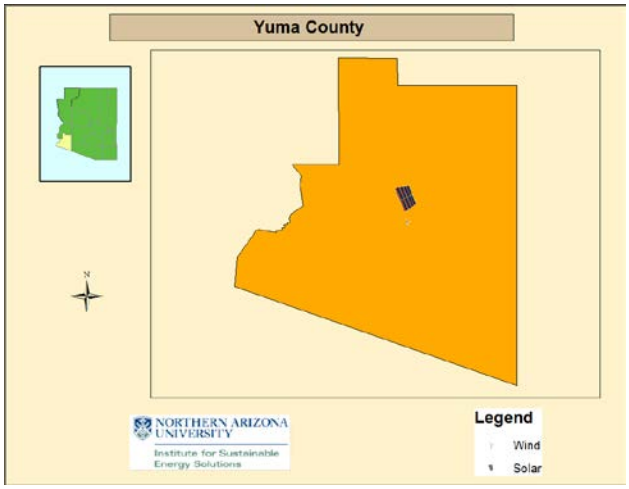
Wind Project Name	Megawatts	Acreage	Stage of Development	Developer	Purchaser of electricity
Yavapai Ranch	130		Under Development	NextEra Energy	
Total Proposed or Under Development	**130**				
Total Under Construction or Operating	**0**				

Yuma County

Population: 202,022

Size: 5,513 sq. mi.

Median Household Income: $41,441



Solar Project Name	Design	Megawatts	Acreage	Stage of Development	Developer	Purchaser of electricity
Agua Caliente	PV	290	2,000	Under Construction	First Solar	PG&E
Arizona Western College	PV	5		Operating		APS
Foothills	PV	35	400	Under Construction	First Solar	PG&E
Hyder I Solar Plant	PV	16	140	Operating		APS
Hyder II Solar Plant	PV	14	240	Under Construction		APS
San Luis Solar Plant	PV	20	175	Under Development		APS
Wildcat Quartzsite	CSP Tower	100	1,675	Under Development	Quartzsite Solar Energy	
Total Proposed or Under Development		**120**				
Total Under Construction or Operating		**360**				

Wind Project Name	Megawatts	Acreage	Stage of Development	Developer	Purchaser of electricity
San Luis	1,500		Proposed	Clean Wind Energy	
Total Proposed or Under Development	**1,500**				
Total Under Construction or Operating	**0**				

AK Chin Indian Community

Population: 1,001

Size: 32 sq. mi.

Median household income: $32,022

The Ak Chin Indian Community performed a feasibility study with USDOE's Tribal Energy Program for a biomass plant in 2004, to utilize manure from local chicken farming and other feedstock for electricity generation. The project did not move forward, as other economic uses of the agricultural wastes proved to be more feasible.

The Community also established its own electric utility, ACES, in 1992 and began providing all electricity service in 1997. Until recently, APS provided all operation, maintenance and construction services. ACES now partners with ED3, a regional provider of services for electric utilities.

The Community does not currently have any renewable energy generation capacity, but it explored commercial-scale solar development (utility-scale, for sale to external parties) with support from the U.S. Office of Indian Energy Policy and Programs. No projects were feasible economically at the time of the investigation.

The Community continues to consider smaller-scale renewable energy projects on a case-by-case basis. The Community is investigating solar street-lighting for new streets where there is not already electricity access to the light poles. In addition, large new structures are designed to be able to accommodate future installation of PV panels.

This information was gathered using web searches and conversations with tribal representatives. The census data was found online and represents 2010 figures.

Sources:

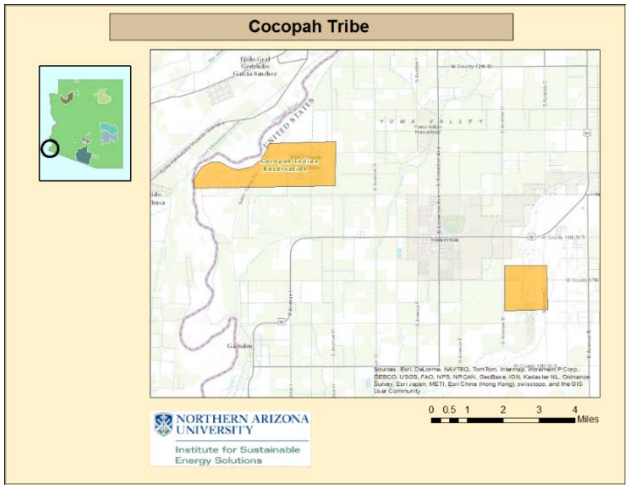
- Jayne Long, Building Director and Capital Projects Manager, Ak Chin Indian Community
- Leonard Gold, Consultant, helped Community to establish Ak Chin Energy Services utility
- U.S. DOE Tribal Energy Program website: http://apps1.eere.energy.gov/tribalenergy/projects_detail.cfm/project_id=77
- Presentation to U.S. DOE on utility development: http://apps1.eere.energy.gov/tribalenergy/pdfs/tribal_business/aces_0811.pdf
- Tribal Demographic Analysis http://azcia.gov/Documents/Links/DemoProfiles/Ak%20Chin%20Indian%20Community.pdf

Cocopah Tribe

Population: 1,025

Size: 10 sq. mi.

Median household income: $43,300



The Cocopah tribe is interested in solar projects and has begun discussion with potential partner Native American Environmental Protection Coalition.

This information was gathered from conversations with tribal representatives. The census data was found online and represents 2010 figures.

Sources:

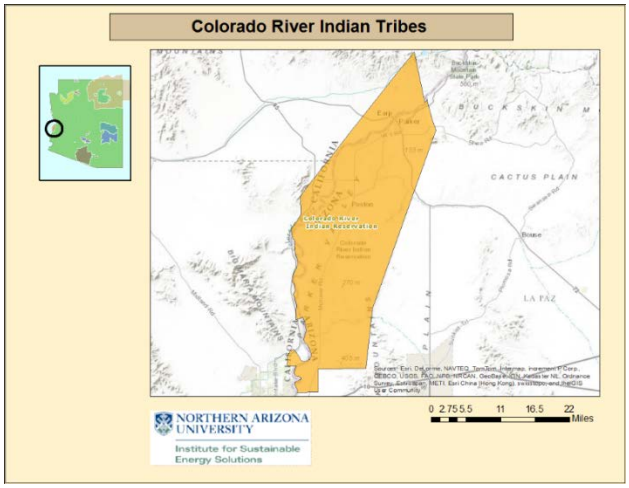
- Hector Salas, Environmental Specialist
- Demographic Analysis of the Cocopah Tribe http://azcia.gov/Documents/Links/DemoProfiles/Cocopah%20Indian%20Tribe.pdf

Colorado River Indian Tribes

Population: 7,077

Size: 389 sq. mi.

Median household income: $27,925



The Colorado River Indian Tribes are not pursuing any renewable energy development. They receive electricity from a hydroelectric power allocation from the Colorado River. They also are in the process of protesting the utility-scale Genesis solar PV project on BLM land about 30 miles west of their tribal reservation due to concerns about the installation's impact on cultural archaeological sites[5].

This information was gathered from web searchers and conversations with tribal representatives. The census data was found online and represents 2010 figures.

Sources:

- Demographic Analysis for the Colorado River Indian Tribes http://azcia.gov/Documents/Links/DemoProfiles/Colorado%20River%20Indian%20Tribes.pdf
- CRIT Website news: **http://www.crit-nsn.gov/crit_contents/news/03192012.shtml**

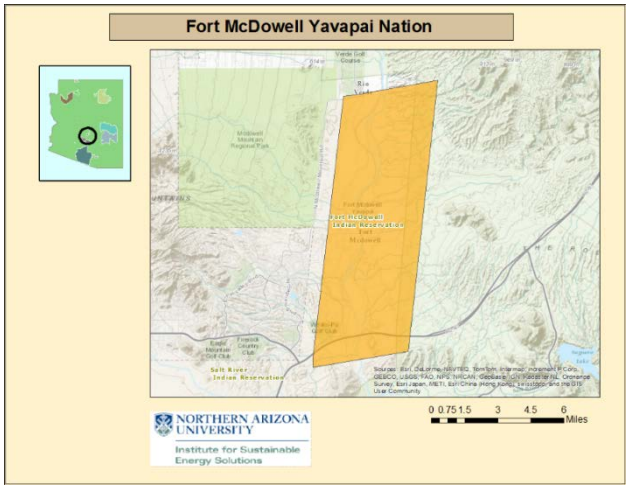
[5] See http://www.crit-nsn.gov/crit_contents/news/03192012.shtml

Fort McDowell Yavapai Nation

Population: 971

Size: 39 sq. mi.

Median household income: $51,157



The Fort McDowell Yavapai Nation installed a 12 kW solar PV system on one of the tribal headquarters buildings in 2010. There are also two systems at the air monitoring station that are a demonstration project comparing tracking systems: a ~1.5 kW array on a Watson motorized solar tracker, and ~1.8kW on a Zone Works single-axis passive tracking system.

The headquarters building project has generated more than the projected quantity of electricity, and due to this positive experience, the tribe decided to pursue the development of 1 MW of solar PV capacity, working with EPA and NREL.

This information was gathered using web searches and conversations with tribal representatives. The census data was found online and represents 2010 figures.

Sources:

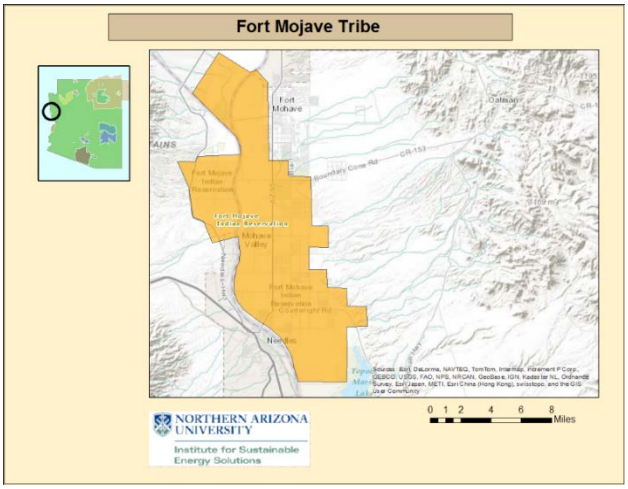
- Dan Catlin, Air Quality Specialist
- EPA website on tribal projects to combat climate change: http://www.epa.gov/Region09/climatechange/tribes/index.html

Fort Mojave Tribe

Population: 1,004

Size: 37 sq. mi.

Median household Income: $33,424



The Fort Mojave Indian Reservation is located along the Colorado River in the vicinity of Needles, California. The Reservation covers nearly 42,000 acres in the tri-state area of Arizona, California, and Nevada. The land is divided into three major segments: 23,669 acres in Mojave County Arizona; 12,633 acres adjacent to Needles, California; and 5,582 acres in Clark County, Nevada. Tribal headquarters are located in Needles, California.

The Fort Mojave tribe is in the process of developing a 310 MW solar PV project on tribal reservation land in Arizona and California. A proposal for a transmission line to connect the project to the Mojave Generating Station substation was submitted to the Public Utility Commission of Nevada in March 2013. The project does not currently have a PPA for selling the electricity.

The status of the project is not certain, and further information about the project is not public, according to tribal representatives.

The Aha Macav tribal power utility has a 28 kW PV system on its main office building, which meets the building's needs, and has a smaller (3-4 kW) system on the operations center. The tribe is pursuing utility-scale development for sale to external partners, and is examining a large 1-2 MW size PV system to meet the utility/tribe's internal load. The utility's primary source of electricity for meeting consumer load currently is power contracts and market purchases.

This information was gathered using web searches and from conversations with tribal representatives. The census data was found online and represents 2010 figures.

Sources:

- U.S. Department of Energy Tribal Energy Program website: http://apps1.eere.energy.gov/tribalenergy/projects_detail.cfm/project_id=67
- Laughlin Times article: http://www.laughlintimes.com/articles/2013/04/03/news/local/news882.txt
- Demographic Analysis for Fort Mojave Tribe

  http://azcia.gov/Documents/Links/DemoProfiles/Fort%20Mojave%20Reservation.pdf

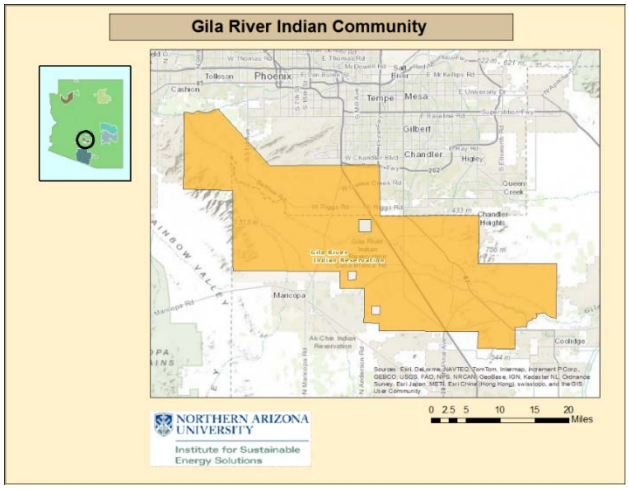
- Lisa Wayne, Tribal Representative
- Bill Cyr, Aha Macav Tribal Power Service

Gila River Indian Community

Population: 11,712

Size: 585 sq. mi.

Median household income: $28,779



The Gila River Indian Community has its own Utility Authority and a Community Renewable Energy Team made up of Council representatives, Community Department representatives, and Utility Authority members. This team and the Utility Authority conducted a Strategic Energy Planning workshop in 2010 with more than 50 participants. A highlight of the Energy Plan was the designation of several brownfield sites for future potential solar energy development.

The Community has installed solar street lighting in the Sacaton and Casa Blanca communities through federal grants, and used community funds to install solar lighting at the George Webb and D-5 Multi-purpose facility projects.

The Community obtained grants from the U.S. Departments of Energy and Agriculture for facility- and commercial-scale solar or biomass projects on tribal land, but has not currently pursued the construction of either project.

The Community is pursuing the development of a 33 MW tracking solar PV system, on tribal reservation land, for Community use, to provide electricity for water pumping and irrigation, and to sell power to nearby municipal and agricultural systems.

This information was gathered from conversations with tribal representatives. The census data was found online and represents 2010 figures.

Sources:

- Statement developed by Utilities Director Leonard Gold, approved by Gila River Indian Community Utility Authority board.
- Conversations with John Lewis and Jason Hauter, Community members.
- Demographic Analysis for the Gila River Community

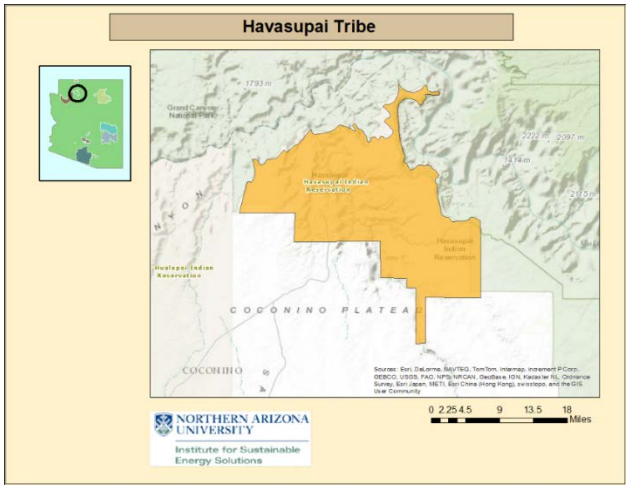
  http://azcia.gov/Documents/Links/DemoProfiles/Gila%20River%20Indian%20Community.pdf

Havasupai Tribe

Population: 465

Size: 275 sq. mi.

Median household income: $32,000



In 2012 and 2013, the Havasupai tribe partnered with EPA, BIA, and others to build a 500 kW solar PV system on Long Point, above the canyon where the tribal community lies. The system was built as part of a settlement enforcement action taken by U.S. EPA for violations of RCRA, CAA, AHERA, and the SDWA[6].

This information was gathered using web searches and not from conversations with tribal representatives. The census data was found online and represents 2010 figures.

Sources:

- BIA website reports and videos on solar project: http://www.bia.gov/cs/groups/xofecr/documents/text/idc017650.pdf
- Demographic Analysis for Havasupai Tribe http://azcia.gov/Documents/Links/DemoProfiles/Havasupai%20Tribe.pdf

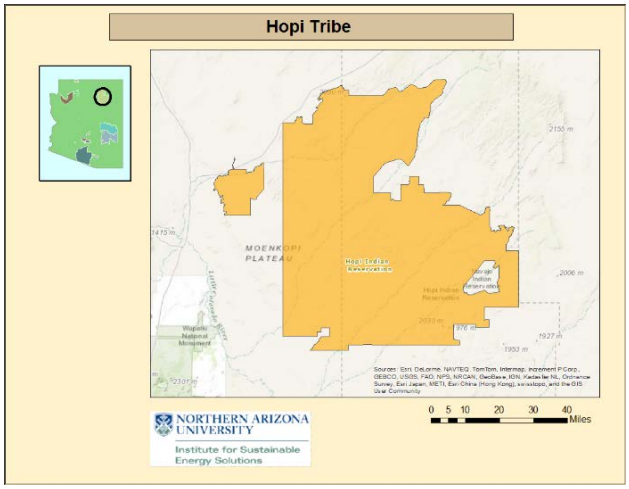
[6] See http://www.bia.gov/cs/groups/xofecr/documents/text/idc017650.pdf

Hopi Tribe

Population: 7,185

Size: 2,533 sq. mi.

Median household income: $34,016



The Hopi Tribe is exploring a number of options for utility-scale solar PV development. Several proposed projects have been presented at the Hopi Tribal Council, as recently as fall 2013. The Council has not voted to partner with any developer to date.

Over the past several years, the Tribe performed wind resource assessment in Kykotsmovi and on a ranch that the tribe purchased near Clear Creek. The tribe does not have plans to pursue wind development at this time.

This information was gathered from conversations with tribal representatives. The census data was found online and represents 2010 figures.

Sources:

- Conversations with:
  Ken Lomayestewa, Director, Hopi Tribe Renewable Energy Office
- Demographic Analysis for the Hopi Tribe
  http://azcia.gov/Documents/Links/DemoProfiles/Hopi%20Tribe.pdf

Hualapai Tribe

Population: 1,335

Size: 1,604 sq. mi.

Median household income: $34,375

The Hualapai Tribe has been working to pursue utility-scale wind and solar development for several years. The tribe received U.S. Department of Energy funding for resource and feasibility assessment through the Tribal Energy Program in 2009-2010. The tribe also received funding through the 2012 DOE START program to pursue developing a utility-scale wind project.

The Tribe is pursuing 170 MW of wind development at Buck and Doe on Reservation land. The Tribal Council has discussed the possibility of partnering with PNE Wind of Germany to lease land for the wind development project. The tribe is considering proposing the wind development project for the Southern California Public Power Authority PPA request due December 31, 2013.

The tribe is has filed an interconnection application and is performing a feasibility study to use the WAPA Liberty-Mead 345 kV transmission line for selling generation from the 170 MW of wind plus solar capacity. The tribe is also preparing an environmental impact report for its own Tribal Historic Preservation Office. The tribe has performed avian surveys and other environmental studies.

In 2010, the tribe also received funding from the BIA Energy and Mineral Development Program for a solar feasibility study. This project identified potential sites for 100-MW solar projects, and several options for an array of up to 1 MW at Grand Canyon West. As a result of this analysis, the tribe is pursuing 100-150 MW of solar PV development at Nelson or Clay Springs.

The tribal planning and economic development office leads renewable energy development, but the tribe has prioritized the development of its own utility authority. The tribe received support from the U.S. DOE Tribal Energy Program in 2005 for the establishment of a utility authority to provide service first at Grand Canyon West and then for the remainder of the reservation.

The tribe has some distributed solar capacity as well. There is a 34kW solar PV array at Grand Canyon West, which according to tribal representatives, does not function due to poor maintenance. There is also a new 19kW solar PV array at the school in Peach Springs.

This information was gathered from conversations with tribal representatives. The census data was found online and represents 2010 figures.

Sources:

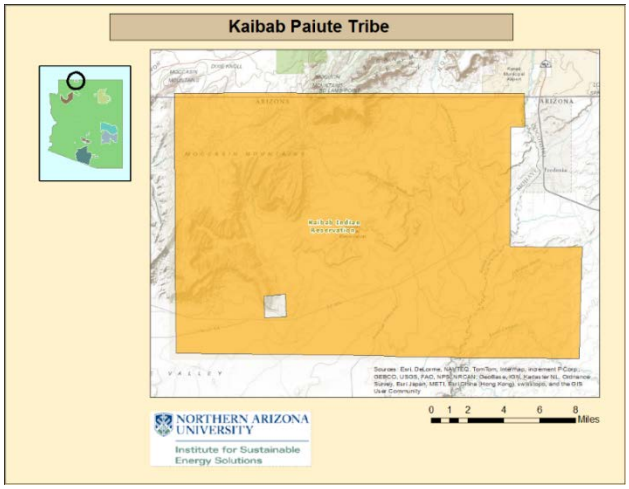
- Kevin Davidson, Director, Hualapai Tribe Planning and Economic Development Office
- Demographic Analysis for Hualapai Tribe http://azcia.gov/Documents/Links/DemoProfiles/Hualapai%20Indian%20Tribe.pdf

Kaibab Paiute Tribe

Population: 240

Size: 190 sq. mi.

Median household income: $28,750



The Kaibab Paiute is not considering any renewable energy development at this time.

This information was gathered from conversations with tribal representatives. The census data was found online and represents 2010 figures.

Sources:

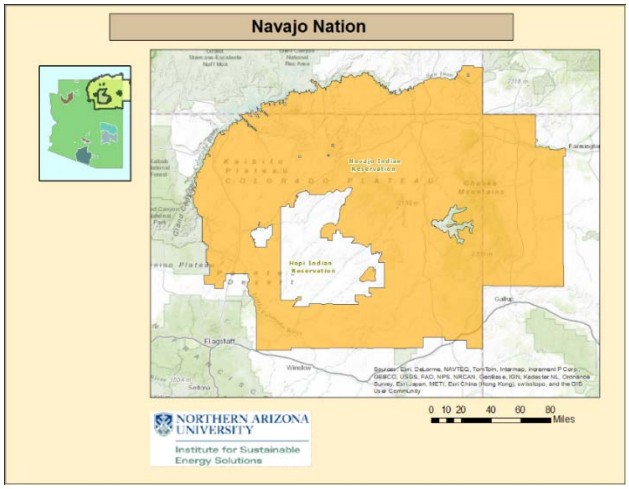
- Daniel Bulletts, Acting Environmental Director
- Demographic Analysis for the Kaibab Paiute Tribe http://azcia.gov/Documents/Links/DemoProfiles/Kaibab%20Paiute.pdf

Navajo Nation

Population: 173,667

Size: 24,156 sq. mi.

Median household income: $27,389



The Navajo Nation recently passed the Energy Policy Act of 2013, which mandates the establishment of a Navajo Nation Energy Office. The Navajo Nation Department of Justice is charged with the implementation of the Act. The Energy Office, when established, will function as a central agency for the assessment, prioritization, and development of renewable energy projects.

The Navajo Nation has its own utility authority, Navajo Tribal Utility Authority (NTUA), which provides electric service to the entire reservation. NTUA operates an off-grid renewable energy program to provide electric service to customers who are outside the geographic range of its electricity grid. NTUA operates roughly 300 off-grid solar and wind installations, and provides operation and maintenance services.

The Navajo Nation and NTUA have performed wind assessments and feasibility investigations with private development partners at a number of sites on and off the Navajo Reservation, including Gray Mountain and the Big Boquillas ranch, but none of the projects are moving forward at this time. The Nation is also considering solar project development at facility and utility scale.

This information was gathered from conversations with tribal representatives.

Sources:

- Terry Battiest, Derrick Terry, NTUA
- Toni Flora, Navajo Nation Department of Justice
- Anthony Peterman, Navajo Nation Office of the Speaker
- Demographic Analysis for Navajo Nation
  http://azcia.gov/Documents/Links/DemoProfiles/Navajo%20Nation.pdf

Pascua Yaqui Tribe

Population: 3,484

Size: 2 sq. mi.

Median household income: $31,875

In 2012 the Pascua Yaqui Tribe received funding from the Department of Energy to conduct a Renewable Energy Development and Deployment Feasibility Study. This study looked at the economic and technical viability for commercial and community scale renewable energy projects on the 6,289 acres of Turtuga Ranch, primarily to identify an optimal location for a 1 MW solar installation. The Casino Del Sol, government facilities, and other buildings have been identified as potential projects.

This information was gathered using web searches and not from conversations with tribal representatives. The census data was found online and represents 2010 figures.

Sources:

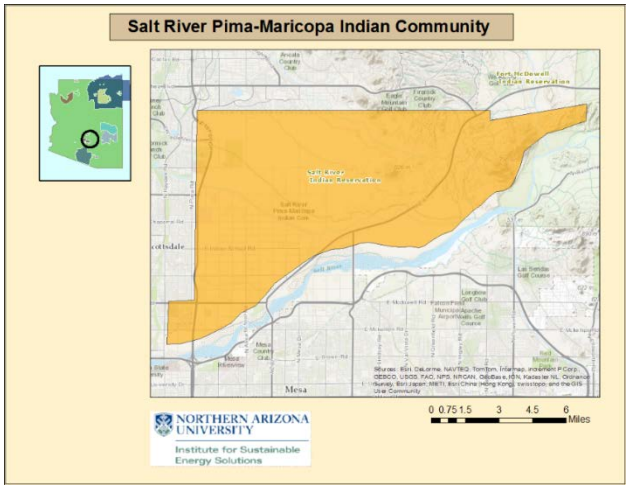
- Department of Energy Tribal Energy Program **http://apps1.eere.energy.gov/tribalenergy/projects_detail.cfm/project_id=213**
- Demographic Analysis of the Pascua Yaqui Tribe http://azcia.gov/Documents/Links/DemoProfiles/Pascua%20Pueblo%20Yaqui.pdf

Salt River Pima-Maricopa Indian Community

Population: 6,289

Size: 85 sq. mi.

Median household income: $31,892



The Salt River Pima-Maricopa Indian Community has not installed any major renewable energy projects at this time, but momentum seems to be growing.

Au-Awthum Tash LLC, a renewable energy developer based in Salt River Pima-Maricopa Indian Community, signed a letter of intent to install Crystal Research Corporation's energy technologies within the Community. Also, with funding through the Renewable Energy Investment Fund managed by the Grand Canyon Trust, a 75kW solar PV parking structure has been designed and is in the bid phase of construction. The project will offset electricity costs for a 5 building apartment complex that houses community elders.

Through the EarthWise energy program, the Salt River Prima-Maricopa Indian Community had partnered with the Salt River Project to provide methane from a closed landfill to power a 4 MW biogas generation facility. This project has been running for 7-8 years now.

This information was gathered using web searches and conversations with tribal representatives. The census data was found online and represents 2010 figures.

Sources:

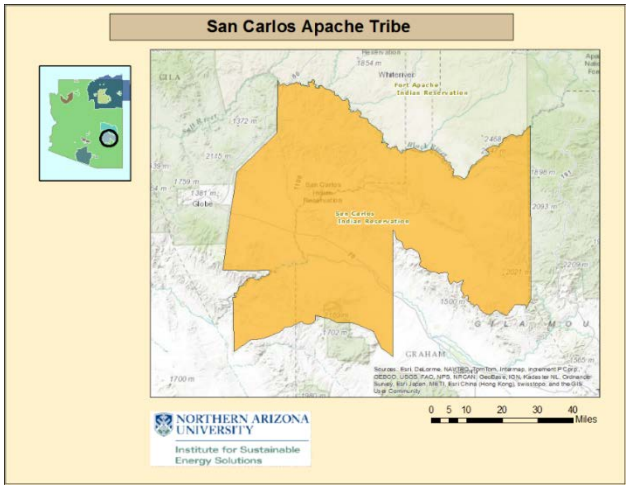
- Scott Thigpen, Assistant Director of Engineering and Construction Services
- Demographic Analysis of the Salt River Pima-Maricopa Indian Community http://azcia.gov/Documents/Links/DemoProfiles/Salt%20River%20Pima-Maricopa%20Indian%20Community.pdf

San Carlos Apache Tribe

Population: 10,068

Size: 2,927 sq. mi.

Median household income: $26,915



The San Carlos Apache Tribe is pursuing a 1.4 MW community-scale solar PV installation to provide power to its casino enterprise. With support through the receipt of a U.S. DOE START program 2013 technical assistance grant, the tribe is working with NREL to develop a PPA whereby the PV installation would be owned by the tribe, and the casino would be the off-taker. The tribe is served by three distinct electrical utilities, and the casino sits within APS territory. The tribe is working with third-party Ameresco to develop the project.

The tribe also completed a feasibility study for utility-scale solar PV in the 5-20 MW range with support from the U.S. DOE Tribal Energy Program in 2012. The study identified transmission access as a prohibitive barrier and recommended focusing on community-scale solar projects and the establishment of a tribal utility authority.

The tribe also has distributed-scale solar generation capacity. There is a 3.5kW ground-mounted off-grid solar PV array at the radio tower site, and a 7.1kW PV system at the radio studio building.

This information was gathered from conversations with tribal representatives and using web searches. The census data was found online and represents 2010 figures.

Sources:

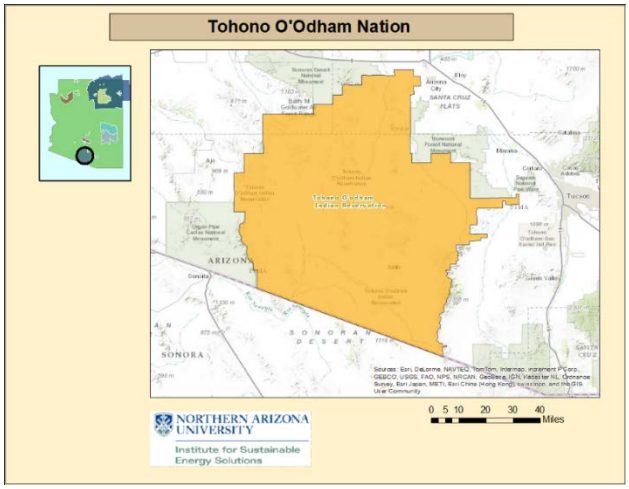
- Ken Duncan, Jr. Energy Coordinator, Planning Division
- Demographic Analysis of the San Carlos Apache Tribe http://azcia.gov/Documents/Links/DemoProfiles/San%20Carlos%20Apache%20Tribe.pdf

Tohono O'Odham nation

Population: 10,201

Size: 4,454 sq. mi.

Median household income: $27,040



The Tohono O'Odham tribe elected not to participate in this report at this time.

This information was gathered from conversations with tribal representatives. The census data was found online and represents 2010 figures.

Sources:

- Phil Hobbs and Gerald Fayaunt, Planning and Economic Development office
- Demographic Analysis of the Tohono O'Odham nation
- http://azcia.gov/Documents/Links/DemoProfiles/Tohono%20O'odham%20Nation.pdf

Tonto Apache Tribe

Population: 120

Size: .31 sq. mi.

Median household income: $16,667

The Tonto Apache tribe applied for and was awarded support from the U.S. Department of Energy's Tribal Energy Program to help fund the installation of solar PV arrays on three of the tribe's buildings with the highest energy consumption. The PV systems are expected to meet more than 60 percent of the buildings' total electricity needs.

This information was gathered using web searches. The census data was found online and represents 2010 figures.

Sources:

- http://energy.gov/articles/energy-department-invests-over-7-million-deploy-tribal-clean-energy-projects
- http://azcia.gov/Documents/Links/DemoProfiles/Tonto%20Apache.pdf

White Mountain Apache Tribe

Population: 13,409

Size: 2,631 sq. mi.

Median household income: $26,973

The White Mountain Apache Tribe will be conducting a feasibility study during March and April of 2014 to investigate the potential for developing a biomass electricity generation plant, fueled from slash and waste from forest restoration.

This information was gathered from conversations with tribal representatives. The census data was found online and represents 2010 figures.

Sources:

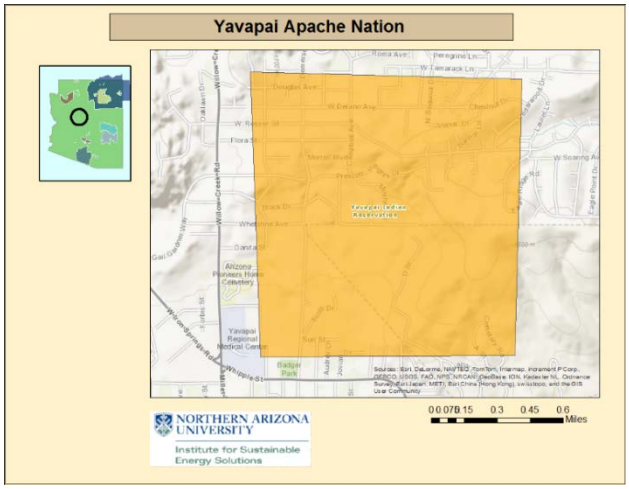
- Derreck Wheeler, Planning Department
- Demographic Analysis of the White Mountain Apache Tribe

Yavapai Apache Nation

Population: 718

Size: 1 sq. mi.

Median income: $27,600



The Yavapai Apache Nation is pursuing several facility-scale solar PV arrays, and has performed feasibility studies for PV capacity on its administration building (65 kW) and social services building (20kW). The Nation has identified the system size, developed plans for construction, and is working through the process of developing a sound financing mechanism to fund the project. The Nation submitted a proposal to the U.S. DOE 2013 TEP funding opportunity to support both installations, but the project was not selected.

The Nation also performed a feasibility study for 400 kW of solar PV capacity to power its casino operation but is not currently pursuing the project because it does not believe it would be financially beneficial.

The Yavapai Apache Nation has distributed solar capacity on 38 residential rooftops and powers streetlights with solar in the Clarkdale, Camp Verde, Middle Verde and Tunlii communities. The residences are newly constructed all-electric-appliance homes, and the solar capacity installed defrays energy costs for occupants.

This information was gathered from conversations with tribal representatives. The census data was found online and represents 2010 figures.

Sources:

- Buddy Rocha, Jr., Economic Development Director
- David Lewis, Environmental Specialist
- http://azcia.gov/Documents/Links/DemoProfiles/Yavapai-Apache%20Nation.pdf

Armed Forces Bases in Arizona

The Department of Defense (DoD) and the Department of Energy (DOE) published a Memorandum of Understanding (MOU) in July 2010 to facilitate cooperation to accelerate the research, development, and deployment of energy efficiency and renewable energy technologies.[7] The Army is making a special effort to purchase renewable energy generated from solar, wind, geothermal, and biomass.[8] In Arizona, the Marine Corps Air Station recognizes the importance of energy conservation as a means of protecting limited natural resources, and is committed to meeting established energy goals.[9] In May 2010, the Air Force published its Air Force Energy Plan with the vision "to consider energy in all that they do."[10] In addition to the consideration of their environmental footprint, these initiatives represent the Armed Forces concern over energy security heading into the future.

Specific goals articulated by each branch's policy documents are highlighted at the beginning of the sections below. Net-zero energy means the installation produces as much energy on-site as it uses.

United States Marine Corps

Goals:

- Produce at least 50 percent of shore-based energy from alternative sources by 2020; 50 percent of Navy and Marine Corps installations will be net-zero by 2020.
- By 2020, 50 percent of total energy consumption will come from alternative sources.

Marine Corps Air Station Yuma: According to press reports from the Arizona Governor's office, Marine Corps Air Station Yuma was to place a 33kW solar array on building 234 as of 2009. This could not be confirmed with personnel at the base.

Department of the Air Force

Goals:

- Reduce energy demand by installations, flight operations, and ground operations.
- Increase energy supply by developing and utilizing renewable and alternative energy wherever possible.
- Change the culture to increase energy awareness in day-to-day operations.

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[6] http://files.eesi.org/dod_eere_factsheet_072711.pdf
[7] http://army-energy.hqda.pentagon.mil/renewable/renewable_projects.asp
[8] http://azgovernor.gov/renewable/documents/Feb2010/MarineCorpsAirStationYuma.pdf
[9] See #6 above.

Barry M. Goldwater Range: No projects at this time.

Davis-Monthan Air Force Base: There are two renewable energy facilities currently producing electricity. These include the Solar PV Project with 14.5 MW capacity and the Soaring Heights Community PV Array with 6 MW capacity, both located within the Soaring Heights Community.

Luke Air Force Base: Luke Air Force Base's APS solar PV 14 MW farm is permanently on hold as of December, 2013.

Department of the Army

Goals:

- Five installations will meet net-zero energy usage goals by 2020, and an additional 25 will achieve net-zero energy by 2030.
- Reduce energy consumption.
- Increase energy efficiency across platforms and facilities.
- Increase use of renewable/alternative energy supplies.
- Reduce adverse impacts on the environment.

Camp Navajo: No projects at this time.

Fort Huachuca: Fort Huachuca currently has one facility producing electricity, a 1-MW wind turbine. In the next year, the Fort plans to construct a 20 MW solar PV array on 70 acres. Construction is scheduled to begin during the spring of 2014 and to be completed in December of 2014. This solar array will be owned and operated by a non-military entity.

Yuma Proving Ground: In close coordination with the Army Energy Initiatives Task Force (EITF), YPG is exploring opportunities for utility-scale renewable energy projects located at YPG. California utilities are the expected off-takers of the majority of the power generated from these projects.

Army National Guard

National Guard renewable energy facilities throughout the state are limited in size and are often not staffed or operational daily year-round. These facilities in Arizona make use of renewable technologies, including solar arrays up to 250kW, but there are no installations more than 1 MW.

Appendix A: Additional JEDI Modeling Details

The following tables detail the construction-phase and operation-phase jobs of 100 MW of wind capacity in Arizona.

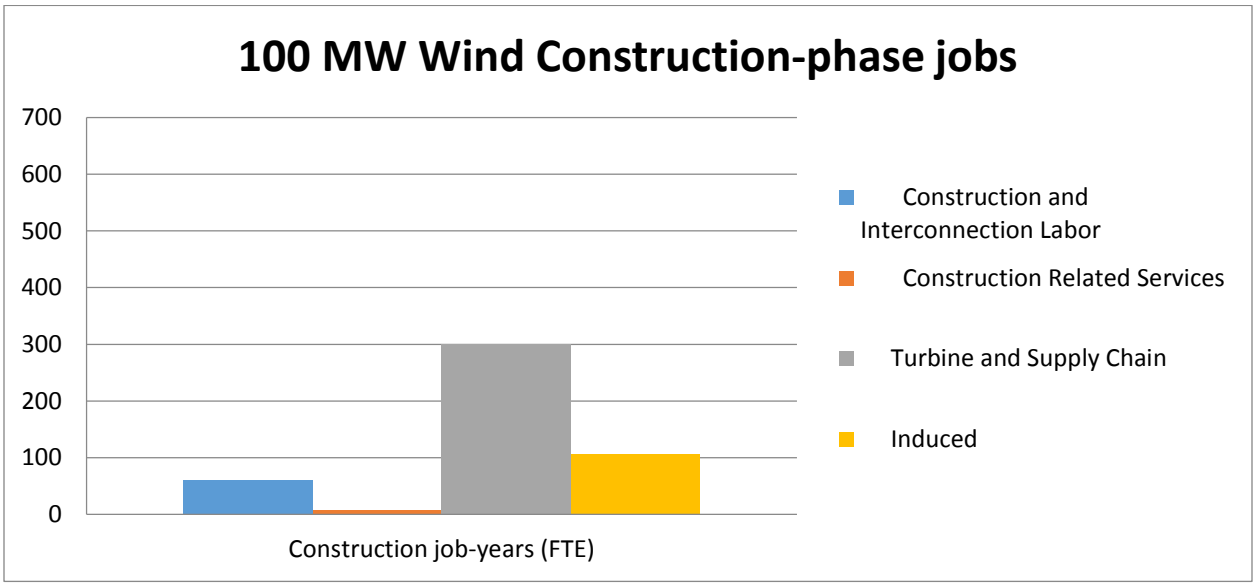

Figure 5. Job creation from the construction phase of a 100 MW wind plant.

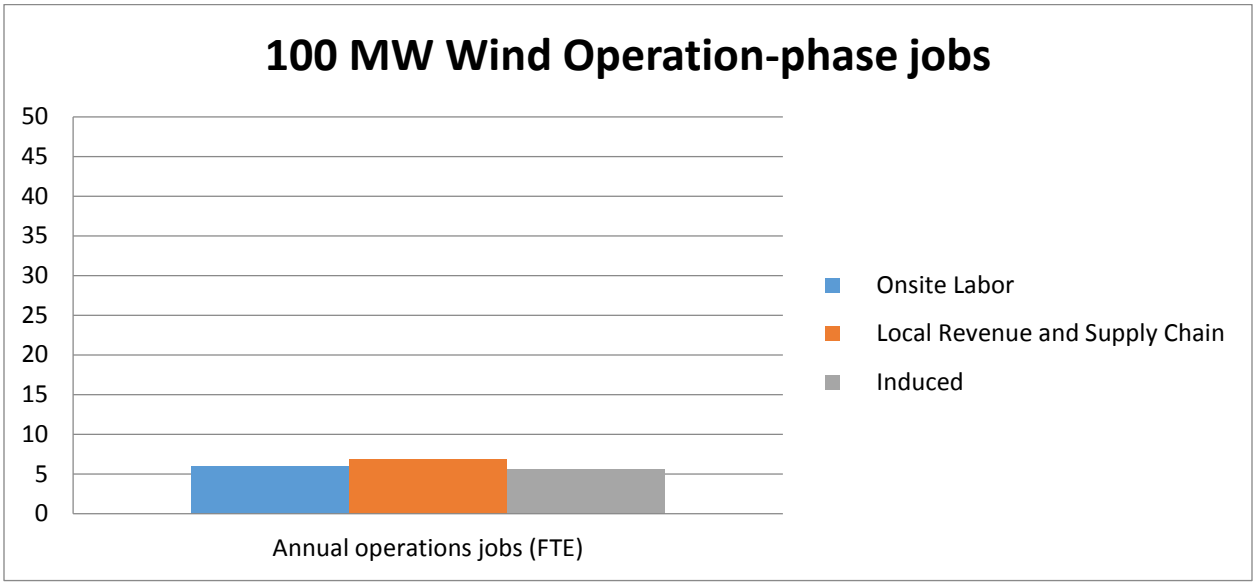

Figure 6. Job creation during the operation phase of a 100 MW wind plant.

The following tables detail the construction-phase and operation-phase jobs of 100 MW of solar PV capacity in Arizona.

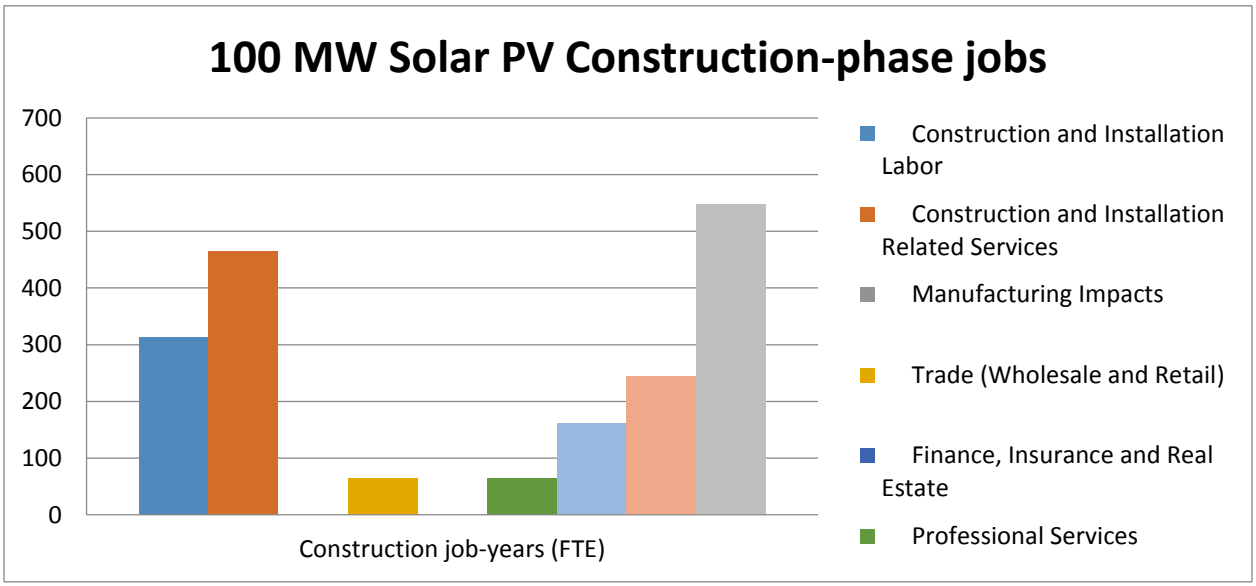

Figure 7. Job creation from the construction phase of a 100 MW solar PV plant.

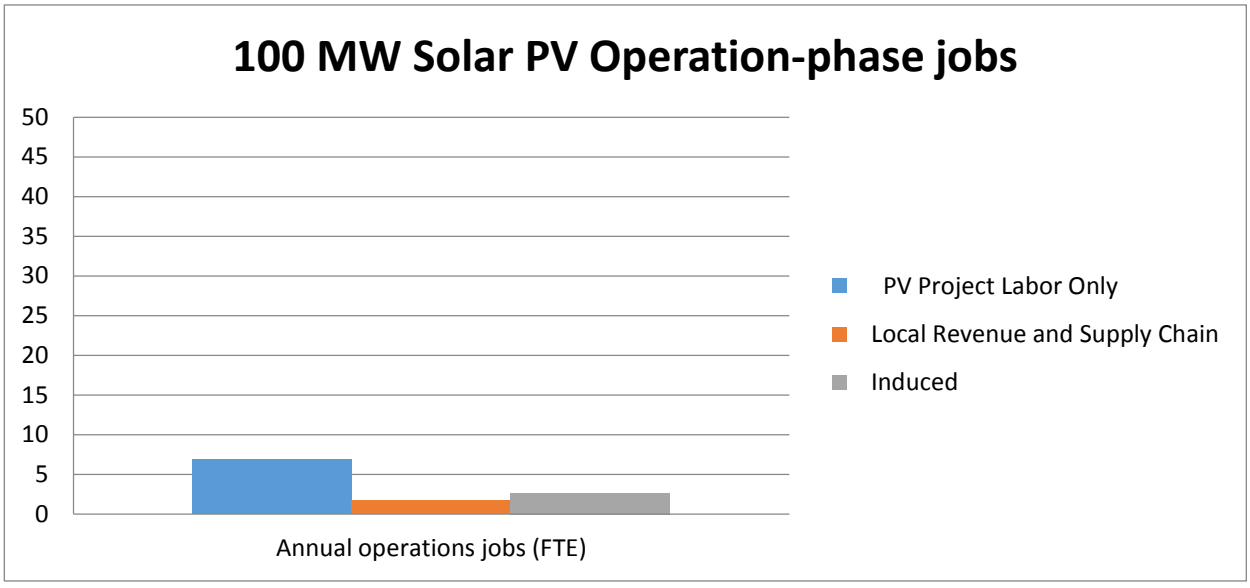

Figure 8. Job creation during the operation phase of a 100 MW solar PV plant.

The following tables detail the construction-phase and operation-phase jobs of 100 MW of CSP capacity in Arizona.

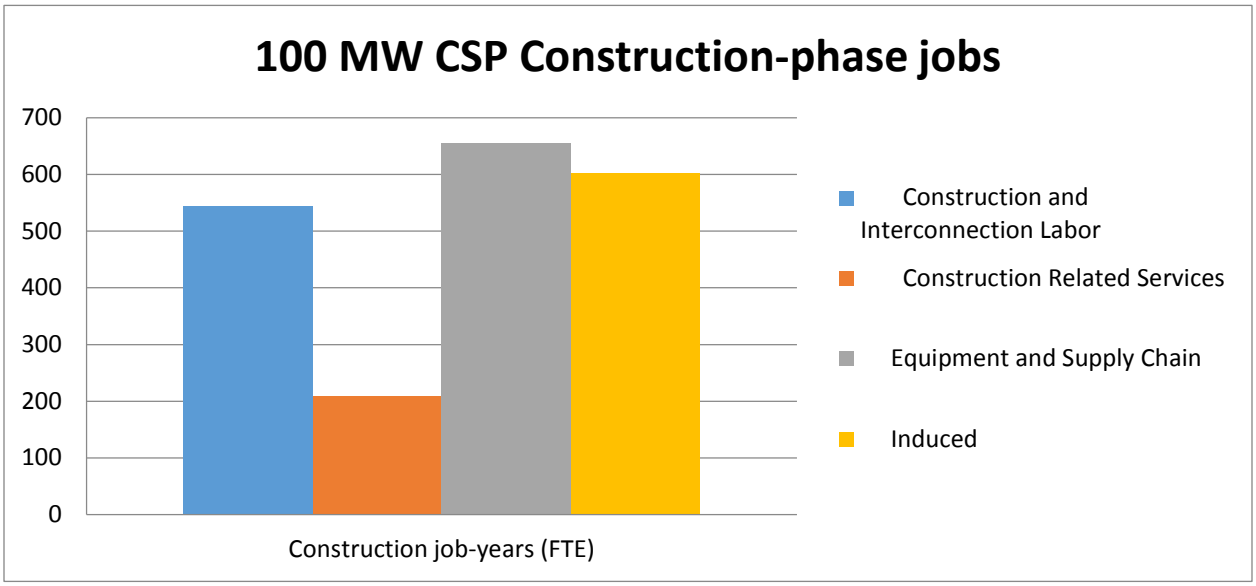

Figure 9. Job creation from the construction phase of a 100 MW CSP plant.

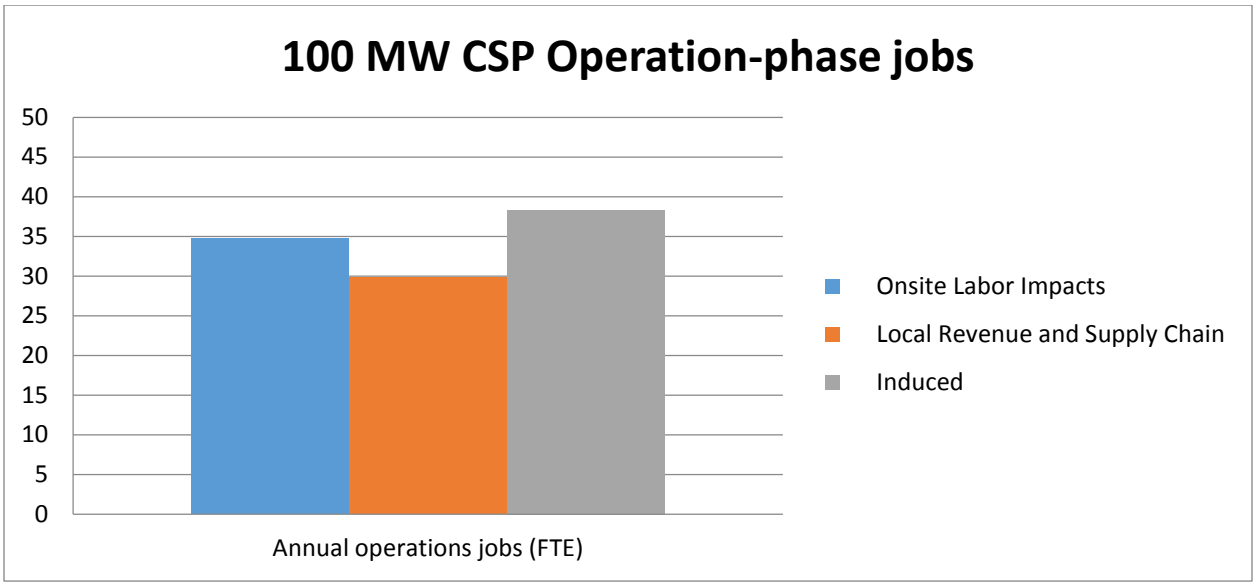

Figure 10. Job creation from operation phase of a 100 MW CSP plant.

Appendix B: Additional Resources

Following is a list of resources that our team used in compiling this report, as well as a series of links that provide additional information on renewable energy goals, permitting, and requirements, at the state, local, and federal level.

Arizona Utility Requirements and State Incentives:

Database of all Renewable Energy Incentives in Arizona – includes up-to-date information on state, utility, and local incentives for renewable energy installations
http://www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=AZ

Arizona State Renewable Energy Standards and Tariff (REST) – the Arizona requirement for utilities to provide a percentage of their electricity from renewables

http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=AZ03R&ee=1

http://www.cc.state.az.us/divisions/utilities/electric/environmental.asp

Arizona Governor's Office of Energy Policy

http://www.azenergy.gov/

Renewable Energy Production Tax Credit Arizona – this is an individual or corporate income tax credit of $0.01-$0.04/kWh for renewable energy generation systems installed between 2010 and 2021. The credit lasts for ten years from the system installation.

http://www.azdor.gov/LinkClick.aspx?fileticket=FW9Ym9tAbMg%3D

Arizona Commercial / Industrial solar energy tax credit – this is a credit of up to 10% or $25,000 of system installation costs for solar generation facilities on commercial sites.

http://www.azenergy.gov/

Residential Solar and Wind Energy Systems tax credit – this is a credit of up to $1000 or 25% of system installation costs for solar or wind generation facilities on residential sites.
http://www.azdor.gov/Portals/0/Brochure/543.pdf

Federal policies, incentives, and land management:

Renewable Electricity Production Tax Credit

http://dsireusa.org/incentives/incentive.cfm?Incentive_Code=US13F

Business Energy Investment Tax Credit

http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US02F

Renewable Energy Credits (RECs) overview from U.S. EPA

http://www.epa.gov/greenpower/gpmarket/rec.htm

DOE Office of Energy Efficiency and Renewable Energy

http://energy.gov/eere/office-energy-efficiency-renewable-energy

Information on Clean Renewable Energy Bonds (CREBs)

http://www.irs.gov/pub/irs-tege/ncrebs_2009_allocations_v1.1.pdf

http://energy.gov/savings/clean-renewable-energy-bonds-crebs

Bureau of Land Management (BLM) information about renewable energy projects, policies and permitting

http://www.blm.gov/az/st/en/prog/energy/clearinghouse.html

BLM Solar and Wind Map

http://www.blm.gov/pgdata/etc/medialib/blm/az/pdfs/energy.Par.18131.File.dat/AZSolar_Wind_Map.pdf

Proposed Projects on BLM land

http://www.blm.gov/az/st/en/prog/energy/solar/prop-projs.html

U.S. Energy Information Agency Arizona Profile

http://www.eia.gov/state/?sid=az

County Ordinances:

Pima County- Ordinance and Amendments

http://www.dsd.pima.gov/documents/Planning/PZ_Agenda/2014/supplement/Co8-11-06_final_20140116124340.pdf

Yuma County – Renewable Energy Ordinance

http://www.yumacountyaz.gov/Modules/ShowDocument.aspx?documentid=18347

Maricopa County Zoning Ordinance

http://www.maricopa.gov/planning/Resources/Ordinances/pdf/reform_ordinance/mczo1.pdf

Navajo County Wind Energy Ordinance

http://www.navajocountyaz.gov/pubworks/pz/energy/

Coconino County Comprehensive Plan Energy Element

http://www.coconino.az.gov/DocumentCenter/View/2993

La Paz Comprehensive Plan Updated 2010

http://www.co.la-paz.az.us/2010_La%20Paz%20County%20Comprehensive%20Plan.pdf

Cochise Zoning Regulations

http://cochise.az.gov/cochise_planning_zoning_article.aspx?id=1146#article1823

State:

Arizona Solar Map

https://renewablemap.az.gov/portal/

Arizona Permitting and Policy PowerPoint from Arizona Game and Fish Department

http://www.azgfd.gov/inside_azgfd/documents/RenewableEnergyCommPresent.pdf

Guidelines for Solar Energy Development from Arizona Game and Fish Department

http://www.azgfd.gov/hgis/documents/FinalSolarGuidelines03122010.pdf

Guidelines for Wind Energy Development from Arizona Game and Fish Department

http://www.azgfd.gov/hgis/pdfs/windenergyguidelines.pdf

Arizona State Land Department Right of Way guidelines (call department for specific application forms)

http://www.azland.gov/programs/realestate/sections/row.htm

Military:

Department of Defense Goes Green

http://www.defense.gov/home/features/2010/1010_energy/

U.S. Air Force Energy Initiatives

http://www.af.mil/energyinitiatives.aspx

U.S. Navy Task Force Energy

http://greenfleet.dodlive.mil/energy/task-force-energy/

U.S Army Energy Initiatives Task Force

http://www.armyeitf.com/

Army National Guard

http://www.arng.army.mil/aboutus/Pages/Sustainability.aspx

Industry Associations:

Solar Energy Industries Association: Major Solar Projects

http://www.seia.org/research-resources/major-solar-projects-list

American Wind Energy Association – Market Reports

http://www.awea.org/marketreports

Solar Energy Industries Association U.S. Solar Market Insight 2012 Year in Review

http://www.seia.org/research-resources/us-solar-market-insight-2012-year-review

Native American renewable energy development resources and reports:

U.S. Department of Energy Tribal Energy Program
http://apps1.eere.energy.gov/tribalenergy/

U.S. Department of Energy Office of Indian Energy Policy and Programs

http://energy.gov/indianenergy/office-indian-energy-policy-and-programs

Military Lands and Native American Energy Projects report from NREL

http://www.nrel.gov/docs/fy13osti/57501.pdf

Geospatial Analysis of Renewable Energy Technical Potential on Tribal Lands from NREL

http://www.nrel.gov/docs/fy13osti/56641.pdf