THE POTENTIAL OF GEOTHERMAL ENERGY

A ONCE AND FUTURE FOCUS
OF
THE BUREAU OF ECONOMIC GEOLOGY

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BUREAU OF ECONOMIC GEOLOGY

Geothermal Energy

A Once and Future Focus of the Bureau of Economic Geology

- Brief History of Geothermal Investigations and Research at the Bureau of Economic Geology
- Driving Forces
  - Past:
    - Economics
    - Relationship to Petroleum Yields and Reserves
    - Alternate source of energy
  - Now:
    - Economics and Energy Security
    - Economics and Carbon Emissions
    - Economics and Alternative Energy Resources
- Where are we going, now and in the Future?

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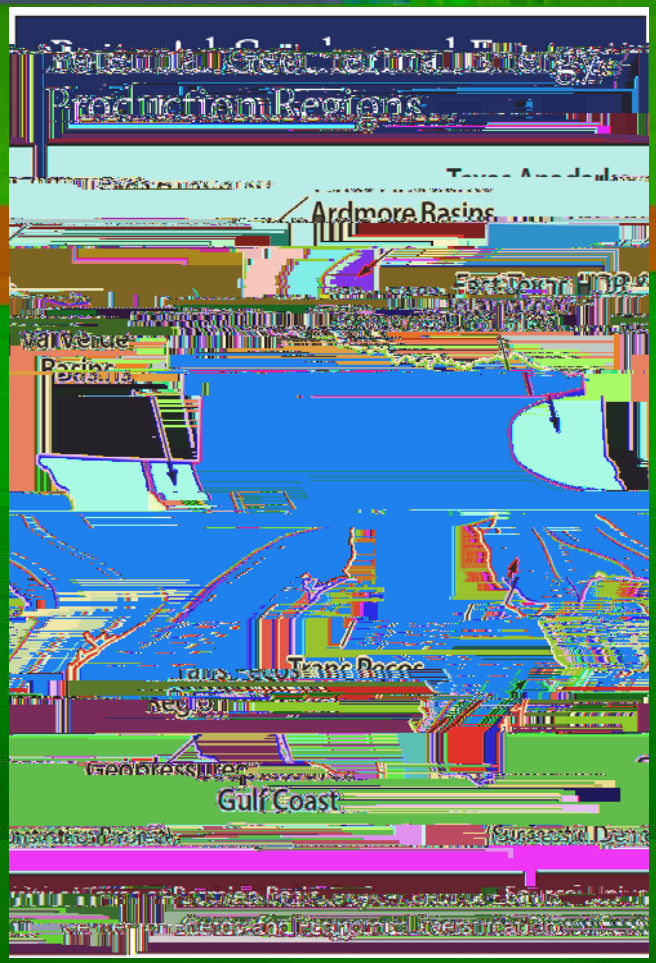

The Successful investigations in the early 1970s and 1980s clearly defined a unique set of source regions in Texas,

- From the deep, geopressured zones along the coast
- to deep circulating groundwaters in the Trans Pecos Regions and
- Hot Dry Rock areas in the north.

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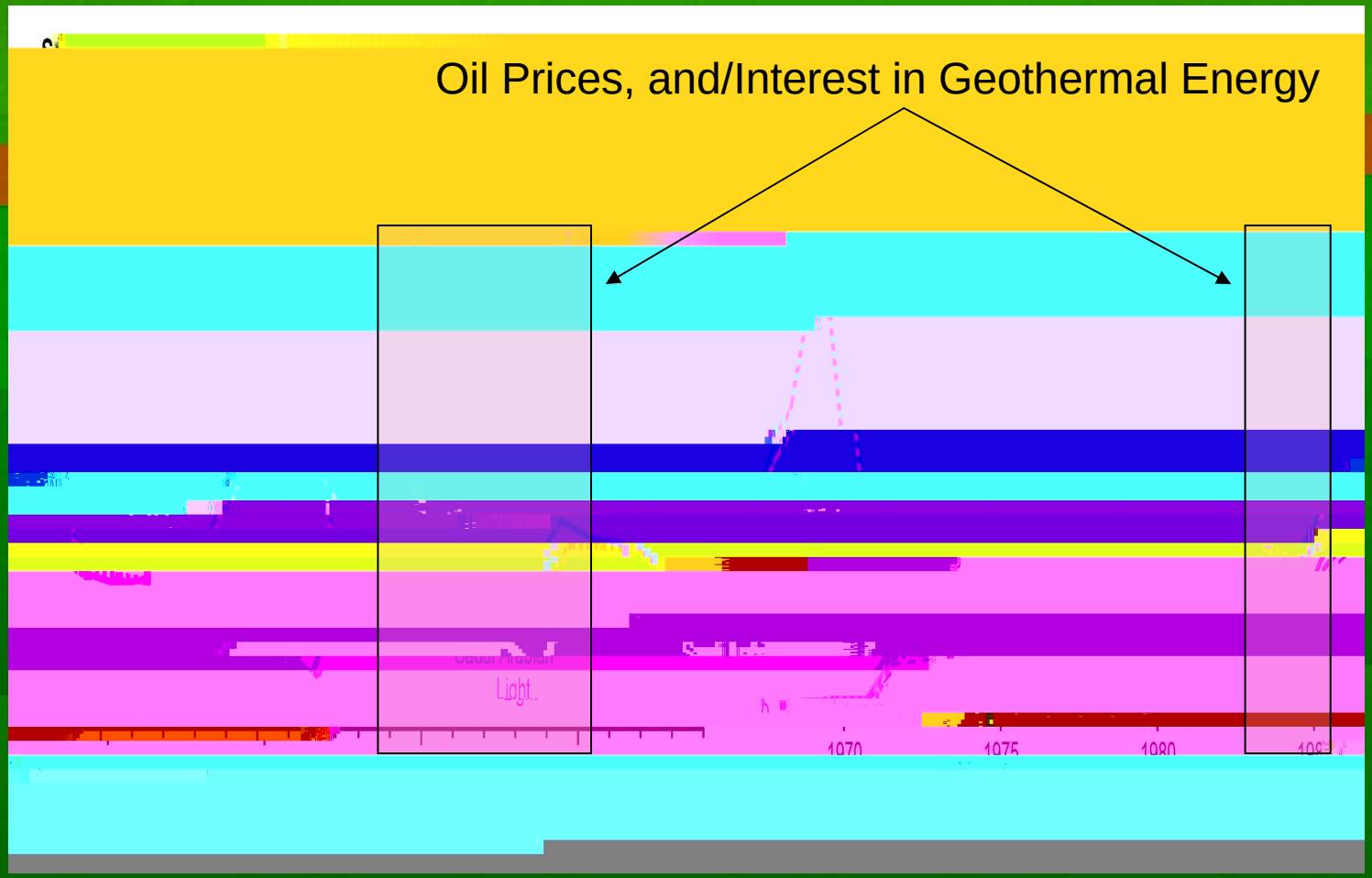

- What were the driving forces?
- Oil Prices then,
- and/now?
- Carbon Emissions
- Energy Security
- Renewable Resources

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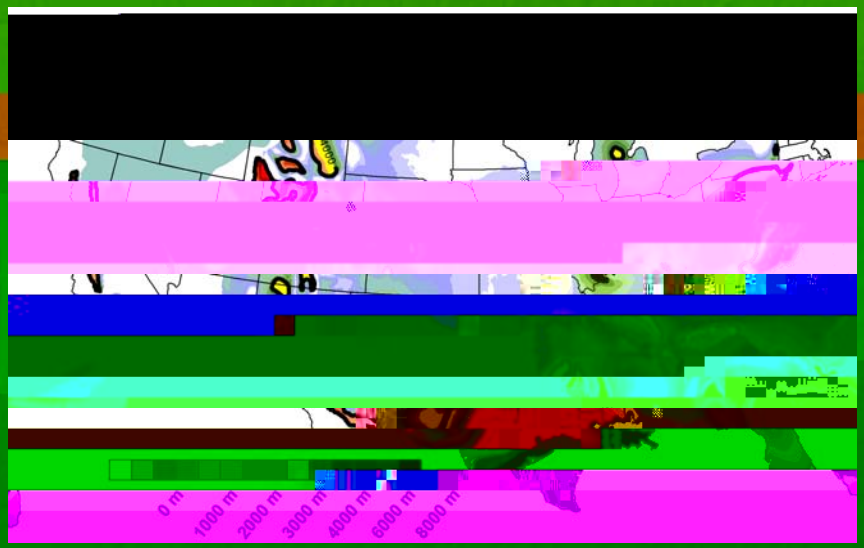
- **Critical Re-assessment:**

  DOE - MIT (2006) Study Found:

ü **THE EXTRACTABLE RESOURCE BASE IS ESTIMATED AT 2,000 TIMES THE ANNUAL PRIMARY ENERGY CONSUMPTION OF THE UNITED STATES IN 2005.**

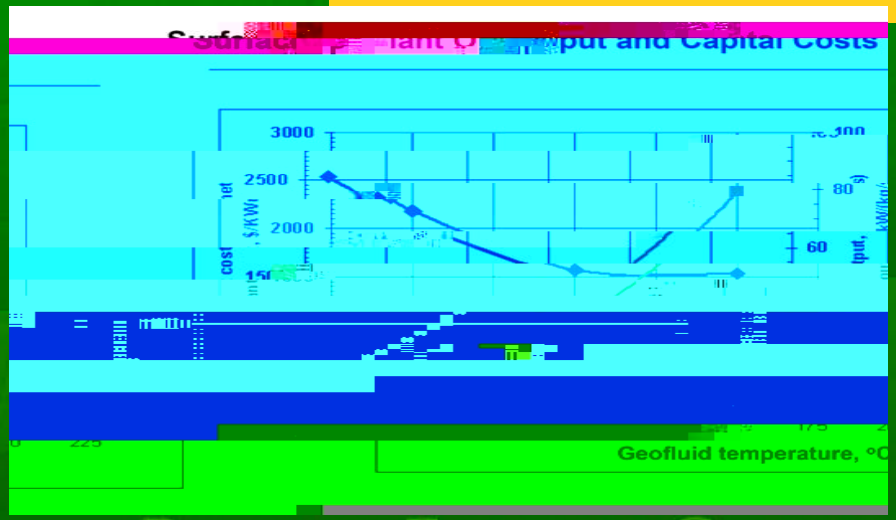
ü **A SIGNIFICANT PORTION OF THIS ENERGY IS IN GEOPRESSURED ZONES IN THE NORTHERN GULF OF MEXICO**



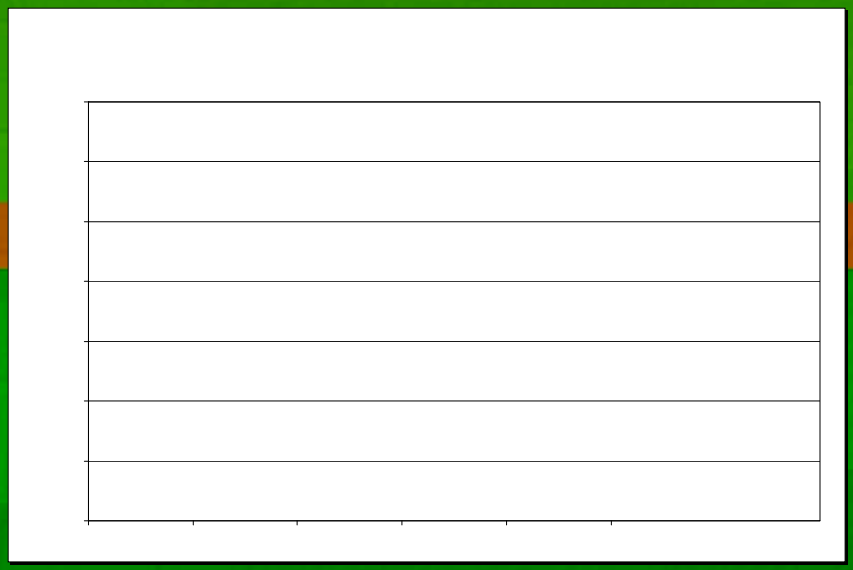
Sediment Thickness Map of US

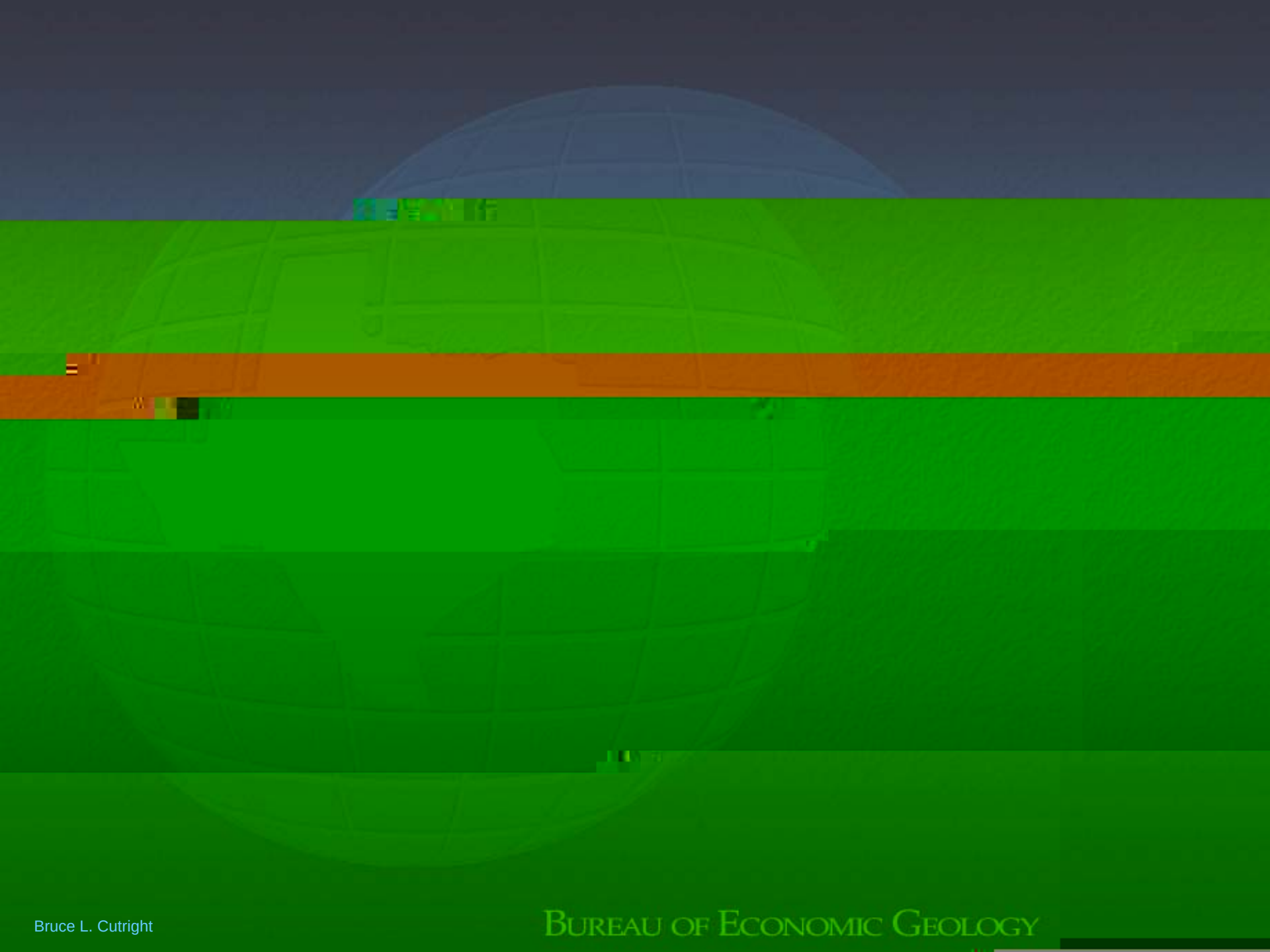
The Case for Geothermal Energy

- Raser Technologies Hatch Geothermal Power Plant
- constructed in just six months
- Modular power plant design.
- Can produce power from geothermal resources that were previously thought to be not hot enough for commercial power production.



Comparison of the costs per kilowatt hour to generate electricity from alternative/renewable sources versus hydrocarbon sources





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Bureau of Economic Geology

Why Geothermal?
Why Now?

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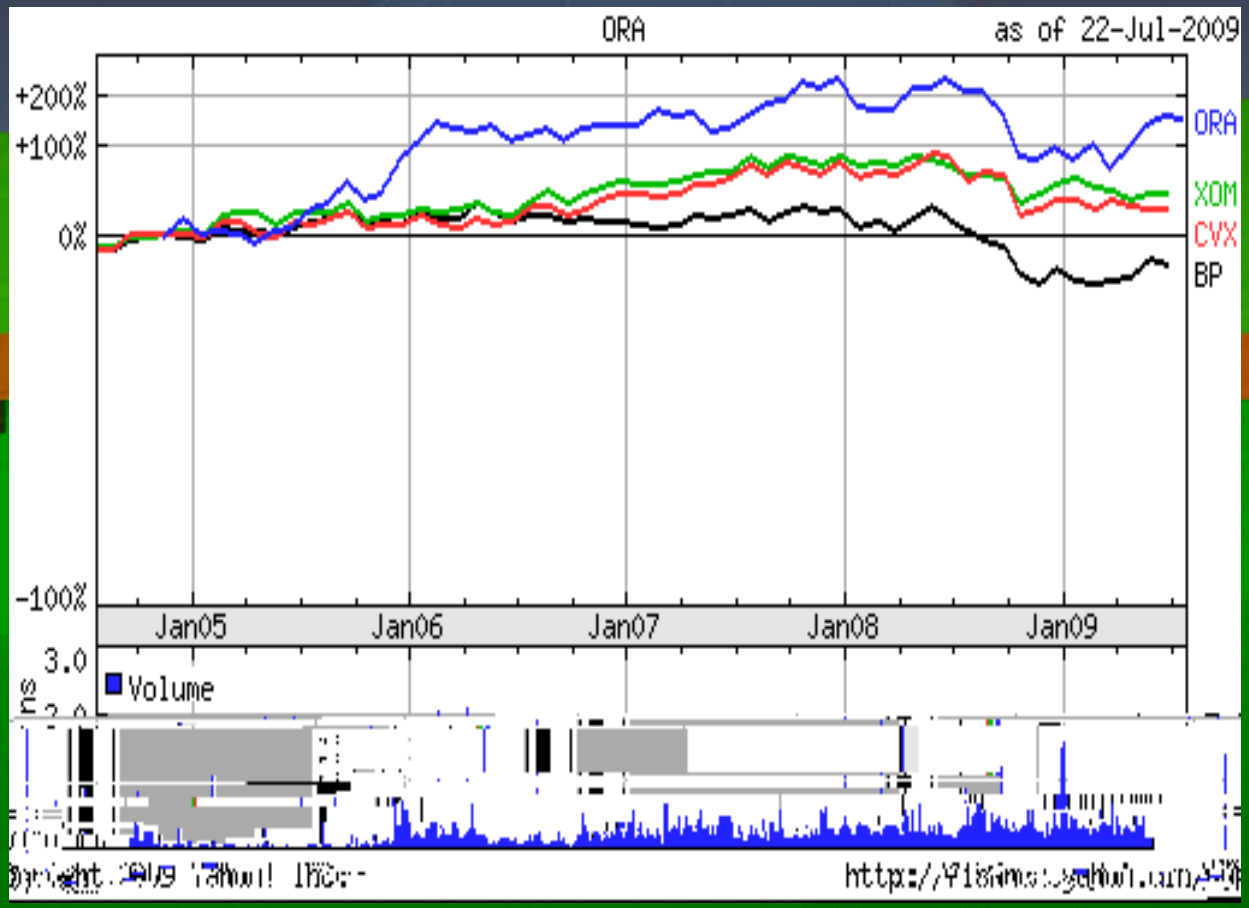
What Is Business Doing



Five Year Stock Price Trends
ORA = Ormat Technologies (geothermal)
XOM = ExxonMobil
CVX = Chevron
BP = British Petroleum

What Our Partners are doing

- Chevron is the largest producer of geothermal energy in the world, with operations in Indonesia and the Philippines.
- US energy companies Unocal and Gulf Resources are willing to invest US$1.2 billion in geothermal and natural gas projects in the Philippines

Source: Chevron Geothermal

The Case for Geothermal Energy

- What is the Bureau doing now?
  - Cooperative work with SMU to develop searchable, useful database of information critical for economic analysis
  - Concentrating on resource definition throughout the State, and nationally and internationally
  - Applying the skills in reservoir characterization that are essential in economic decision-making.

Where is the Cutting Edge?

- ü Primary Focus is on Geopressured Zones having Thermal-Kinetic-Chemical Energy Content, next is deep sedimentary basins and then hot dry rock.
- ü Combining geothermal heat extraction using supercritical carbon dioxide may solve CO_2 problem, and provide more economical electricity generation.
  - Ç Links geologic sequestration of CO_2 with non-polluting, renewable energy production
  - Ç Results in improvement of heat extraction efficiency by 40% to 180% (Pruess, K. 2006)
  - Ç Provides a methodology for coal fired power plants to recover the energy penalty incurred in CO_2 capture
- ü Metal – Organic heat carriers (MOHC) offer additional improvements in efficiency, at a cost.

THE POTENTIAL OF GEOTHERMAL ENERGY
Summary

- ü Not just magmatic hot spots, not geographically limited
- ü Less costly than crude oil, solar or wind, in ¢ per KWhr
- ü Largest return on investment of R&D Dollars
- ü Renewable, small footprint, negligible emissions
- ü Existing skills in reservoir characterization, flow modeling and carbon sequestration are directly applicable to geothermal energy assessment and development.

Iceland

Thank you