

DOE OFFICE OF INDIAN ENERGY

# Overview of Tribal Land Opportunities

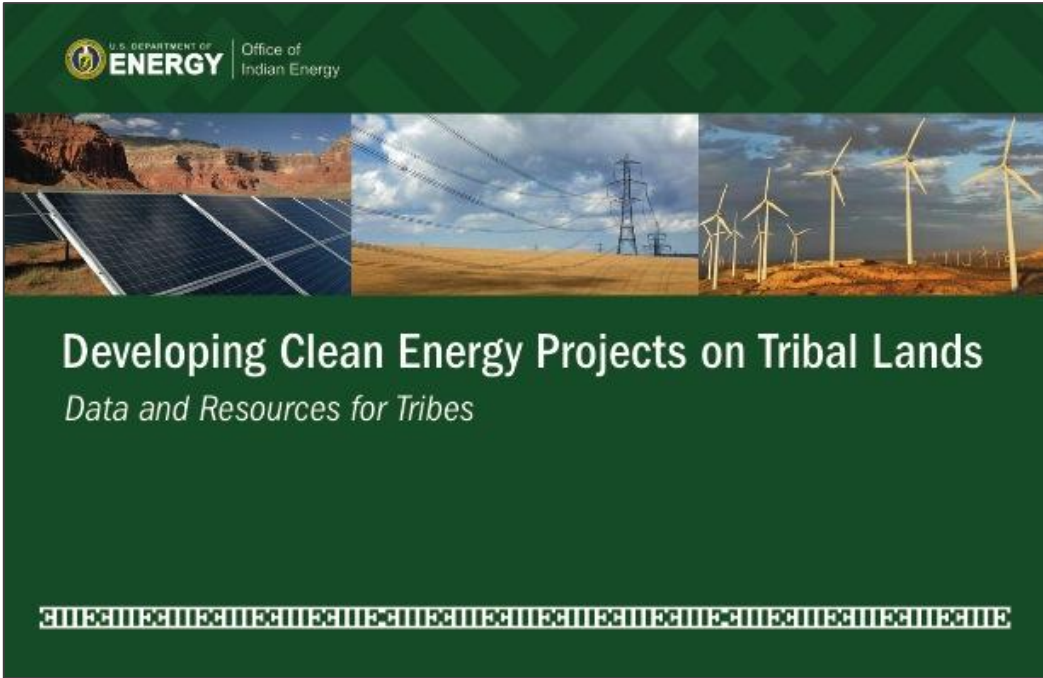
John Nangle, National Renewable Energy Laboratory (NREL)

Tribal Leader Forum, Phoenix, AZ - May 30 - 31, 2013



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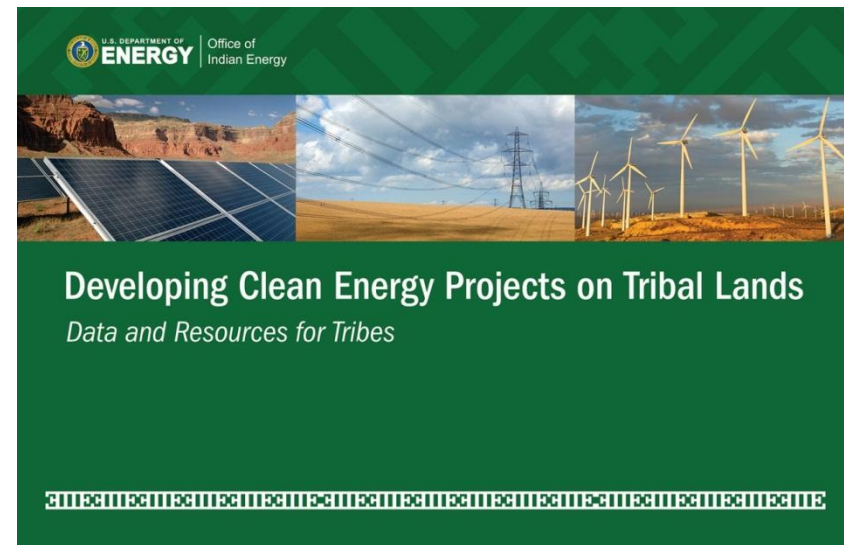
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# RENEWABLE ENERGY POTENTIAL ON TRIBAL LANDS

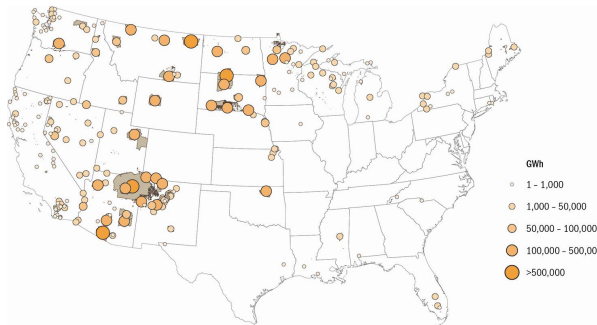
# Geospatial Analysis: Renewable Energy Technical Potential

- New analysis represents an increase in potential density on tribal lands
- *Renewable energy technical potential* on tribal lands is about 5% of the total national technical potential

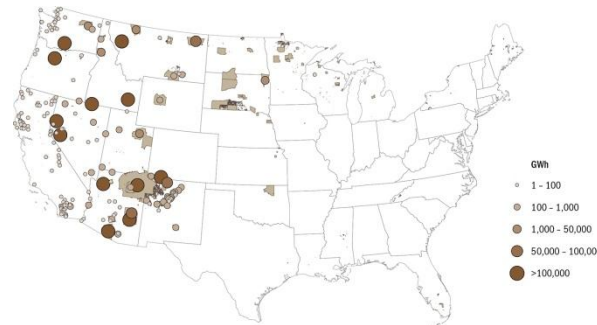


# Why is Geospatial Analysis Different?

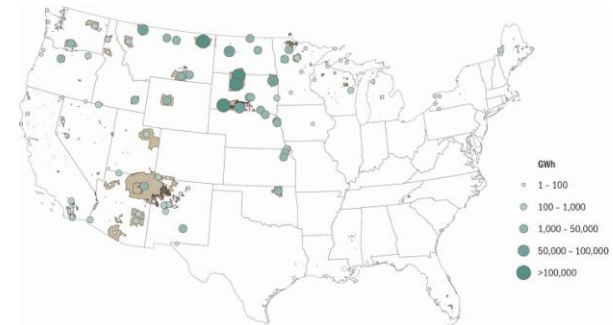
- A statistical approach to analyzing information that incorporates data that has a geographic component
- Using GIS software, NREL applies geospatial analysis to determine renewable energy resources potential on tribal lands
- Allows for a more refined analysis or technical potential for all Tribes by parsing it to individual tribal lands



Solar PV (Rural) Generation Potential on Tribal Lands



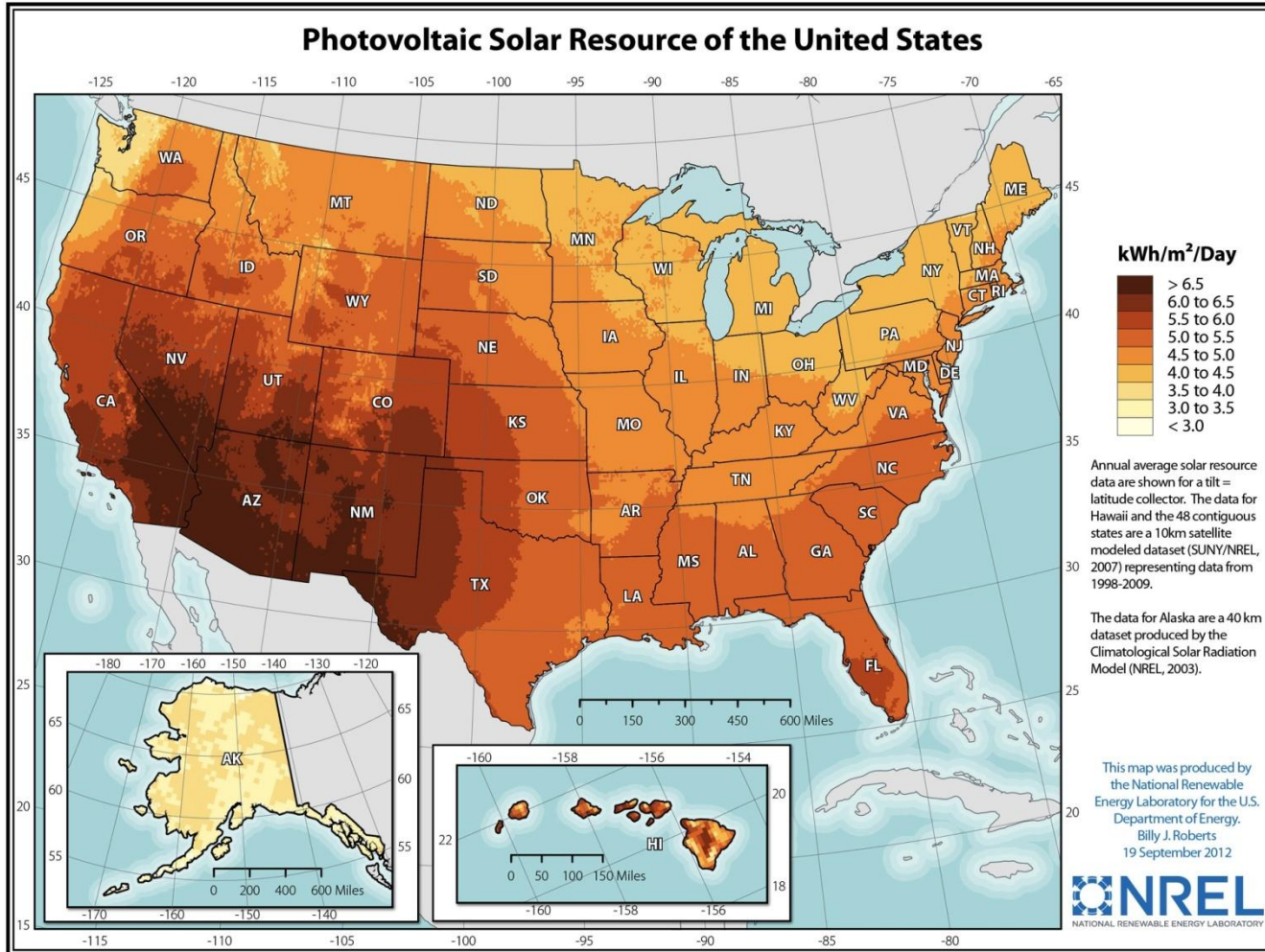
Geothermal Generation Potential on Tribal Lands



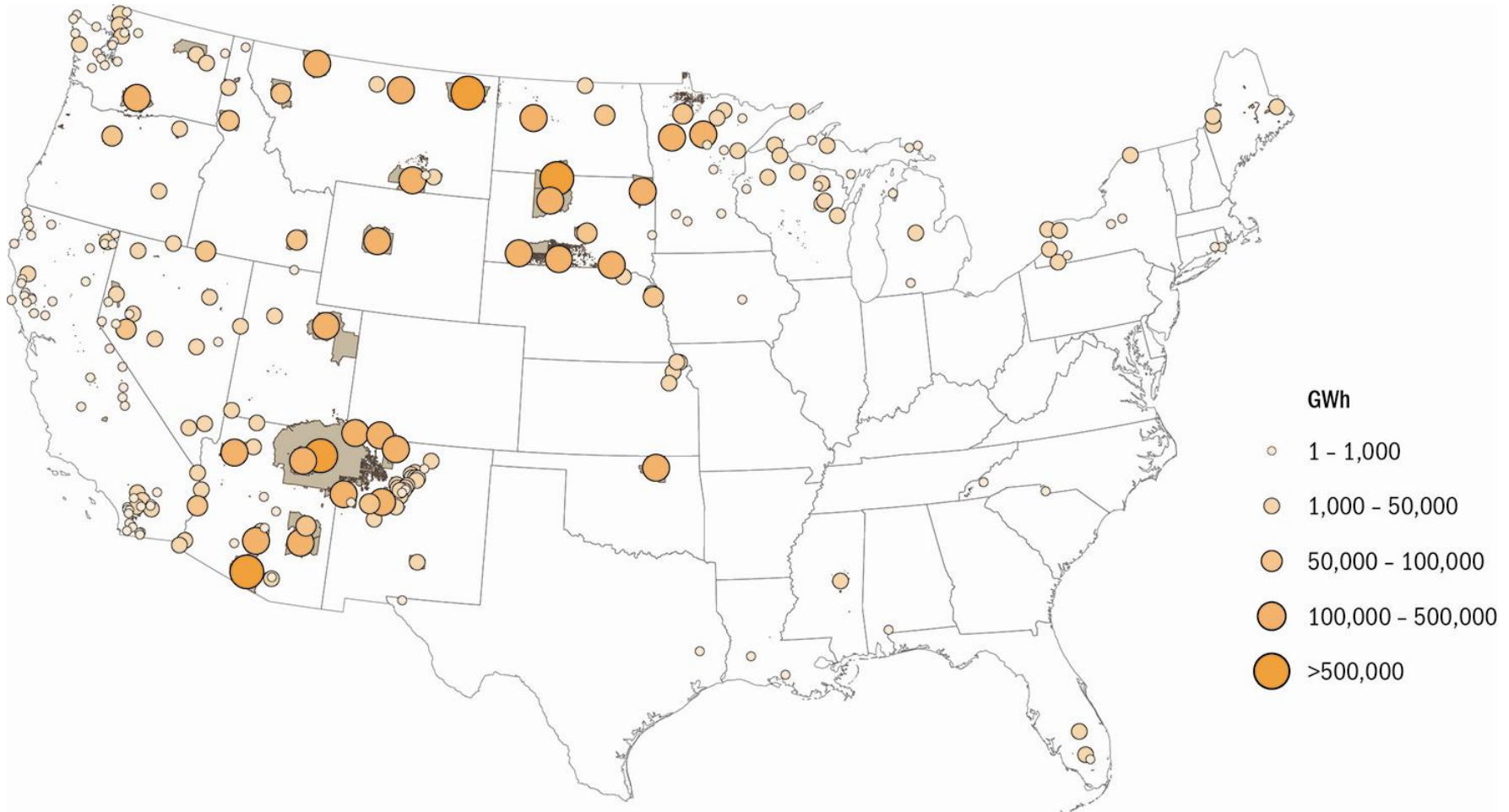
Wind Generation Potential on Tribal Lands



# National Solar PV Resource Map



# Geospatial Analysis Map



Solar PV (Rural) Generation Potential on Tribal Lands

## Report Methodology

- The basic methodology for determining the technical potential on tribal lands is to:
  1. Determine the land area of the tribal lands
  2. Estimate how much renewable resource exists within those areas, and
  3. Estimate the amount of electricity that could possibly be produced from that land area, based on currently available technology for converting that resource into electricity.

# Potential

## Key Assumptions

## Potential

- Physical Constraints
- Theoretical Physical Potential
- Energy Content of Resource

Resource

- System/Topographic Constraints
- Land-Use Constraints
- System Performance

Technical

- Projected Technology Costs
- Projected Fuel Costs

Economic

- Policy Implementation/Impacts
- Regulatory Limits
- Investor Response
- Regional Competition with other Energy Resources

Market

## Sample Exclusions:

- Slope > 3%
- Urban Areas
- Wetlands
- Parks (Federal, Wilderness Areas, refuges etc.,)
- Distance to excluded areas





# Strengths of This New Report

- Reflects the latest knowledge of what we have on commercial technologies
- Generation potential (MWh) refines resource potential
- Removes undevelopable land and federally designated exclusions sites

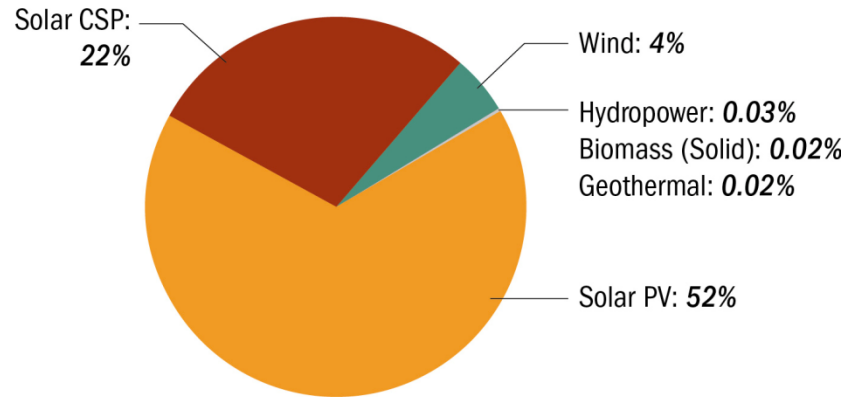
## How Can Tribes Use the Information?

- Understand renewable energy resource
- Supports development decisions
  - Scale of project, purpose of project, cultural sensitivity avoidance
- Assessing potential project viability and economics
  - Prioritize the development of renewable energy resources either for community scale on tribal land use or for revenue-generating electricity sales

# Report Key Findings

## Megawatt-hour (MWh) of Tribal Generation<sup>3</sup> Potential<sup>2</sup>

Total<sup>4</sup> = 16,610,867,594



- American Indian land comprises 2% of U.S. land but contains an estimated **5% of all renewable energy resources**.
- The total technical potential on tribal lands for electricity generation from utility-scale rural solar resource is about **14 billion MWh, or 5.1%** of total U.S. generation potential.
- The total technical potential on tribal lands for electricity generation from **wind** resources is about **1,100 million MWh, or about 3.4%** of the total U.S. technical potential.
- The total technical potential on tribal lands for electricity generation from **hydropower** resource is about **13 million MWh, or about 5.1%** of the total U.S. technical potential.

# Tribal Technical Resources by Technology

| Technology                      | Potential Capacity (MW) | Generation Potential (MWh) | % National Capacity (MW) | % National Generation (MWh) |
|---------------------------------|-------------------------|----------------------------|--------------------------|-----------------------------|
| Solar PV (Utility-Scale, Rural) | 6,888,339               | 14,322,522,713             | 4.5%                     | 5.1%                        |
| Solar PV (Utility-Scale, Urban) | 8,199                   | 6,139,851,743              | 0.7%                     | 0.8%                        |
| Solar CSP                       | 1,818,185               | 38,066,401                 | 4.8%                     | 5.3%                        |
| Wind                            | 374,505                 | 1,146,044,229              | 3.4%                     | 3.5%                        |
| Geothermal (EGS)                | 763,252                 | 6,017,487,000              | 19.2%                    | 19.2%                       |
| Geothermal (Hydrothermal)       | 641                     | 5,050,724                  | 2.1%                     | 2.1%                        |
| Biomass (Solid)                 | 551                     | 673,465                    | 1.1%                     | 1.1%                        |
| Biomass (Gaseous)               | 85                      | 673,465                    | 0.8%                     | 0.8%                        |
| Hydropower                      | 1,687                   | 7,390,196                  | 2.8%                     | 2.9%                        |
| <b>Total</b>                    | <b>9,855,444</b>        | <b>27,660,939,330</b>      | <b>4.8%</b>              | <b>6.0%</b>                 |

# Project Development Roles for Tribes

| Role                           | Opportunity   | Constraints  | Comments  |
|--------------------------------|---|--|---|
| <b>Project Developer</b>       | <ul style="list-style-type: none"> <li>Control and self-determination of project; profit potential</li> </ul> | <ul style="list-style-type: none"> <li>Investors require experience</li> <li>Development risks without portfolio diversification may not make business sense.</li> <li>Community investment portfolio may not seek high risk/return investments</li> </ul> | <ul style="list-style-type: none"> <li>Tribal interests may best be served by outsourcing this risk</li> <li>Assembling a portfolio of projects is good risk mitigation strategy</li> </ul> |
| <b>Lender/Capital Provider</b> | <ul style="list-style-type: none"> <li>Participate financially in project with lower risk</li> </ul>          | <ul style="list-style-type: none"> <li>Required ready capital</li> <li>May be cost prohibitive to document and manage a single debt transaction</li> </ul>   | <ul style="list-style-type: none"> <li>Requires knowledge of lending practices</li> </ul>   |
| <b>Investor</b>                | <ul style="list-style-type: none"> <li>Provide cash for project development</li> </ul>                        | <ul style="list-style-type: none"> <li>Requires ready capital or unique source or capital that provides market advantage</li> </ul>  | <ul style="list-style-type: none"> <li>Must compete with other investment opportunities</li> </ul>  |
| <b>Resource Owner (Lessor)</b> | <ul style="list-style-type: none"> <li>Low risk, known reward, consistent outcome</li> </ul>                  | <ul style="list-style-type: none"> <li>Limited project control</li> </ul>  | <ul style="list-style-type: none"> <li>Limited upside, limited risk</li> </ul>  |
| <b>Off-Taker</b>               | <ul style="list-style-type: none"> <li>Purchasing clean energy from “on-site” provider; security</li> </ul>   | <ul style="list-style-type: none"> <li>Limited Investment, economic development, and capacity-building opportunity</li> </ul>  | <ul style="list-style-type: none"> <li>Implies load-serving entity (utility) or some other purchasing demand.</li> </ul>  |





**Military Base Off-taker  
Opportunities for Tribal  
Renewable Energy Projects**

Prepared for the U.S. Department of Energy  
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by the National Renewable Energy Laboratory

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# DOD OFF-TAKERS OF TRIBAL RENEWABLE ENERGY PROJECTS



## ■ Tribal/DOD Analysis - Background

- **Goal:** Identify DOD installations as potential customers for renewable energy projects on tribal lands
  - Benefits to installations: meet federal energy efficiency/renewable energy requirements
  - Benefits to Tribes: potential revenue stream; jobs and job training
- Builds on previous analysis of:
  - Technical resource potential
  - State RPS markets



## ■ Tribal/DOD Analysis – Methodology

- Installation energy load
  - DOD Annual Energy Management Report – FY 2011
- State commercial electric rates
  - Proxy for installation electric rates
  - Energy Information Administration (EIA)
- State RPS data – indicates potential market appetite for renewable energy projects



| Tribe                                   | Installation                     | Installation State | Resources Required to Meet Load [%] | Distance [miles] |
|---|----------------------------------|--------------------|-------------------------------------|------------------|
| <b>Isleta Pueblo</b>                    | Kirtland Air Force Base          | NM                 | 0.006%                              | 0.2              |
| <b>Cocopah</b>                          | USMC Air Station-Yuma            | AZ                 | 0.066%                              | 1.5              |
| <b>Quechan Tribe</b>                    | Yuma Proving Ground              | AZ                 | 0.006%                              | 2.5              |
| <b>Ysleta Del Sur Pueblo</b>            | Fort Bliss                       | TX                 | 20.470%                             | 3.4              |
| <b>Tohono O'odham</b>                   | Davis-Monthan Air Force Base     | AZ                 | 0.012%                              | 4.8              |
| <b>Colorado River Indian Tribes</b>     | Yuma Proving Ground              | AZ                 | 0.001%                              | 5.9              |
| <b>Santa Rosa Rancheria</b>             | Lemoore Naval Air Station        | CA                 | 3.039%                              | 5.9              |
| <b>Cochiti Pueblo</b>                   | New Mexico National Guard Armory | NM                 | 0.094%                              | 7.9              |
| <b>Santo Domingo Pueblo</b>             | New Mexico National Guard Armory | NM                 | 0.069%                              | 8.3              |
| <b>Pala Band of Mission Indians</b>     | Camp Pendleton Marine Corps Base | CA                 | 0.147%                              | 8.7              |
| <b>Pechanga Band of Luiseno Indians</b> | Camp Pendleton Marine Corps Base | CA                 | 0.365%                              | 8.7              |
| <b>Sandia Pueblo</b>                    | Kirtland Air Force Base          | NM                 | 0.101%                              | 8.9              |
| <b>Mescalero Apache</b>                 | White Sands Missile Range        | NM                 | 0.003%                              | 9.7              |
| <b>Pascua Yaqui</b>                     | Davis-Monthan Air Force Base     | AZ                 | 0.975%                              | 9.9              |
| <b>Gila River Indian Community</b>      | Luke Air Force Base              | AZ                 | 0.003%                              | 10               |



# Tribal/DOD Analysis – Development Scenarios

- Tribe builds/maintains renewable energy system
  - Tribal workforce or partner with developer
- DOD leases tribal land for renewable energy system
  - Military workforce or partner with developer
- Third-party developer leases land from Tribe to build renewable energy systems
  - Tribe and installation could both be customers



## ■ Tribal/DOD Analysis – Immediate Next Steps

- Develop a detailed resource analysis
  - Identify specific sites and resources to develop
  - Physical resource measurements
- Develop an economic analysis
  - Estimate levelized cost of energy for projects
  - Prioritize development of resources
- Each project will require a grid study to determine transmission and distribution capacity

## Resources

- DOE Office of Indian Energy
  - [www.energy.gov/indianenergy](http://www.energy.gov/indianenergy)
- Developing Clean Energy Projects on Tribal Lands
  - [www.nrel.gov/docs/fy13osti/57048.pdf](http://www.nrel.gov/docs/fy13osti/57048.pdf)
- Geospatial Analysis of Renewable Energy Technical Potential on Tribal Lands
  - [www.nrel.gov/docs/fy13osti/56641.pdf](http://www.nrel.gov/docs/fy13osti/56641.pdf)
- Military Base Off-taker Opportunities for Tribal Renewable Energy Projects
  - [www.nrel.gov/docs/fy13osti/57501.pdf](http://www.nrel.gov/docs/fy13osti/57501.pdf)

 Thank You!

Questions?

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# Background Slides



# Example Resource Estimate Assumptions

## - Solar PV -

- Capacity of 48MW/km<sup>2</sup>
- Annual capacity factors calculated from National Solar Radiation Database TMY 3 dataset
- Satellite modeled data from SUNY/NREL
  - 1-axis tracker, 0-degree tilt, 1998-2005.
- Excluded areas
  - > 3% slope; parks, landmarks, forested areas, wetlands, impervious surfaces; areas <0.018km<sup>2</sup>