New Mexico: Land of Energy Options

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Theme: "Exploring Energy"

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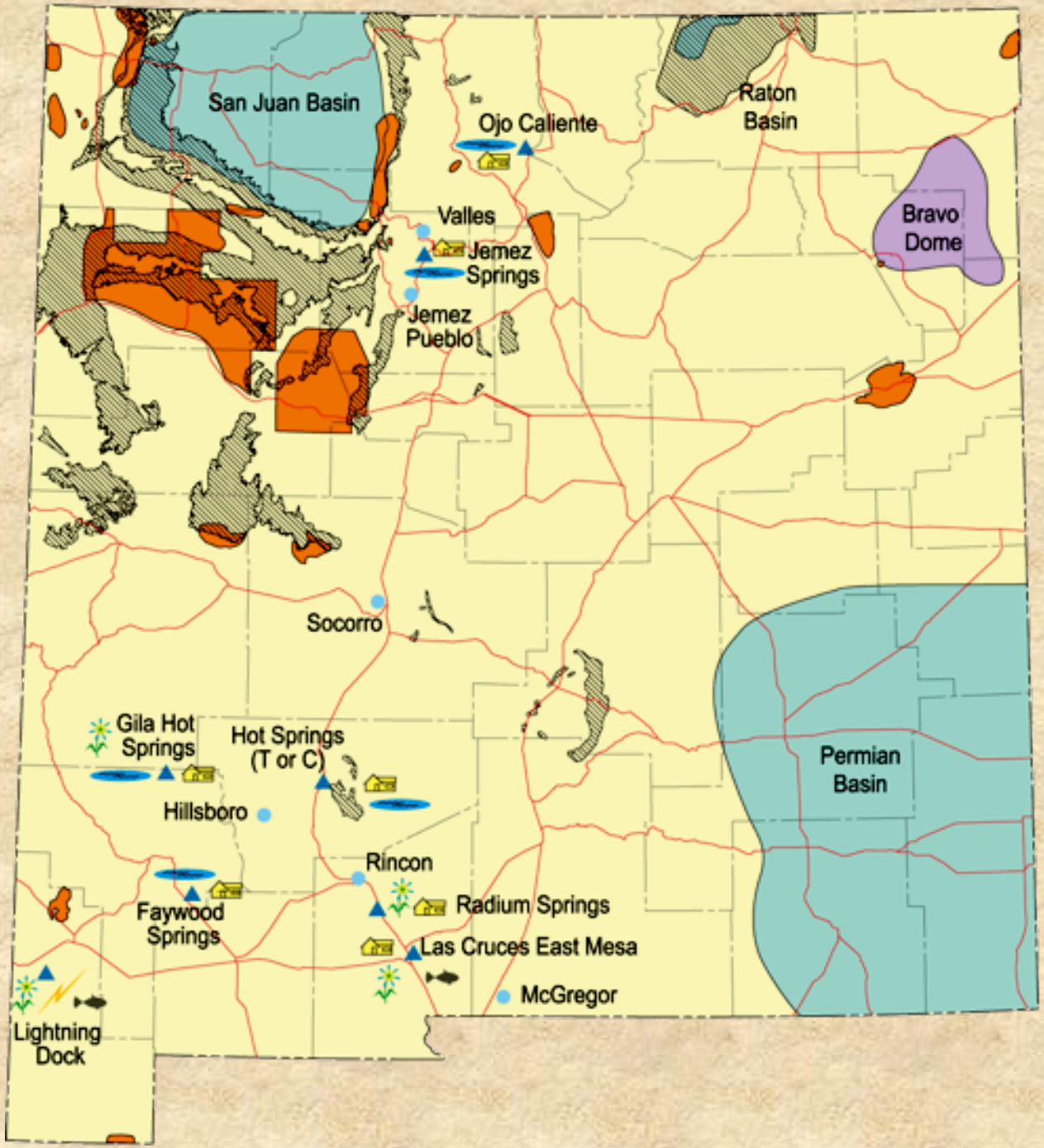
Conventional Energy: NM Economic Mainstay

Commodity	Rank	Annual Production	Annual Value	Year
Natural gas	4th	1.523 trillion cubic feet	$9.65 billion	2006
Oil	6th	59.1 million barrels	$3.99 billion	2006
Coal	13th	26 million short tons	$755 million	2006
Copper	3rd	249 million pounds	$716 million	2006
Potash	1st	831,890 short tons	$238 million	2006
Aggregate	25th	20 million short tons	ca. $129 million	2005
Molybdenum	6th	4.06 million pounds	$85 million	2006
CO_2	2nd - 3rd	101 billion cubic feet	$77 million	2006
Perlite	1st	337,000 short tons	ca. $13 million	2006
Zeolites	1st	35,000 short tons	ca. $3 million	2006

New Mexico's Terrestrial Energy Resources

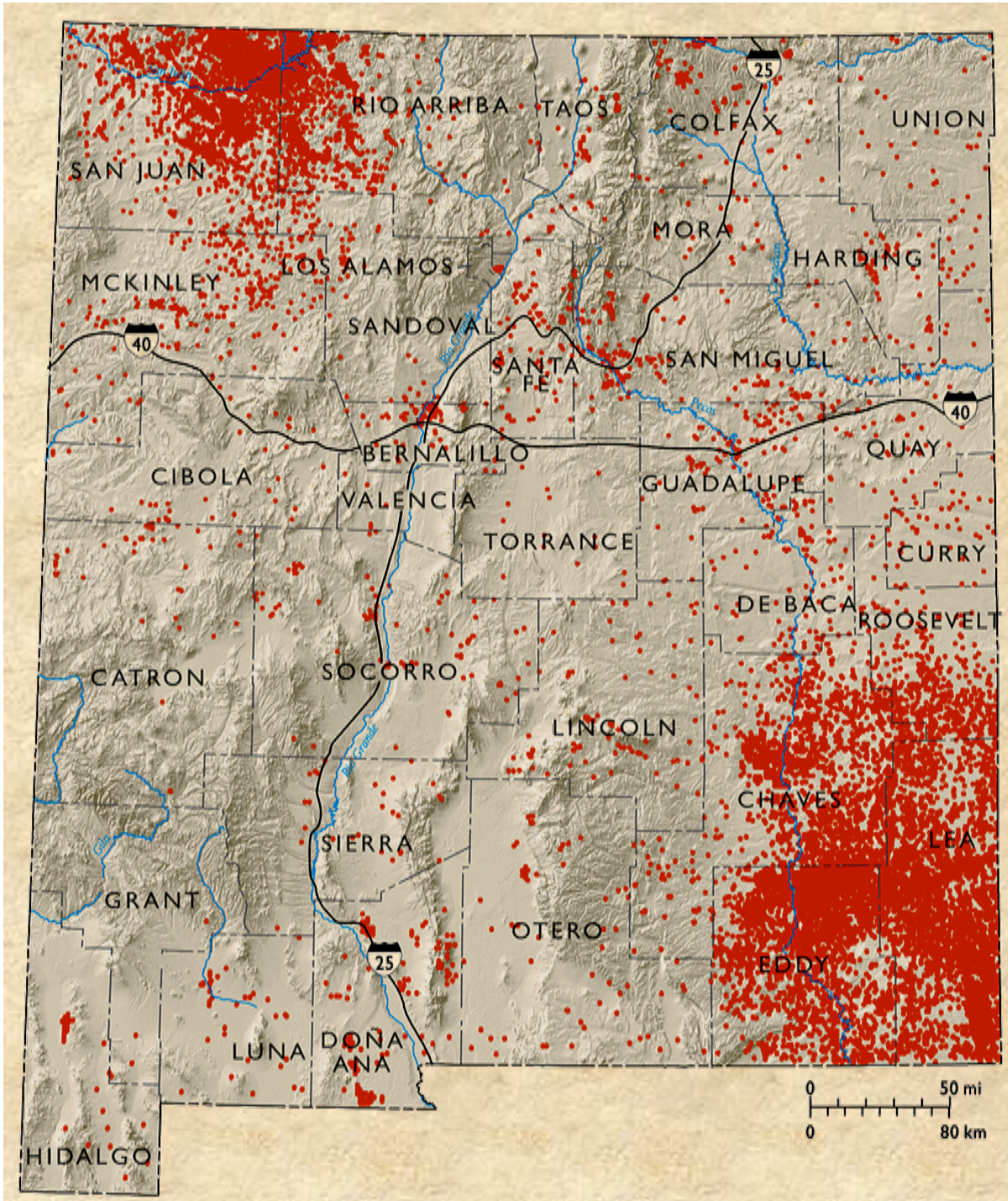


- Coal fields
- Areas of uranium resources
- Major oil, natural gas, and coalbed methane production
- Carbon dioxide production
- Geothermal Areas
  - aquaculture
  - greenhouse
  - resort/spa
  - space heating
  - electric power
- Major geothermal prospects

Source: NM Bureau of Geology & Mineral Resources

Oil and Natural Gas

- Look northwest and southeast
- New Mexico was 4th in natural gas production in 2008 and 6th to 8th in oil production over the past 3 years. New Mexico rivals Colorado and Wyoming as the Nation's top coalbed methane producer, and about one-third of all natural gas produced in New Mexico is coalbed methane.



Location of Oil and Gas Wells with Available Cuttings

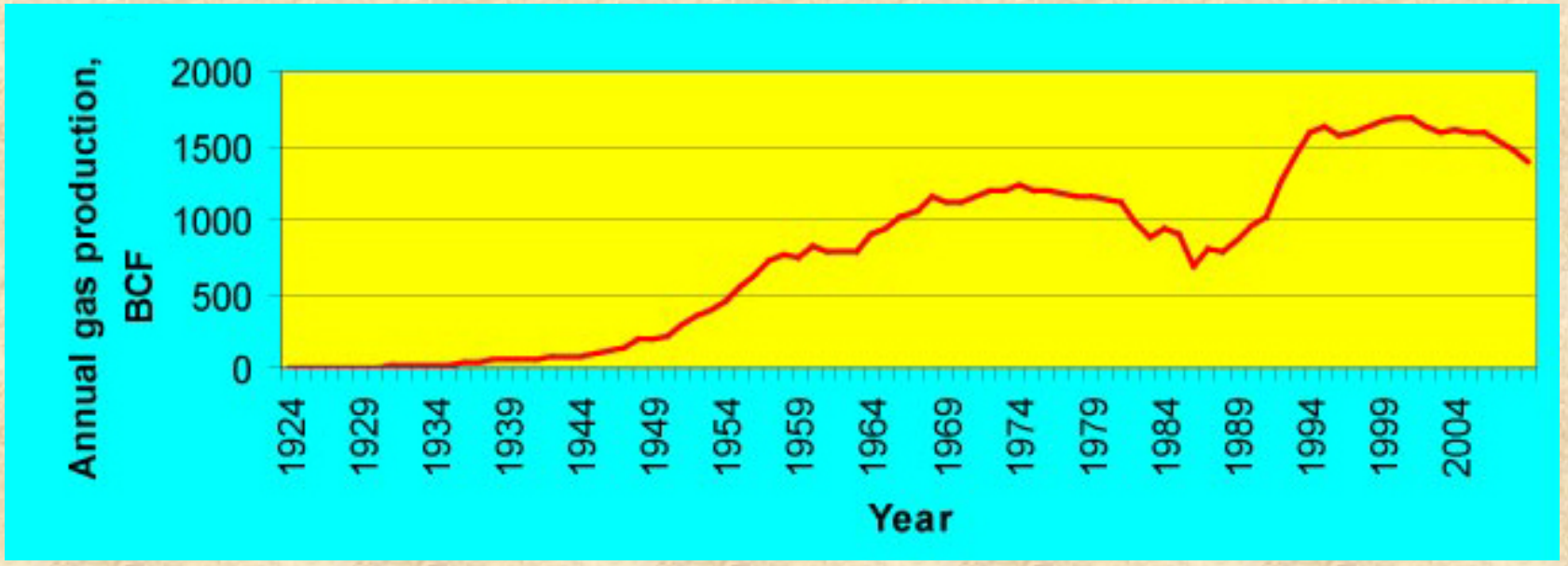
About 16,600 of the more than 100,000 such wells drilled in NM

Source: NM Bureau of Geology & Mineral Resources

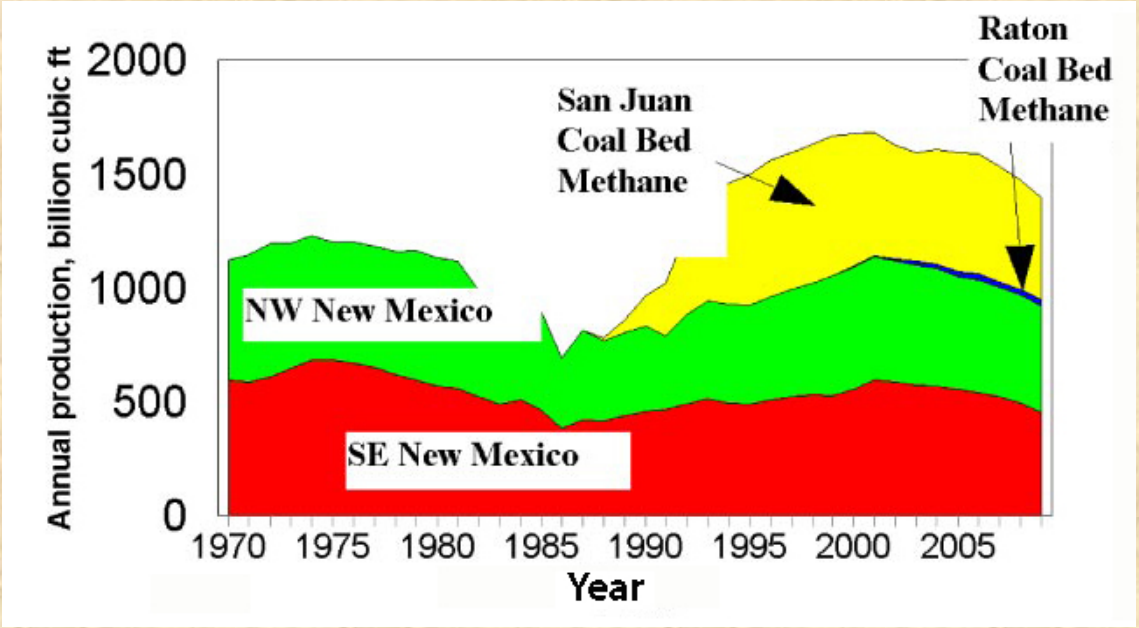
New Mexico Oil Production is Declining

Data from U.S. Energy Information Administration, 2010

New Mexico Gas Production is Stable…

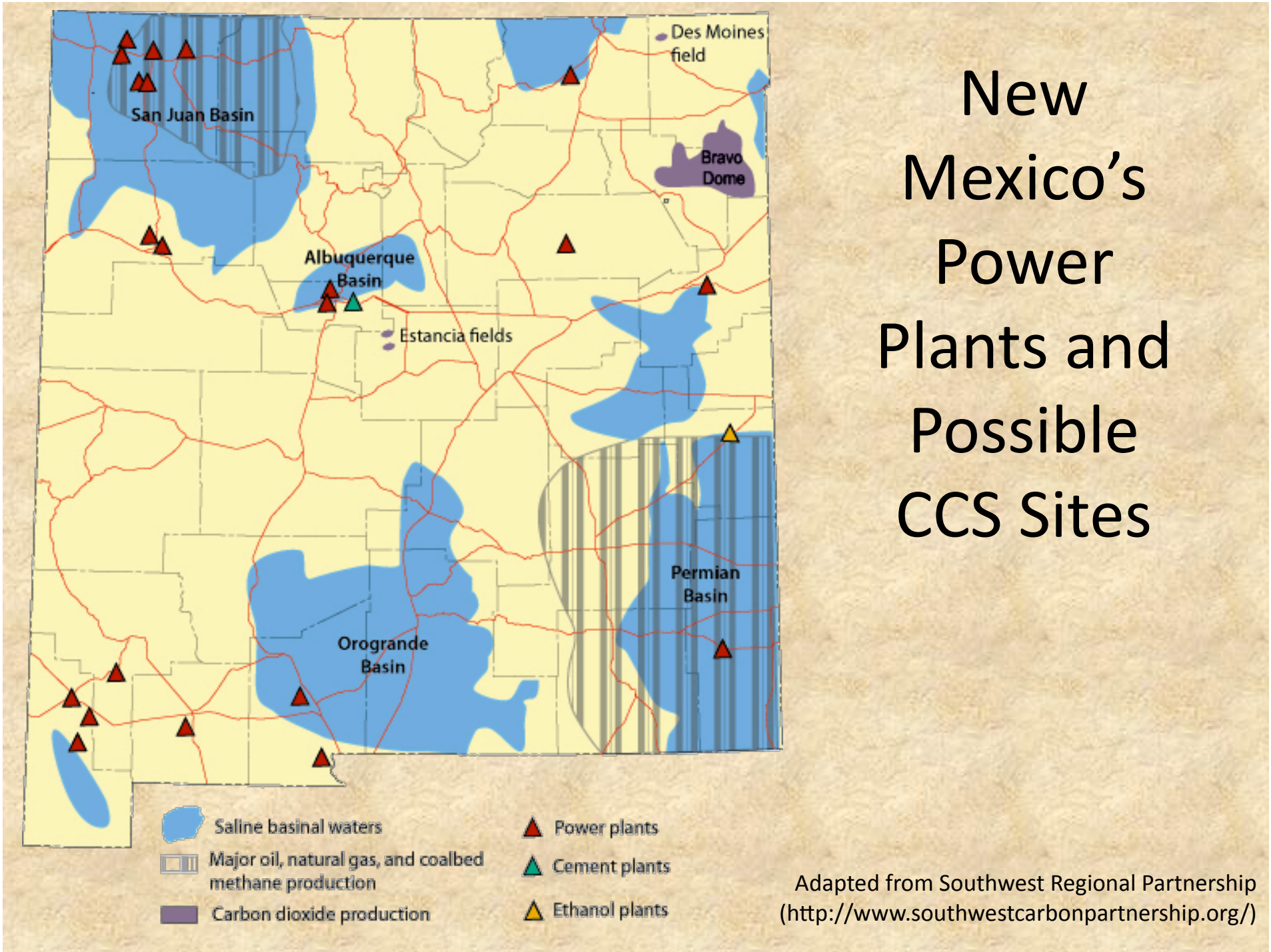


but only because of coal-bed methane production



Coal

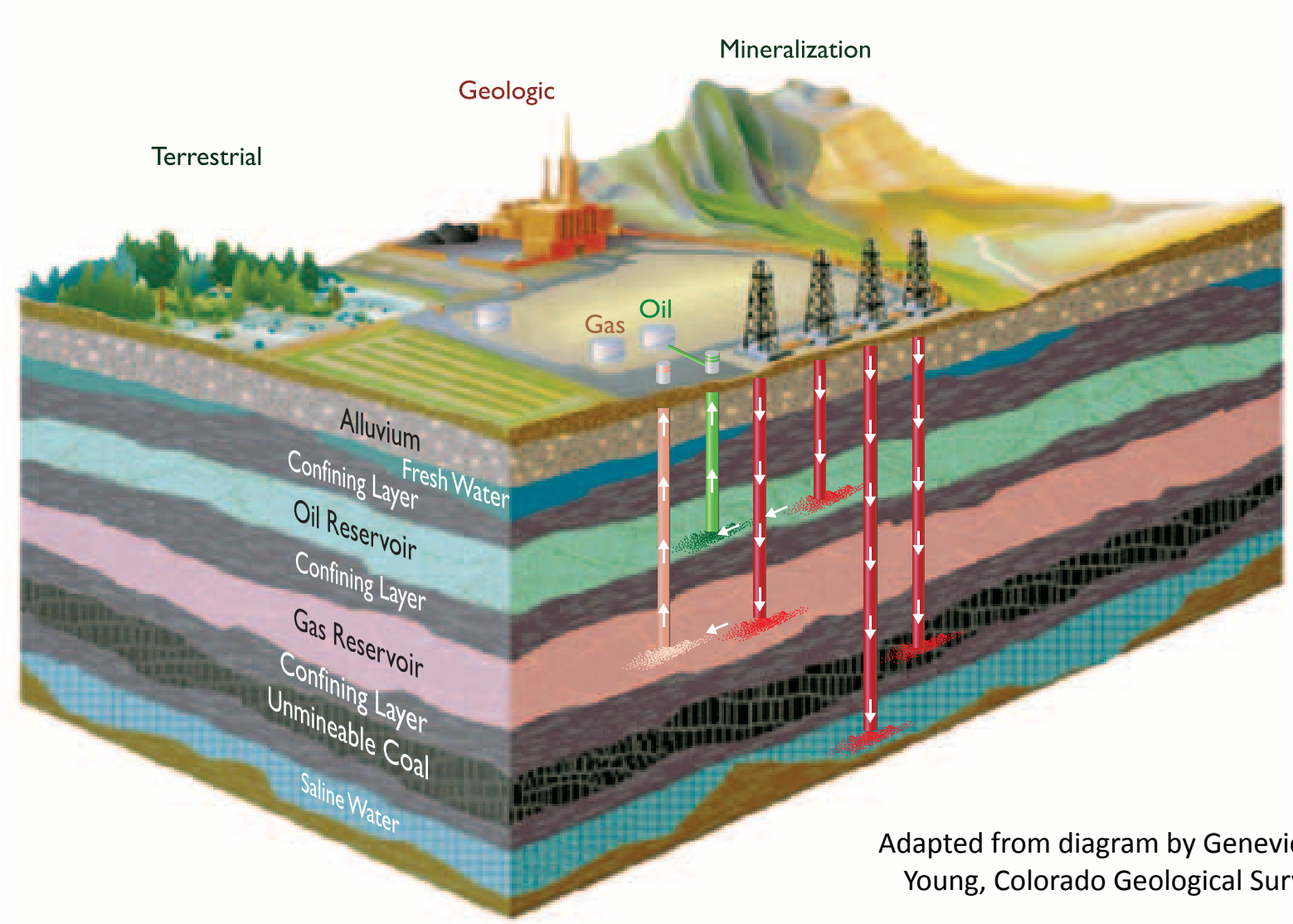
- Look northwest
- New Mexico was 12th in coal production in 2008 with an output of 25.8 million short tons and an approximate market value of $930 million.
- Most is burned in New Mexico to generate electricity due to lack of railroad infrastructure in the northern San Juan basin from which we now get 62% of our coal).
- Stable production but future dependent on possible carbon taxes, cap & trade programs and the like. Future use will likely also involve carbon capture and storage (CCS).



New Mexico's Power Plants and Possible CCS Sites

Adapted from Southwest Regional Partnership (http://www.southwestcarbonpartnership.org/)

Carbon Sequestration Scenarios

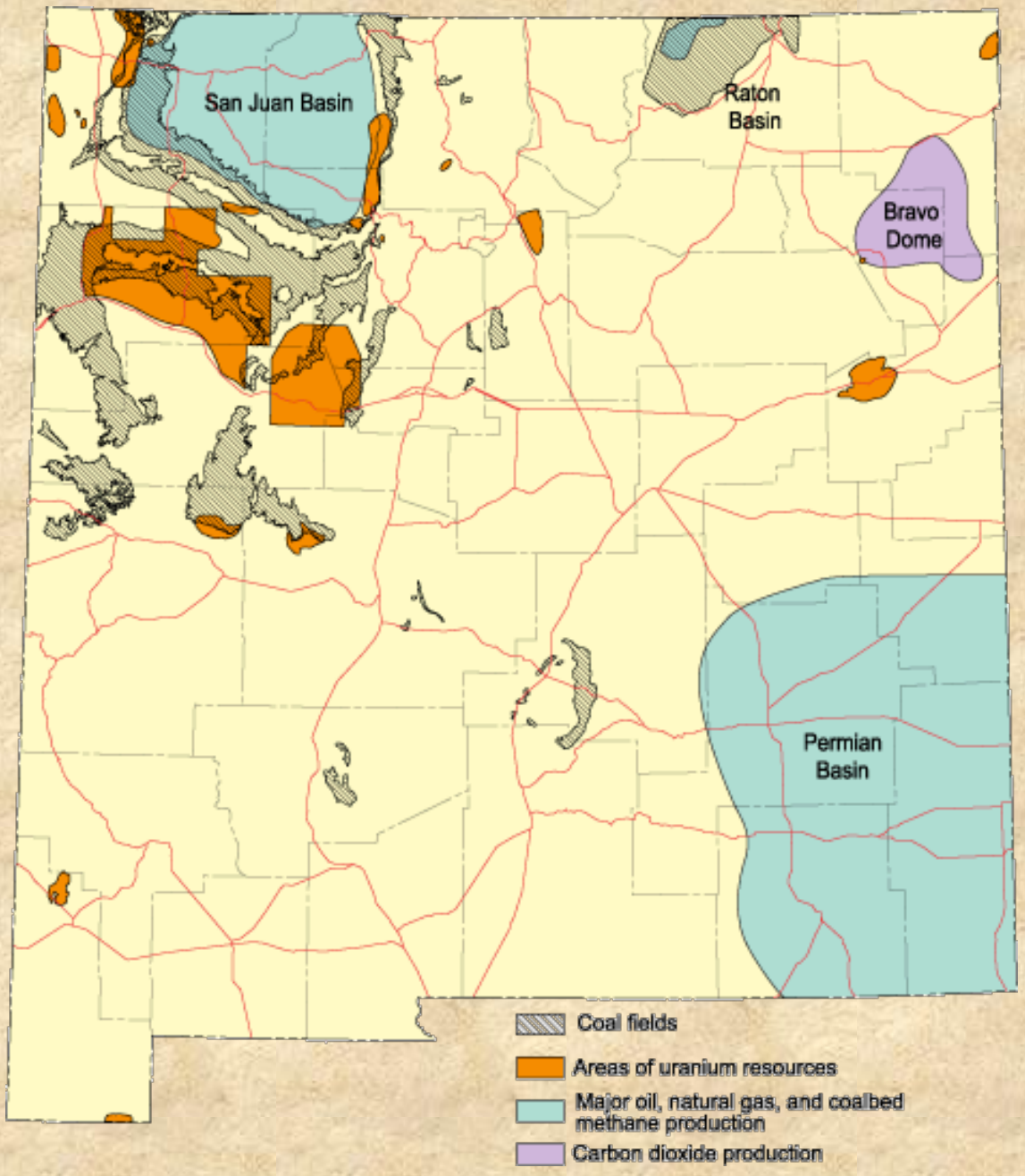


Adapted from diagram by Genevieve Young, Colorado Geological Survey

Uranium/Nuclear

- Look northwest for uranium and southeast for other nuclear.
- New Mexico is 2nd in uranium reserves (after Wyoming) with 84 million pounds (if prices are $30/lb) and 341 million pounds (@ $50/lb).
- New Mexico also hosts the nation's only operating underground radioactive waste repository (the WIPP site near Carlsbad).
- Although nuclear energy produces little CO_2, uranium mining, nuclear plant construction, and uranium mining are all controversial because of potential pollution issues.

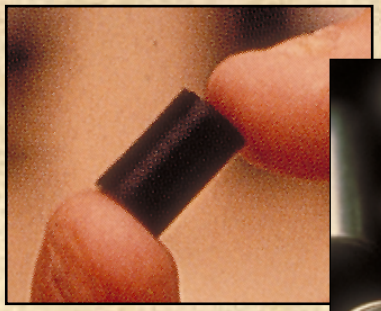
Source: U.S. Energy Information Agency (2006)
http://www.eia.doe.gov/cneaf/nuclear/page/reserves/uresst.html



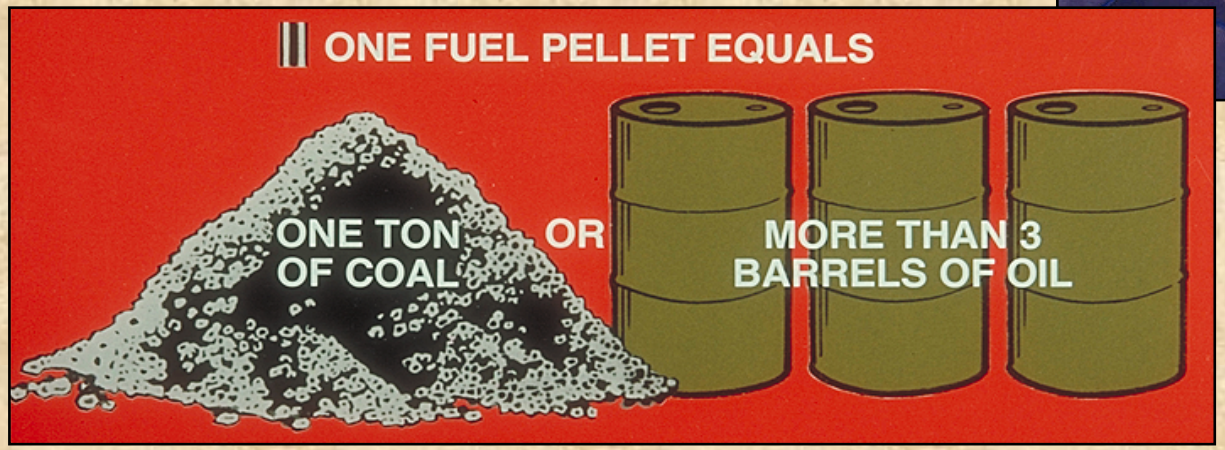
Location of New Mexico's "Traditional" Energy Resources

Source: NM Bureau of Geology & Mineral Resources

Although Nuclear Energy Poses Some Environmental Issues …



it has about a million times the energy density of conventional fuels

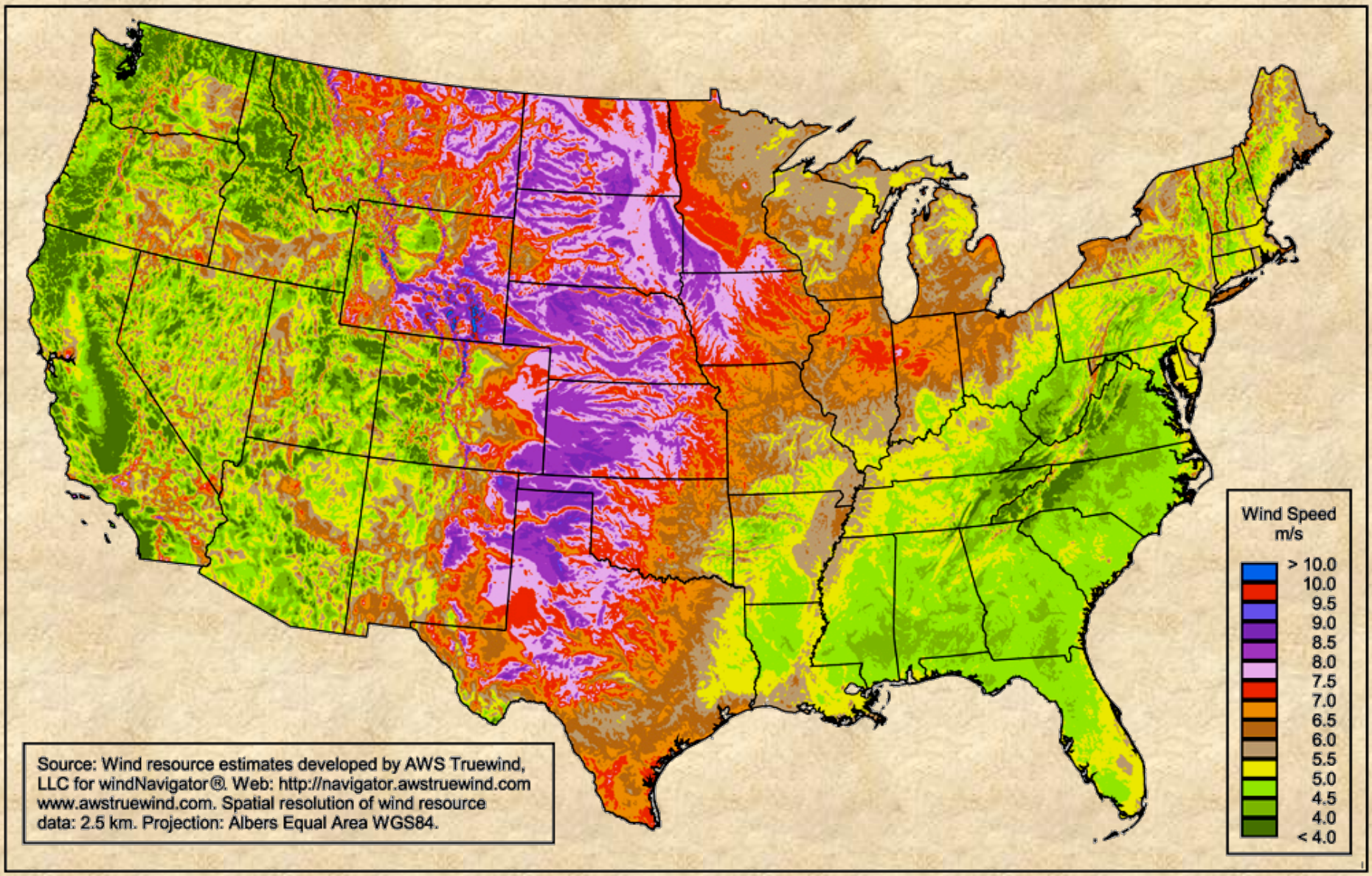


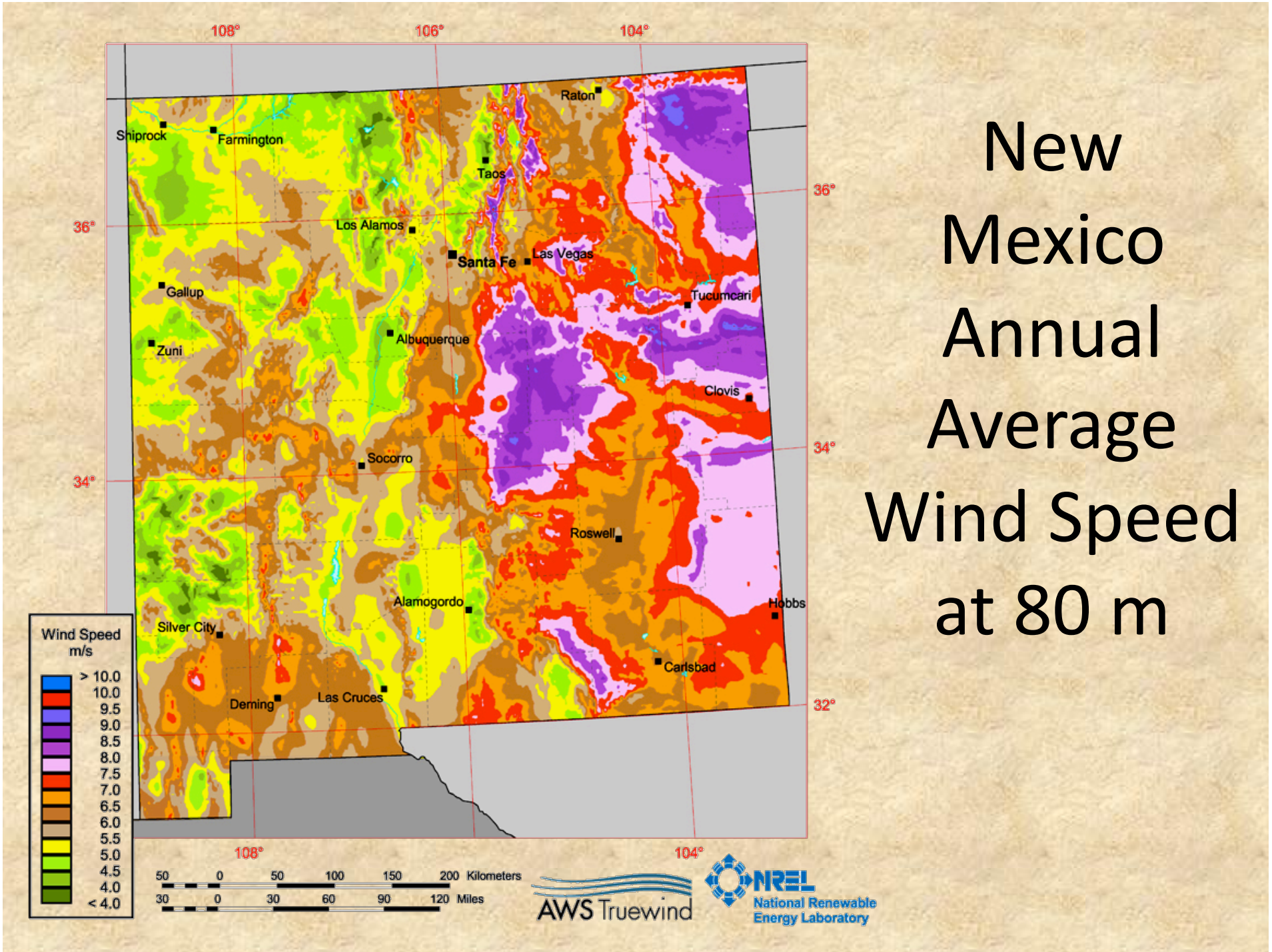
Source: TU Electric & World Nuclear Org.

Wind Energy

- Look east — the High Plains is the main area of wind energy potential
- New Mexico is now ranked #10 nationally in wind energy potential, but has only about 1/16th the installed wind power capacity of Texas, the national leader in wind power production.

Annual Average Wind Speed at 80 m



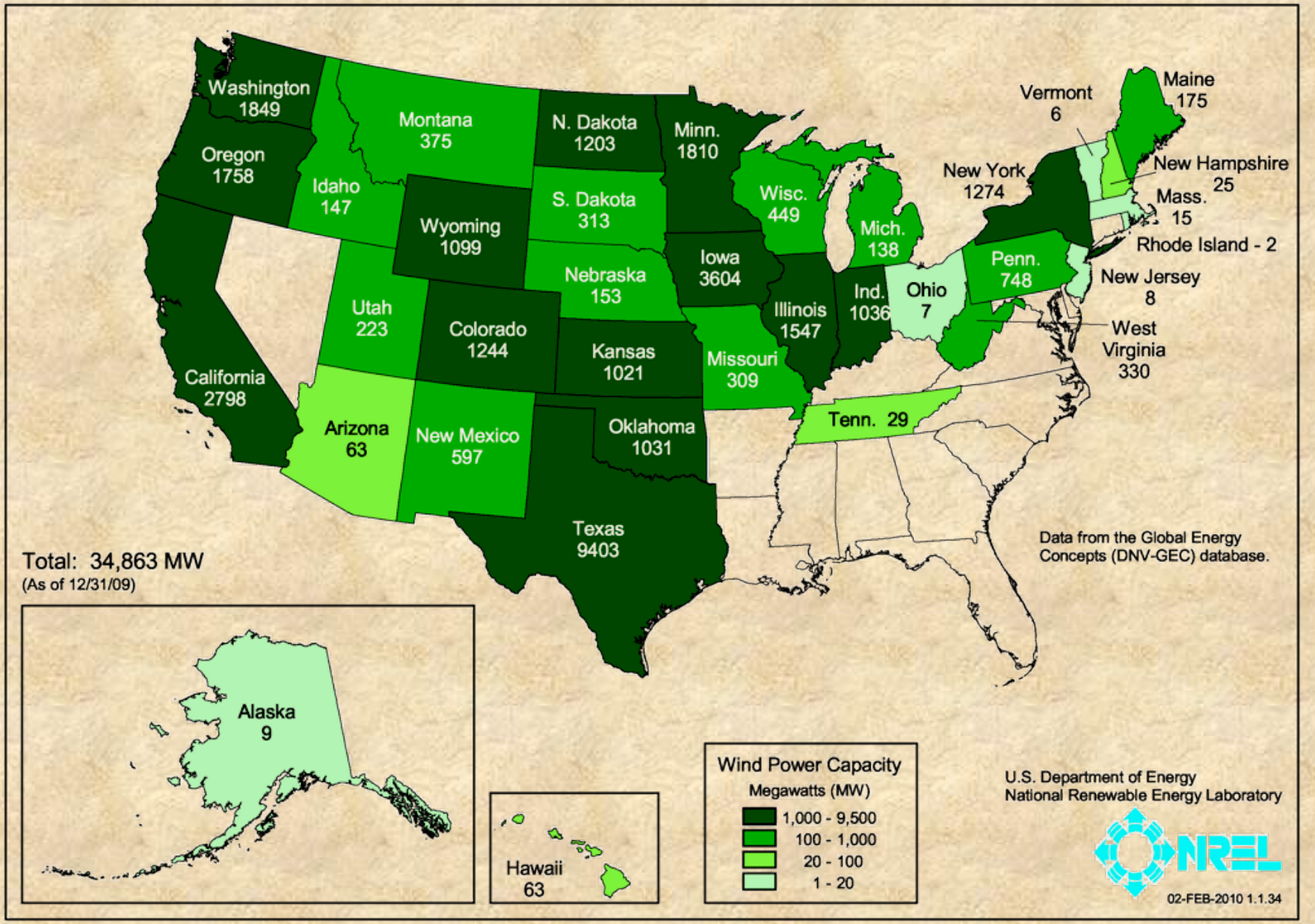


New Mexico Annual Average Wind Speed at 80 m

Some New Mexico Wind Power Installations on the High Plains

Source: http://www.emnrd.state.nm.us/ECMD/renewableenergy/wind.htm

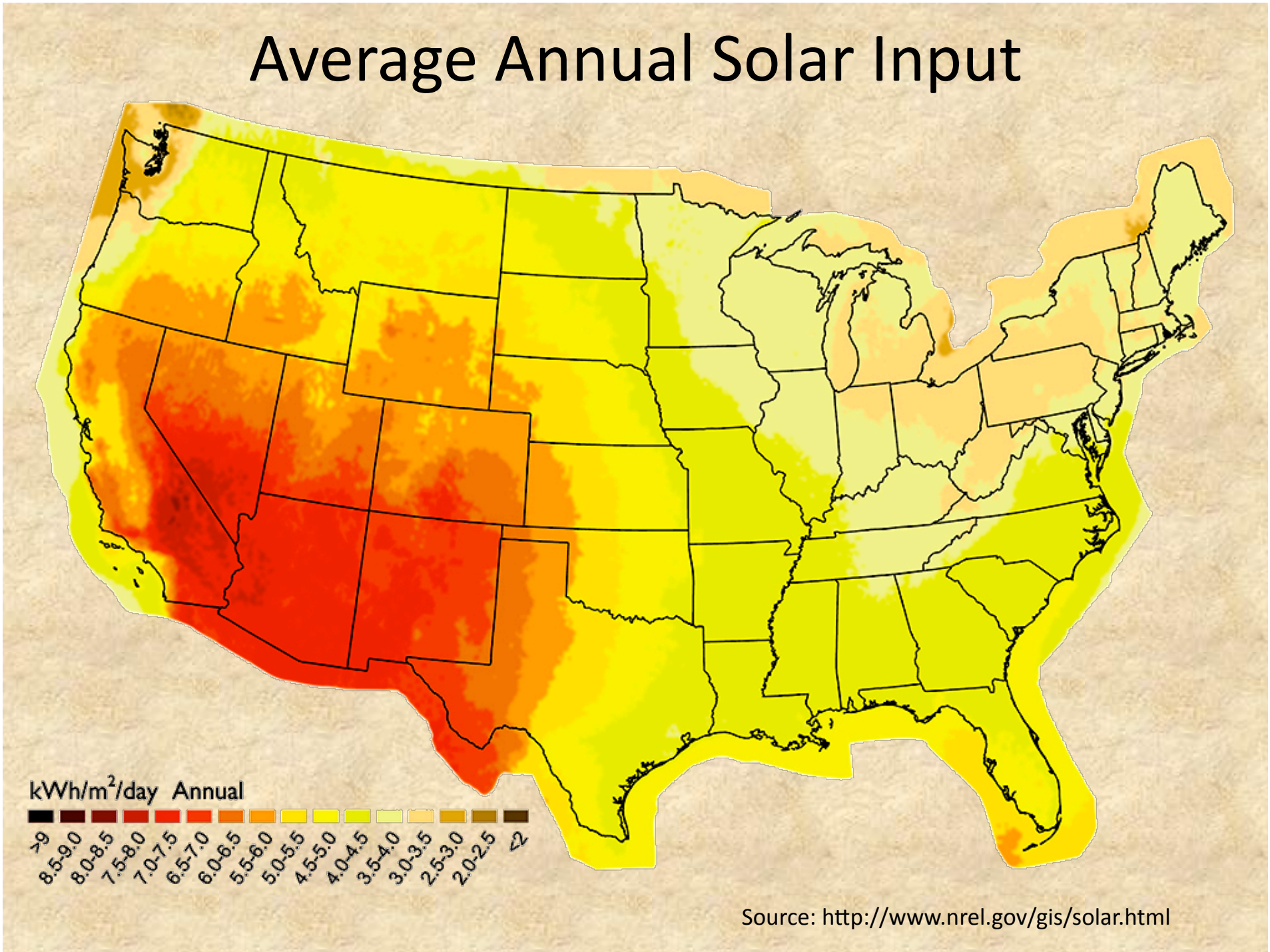
Installed US Wind Power, Dec. 2009 (MW)



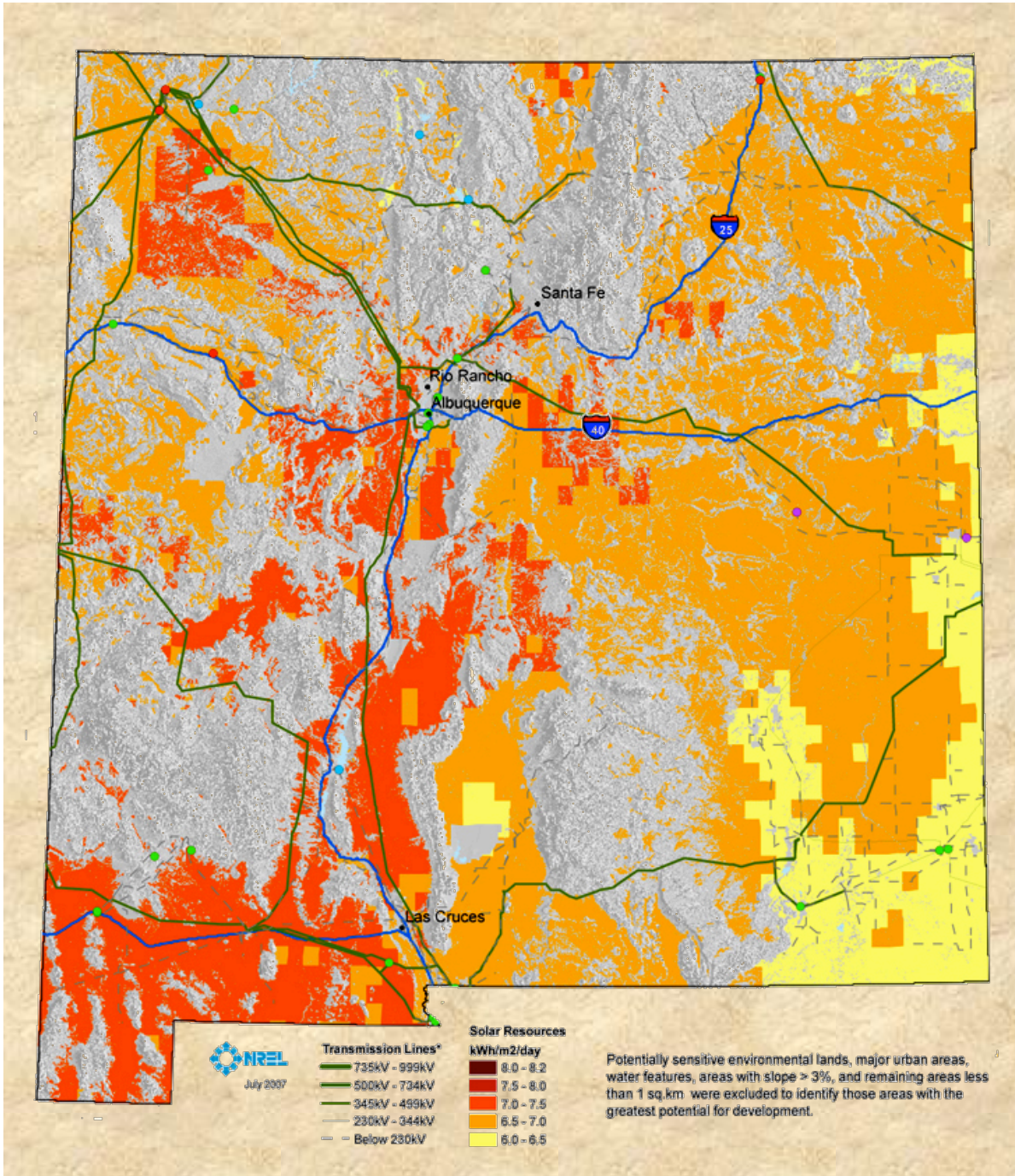
Solar Energy

- New Mexico is now ranked #3 nationally in solar energy potential (behind only Nevada and Arizona) for both concentrating power plants and distributed solar facilities.
- Investment in New Mexico solar has been slow, but several large projects concentrating facilities have been proposed and will likely proceed when the economy improves and if we have a national and state mandate for renewable energy.

Average Annual Solar Input



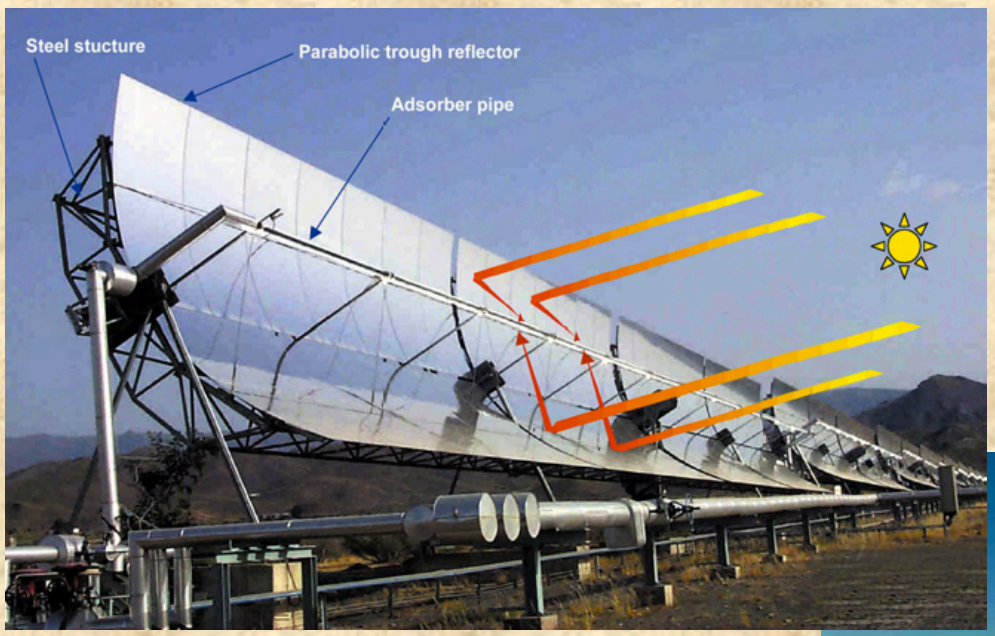
Source: http://www.nrel.gov/gis/solar.html



Prospective Areas for Concentrating Solar Power in New Mexico

Source: http://www.nrel.gov/csp/maps.html

Typical Concentrating Solar Installation



Parabolic Trough System – aligned north-south, these reflectors rotate during the day to collect maximum sunlight an focus it on the absorber pipe.

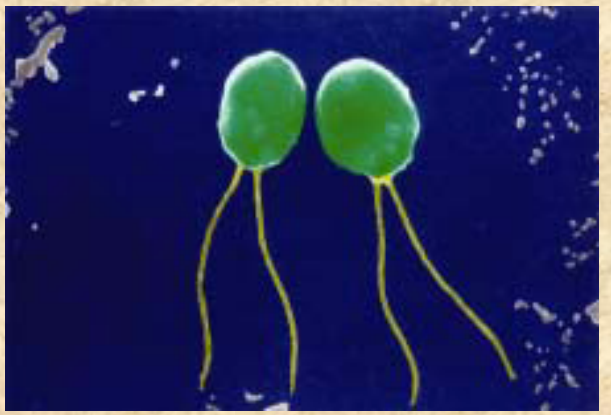
Aerial view of the Kramer Junction site in California with five 30 MW trough installations.

From: New Mexico Concentrating Solar Plant Feasibility Study (NMEM&NR Department)

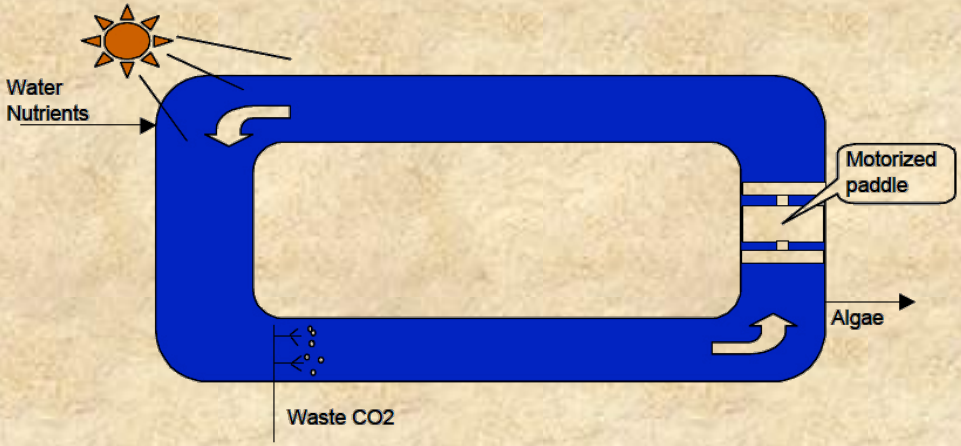
Algal Biodiesel

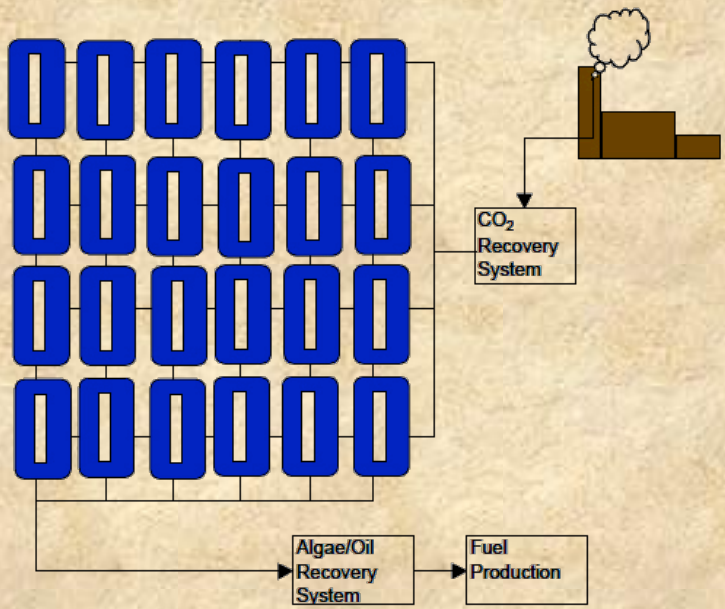
- Look to the southwest and south-central parts of the state.
- It's not just pond scum anymore — algal biodiesel can use the saline waters, abundant sunshine and wide-open desert lands of New Mexico to produce fuels.
- New Mexico already has several experimental facilities near Las Cruces and Artesia and production-scale facilities are not far off.

Algal Biodiesel



"Put quite simply, microalgae are remarkable and efficient biological factories capable of taking a waste (zero-energy) form of carbon (CO2) and converting it into a high density liquid form of energy (natural oil)."



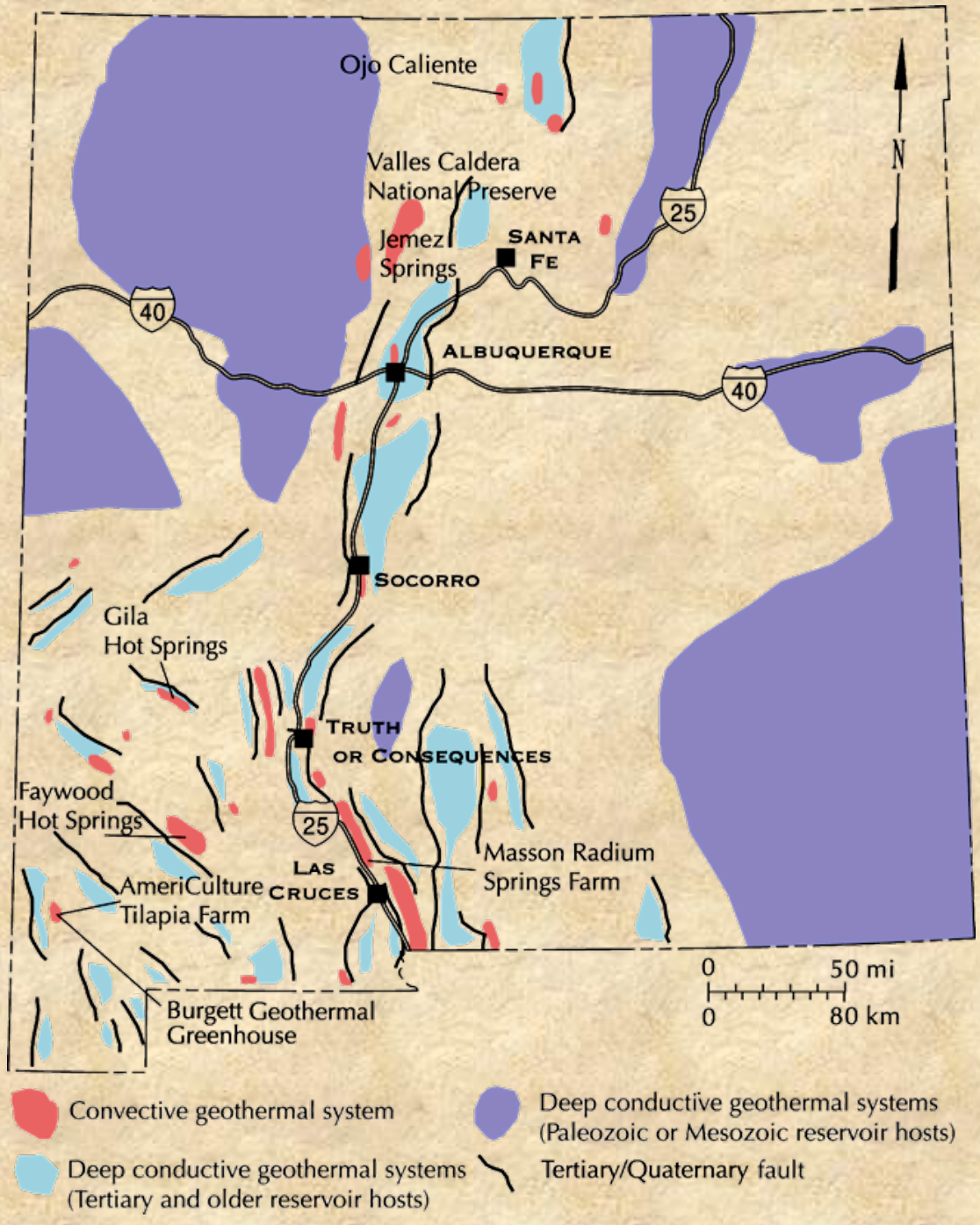


Source: *www.nrel.gov/docs/legosti/fy98/24190.pdf*

Geothermal

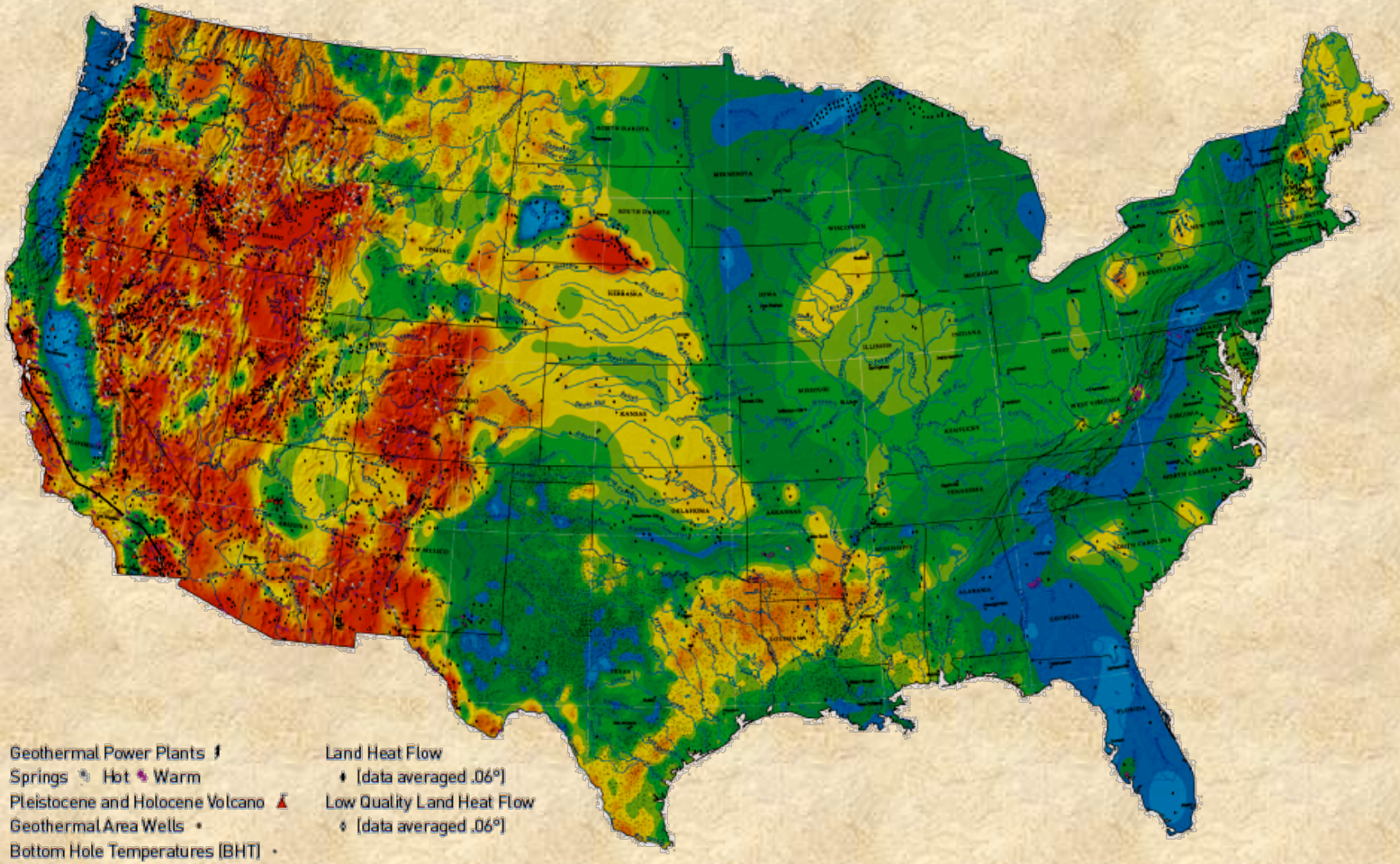
- Look north to southwest through the central part of the state.
- New Mexico has significant geothermal energy potential (ranked 6th in potential for enhanced geothermal systems; http://www.google.org/egs/)

New Mexico Geothermal Facilities and Prospects



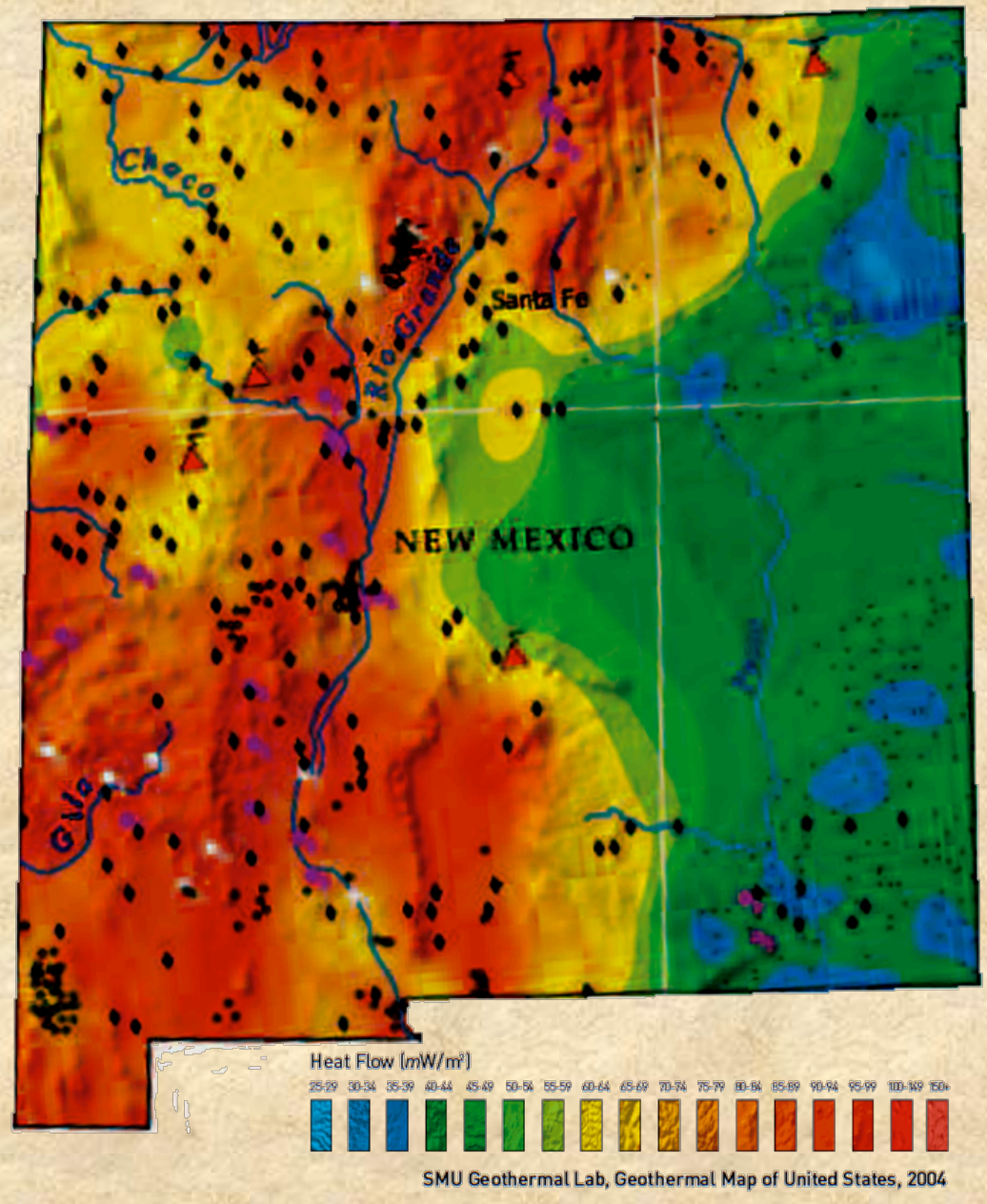
Source: Jim Witcher and NM Bureau of Geology & Mineral Resources

Geothermal Map of the United States



SMU Geothermal Lab, Geothermal Map of United States, 2004

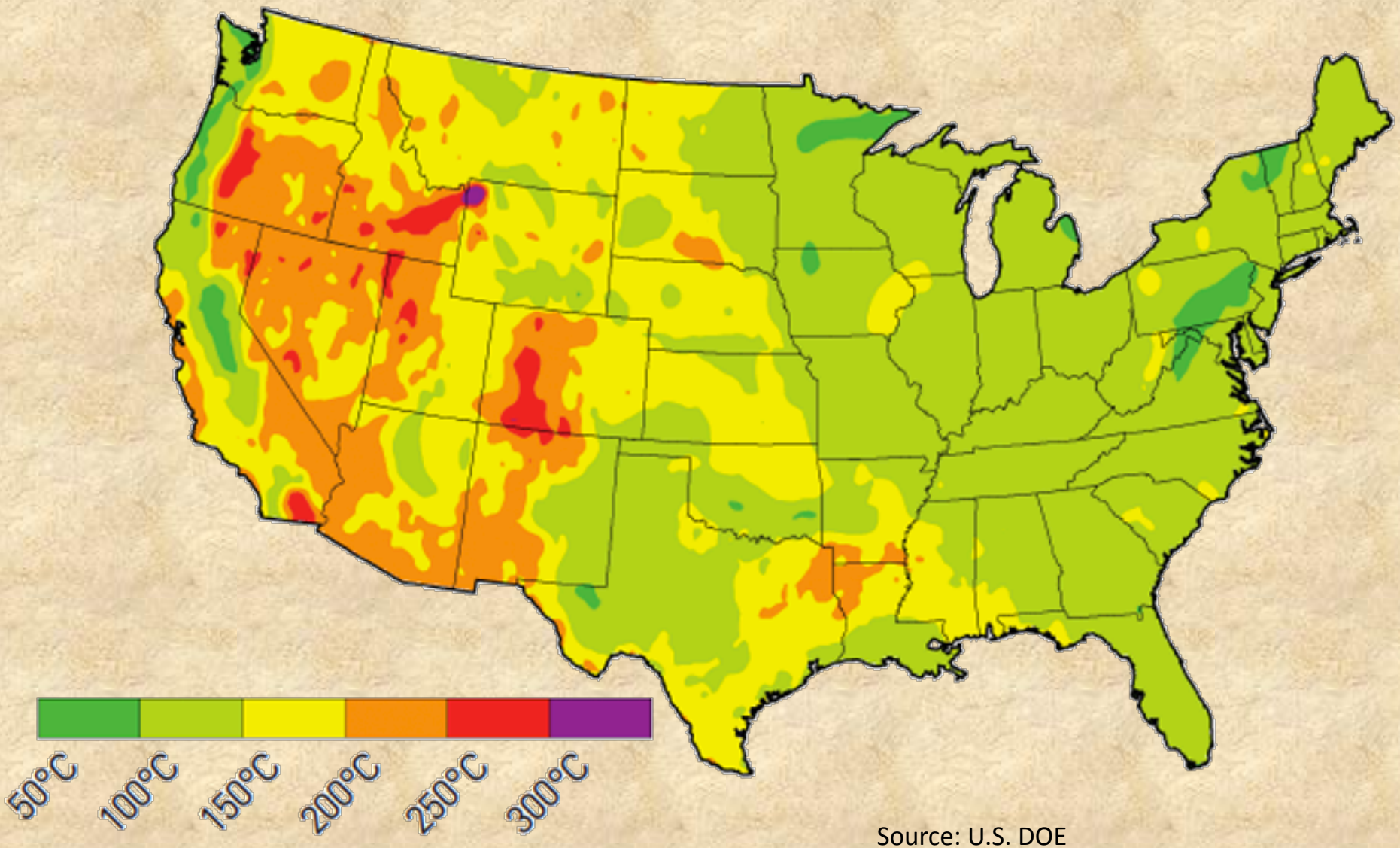
Figure 1.2 Heat-flow map of the conterminous United States



Geothermal Heat Flow map of New Mexico

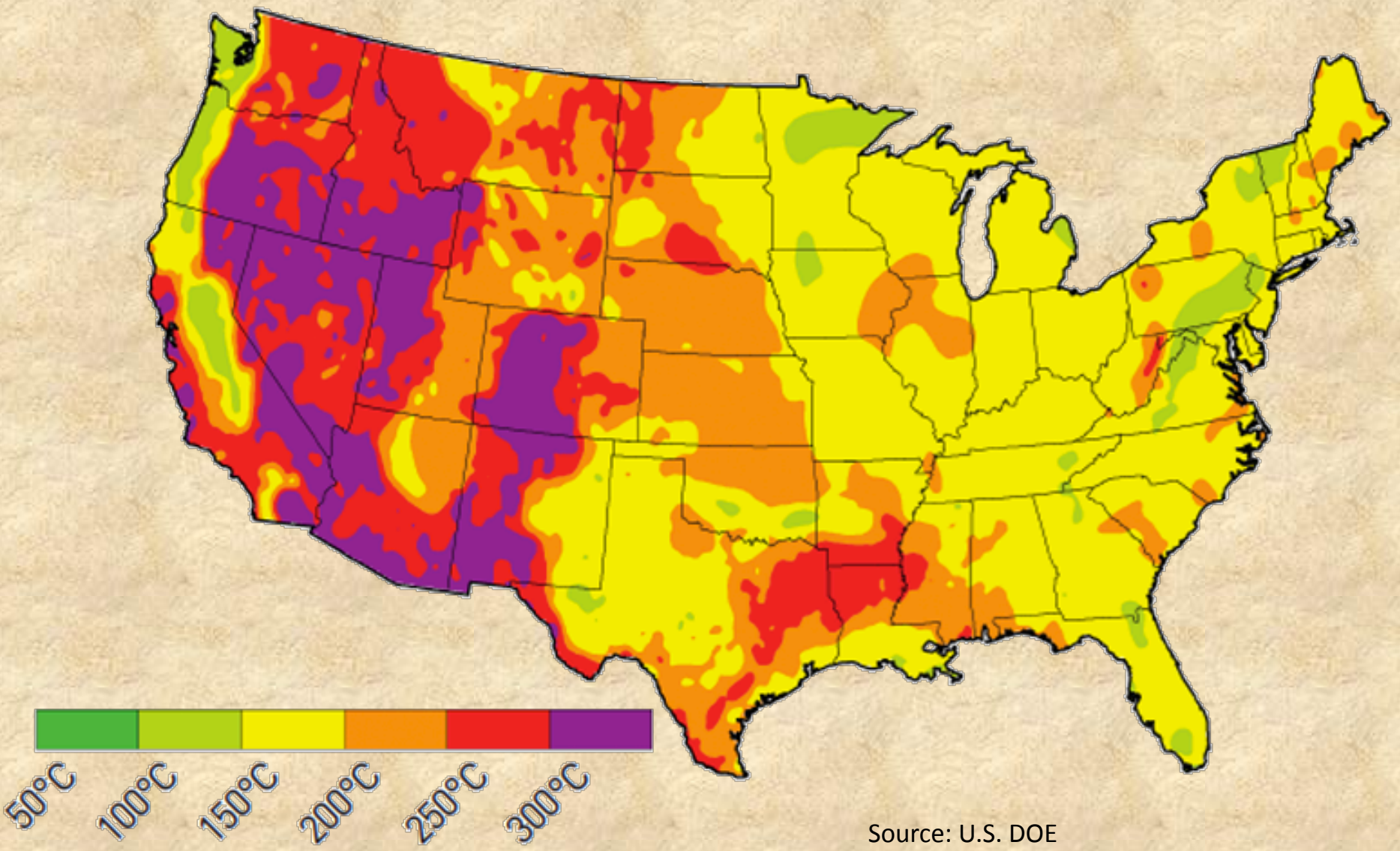
Source: SMU Geothermal Lab, Geothermal Map of United States, 2004

Expected Temperatures at 6.5km Depth



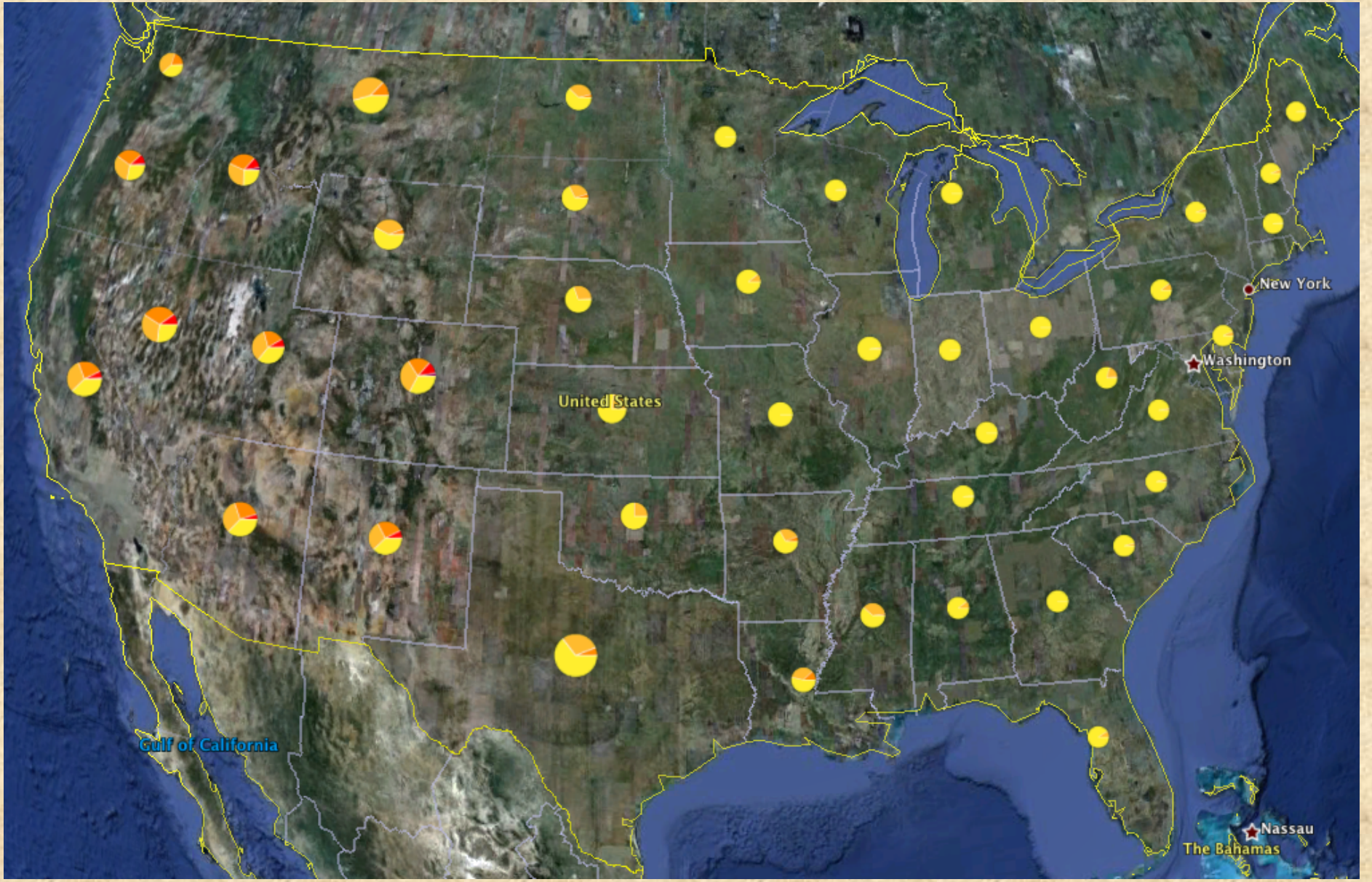
Source: U.S. DOE
http://www1.eere.energy.gov/geothermal/

Expected Temperatures at 10km Depth



Source: U.S. DOE
http://www1.eere.energy.gov/geothermal/

Enhanced Geothermal Systems Potential by State



Source: http://www.google.org/egs/)

Renewable vs. Conventional

- Renewables like wind, solar and some geothermal reduce carbon emissions and will be a necessary part of our future energy mix.
- Wind and solar do not supply 24/7 power, however, and so must be backed up with other energy sources (ideal for New Mexico with transport-stranded coal and gas).
- Nuclear and geothermal do produce 24/7 power but are not well suited to back up wind or solar.

Our Energy Future

- New Mexico has a remarkable mix of energy resources and a bright continuing role in supplying electric power in a reduced carbon-emissions world.
- Geothermal and nuclear are stand-alone sources.
- Wind and solar will require improved methods of energy storage or conventional (mainly natural gas) backup.
- New Mexico needs to make diversification of energy sources a major policy focus to reach its full potential before surrounding states capture the growing market for clean energy.