

## Arizona Wind and Solar Development Status Report



**Date:**

**February 2012**

**By:**

**Karin Wadsack, Kevin Ordean, Cara Corbinmeyer**

**Northern Arizona University**

**Landward Institute / Institute for Sustainable Energy Solutions**



**NORTHERN  
ARIZONA  
UNIVERSITY**

## Introduction

Until recently, wind and solar development in Arizona lagged behind neighboring states. In the last few years, utility-scale development of both technologies has expanded in Arizona in response to a number of factors: aggressive state Renewable Portfolio Standards in the region; the potential shutdown of older coal-fired power plants; and the availability of federal and state incentives for utility-scale renewable energy development. In 2009, Northern Arizona University released a Wind Development Status Report. The present report is an update to that document, and has been expanded to include utility-scale solar energy development.

Historically, developers in Arizona have been slow to embrace utility-scale wind, and to a lesser degree solar, for several reasons: the perception that Arizona has relatively poor wind resources compared to its neighbors; the fact that inexpensive coal power makes Arizona wind and solar energy less competitive; the burden placed on developers by the differences in local, state, and national guidelines regarding permitting, zoning, and pre-construction environmental monitoring; the checkerboard nature of Arizona land and the fact that much of the wind resource falls on tribal lands, which are governed by entirely different authorities; and lack of access to large available quantities of transmission.<sup>1</sup>

Nevertheless, wind and solar energy are emerging in Arizona as viable, stably-priced and local renewable electricity sources. The Dry Lake wind plant, located near Snowflake, Arizona was the first utility-scale project to be built in the state of Arizona. The 125-megawatt (MW) plant provides electricity to the Salt River Project (SRP). The Kingman wind and solar energy project (10 MW wind, 0.5 MW solar) was commissioned in 2011 and is providing electricity to Tucson Electric Power/Unisource (TEP/UES). The Perrin Ranches 99.2-MW wind plant was completed in 2011 and provides electricity to Arizona Public Service Company (APS).

As of the end of 2011, there were a handful of solar photovoltaic (PV) and concentrating solar power (CSP) projects already built, several under construction, and dozens of others at various stages of development. Springerville Generating Station, a 4.6-MW PV system owned by TEP, has been generating electricity for five years. The 1-MW Saguaro Solar CSP Plant in Red Rock, owned by APS, has been running since 2005, and the final phases of APS' 3-MW PV Prescott Solar Power Plant were completed in 2006. The 1.5 MW Tessera/Stirling Maricopa Dish-Engine project came online in early 2010 and provides electricity to SRP. Abengoa is constructing the 280-MW Solana Generating Station CSP plant outside Gila Bend, which will be completed in 2013 and deliver electricity to APS. NRG and FirstSolar are building a 290-MW PV plant west of Phoenix called Agua Caliente, which will deliver electricity to Pacific Gas and Electric Company in California (PG&E). Sempra Energy is developing the Mesquite Solar I PV plant near Yuma, which is anticipated to be 150 MW and should break ground in 2012. This first phase of a potential 700 MW PV development will also provide electricity to PG&E.

This report provides an overview of active wind and solar power development projects in Arizona and describes the status of each. Information in this report was obtained from communications with project

---

<sup>1</sup> These reasons were articulated in our 2009 report by representatives of the following wind developers: BP Wind Energy, Iberdrola, Sempra Energy, Verde Resources, NZ Legacy, and the Hualapai Tribal Planning and Energy office

developers and government representatives, and from public records. It is not intended to be a comprehensive report, but rather a snapshot of the wind and solar industries' activities in Arizona at this time. Some entities that might have been able to provide additional information could not be reached.

In Appendix A, this report provides a list of County, State, and Federal permitting requirements and development guidelines for utility-scale renewable energy, with current links where applicable. This report also provides, in Appendix B, an economic impact analysis for wind and solar development projects, performed using tools developed by and for the National Renewable Energy Laboratory. Resource maps of wind and solar potential in Arizona are shown below.

## Wind and Solar Resources in the United States and Arizona

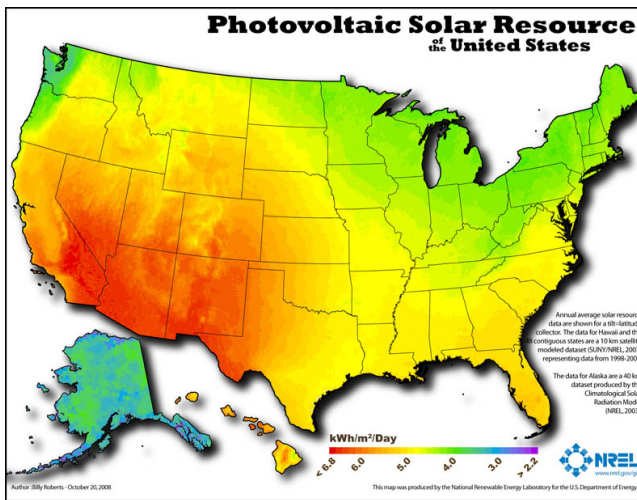


Figure 1. National map of photovoltaic resources. Source: National Renewable Energy Laboratory

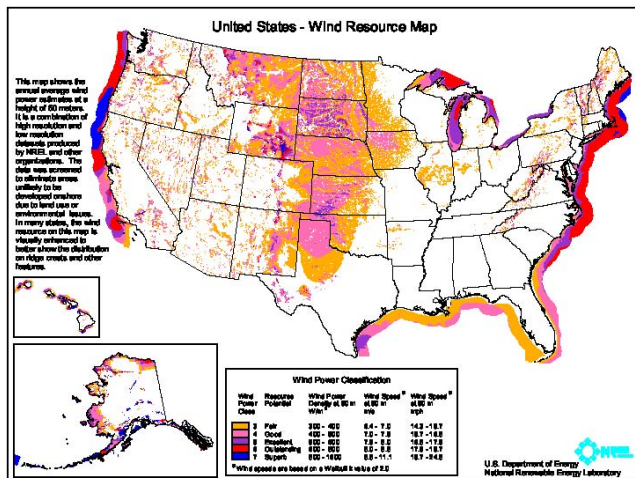


Figure 2. National map of wind resources. Source: National Renewable Energy Laboratory

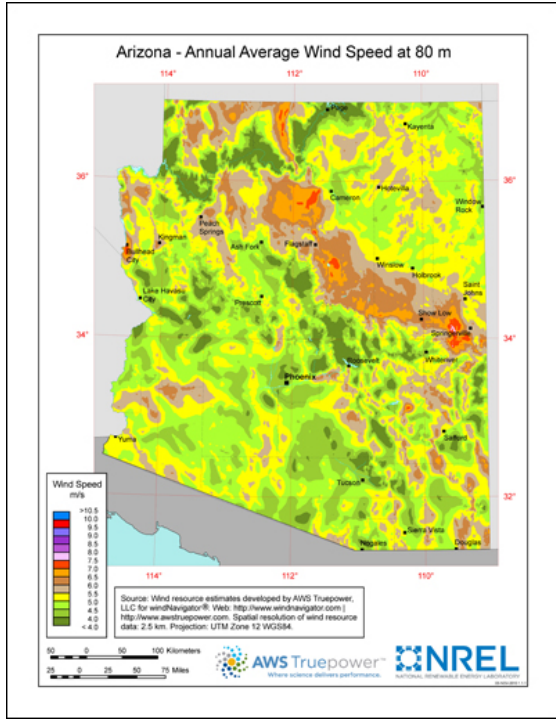


Figure 3. Arizona wind resources at 80m hub height. Source: National Renewable Energy Laboratory

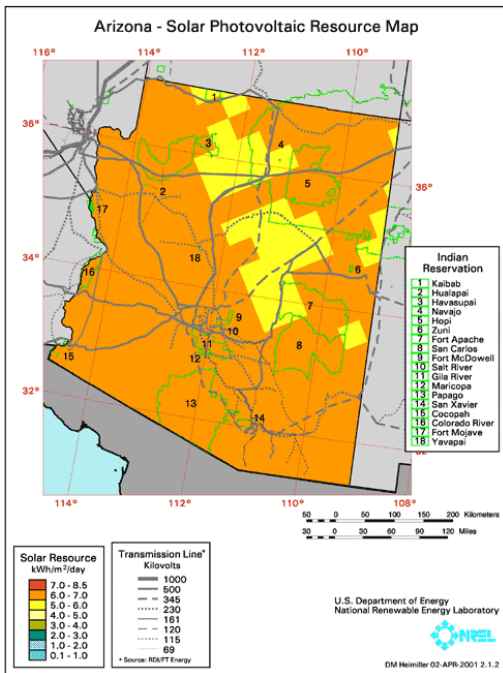


Figure 4. Arizona solar resource map. Source: National Renewable Energy Laboratory

## Wind and Solar Development Status Report

The status of wind and solar power development in the state of Arizona is presented from multiple perspectives in the following pages. First, each county is profiled, showing the available information on wind and solar project development obtained from county staff, state officials, and developers. The second table summarizes development activities separated by tribal jurisdiction.

Each of these profiles and tables refers to a variety of permitting and regulatory processes, which define the steps in a wind or solar development’s progress toward completion. There are multiple layers of permitting processes and regulatory or guidance documents that govern, or influence, wind and solar development in Arizona. Descriptions of several of these, including links for related documents, are found in Appendix A.

### Status by County

Each county in the state is profiled below. According to data from the Arizona Game and Fish Department (which is in communication with most utility-scale renewable energy project developers), there are wind or solar generation projects in some phase of development in 11 of Arizona’s 15 counties – all but Gila, Graham, Greenlee, and Santa Cruz.

<u>County</u>	<u>Status</u>
<b>Apache</b> <b>Population - 71,518</b> <b>Median household income - \$28,956</b> <b>Land area – 11,197.52 sq mi</b>	There are 6 wind projects and 1 wind and solar project proposed with AzGFD on land totaling over 171,000 acres.
<b>Cochise</b> <b>Population – 131,346</b> <b>Median household income - \$43,786</b> <b>Land area – 6,165.69 sq mi</b>	<ul style="list-style-type: none"> <li>• Rainbow Solar Energy has obtained a permit to develop 20 MW of Solar PV on the Rainbows End Ranch.</li> <li>• Clipper Wind has one met tower on Mule Mountain and has not proceeded with project development.</li> <li>• The Fort Huachuca military installation has a 1 MW wind turbine installed and operating.</li> <li>• There are two solar photovoltaic projects by Sustainability Development that have been approved by the County for development               <ul style="list-style-type: none"> <li>○ The Kansas project for 200 MW</li> <li>○ The Bouy project for 200 MW</li> </ul> </li> </ul>
<b>Coconino</b> <b>Population – 134,421</b> <b>Median household</b>	There are 3 wind projects proposed with AzGFD on land totaling over 111,000 acres.  The county has one solar photovoltaic project in process, the APS Community Power Project at a total of 1.5 MW. The project is located in Doney Park and is divided into several hundred rooftop arrays, a

**income - \$49,777**  
**Land area – 18,618.89**  
**sq mi**

~500kW array on one site, and ~500kW at Cromer School.  
The county permitted the 99-MW Perrin Ranches Wind Plant owned by NextEra Energy Resources in 2011. The project is under construction and expected to be completed by the end of 2011.

The county has issued permits to Foresight Wind for several projects:

- Sunshine Wind Park, near Hwy 40 east of Flagstaff, managed by Foresight Wind, has all of the permits in place for construction. The project does not have a power purchase agreement.
- Foresight Wind has permits for five met towers at Aubrey Cliffs, on the Navajo-owned Big Boquillas ranch.
- The Grapevine Canyon Project, southeast of Flagstaff, has been monitoring the wind resource with met towers for several years, and is in the public scoping phase of the NEPA process required for construction of the transmission access across national forest.

NAU has been monitoring wind power since 2005 at several locations: five met towers at Aubrey Cliffs and one at Aubrey Valley; two met towers on Babbitt Ranches; one met tower at Mesa Butte; and two met towers at Grey Mountain. Several of these are on Navajo Nation land and not subject to County permitting rules.

The county received the following additional permit applications for met towers, although most of them have not been put to use:

- four permits issued to Tower Associates
- two permits issued to Torch Renewable Energy (permits finalized)
- five permits applied for by Pacific Southwest Windpower, a subsidiary of Horizon Wind Energy, for the Chevelon Butte area
- two permits issued to Babbitt Ranches/Sempra Generation
- two permits issued to Babbitt Ranches/CO Bar

**La Paz**  
**Population – 20,489**  
**Median household**  
**income - \$30,939**  
**Land area – 4,499.63**  
**sq mi**

There are three solar projects in the permitting process in La Paz County:

- Harqua Gila LLC is proposing a 20-38 MW solar photovoltaic facility but has been put on hold until a power purchase agreement with APS can be worked out
- Solar Reserve is proposing a 150 MW solar facility with a 500 foot tower and heliostat mirrors. They are working on their PPA. Once the PPA is signed they will obtain financing and are looking to break ground in the 2nd quarter of 2012 and have a 30 month build out. Solar Reserve has released their Environmental Impact Study through the Yuma field office of BLM. They are working with WAPA (Western Area Power Association) and will be sending power to Southern California. They're pushing the start date back to the 4th quarter of this year.
- Enviromissions LLC is proposing a 200 MW facility. They plan to build a 2,000 foot tall tower and use convection to turn the

turbines inside the tower. Enviromission is working with WAPA for a PPA and have also pushed their start date back to first or second quarter of 2013 with a 36 month build out.

La Paz county has had six other facilities make proposals along the Vicksburg corridor but none have been successful due to lack of available transmission or demand at APS.

**Maricopa**  
**Population –**  
**3,817,117**  
**Median household**  
**income - \$53,284**  
**Land area – 9,200.14**  
**sq mi**

There are a total of twenty-six projects in various states of permitting and development with a total of 34,065 acres. There are two projects that have received comprehensive plan amendment, special use permit, and building permit approval. The building permits were issued to:

- The Solana Generating Station is a 250-megawatt (MW) concentrating solar power plant to be built 70 miles southwest of Phoenix. The plant will be built by Abengoa Solar Inc., and is scheduled to provide renewable energy beginning in 2013. 3,107 acres approved with a land use changed from Rural Development to Industrial. A special use permit was approved for concentrating solar electrical generating station.
- Sempra Generation is developing the 4,000 -acre Mesquite Solar complex, 40 miles west of Phoenix, generating up to 400 megawatts (MW). Mesquite Solar will be North America's largest photovoltaic solar power installation when complete. Construction on the 150-MW first phase of the solar complex—called Mesquite Solar 1— began in mid-2011. When completed in 2013, the solar plant will generate enough clean electricity for about 56,000 homes. Land Use change from Dedicated Open Space and Rural Residential to Industrial. 2,480 acres approved. A special use permit was approved for the PV Solar electrical generating station.

There are seven projects that have received comprehensive plan amendment approval and special use permits approval but have not applied for or received building permits.

- Arlington Valley Solar Energy Project (AVSE) has three projects at 80 acres each where the Land Use was changed from Rural to Industrial. Their special use permit is for Solar Energy Generation.
- Arlington Valley Solar Energy Project II (AVSE II) has three projects with varied acreage (40, 70, 80) where the Land Use was changed from Rural to Industrial. Their special use permit is for Solar Energy Generation.

There are fifteen projects that have applied, and received approval, for their comprehensive plan amendments. These range in acreage from 160 acres to 3,200 acres. Of the thirteen, four have applied for a special use permit.

On Nov 8, Iberdrola commissioned their first utility-scale solar in AZ,

the 20 MW “Copper Crossing” project located near Florence, AZ. The Sonoran Solar Energy Project, proposed by a subsidiary of NextEra Energy Resources, was approved for construction on BLM lands in the Sonoran Desert National Monument. The PV solar project will produce 300 MW.

**Mohave**

**Population – 200,186**

**Median household**

**income - \$39,863**

**Land area – 13,311.08  
sq mi**

Several projects are under various stages of permitting/development:

- Western Wind Energy has completed construction of a 10.5 MW project (10 wind, 0.5 solar) in the Kingman area, and will sell the power to Unisource. A second phase is anticipated to be permitted next year.
- Solon, Inc has permitted a 15 MW single-axis solar PV project on the I-40 corridor and has a PPA with Unisource. The project is expected to be online in summer 2012.
- Unisource Energy Services has permitted a 1-MW single-axis solar PV project at a school district, which is built and anticipated to be online in October 2011. Unisource is also the off-taker.
- Mohave Solar proposed a 340 MW CSP trough project in the Red Lake area, and obtained a county resolution but has not proceeded with building permits. The project is on hold pending a PPA.
- Silver Ranch Corp proposed a 200 MW CSP trough project near Big Sandy Valley, and obtained a county and P&Z resolution but has not obtained building permits. The project is apparently moving ahead using CPV technology instead of CSP.
- Greenstone Renewables, LLC has proposed a 60 MW fixed solar PV plant in Mohave Valley, and the proposal will be heard by the P&Z Commission in October 2011.
- Havasu Solar Electric has proposed a 7 MW fixed solar PV plant in the Yucca area but requires additional review before permitting.
- Arizona Acreage LLC has proposed a solar project in the Dolan Springs area. It has obtained a general plan resolution but has not submitted site plans or project details.
- Needle Mountain Power LLC has proposed a 1200 MW Sterling Dish development in the Topock area. The project had obtained most of the required permits from multiple areas but is on hold seeking new solar technology in place of the Sterling dishes from Tessera.
- BP Energy is pursuing development of 500 MW of wind on BLM land in the White Hills northwest of Kingman. The first draft of the required EIS is expected to be released in fall 2011. They have eight MET towers operational.
- Five Star Energy has obtained permits for met towers in 2011 in the Red Lake and Fort Rock areas.
- Oak Creek Energy Systems has applied for permits for met towers in the Mohave Valley area. They are in the EA review



---

stage.

- Gamesa obtained permits for met towers in the Arizona Strip area in 2008 but has not sought any permits related to project development.
- NAU obtained permits for met towers in the Mohave Valley in 2005, but has not sought additional permits related to project development.

**Navajo**  
**Population – 107,449**  
**Median household income - \$34,855**  
**Land area – 9,950.42 sq mi**

Several companies have received permits or are in process with Navajo County:

- Iberdrola Renewables has completed construction of Phase I & 2 of the Dry Lake wind plant and the plant is operational. Their generation capacity is approximately 130-135 MW.
- Pacific Wind Development (a subsidiary of Iberdrola Renewables) has received a permit for one met tower north of the Dry Lake wind farms
- Aurora Solar (a subsidiary of Iberdrola Renewables) has received approval to develop a 50 MW photovoltaic solar facility within the Dry Lake II wind farm
- Apache Wind District (a subsidiary of Juwi Wind, LLC) has applied for approval to construct one met tower southwest of Holbrook
- Disgen has received approval for a 390 MW wind farm north of Holbrook
- RES Americas has received approval for 4 MET towers and has installed one of them.

**Pima**  
**Population – 980,263**  
**Median household income - \$43,243**  
**Land area – 9,187.04**

There are no wind projects planned, underway or constructed in the county. Pima County has a 1 MW solar plant that was commissioned in 2010, as well as a 1.1 MW solar plant that was completed in July, 2011. Both projects are located at the Pima County Wastewater Reclamation Facility.

The Pima County Board of Supervisors approved Conditional Use Permits in 2011 for two 25 MW solar plants in the Avra Valley area for NRG Energy and Fotowatio Renewable Energy; however, construction has not commenced on either one to date. Recurrent Energy constructed a solar farm in the Ajo area with an approximate size of 6 MWs. There is also a Solar Zone at the University of Arizona Tech Park. Aurora Solar has a project in the entitlement process.

**Pinal**  
**Population – 375,770**  
**Median household income - \$49,088**  
**Land area – 5,365.61 sq mi**

Iberdrola Renewables is in the permitting process for a 45-50 MW project, and the permitting could be done by March 2012. Permits were obtained, by Rose Law group, for a 40 MW solar PV project off Picacho Peak but it was never built.

**Yavapai**  
**Population – 211,033**  
**Median household income - \$40,837**

The county issued a Use Permit to NextEra Energy Resources for a wind and solar project with 99 MW of wind and up to 30 MW of solar, located about 15 miles southeast of Seligman. The project is seeking approvals required by the Prescott National Forest, and has a PPA with

---

<b>Land area – 8,123.50 sq mi</b>	Salt River Project. Recurrent Energy received a permit in December 2010 for a 15 MW PV solar plant north of Bagdad, which is under construction. Sun Edison received a permit in January 2011 for a 10 MW PV solar plant north of Prescott airport, which is also under construction.
<b>Yuma Population – 195,751 Median household income - \$38,251 Land area – 5,513.99 sq mi</b>	The county has two ongoing projects: <ul style="list-style-type: none"> <li>• First Solar and NRG - Solar PV 1 is being built and permits have been issued for 10 months. 291MW approved (may get close to 350MW with more blocks potentially being added into design).</li> </ul> <p>APS owned 2nd one - pursuing permits for flood control and grading. 17MW +/-</p> <p>In addition to those listed above, Yuma county has six solar projects that have to meet special use permit requirements and be approved. One Special Use permit has been denied on a 36MW project, and there are pre development meetings for two other solar projects that are over 100MW each.</p>
<b>Arizona Population – 6,392,017 Median household income - \$48,711 Land area – 113,594.08 sq mi</b>	<a href="http://quickfacts.census.gov/qfd/states/04000.html">http://quickfacts.census.gov/qfd/states/04000.html</a> Population data – 2010 Median Household Income data – 2009 Land Area data – 2010

*The following counties had no utility scale wind or solar development to report: Gila County, Graham, Greenlee, and Santa Cruz.*

## Status by County

Each of the tribes in Arizona was contacted for this report. The information obtained is summarized in the table below.

<b>Tribal Nation</b>	<b>Status</b>
<b>Colorado River Tribes Population – 7,466 Land area (AZ) – 353 sq mi</b>	Since the Tribe is located on the Colorado River, it is fortunate to have its electrical power needs met with renewable energy from the hydroelectric dam located here. The resulting low cost of electricity has made investment in solar and wind not very cost effective for the Tribe. The tribe is not pursuing renewable energy development as an export.
<b>Fort Mohave Population – 773</b>	The Fort Mohave tribe conducted a renewable energy development feasibility study several years ago, and had wind monitoring

<b>Land area (AZ) – 37 sq mi</b>	equipment erected at that time. The study concluded that the wind resource was marginal, so the tribe is pursuing solar power development instead.
<b>Hopi Population – 6,946 Land area – 2,438.6 sq mi</b>	<p>The Hopi tribe has been collecting wind data for several years on the reservation lands. The Hopi Tribe completed a new wind study in collaboration with the United States Department of Energy in December 2010. They collected a year’s worth of wind data with two 50-meter met towers on the Clear Creek ranch lands south of Winslow. They submitted this data and final reports to DOE and are waiting for DOE replies. In the meantime, the Tribal Council and Hopi tribal energy utility office are considering both wind and solar development and are evaluating the resources and the options for development, both in conjunction with USDOE and with private partners. The Hopi Tribe’s Renewable Energy Office staff also designed, executed and completed an avian impacts research project with the met towers on the ranch lands.</p> <p>The Hopi Tribe worked in partnership with Foresight Wind on the development of part of the Sunshine Wind project on Hopi land. The project is pending the approval of a power purchase agreement.</p> <p>The Tribe also has one 50-meter met tower on the west side of Hotevilla which has been monitoring wind speeds for about five years. There are also apparently some 30-meter towers near Moenkopi and Tuba City.</p>
<b>Hualapai Population – 1,353 Land area – 1,550.2 sq mi</b>	<p>The Hualapai Renewable Energy Development Project has been assessing renewable energy resources on the Hualapai Reservation for the past five years. During that time, the Tribe has identified developable wind and solar energy resource areas on the Hualapai Reservation as well as on fee land owned by the Tribe and on public lands adjacent to the Hualapai Reservation.</p> <p><b>Area Designation/Technology/Capacity (MW)– Tribal Trust</b>  Nelson / Wind / 50  Peach Springs / Solar / 50  Grand Canyon West / Wind / 50  Clay Springs / Wind / 50</p> <p><b>Area Designation/Technology/Capacity (MW)– Tribal Fee</b>  Clay Springs / Solar / 50</p> <p><b>Area Designation/Technology/Capacity (MW)– BLM</b>  Lost Creek / Wind / 50  Clay Springs / Wind / 50</p> <p><b>Additional</b>  Collector power line and service roads / 50 – miles  Gen-tie Power line and service roads / 10-20 – miles</p>
<b>Navajo Nation Population – 104,565 Median Household Income - \$21,136 Land area – 18,119.2 sq</b>	According to information presented by Terry Battiest of NTUA at the Arizona Wind Working Group meeting in September 2011, the Navajo Nation is moving forward with the development of the Big Boquillas wind energy project, in partnership with Edison Mission Energy out of California. The project would be a utility-scale wind

<b>mi</b>	project located on Navajo-owned ranch lands north of Seligman, Arizona, with development potentially taking place in phases. The Navajo Nation has significant wind development potential on Gray Mountain as well, but does not have development plans or an agreement with an outside developer at the time of this writing. The Navajo Nation also has solar energy development potential. The Navajo Nation is also developing an updated Energy Policy to replace its 1980s policies.
<b>Population / Land area (2000 census)</b>	<a href="http://edrp.arid.arizona.edu/tribes.html">http://edrp.arid.arizona.edu/tribes.html</a>
<b>Navajo (median income)</b>	<a href="http://censtats.census.gov/cgi-bin/pct/pctProfile.pl">http://censtats.census.gov/cgi-bin/pct/pctProfile.pl</a>

*The following tribes have no utility scale wind or solar: Ak-Chin Indian Community, Fort McDowell – Yavapai Nation, Havasupai, Pueblo of Zuni, San Carlos Apache, Tonto Apache Tribe. The following tribes were not able to be reached for comment: Cocopah, Fort Mojave, Gila River Indian Community, Hulapai, Kaibab Paiute, Pascua Yaqui, Quechan*

## Contact information for this report:

### County Contact Information

Apache County - Michelle Johnson / (928) 337-7526 / [mjohnson@co.apache.az.us](mailto:mjohnson@co.apache.az.us)

Cochise County - Keith Dennis / (520)432-9240 / [kdennis@cochise.az.gov](mailto:kdennis@cochise.az.gov)

Coconino County - Melinda Rockhold / 928.679.8850

Gila County - Angela Parker / 928-425-3231 Ext. 4224

Graham County - Karen Ulibarri / (928)-428-0410 / [KUlibarri@graham.az.gov](mailto:KUlibarri@graham.az.gov)

Greenlee County - Philip Ronnerud / (928) 865-4762 / [pronnerud@co.greenlee.az.us](mailto:pronnerud@co.greenlee.az.us)

La Paz County - Mike Baker/ 928-669-6138 / [mbaker@co.la-paz.az.us](mailto:mbaker@co.la-paz.az.us)

Maricopa County - Robert Kuhfuss / 602-506-6533 / [robertkuhfuss@mail.maricopa.gov](mailto:robertkuhfuss@mail.maricopa.gov)

Additional information: <http://www.aps.com/main/green/Solana/About.html> / <http://www.semprageneration.com/energy-solutions/solar-mesquite-solar.html>

Mohave County - Susie Parel-Duranceau / 928-753-0723 Ext 4780

Navajo County - Greg Loper / (928) 524-4100

Pima County - Betty Stamper / 520-740-6463

Pinal County - Tim Kanavel / 520-866-6664 / [econdev@pinalcountyaz.gov](mailto:econdev@pinalcountyaz.gov)

Santa Cruz County - Sylvia Jontow / 520 375 7880 / [Sjontow@co.santa-cruz.az.us](mailto:Sjontow@co.santa-cruz.az.us)

Yavapai County – Nicole Russell / (928) 771-3214 / [nicole.russell@co.yavapai.az.us](mailto:nicole.russell@co.yavapai.az.us)

Yuma County - Pat Heddington / 928 817 5068

Tribal Contact Information

Ak-Chin Indian Community - Jerry Owen / (520) 568-1070

Colorado River Indian Tribes - Rick Ench / (928) 669-1301 / [rickench@msn.com](mailto:rickench@msn.com)

Fort McDowell Yavapai Nation - Erika McCalvin / 480.789.7741 / [emccalvin@ftmcdowell.org](mailto:emccalvin@ftmcdowell.org)

Havasupai Tribe - Tribal Office / 928-448-2731

Hopi Tribe - Ken Lomayestewa / 928- 734-7147 / [klomay@hopi.nsn.us](mailto:klomay@hopi.nsn.us)

Pueblo of Zuni - Andrew Athole / 505-782-3054

Federal Contact Information

BLM - Arizona Strip Field Office - Laurie Ford / 435.688.3200

BLM - Renewable Energy Coordination Office - Eddie Aureola / 602.417.9505 / [earreola@blm.gov](mailto:earreola@blm.gov)

BLM - Kingman Field Office - Andy Whitefield / 928.718.3700

BLM – Safford - Roberta Lopez / 928.348.4400

Game and Fish - Mark Ogonowski / 928.774.5045 / [mogonowski@azgfd.gov](mailto:mogonowski@azgfd.gov)

Game and Fish - Ginger Ritter / 623.236.7606

## Appendix A: guidance and permitting document resources

Utility-scale wind and solar developments must consider the following:

- Conditional/Special use permit: Issued by the County, this permit is used separately for the installation of resource assessment equipment such as meteorological towers with anemometers, and for the project development phase and construction of a wind or solar power plant. In some cases, one permit can be used both for the installation of resource assessment equipment and for the construction of the power plant.
- County ordinances on utility-scale wind and solar development: Some of Arizona's counties have approved ordinances governing utility-scale wind and/or solar energy development. These ordinances generally establish guidelines for developers in terms of what documents must be submitted to the County in order to approve a project, and what limits the County has established in terms of setbacks to property lines, noise levels, visibility of the project, water use, lighting, etc.
- County Comprehensive or Area Plan guidance on renewable energy development: Several counties have an Energy Element as a component of their Comprehensive Plan, and this may also provide guidance on utility-scale wind and solar development and permitting. In addition, Area Plans typically provide detailed information on the approved uses of land within the area.
- A right-of-way permit for land access: Issued by the County, state Land Department, U.S. Forest Service, or the BLM, this permit allows the developer of a wind/solar power plant access to the land to be used for the plant. In the case of Counties, the right-of-way is generally to allow travel and transport of materials across county land to the plant site. The Arizona State Land Department requires a right-of-way for access to and use of state lands for wind power development, but does not require a commercial lease of the land as it can be co-used for wind power development and other purposes. (<http://www.land.state.az.us/programs/realestate/sections/row.htm>) For solar development, the State Land Department does execute a commercial lease. (<http://www.land.state.az.us/programs/realestate/pdfs/LeasingFlyer.pdf>)  
In the case of the BLM, Instruction Memorandum (IM) 2011-061 provides updated guidance on the review of right-of-way applications for solar and wind energy development projects on public lands administered by the Bureau of Land Management (BLM):
  - [http://www.blm.gov/wo/st/en/info/regulations/Instruction\\_Memos\\_and\\_Bulletins/national\\_instruction/2011/IM\\_2011-061.html](http://www.blm.gov/wo/st/en/info/regulations/Instruction_Memos_and_Bulletins/national_instruction/2011/IM_2011-061.html)
- Environmental (wildlife) consideration requirements of the Federal government (for wind). The US Fish & Wildlife Service provides guidelines on wind development for the protection of wildlife.
  - <http://www.fws.gov/windenergy/>
- Environmental monitoring requirements of the State of Arizona: The Arizona Game and Fish Department (AGFD) works with wind and solar energy developers to plan monitoring of environmental impacts before and after construction of a plant. Per an interagency Memorandum

of Understanding, the Arizona State Land Department is required to consult with AGFD regarding the wind developer's environmental monitoring plans as part of the right-of-way permitting process. The Arizona State Land Department also has released guidelines for wind and solar development.

- <http://www.azgfd.gov/hgis/documents/FinalSolarGuidelines03122010.pdf>
- <http://www.azgfd.gov/hgis/pdfs/WindEnergyGuidelines.pdf>
- National Environmental Policy Act (NEPA) process, Environmental Impact Statement (EIS), Environmental Assessment (EA), and biological and cultural assessments: Any development on federal land, using federal funding, or interconnecting into a federally managed portion of the electricity grid is required to perform an analysis of potential environmental and cultural impacts. This process involves public participation, and results in the writing of EIS, EA, and/or other required reports. All projects are required to abide by federal regulations protecting wildlife (including the Endangered Species Act, Bald and Golden Eagle Protection Act, and others) and cultural artifacts (including the Native American Graves Protection and Repatriation Act).
- Permitting documents and environmental, archaeological, and cultural impacts surveys required by Tribal governments.
- 

Other documents that may govern developments on federal land include:

- The BLM Solar Programmatic EIS (draft):
  - <http://solareis.anl.gov/documents/dpeis/index.cfm>
- The BLM Wind Programmatic EIS (final):
  - <http://windeis.anl.gov/documents/fpeis/index.cfm>

## Appendix B - Economic Impacts of Wind and Solar Development

The following sections detail the economic impacts of utility-scale wind, solar photovoltaic, and concentrating solar thermal (parabolic trough) development. For each section, information is presented in 2011 dollar and job impacts, and for both the construction and operation phases. The information presented is for 100 megawatts of development of each technology type, which can be roughly extrapolated up or down for projects of different sizes. The information was obtained using the National Renewable Energy Laboratory's Jobs and Economic Development Impacts (JEDI) models, available for download at: <http://www.nrel.gov/analysis/jedi/download.html> . The model is an input-output model, which uses nationally available data about product and service availability in Arizona to calculate the state-wide direct, indirect, and induced impacts of a certain quantity of investment in the given development (in this case, 100 MW project sizes). Additional assumptions for each case are given below.

### Wind Development

The following tables and graphs show the impacts of 100 MW of wind development in Arizona. The construction costs were assumed to be \$2155/kW of capacity, based on the costs reported in the 2010 Wind Technologies Market Report.<sup>2</sup> The operation costs were assumed to be \$20/kW of capacity, based on the default values of the JEDI model.

Table B 1. Jobs and economic impacts of 100 MW Wind Development in Arizona

	Jobs	Earnings*	Output*
<b>During construction period</b>			
<b>Project Development and Onsite Labor Impacts</b>	68	\$3.96	\$4.57
<i>Construction and Interconnection Labor</i>	60	\$3.37	
<i>Construction Related Services</i>	8	\$0.59	
<b>Turbine and Supply Chain Impacts</b>	315	\$17.01	\$44.60
<b>Induced Impacts</b>	111	\$4.83	\$8.53
<b>Total Impacts</b>	494	\$25.79	\$57.70
<b>During operating years (annual)</b>			
<b>Onsite Labor Impacts</b>	6	\$0.37	\$0.37
<b>Local Revenue and Supply Chain Impacts</b>	7	\$0.35	\$1.67
<b>Induced Impacts</b>	6	\$0.26	\$0.51
<b>Total Impacts</b>	19	\$0.97	\$2.56

\* \$Million 2011

<sup>2</sup> <http://eetd.lbl.gov/ea/emp/reports/lbnl-4820e.pdf>



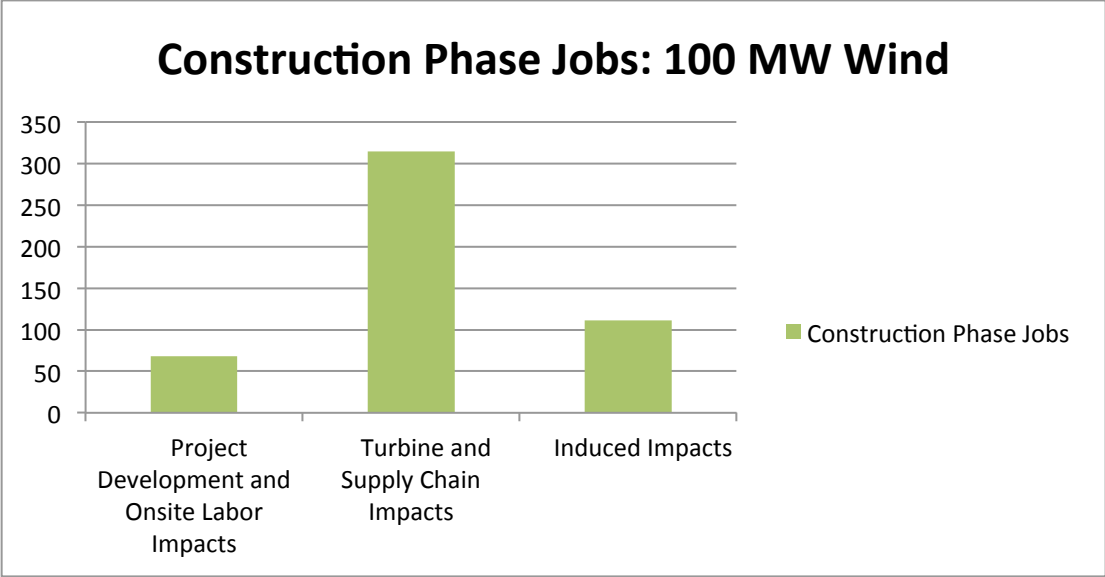


Figure B 1. Full-time jobs during the construction phase of 100 MW wind plant in Arizona

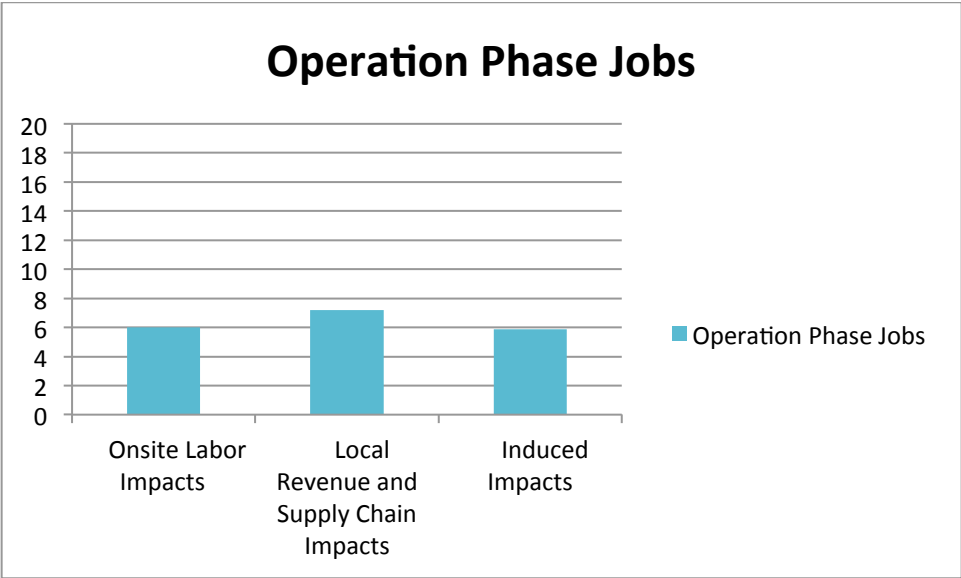


Figure B 2. Full-time jobs during the operation of 100 MW wind plant in Arizona

**Solar Photovoltaic (PV) Development**

The following tables and graphs show the impacts of 100 MW of solar PV development in Arizona, using the JEDI Model’s default utility-scale calculations, and default construction cost of \$4869/kW and operation and maintenance costs of \$19.93/kW of capacity.

Table B 2. Jobs and economic impacts of 100 MW Solar PV Development in Arizona

	Jobs	Earnings*	Output*
<b>During construction and installation period</b>			
<b>Project Development and Onsite Labor Impacts</b>			
Construction and Installation Labor	685	\$44	
Construction and Installation Related Services	1059	\$36	
<b>Subtotal</b>	<b>1744</b>	<b>\$80</b>	<b>\$135</b>
<b>Module and Supply Chain Impacts</b>			
<b>Subtotal</b>	<b>1358</b>	<b>\$55</b>	<b>\$174</b>
Induced Impacts	993	\$37	\$121
<b>Total Impacts</b>	<b>4094</b>	<b>\$172</b>	<b>\$431</b>
<b>During operating years (Annual)</b>			
<b>Onsite Labor Impacts</b>			
PV Project Labor Only	18	\$1.1	\$1.1
Local Revenue and Supply Chain Impacts	7	\$.4	\$1.1
Induced Impacts	6	\$.2	\$.7
<b>Total Impacts</b>	<b>31</b>	<b>\$1.7</b>	<b>\$2.9</b>

\* Million 2012 \$

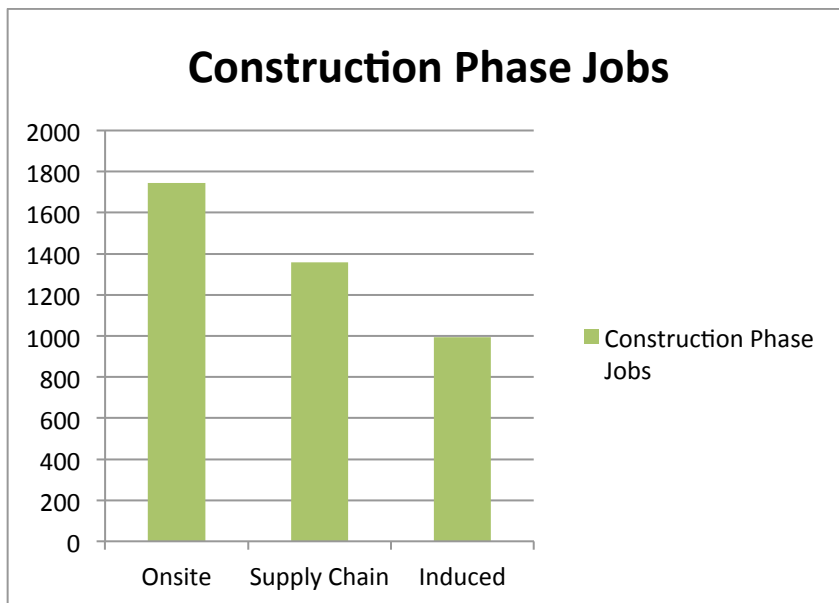


Figure B 3. Full-time jobs during the construction phase of 100 MW Solar PV Development in Arizona

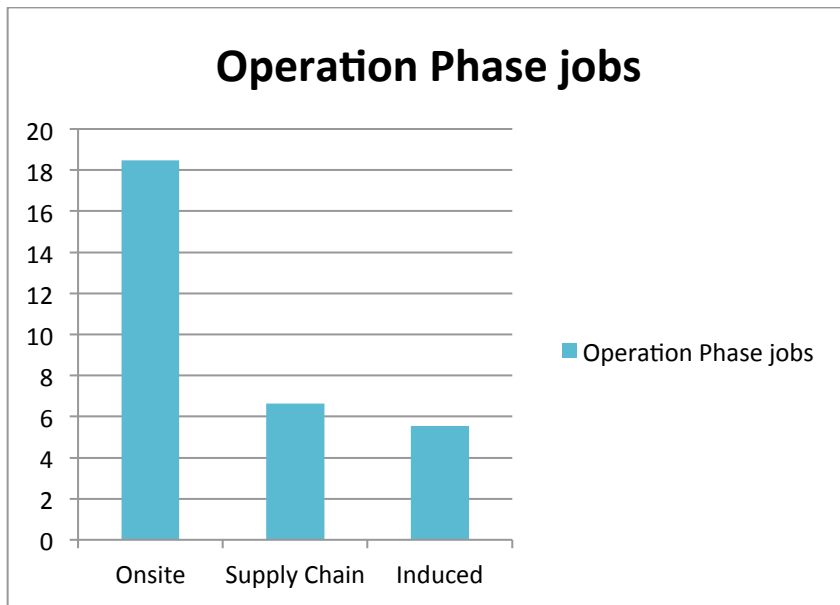


Figure B 4. Full-time jobs during the operation phase of 100 MW Solar PV Development in Arizona

### Concentrating Solar Power (CSP) Development

The following tables and graphs show the impacts of 100 MW of solar CSP development in Arizona. The construction costs were assumed to be \$4862/kW of capacity, and the operation costs were assumed to be \$72.68/kW of capacity, based on the default values of the JEDI model.

Table B 3. Jobs and economic impacts of 100 MW Concentrating Solar Power Development in Arizona

	Jobs	Earnings*	Output*
<b>During construction period</b>			
Project Development and Onsite Labor Impacts	789	\$95	\$116
Construction and Interconnection Labor	570	\$80	
Construction Related Services	219	\$15	
Equipment and Supply Chain Impacts	688	\$41	\$155
Induced Impacts	632	\$27	\$51
<b>Total Impacts</b>	<b>2,109</b>	<b>\$164</b>	<b>\$321</b>
<b>During operating years (annual)</b>			
Onsite Labor Impacts	35	\$3.0	\$3.0
Local Revenue and Supply Chain Impacts	31	\$1.6	\$5.4
Induced Impacts	40	\$1.7	\$3.5
<b>Total Impacts</b>	<b>106</b>	<b>\$6.4</b>	<b>\$11.9</b>

\* \$Million

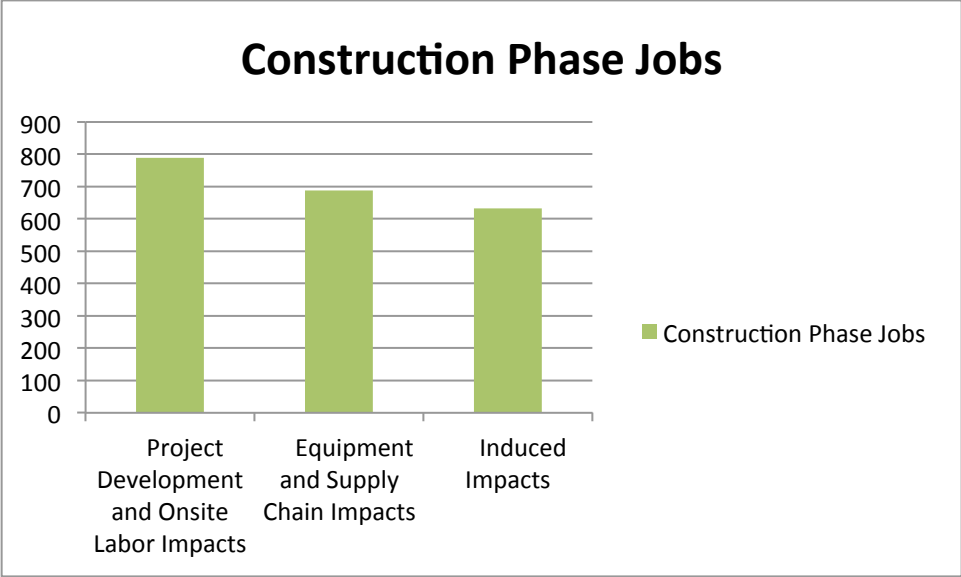


Figure B 5. Full-time jobs during the construction phase of 100 MW Concentrating Solar Power Development in Arizona

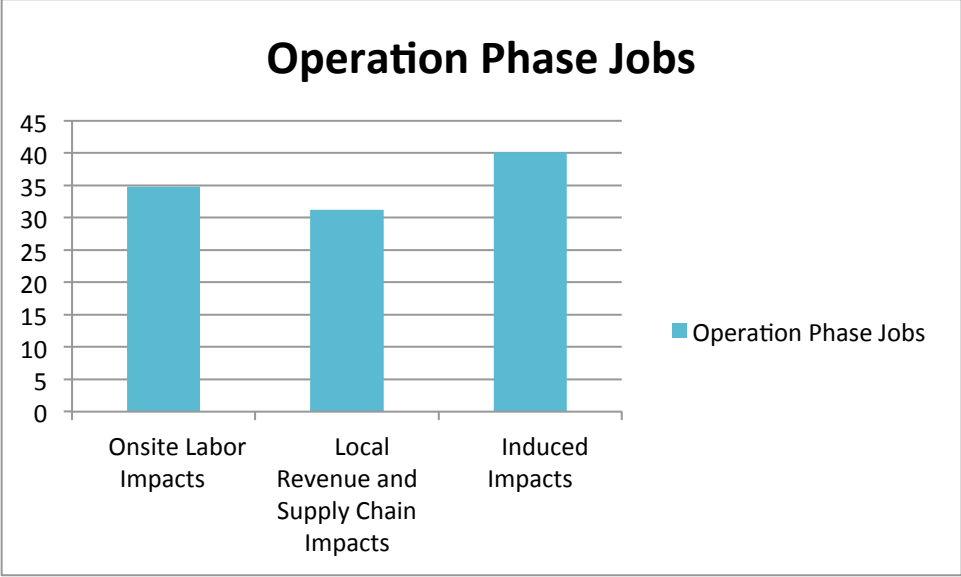


Figure B 6. Full-time jobs during the operation phase of 100 MW Concentrating Solar Power Development in Arizona

## Appendix C

### The Northern Arizona University Institute for Sustainable Energy Solutions

The NAU Institute for Sustainable Energy Solutions (ISES) has managed a wind resource assessment and reporting program for many years. In addition, ISES performs a range of wind and solar resource assessment and integration research. The following figure shows the locations of the program's wind resource test sites. Additional information and wind resource reports for each test site are available through the ISES website.<sup>3</sup>

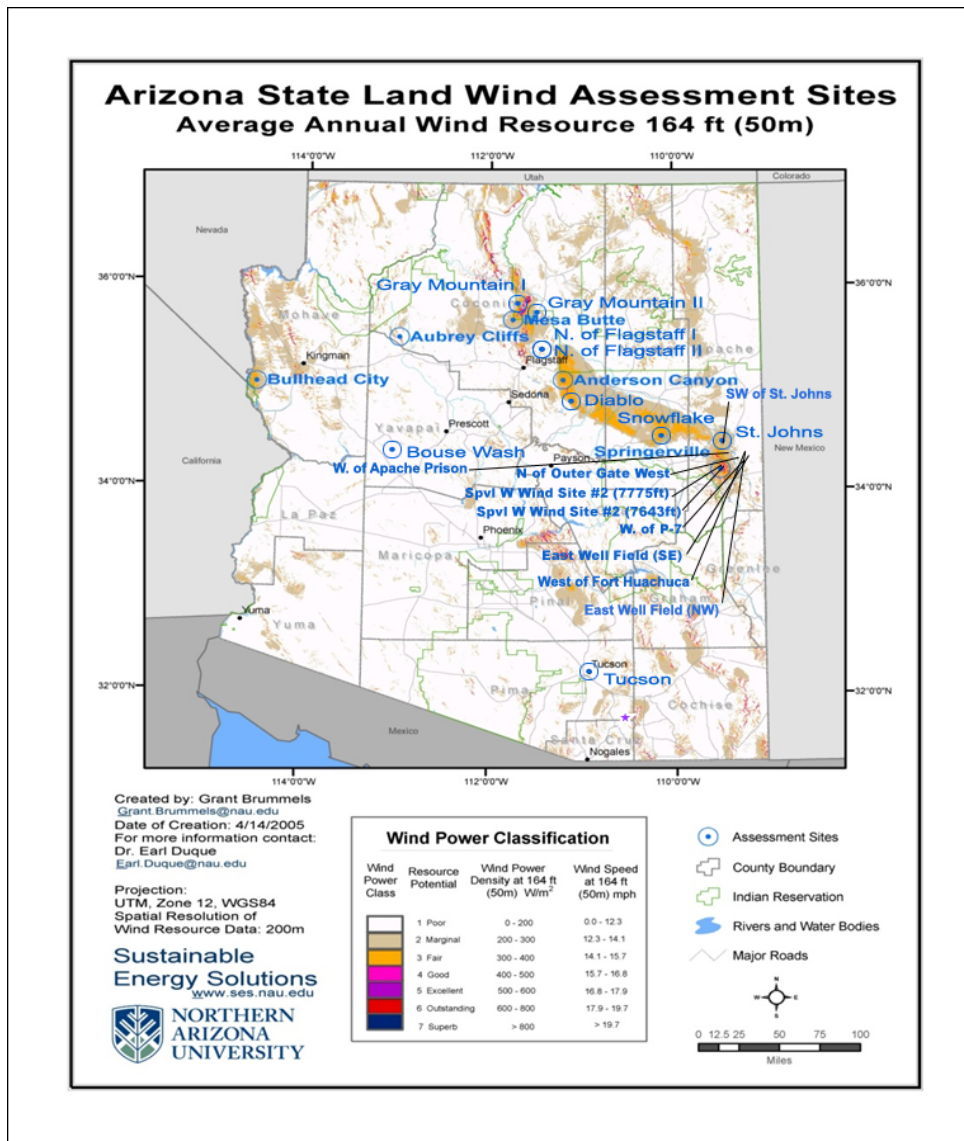


Figure C 1. Map of locations of anemometer loan program test sites.

<sup>3</sup> See <http://ses.nau.edu/>