



• August 15-18, 2010 • Dallas, Texas •
• Dallas Convention Center •

Maria Richards

SMU Geothermal Laboratory
Dallas, Texas

mrichard@smu.edu
214-768-1975



**There's no stopping Geothermal Energy:
Join the bandwagon with Coproduction**

Does one not belong?



Sedimentary Basins Offer



Coproduction

Geopressure

**EGS - Enhanced
Geothermal
Systems**

RMOTC - Wyoming

Coproduced Geothermal Energy

- Hot water ~180°F or greater
- Byproduct of oil & gas wells
- 25 billion barrels/yr produced
- Binary technology added at surface
- Electricity for field use or sold to the grid
- Diminish greenhouse gas emissions
- Extends the life of oil and gas fields



ORMAT Technology

Geopressure

- Trapped fluids under an impermeable layer from sedimentary structure
- Elevated pressures flow fluids to surface without pumping
- Temperatures typically range from 200°F to 400°F
- Fluid often contains dissolved natural gas
- Located along the Gulf of Mexico, California, Appalachia, and other deep sedimentary basins



Enhanced Geothermal Systems (EGS)

- Development of the Reservoir through
 - Engineering of permeability
 - Addition of fluids
 - Connection of existing field plumbing
- Temperatures typically range from 300°F to 500°F
- Location: deep sedimentary basins
large hot/dry formations
periphery of existing sites

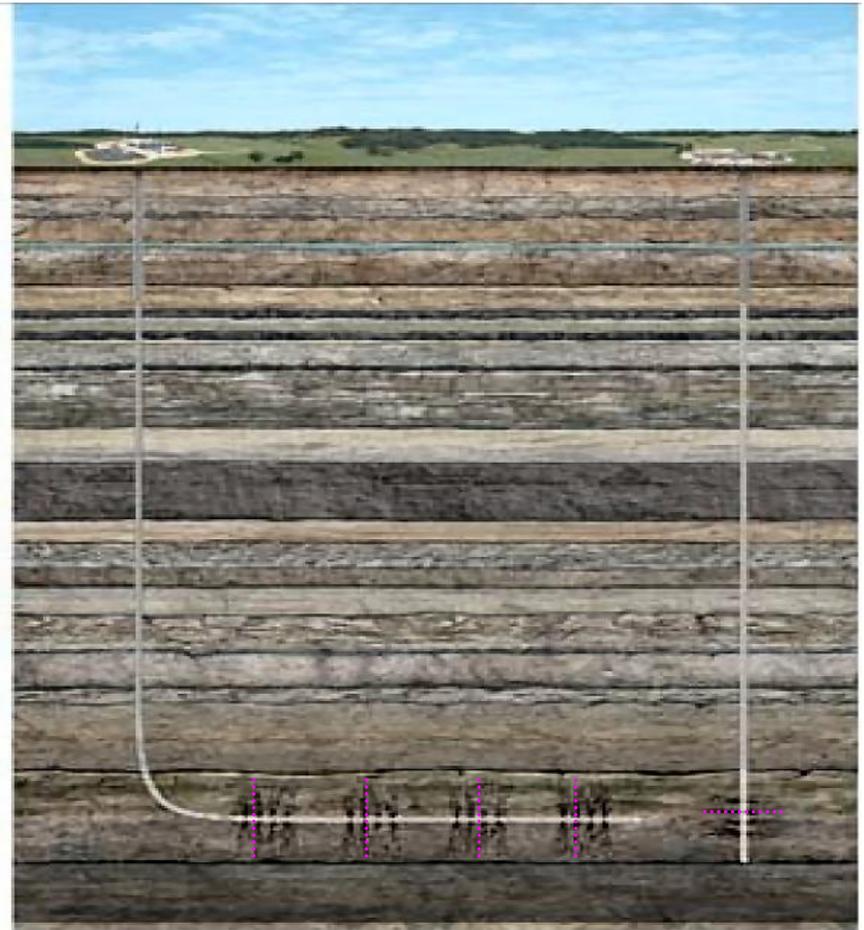


Figure 4: Horizontal and Vertical Well Completions
Source: John Perez, Copyright ©, 2008

Sedimentary EGS will be large-scale projects (10 to 100s of MW)

US Geothermal Resource Base Estimates to 10 km

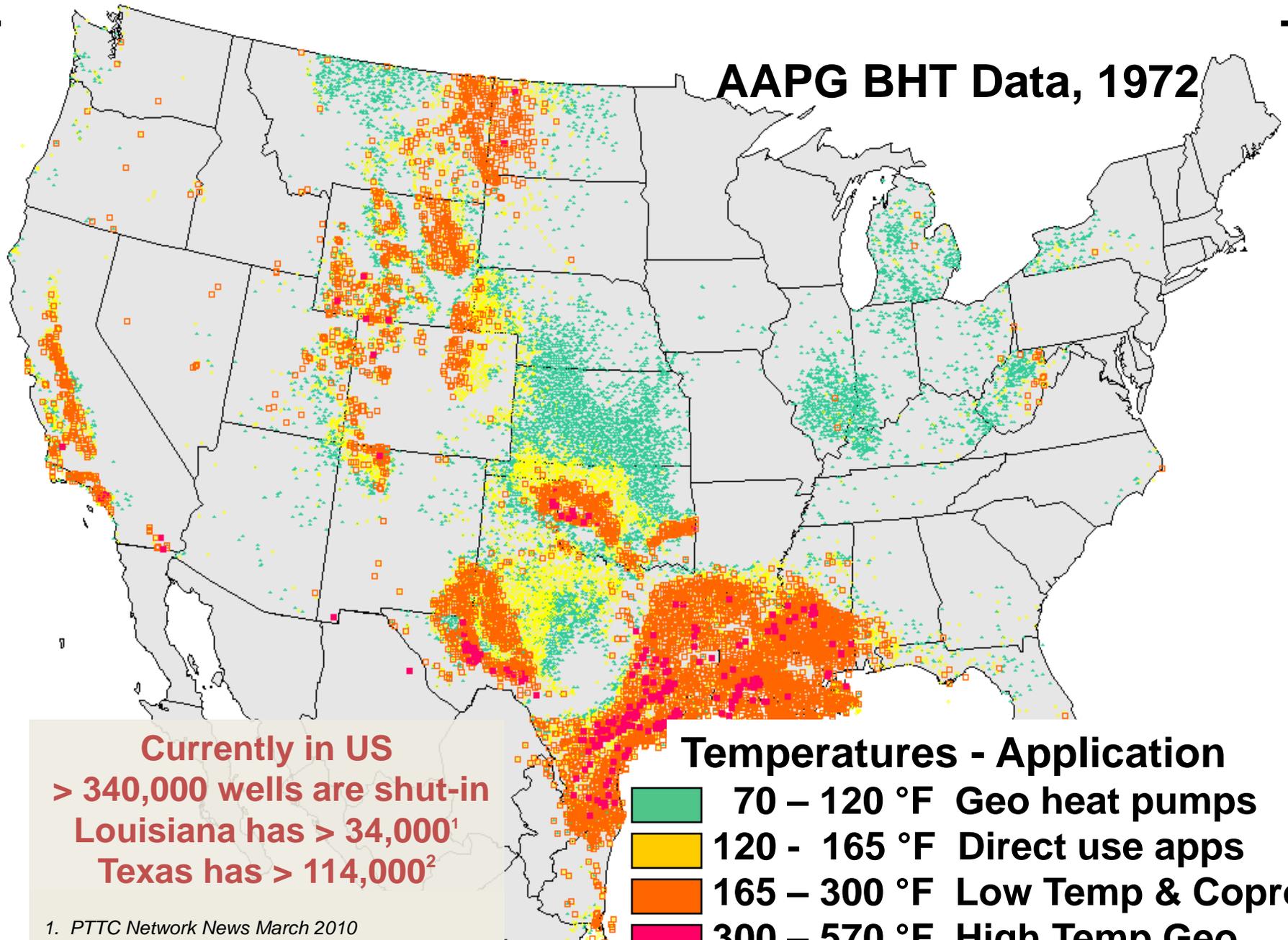
Category of Resource	Thermal Energy, 10^{18} J	Reference
Hydrothermal (W US)	2,400 – 9,600	USGS Circulars 726 & 790
Sedimentary EGS	> 100,000	FGE, 2006
Basement EGS	13,900,000	FGE, 2006
Supercritical Volcanic EGS*	74,100	USGS Circular 790
Co-produced fluids	0.0944 - 0.4510	McKenna, et al. (2005)
Geopressed systems	71,000 – 170,000**	USGS Circulars 726 & 790

* Excludes Yellowstone National Park and Hawaii

** Includes methane content

(Reference: Future of Geothermal Energy, Tester et al., 2006)

AAPG BHT Data, 1972



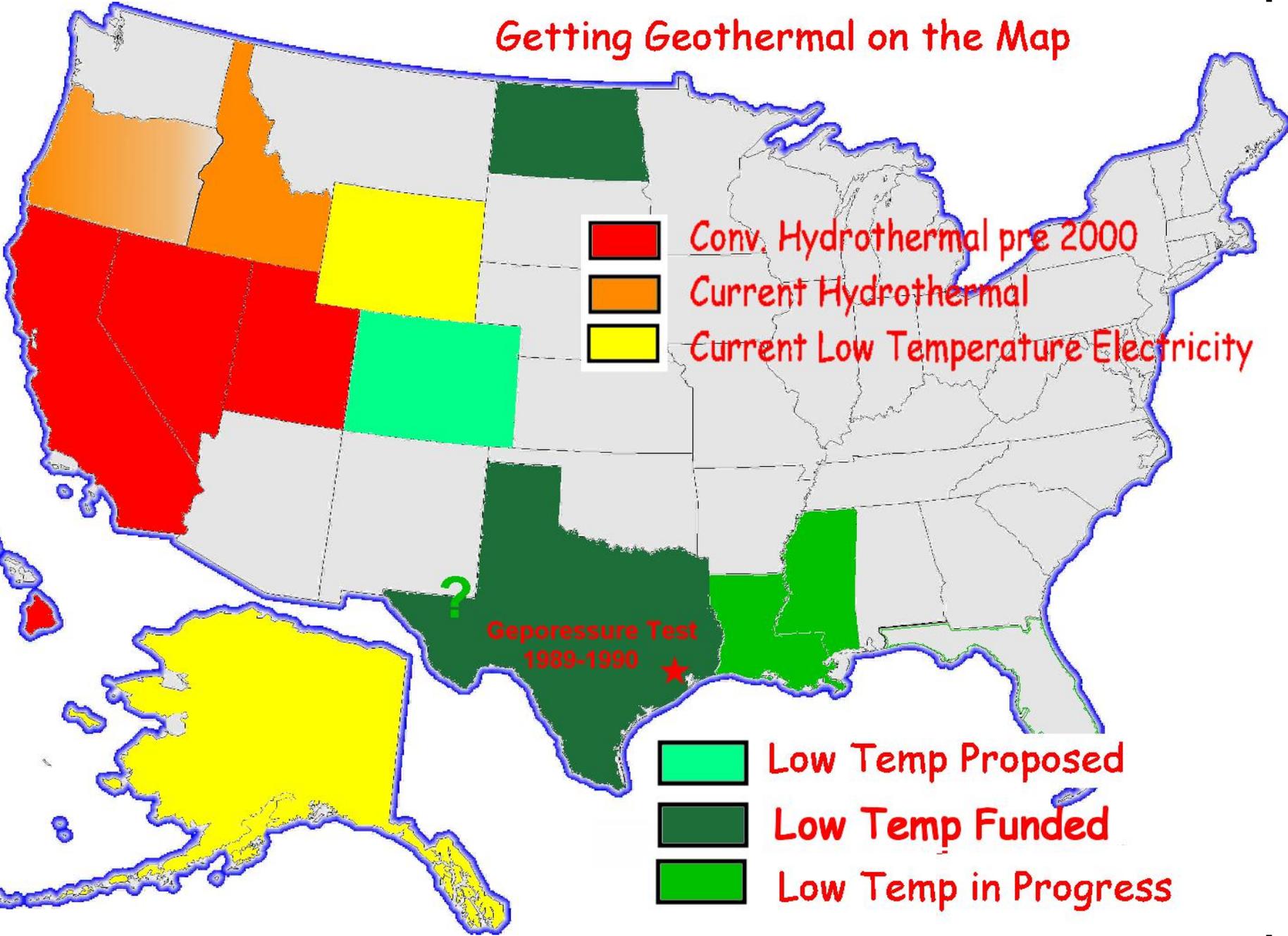
Currently in US
> 340,000 wells are shut-in
Louisiana has > 34,000¹
Texas has > 114,000²

1. PTTC Network News March 2010
2. <http://www.tlma.org/water.htm>

Temperatures - Application

	70 – 120 °F	Geo heat pumps
	120 - 165 °F	Direct use apps
	165 – 300 °F	Low Temp & Coprod.
	300 – 570 °F	High Temp Geo

Getting Geothermal on the Map



Conv. Hydrothermal pre 2000



Current Hydrothermal



Current Low Temperature Electricity



Low Temp Proposed



Low Temp Funded



Low Temp in Progress

Projects in the Ground

- Chena Hot Springs, Alaska (400 kW)
 - Pratt & Whitney Power Systems
 - 4th year of project - 2 Pure Cycles
 - 165°F hot source - 40°F cold source



August 20th, 2006 Official Ribbon Cutting Ceremony for the Chena Geothermal Power Plant



Projects in the Ground

- Rocky Mountain Oilfield Testing Center (RMOTC)
Casper, Wyoming (250 kW turbine)
 - ORMAT Binary System
 - Second year of Project
 - 195°F hot fluids
 - 170°F cold fluids



Projects in the Ground

- Gulf Coast Green Energy- Denbury Resources
Jones County, Mississippi (30kW)
 - ElectraTherm Green Machine - 190°F hot fluids
 - RPSEA Demonstration - Power up September 2010



Projects in the Ground

- CLECO - Hilcorp Energy - Gulf Coast Green Energy
Western, Louisiana (60 kW)
800 psi, 4000 BPWD (120 GPM) at 250°F
 - ElectraTherm Green Machine
 - Private funding
 - September 2010



Why is a Utility developing geothermal?

- Distributed Generation
 - Enable the Electrification of remote regions
- High Reliability
 - 365 day/year, 24 hours/day baseload
- Renewable Requirements

2009 DOE Geothermal Stimulus Funding: \$338,000,000

2) Coproduced, Geopressured, and Low Temperature Projects

Universal GeoPower LLC	\$1,499,288	Liberty County	TX	Universal GeoPower LLC will utilize a modular low temperature binary unit to produce power from oil and gas wells in Liberty County, Texas.
University of North Dakota	\$1,733,864	Williston Basin, (Bowman County)	ND	The University of North Dakota will utilize a low temperature binary unit to produce power from oil and gas wells in Bowman County, North Dakota.
Louisiana Tank, Inc.	\$5,000,000	Cameron Parish	LA	Louisiana Tank, Inc. will demonstrate the feasibility of a geopressured power plant in Cameron Parish, Louisiana.

RPSEA.org \$\$ now

Research Partnership to Secure Energy for America

(RPSEA), recently announced the **2010 Request for Proposals (RFP) for the Small Producers Program**. Up to \$3.2 million is available for a variety of projects, including among others "Creative capture and reuse of industrial waste products (CO₂, produced water, excess heat) to reduce operating costs or improve recovery."

Proposals are due September 28, 2010

The full RFP can be found at: http://www.rpsea.org/req_proposals/

ITEMS TO CONSIDER FOR DEVELOPMENT

Geopressure

Public Information

Power Plant Eng.
-Turbine
-Cooling Methods

Economics

Transmission Lines

Injection Wells

Abandoned Wells

Oil & Gas Wells
Producing Water

RECs/ Tax Credits

Gov/Private Leases

Legal Regulations

-Assess Resources

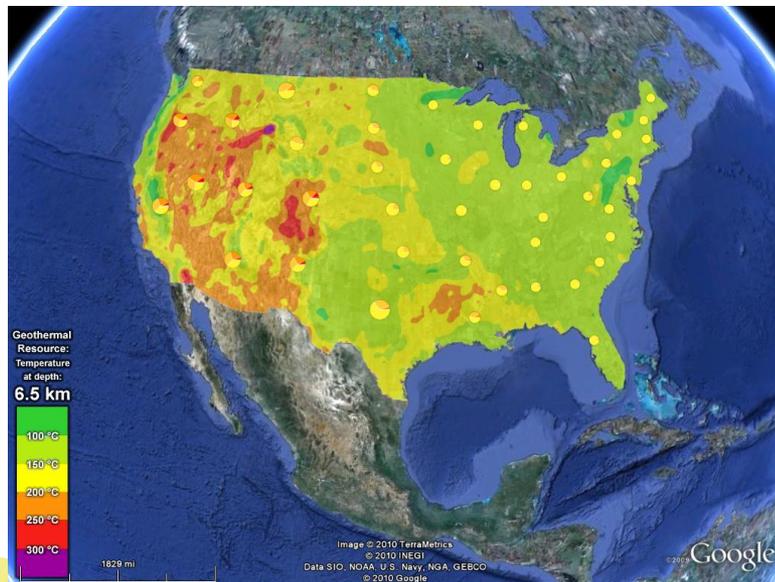


Where to go from here?

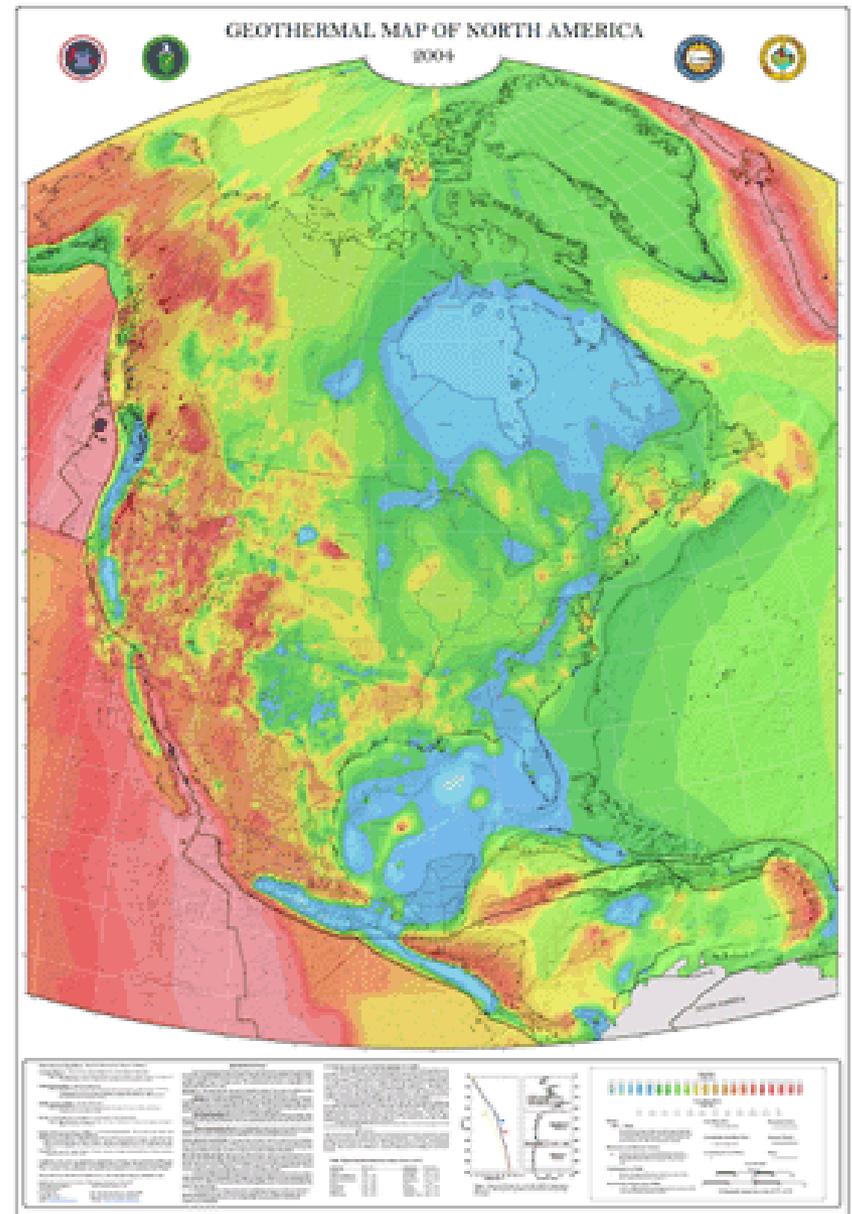
GMNA update completed in 2011

Google.org/EGS

- temperature @ depth layers
- 3 km to 10 km



Geothermal Map of North America, 2004



Now it's your turn!

Use geothermal energy

- Find temperatures $\sim 180^{\circ}\text{F}$ or higher
- Develop high fluid flows ($200^{\circ}\text{F} + 200 \text{ gpm} = 50 \text{ kW}$)
- Locate a cold source (surface, water tower)
- Select technology to meet resources
- Sell or use your baseload energy
- Ask for assistance along the way
 - Maria Richards - 214.768.1975 mrichard@smu.edu
 - David Blackwell - 214.768.2745 blackwel@smu.edu
<http://smu.edu/geothermal>
 - DOE Low Temperature - Tim Reinhardt 202.287.1351
Timothy.Reinhardt@ee.doe.gov