DOE OFFICE OF INDIAN ENERGY

# EERE Technologies

U.S. DEPARTMENT OF ENERGY | Office of Indian Energy

# EERE TECHNOLOGY SUMMARY

# Technology Summaries

- Efficiency
  - —Appliances & Lighting
  - —Deep Energy Retrofits
- Solar
- Wind
- Geothermal

Technology Videos:

EERE video library:
http://energy.gov/eere/videos


ENERGY EFFICIENCY FIRST

# Community-Scale Consumption and Savings Potential

- Homes and commercial buildings consume 41% of U.S. energy
- The average American spends $2,000 annually on energy costs, $200 to $400 of which is wasted from air leakage and outdated heating, ventilating, and air-conditioning (HVAC)

Data source: U.S. Department of Energy

# Energy-Efficient Technologies

- Building energy modeling tools
- Lighting
- Appliances
- Deep energy retrofits (getting to net-zero energy)

# Lighting

- Replace T-12 with T-8 electronic ballasts
- CFLs save 75% over a traditional incandescent lightbulb
- LED lighting saves 85% over a traditional incandescent lightbulb, but lasts much longer

| *All bulbs deliver equivalent brightness* | Single bulb wattage | Wattage used for whole house | Monthly Cost at $0.12/kWh (assuming 150 hours of use) |
|---|---|---|---|
| **Incandescent bulbs** | 60 watts | 2,820 watts | $50.25 |
| **CFL bulbs** | 14 watts | 658 watts | $11.73 |
| **LED bulbs** | 9.5 watts | 446.5 watts | $7.97 |

# Appliances

- ENERGY STAR®-rated appliances
  - Refrigerator and freezer replacement are often overlooked as money savers
    - Can save an estimated $150 annually by replacing one 10-year-old or older
  - Clothes washers
    - Use 15 gallons of water per load compared to 23 gallons used by a standard machine.
    - 20% more efficient than non ENERGY STAR washers, and only use 270 kWh of electricity annually
  - Dishwashers
    - New washers save an extra $35/year and wastes more than 10 gallons of water per cycle

# Deep Energy Retrofits

- Building performance whole-house approach
  - Residential, Facility, and Commercial
- Insulation and air sealing
- Heating and cooling upgrades
- Natural ventilation
- Efficient building controls
- Lighting and daylighting upgrades
- Savings of 30% or more


BUILDING HEAT

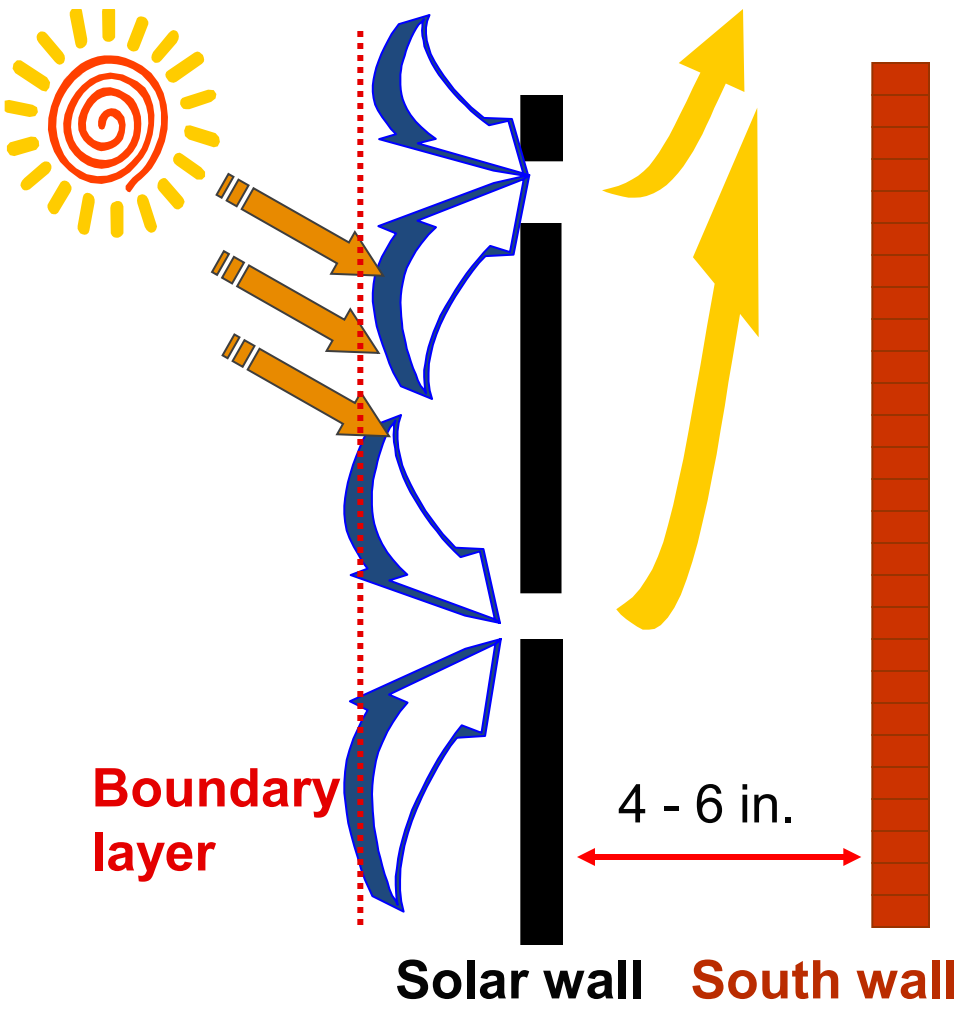
# Solar Vent Preheat (SVP)

- Sunlight strikes south facing vertical box wall.
- South-facing wall surface is best
- Reliability of equipment and system
  - Only moving part is the fan
  - Operates at ambient temperature
- Very low maintenance
- High efficiency
- No storage

NREL/PIX 09173

NREL/PIX 09355

# Solar Vent Preheat Principle




- Sun warms the collector surface
- Heat conducts from collector surface to thermal boundary layer of air (1 millimeter [mm] thick)
- Boundary layer is drawn into perforation by fan pressure before heat can escape by convection

# SOLAR PHOTOVOLTAICS (PV)

# Photovoltaics System (Grid Connected)

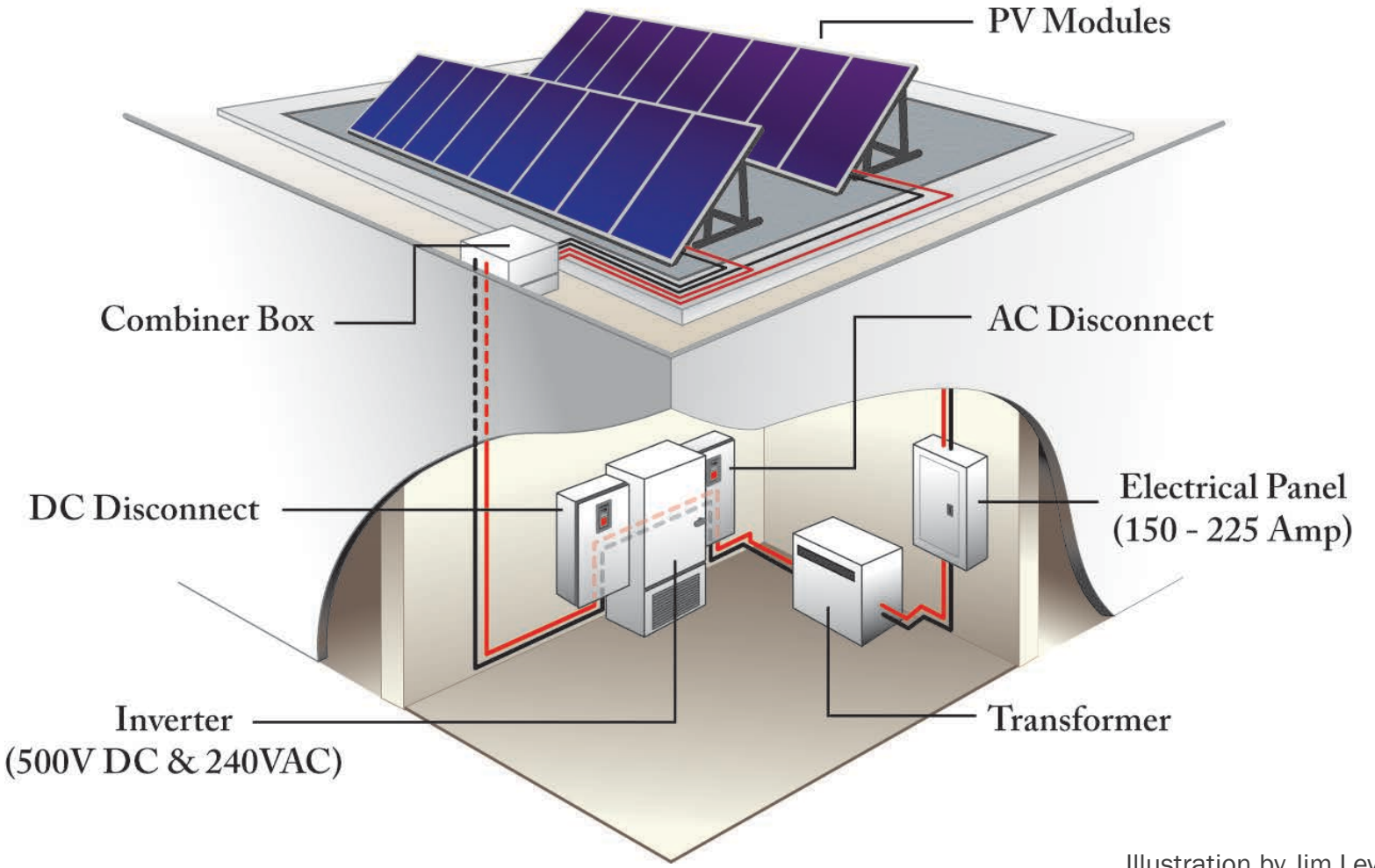
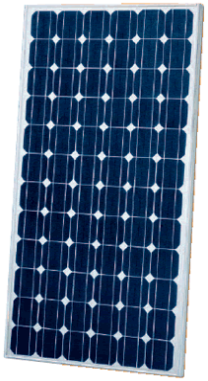


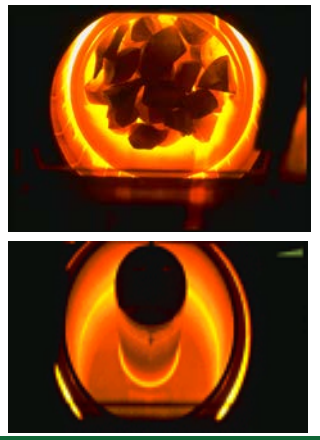

Illustration by Jim Leyshon, NREL

# Common PV Technologies



**Single Crystal**
14 to 23%

**Notes:** Most efficient. Rigid.



**Multi-Crystal**
13 to 17%

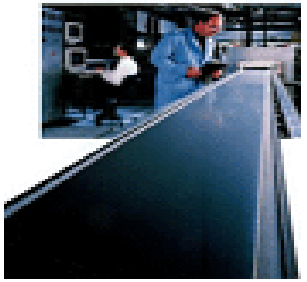
**Notes:** Efficient. Most Common. Less area per watt. Rigid.

**Copper Indium Gallium Diselenide (CIGS)**
12% to 14%

**Notes:** Uses no Silicon. Can be made flexible.

**Cadmium Telluride**
10% to 11%

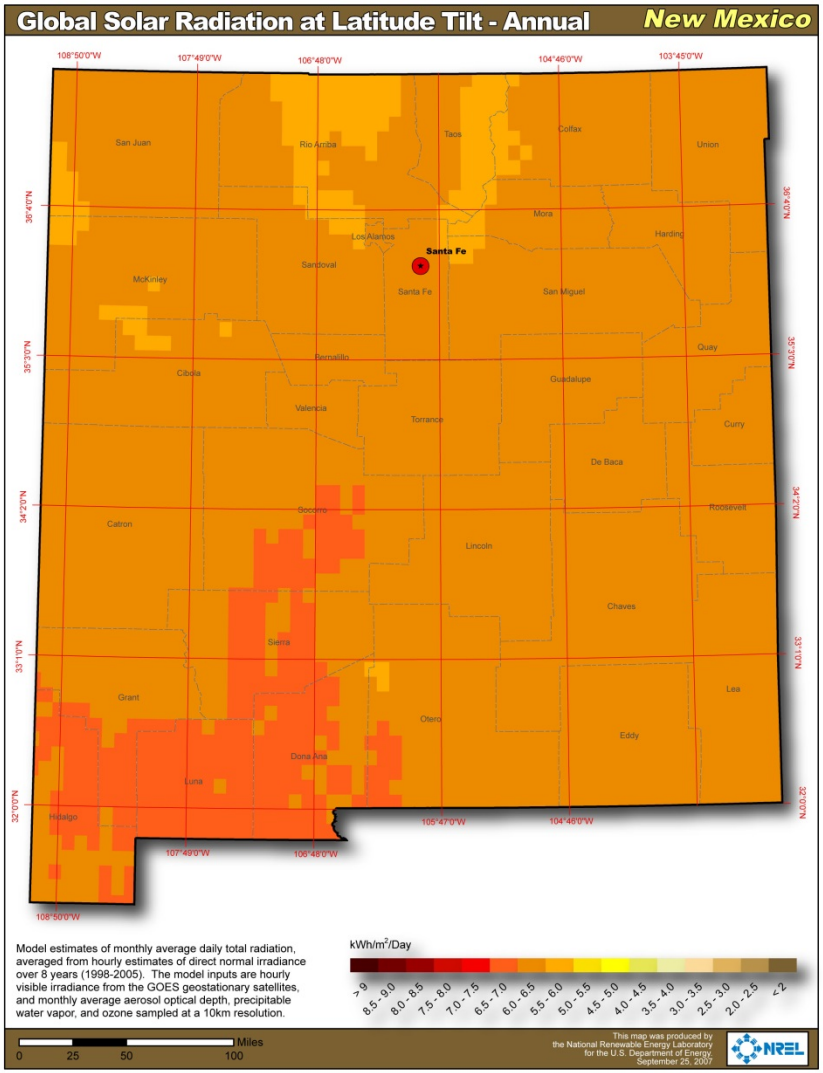
**Notes:** Uses no Silicon. Rigid.

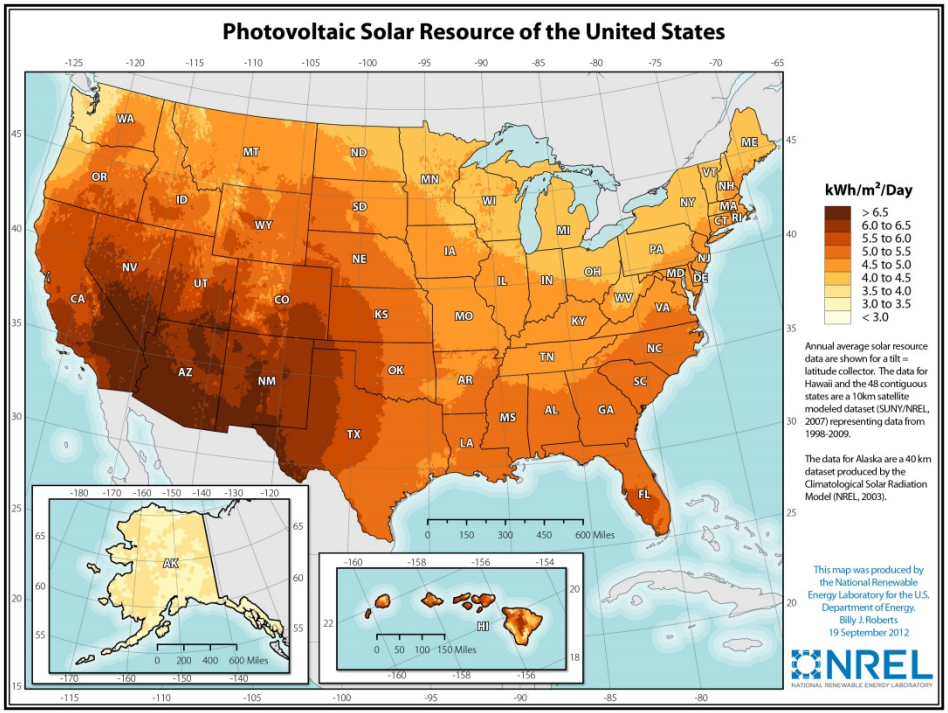


**Thin Film Si**
6 to 11%

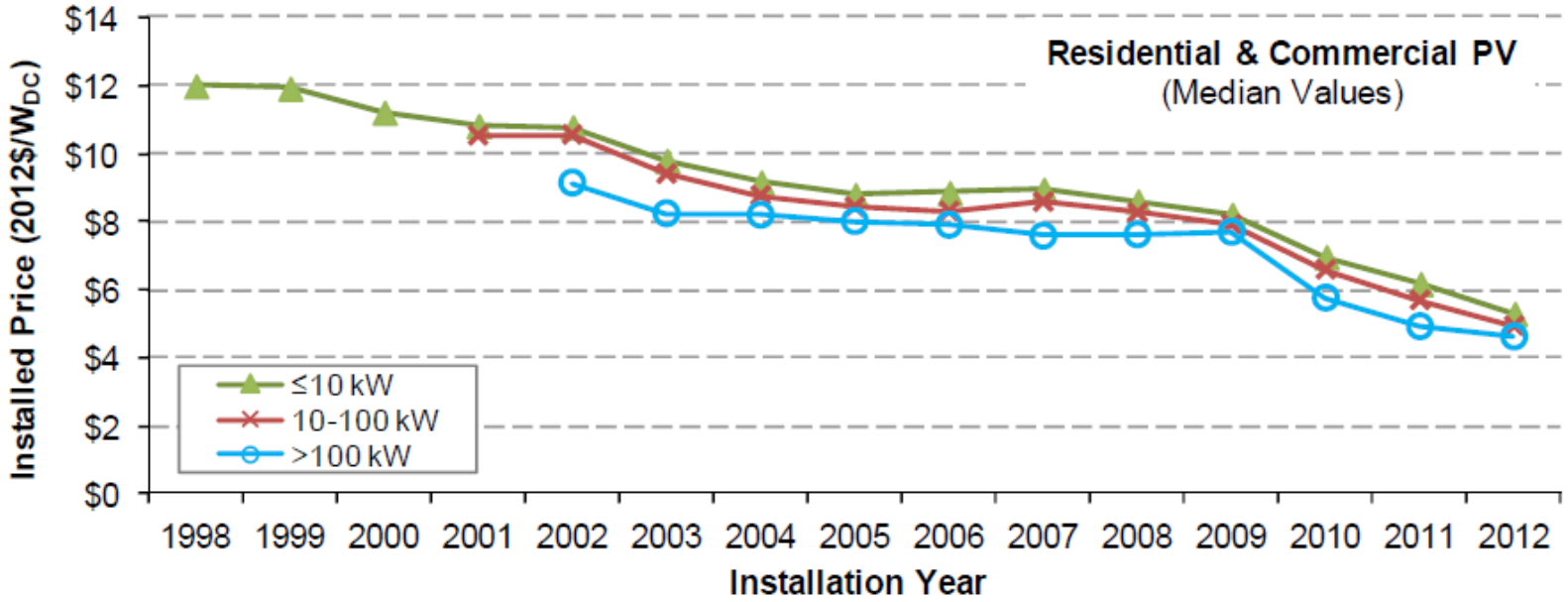
**Notes:** Uses relatively little Silicon. Can be made flexible.

# New Mexico Has Significant Solar Potential



# Installed Price of Residential and Commercial PV Over Time




*Notes: See Table 1 and Table B-2 for residential and commercial PV sample sizes by installation year. Median installed prices are shown only if 15 or more observations are available for the individual size range.*

**Figure 7. Installed Price of Residential & Commercial PV over Time**

Source: EIA 2005 data

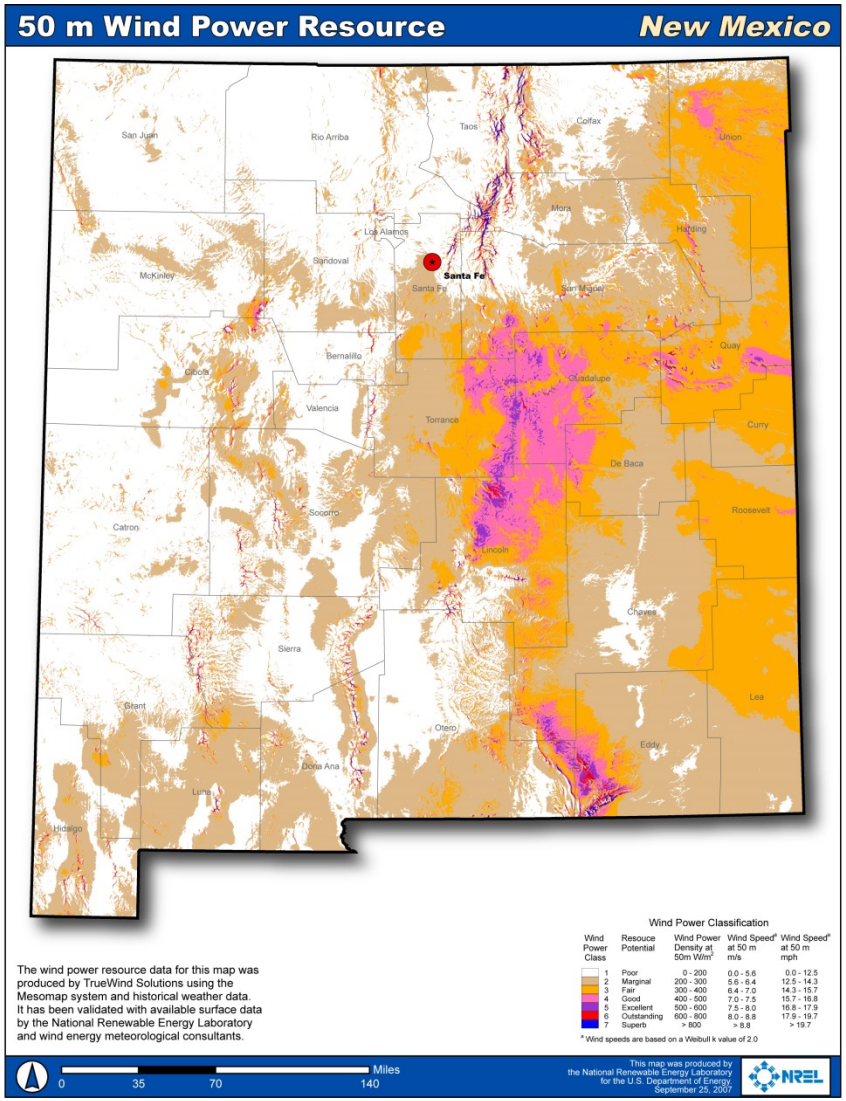
Source: Lawrence Berkeley National Laboratory, "Tracking the Sun VI". http://emp.lbl.gov/sites/all/files/lbnl-6350e.pdf

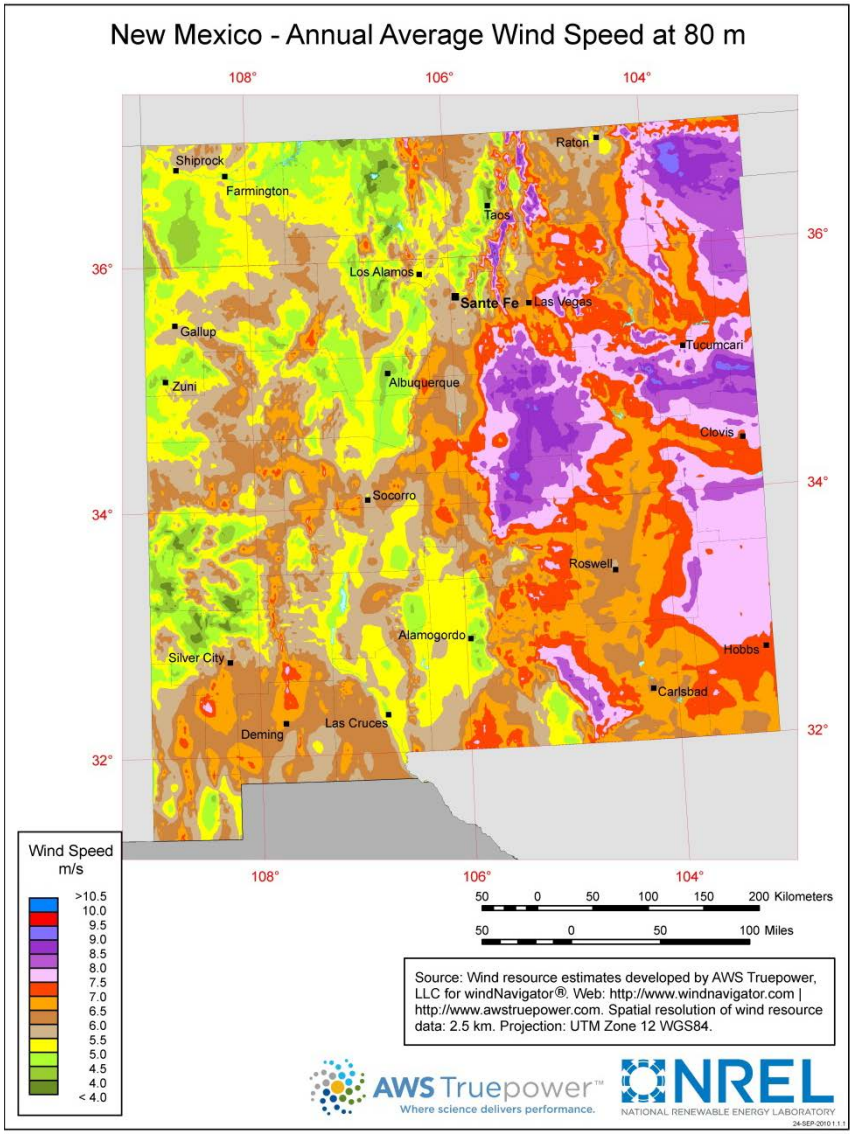
# Useful Solar Resources for PV

| | |
|---|---|
| **PROJECT DEVELOPMENT & FINANCE "GENERAL"** | • For General Project Development & Finance: http://www.nrel.gov/applying_technologies/financing.html<br>• *Tribal Business Structure Handbook* (Nilles, Kathleen, NAFOA): www.nafoa.org<br>• *Renewable Energy Handbook in Indian Country:* (Douglas C. MacCourt and Ater Wynn, Indian Law Practice (http://www.nrel.gov/docs/fy10osti/48078.pdf |
| **PROJECT DEVELOPMENT "RESOURCES"** | • NREL Learning About Renewables: http://www.nrel.gov/learning/re_photovoltaics.html<br>• Renewable Energy Atlas: http://maps.nrel.gov/re_atlas<br>• PVWatts: http://www.nrel.gov/rredc/pvwatts/<br>• RETScreen: http://www.retscreen.net/ang/home.php |
| **PROJECT DEVELOPMENT "OFF-TAKE"** | • Power Purchase Agreement Checklist: http://www.nrel.gov/docs/fy10osti/46668.pdf<br>• Renewable Portfolio Standards: http://apps1.eere.energy.gov/states/maps/renewable_portfolio_states.cfm |

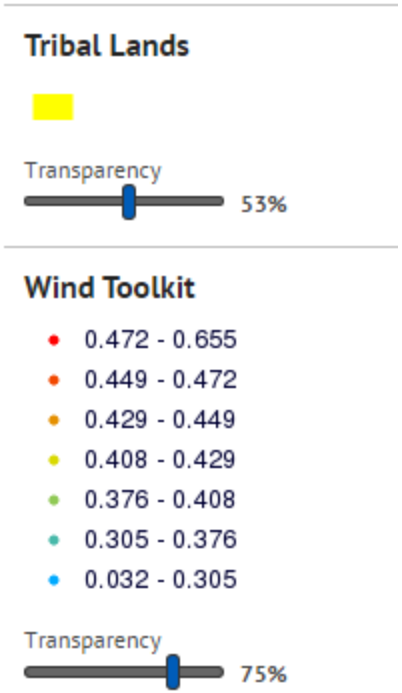

WIND POWER

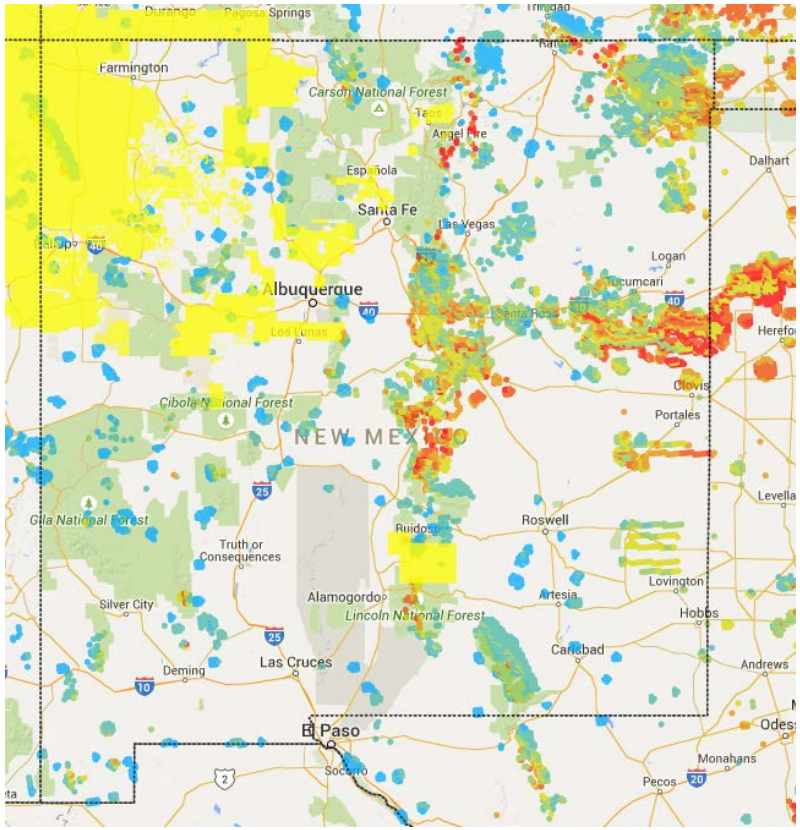
# New Mexico Wind Resource Map



# Wind Prospector Tool




https://mapsbeta.nrel.gov/wind-prospector/?visible=wind_3tier_site_metadata#/?activeLayers=p7FOkI&baseLayer=groad&mapCenter=40.21244%2C-91.625976&zoomLevel=4

# New Mexico Wind Projects

The utility-scale wind power plants in New Mexico are:

- 204 MW New Mexico Wind Energy Center, De Baca and Quay Counties
- 80 MW Caprock Wind Ranch, Quay County
- 120 MW San Juan Mesa Wind Project, Roosevelt County
- 90 MW Aragonne Wind Facility, Guadalupe County
- 2 MW Llano Estacado, Curry County
- 100 MW High Lonesome Mesa, Torrance County
- 102 MW Red Mesa Wind Energy Center, Cibola County
- 50 MW Macho Springs Power

Source: http://www.emnrd.state.nm.us/ECMD/RenewableEnergy/wind.html

# Sizes and Applications

Photo from Bergey Windpower Co. Inc., NREL 02102

## Small (≤100 kW)

- Homes
- Farms
- Remote applications (e.g., water pumping, telecom sites, ice making)

Photo from Tjaden Farms, NREL 13764

## Mid-scale (100 kW –1,000 kW)

- Community power
- Hybrid systems
- Distributed power

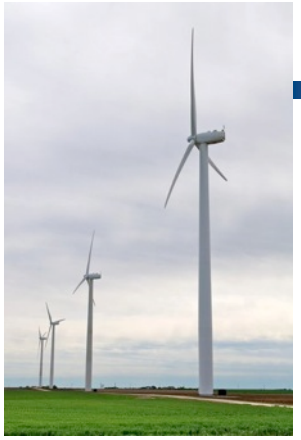
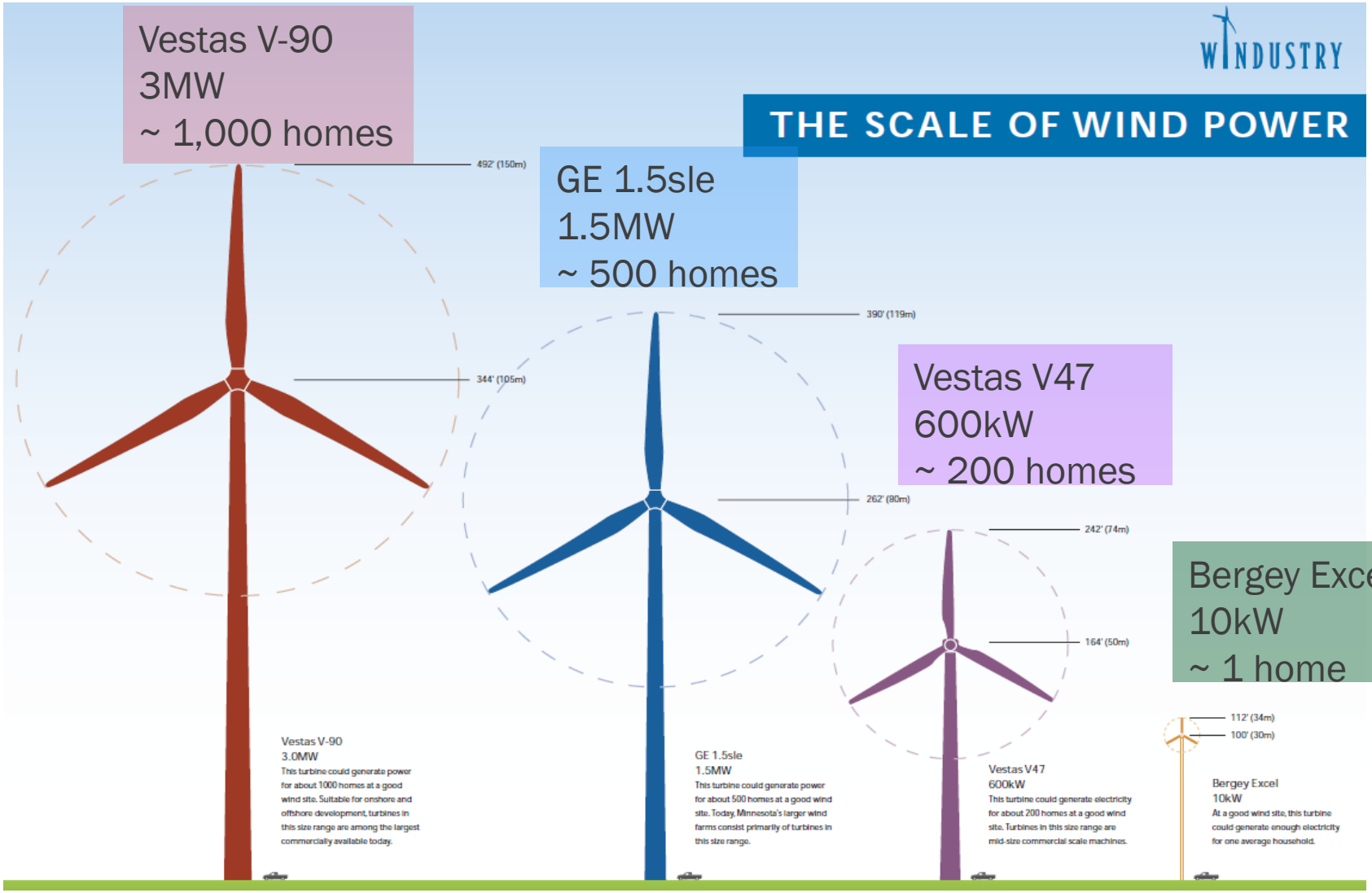


Photo from Native Energy Inc., NREL 7593

## Large, land-based (1 MW –3 MW)

- Utility-scale wind farms
- Large distributed power

# Turbine – Sized to Economic Project Goals



# Key Takeaways

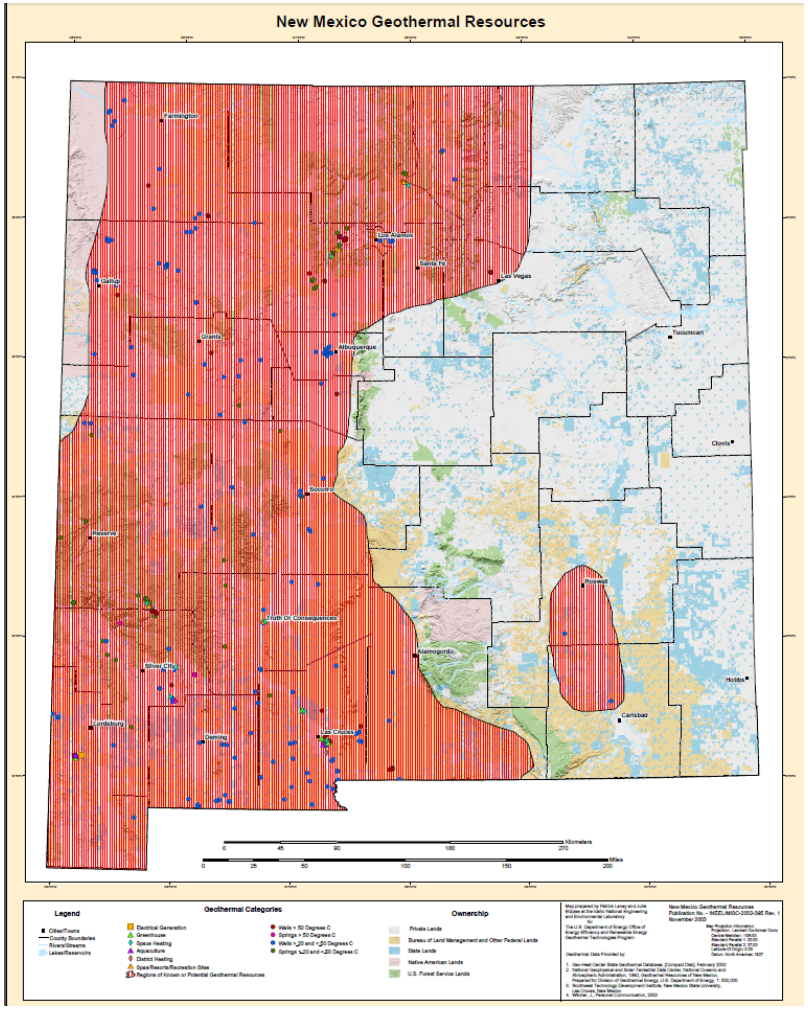
- Wind energy is a mature, yet evolving technology
- Wind energy comes in many sizes, including community-scale
- Wind turbine project development (from 5 kW to 200 MW) has clear impacts to neighbors/neighboring communities that are both positive and negative and therefore requires active stakeholder engagement

# Wind Resources

| | |
|---|---|
| RESOURCE | • http://apps2.eere.energy.gov/wind/windexchange/<br>• Guide to Tribal Clean Energy Development<br>• http://www.akenergyauthority.org/<br>• Guide to Tribal Clean Energy Development |
| TECHNOLOGY | • http://www.nrel.gov/wind/<br>• http://www.smallwindcertification.org/ |
| POLICY | • www.dsireusa.org |


GEOTHERMAL

# NM Geothermal Resource

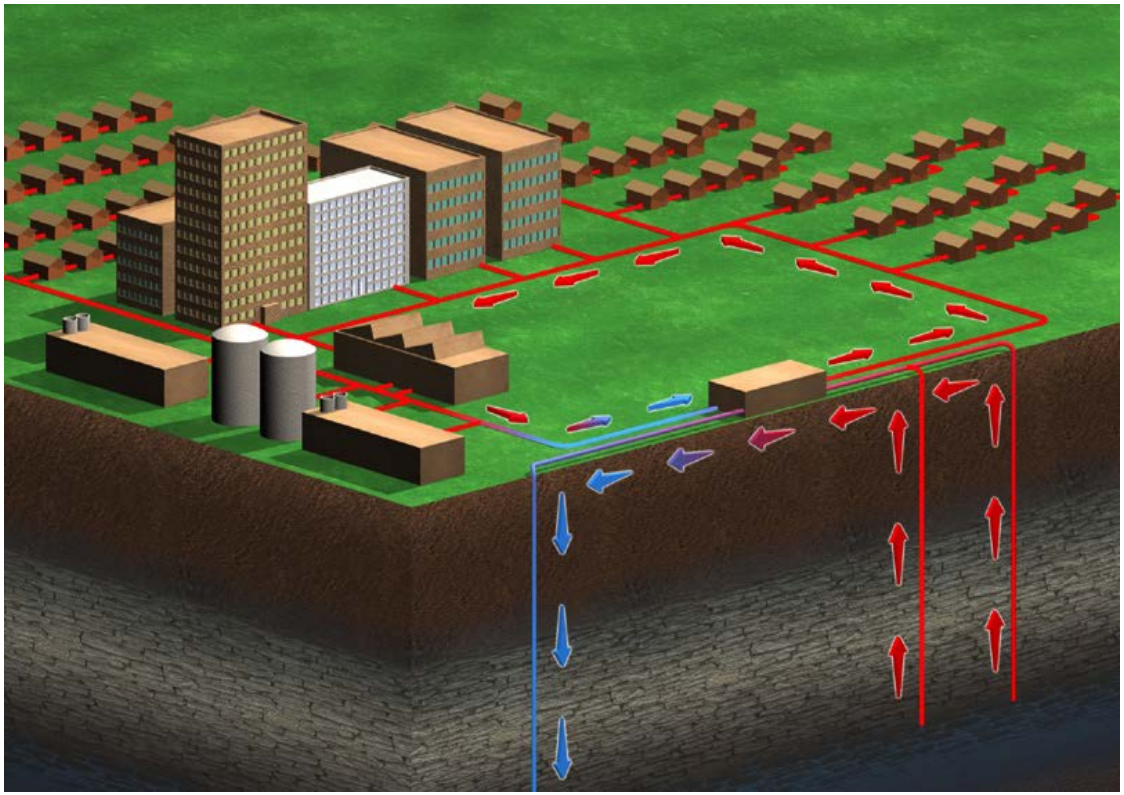



http://www.emnrd.state.nm.us/ECMD/RenewableEnergy/documents/INEELmapgeothermal.pdf

## Geothermal Heat Pumps (Ground Source Heat Pumps)

- Geo-exchange or ground-source heat pumps (low-temperature geothermal) can be cost-effective depending on:
- Soil type or drilling costs
- The cost of energy being offset.
- Drilling obstacles
  - Dense rock will have high construction costs
  - Agreeable soil and possibly warm water will agree with technology

# Community-Scale

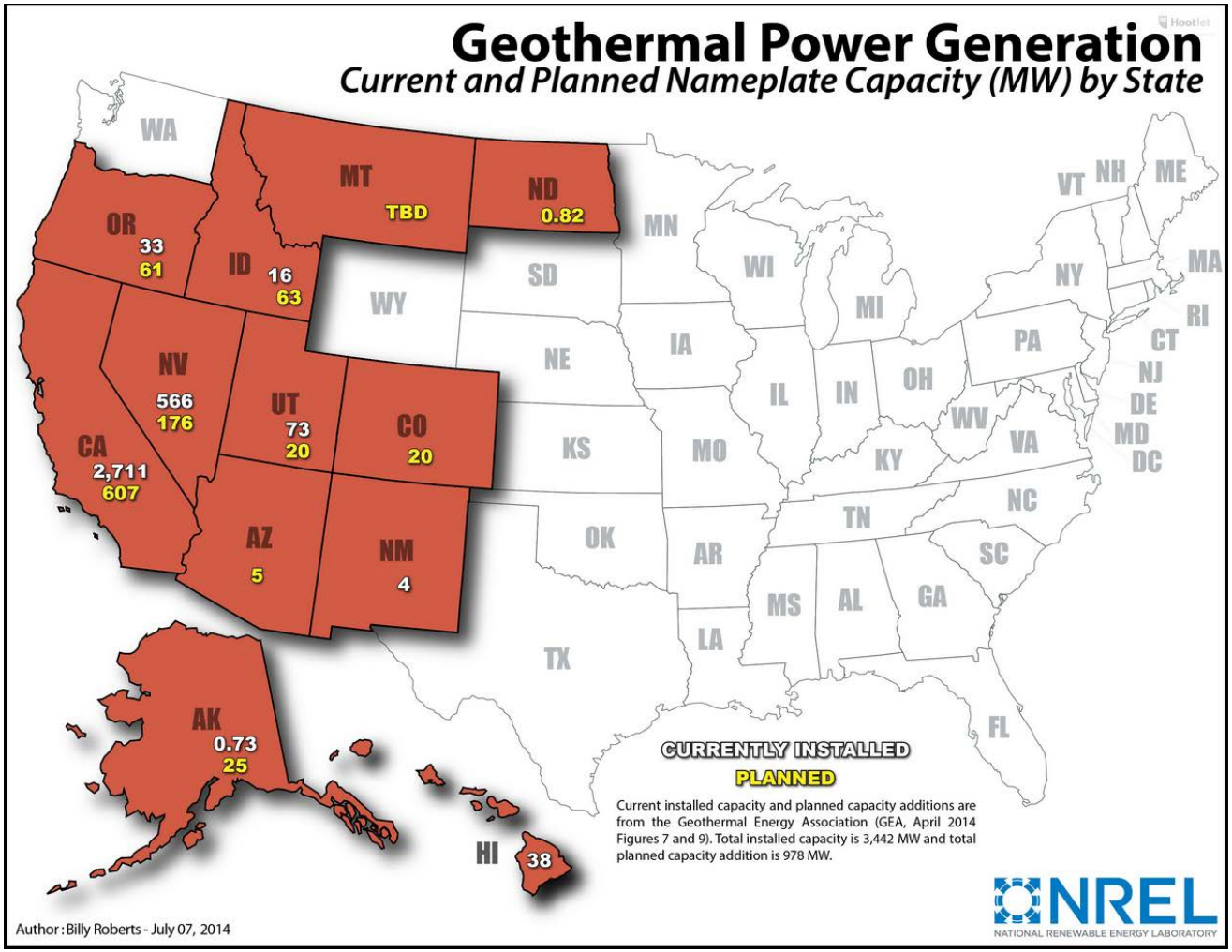


## Direct Use

Uses low-temperature resources:

- District Heating
- Process Heat
- Agriculture
- Aquaculture

# Geothermal Development in the US




Source: http://www.nrel.gov/gis/images/2014_07_14_Geothermal_Capacity-01.jpg

# Dale Burgett Geothermal Plant in Animas Valley, NM

The first phase of the project is delivering 4MW of power to PNM. An additional 6MW are under development.

Photo source: PNM

# Citizen Potawatomi – All in for GSHP

- Cultural Heritage Center
  - 100 ton system
  - Utilizes a pond on the first fairway on our golf course .
  - Finished in 2005
- Grand Casino
  - Approx. 230,000 sq.ft.
  - 1000 ton system with 1000 ton back-up fluid coolers
  - 46 miles of poly pipe
- Bowling Center
  - Bore field under softball complex
- Two Clinics
- Rodeo/Concert Arena
- Elderly and Family Housing


Photo Credit: Donny Vaughn, Citizen Potawatomi Nation

# Useful Geothermal Resources

| | |
|---|---|
| RESOURCE | Renewable maps for Alaska<br>http://map.akenergyinventory.org/ |
| TECHNOLOGY | Geothermal Resources Council:<br>http://www.geothermal.org/ |
| POLICY | Geothermal Regulatory Roadmap:<br>http://en.openei.org/wiki/GRR |