

GETTING GEOTHERMAL ELECTRICITY PROJECTS ON-LINE

**October 19, 2007
Montrose, Colorado
Geothermal Investor's Forum**

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ORMAT: Innovative Power Plant Technology

- ❑ Vertically integrated company active in the design, engineering, supply, installation, support & operation of renewable & sustainable energy products and projects since 1965.**
- ❑ Four decades of experience developing modular power plants from 0.3 MW to 130 MW for geothermal, waste heat, biomass, solar, and re-powering rehabilitation of existing plants.**
- ❑ Supplied app. 900 MW of geothermal and heat recovery power generation in 23 countries, about half of the supplied MW are currently owned by Ormat.**
- ❑ The only pure play geothermal and renewable energy company supplying equipment and technology to utilities and developers as well as owning and operating geothermal projects world wide.**

ORMAT'S WORLD WIDE PRESENCE

Over 800 MW of Geothermal Power Plants



**30 MW Puna Combined Cycle
Geothermal Power Plant, Hawaii**



**125 MW Upper Mahiao Combined
Geo Power Plant, Philippines**



**20 MW Burdette Binary
Geothermal Power Plant, Nevada**



**60 MW Mokai Combined Geo
Power Plant, New Zealand**

Geothermal is resurging

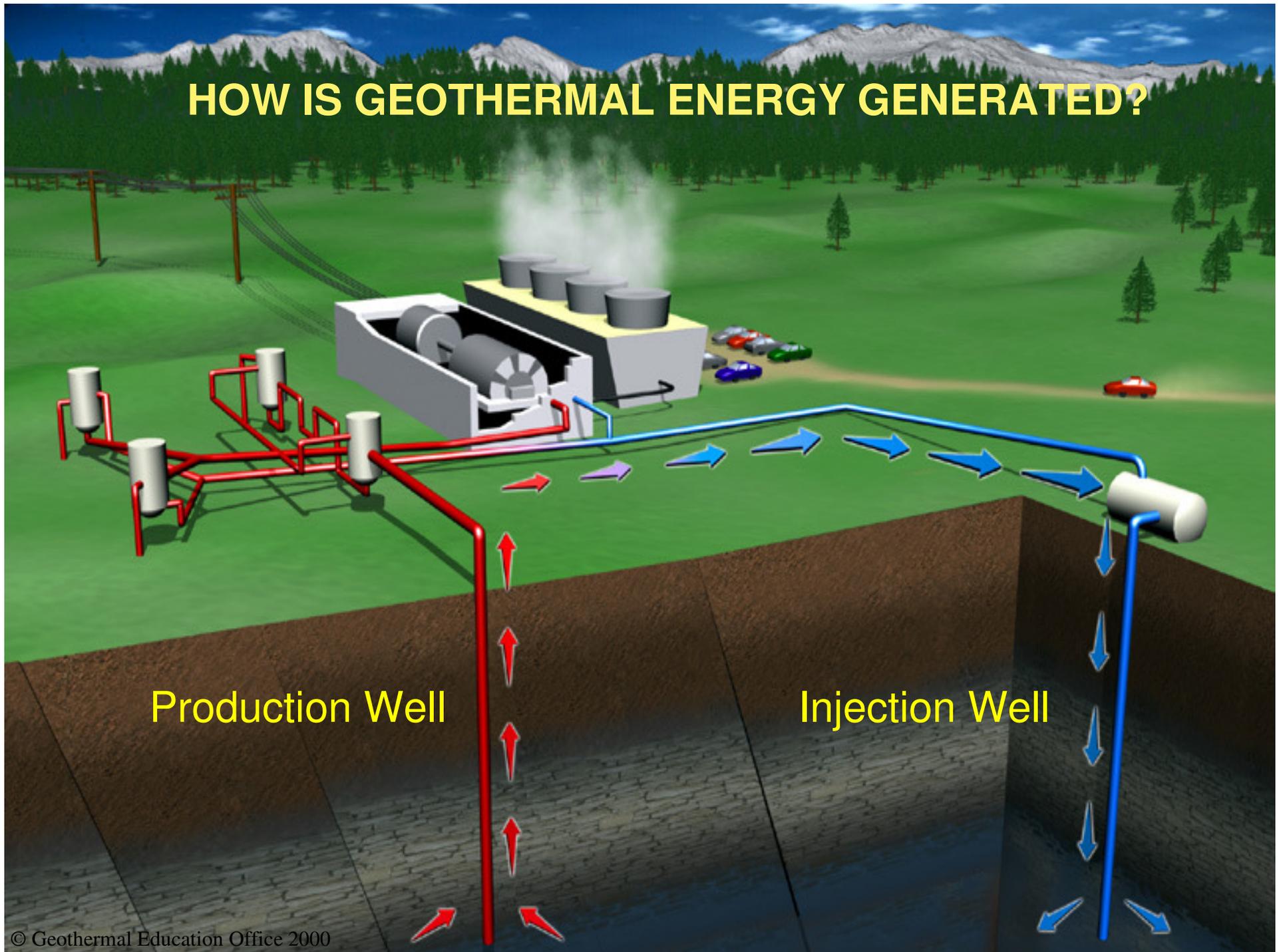
- Facilitated by rising interest in energy independence /energy security
- Concern over climate change/climate change policy
- Costs becoming competitive with fossil fuels/other renewables
- Desire by utilities for base-load renewable energy
- RPS standards/Production Tax Credits/Clean Renewable Energy Bonds
- A maturing industry, seeing technological progress

GEOHERMAL ELECTRICITY

QUESTIONS TO BE ANSWERED

- 1. How is geothermal electricity generated?**
- 2. What are the attributes of geothermal energy?**
- 3. What are the barriers to geothermal development?**
- 4. Where can we find geothermal resources?
(General U.S. and Colorado)**
- 5. How much does it cost to bring to market?**

HOW IS GEOTHERMAL ENERGY GENERATED?



How is Geothermal Energy Generated?

RESOURCE TEMPERATURES FROM 250° TO 350° F

- Organic Rankine cycle (ORC) Technology most appropriate
- Plant uses organic fluid with lower boiling temp than water
- Air cooled condensers possible – 100% injection of all fluids/gases
- Most new western US resources are in this category (including Colorado)
- Lowest environmental impact

RESOURCE TEMPERATURES OVER 350° F

- Flash technology produces steam for driving turbine (see previous slide)
- Combined steam & ORC system allows for air cooling

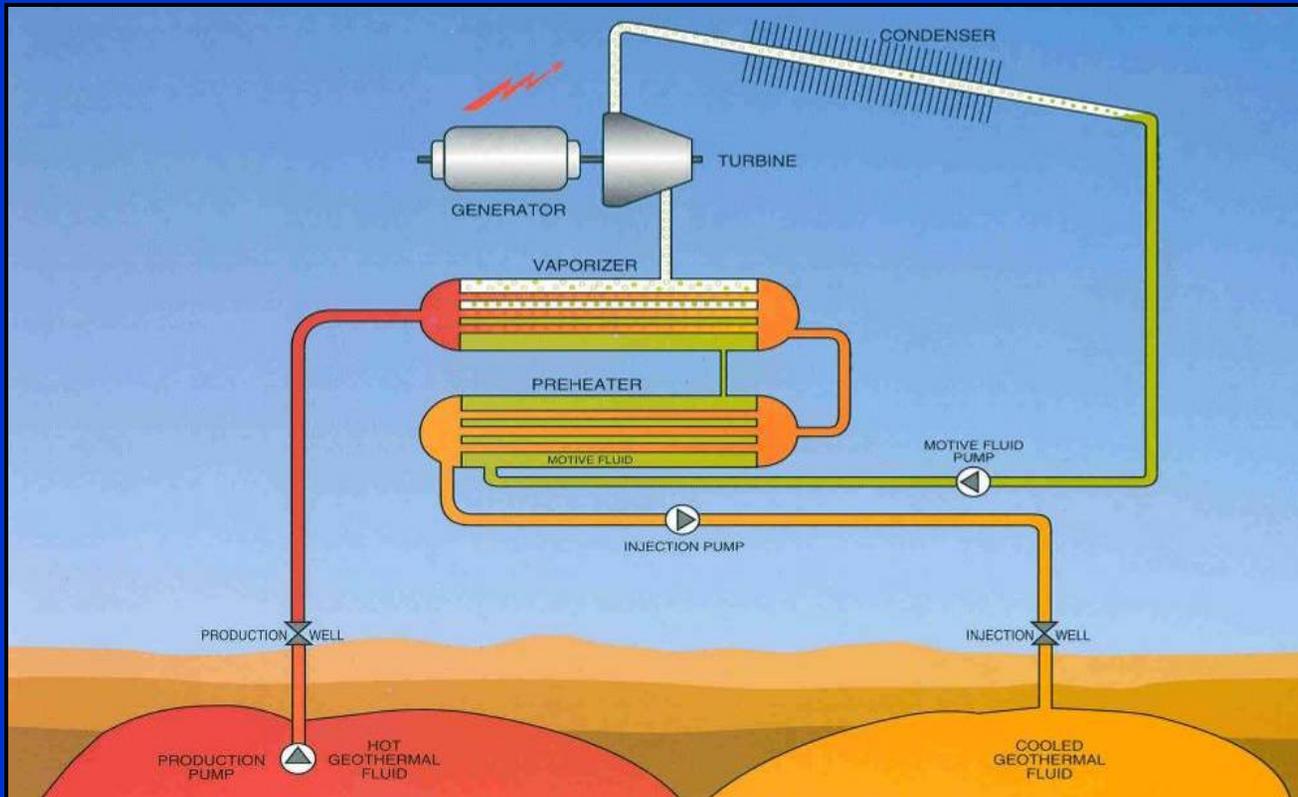
DRY HIGH PRESSURE STEAM PRODUCTION

- Conventional steam turbine technology most appropriate
- Geysers (CA), Italy, Iceland, Indonesia & New Zealand
- Water cooled condensers needed
- Higher environmental impact

Binary Power Plants (most appropriate for Colorado)



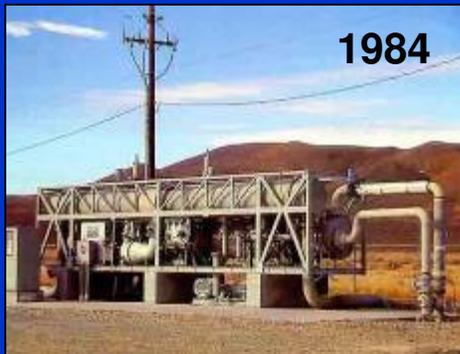
Binary Geothermal Power Plants



24 MW Zunil Geothermal Power Plant, Guatemala

Plug and Play On Site Geothermal Power Pre-Packaged Equipment Supply for Self Construct

Ormat supplied equipment for remote and rural applications



1984

First commercial geothermal application in Nevada. 800 kW OEC. with power supplied to Sierra Pacific Power Co. 23 years of operation.

800 kW Wabuska Geothermal Power Unit, Nevada.



1989

Supplying local electrical power and energy for crop drying and cold storage since 1989. 18 years of operation.

300 kW Egat Geothermal Power Plant, Thailand



2004

Owner installed plant using Ormat supplied equipment, documentation and technical assistance.

1.8 MW Oserian Geothermal Power Plant in Naivasha, Kenya



2001

250 kW air-cooled geothermal CHP plant generating electrical power as well as district heating, by utilizing a low temperature geothermal resource. 6 years of operation

250 kW Geothermal Power Unit at Rogner Hotel & Spa, Bad Blumau, Austria

GEOHERMAL ENERGY ATTRIBUTES

COST EFFECTIVE UTILITY POWER

- ◆ Modular power plants are readily expanded as needs increase.
- ◆ Power costs competitive with current fossil fuel technologies.
- ◆ Base Load power produced 24/7 @ over 90% Capacity Factor.

RELIABLE, SUSTAINABLE & ENVIRONMENTALLY SAFE

- ◆ Renewable – first geothermal power plant in Larderello, Italy – 1904; field still producing electric power.
- ◆ Many projects operating for decades at 98%+ availability.
- ◆ Geothermal is non-combustion - near zero emissions.

MINIMAL LAND SURFACE IMPACT

FIELD PROVEN TECHNOLOGIES - ~9,000 MW installed WORLD WIDE

EASY TO INSTALL, OPERATE AND MAINTAIN

- ◆ Projects developed over 3 year period - O&M by local staff.

CAPITAL INTENSIVE

- ◆ Exploration, drilling costs high upfront.
- ◆ Lifetime supply of fuel capitalized – no fuel price risk.

BARRIERS TO GEOTHERMAL DEVELOPMENT

- **Federal Agency Procedures - Including**
 - Delayed leasing of Federal Lands by the BLM
 - Extended Environmental Reviews
 - Extended Processing of Permits
 - Results of Programmatic Environmental Impact Statement (PEIS) will have a huge impact on future geothermal development in Colorado

- **Availability of Financing for new projects**
 - Need to reduce exploration costs and risks

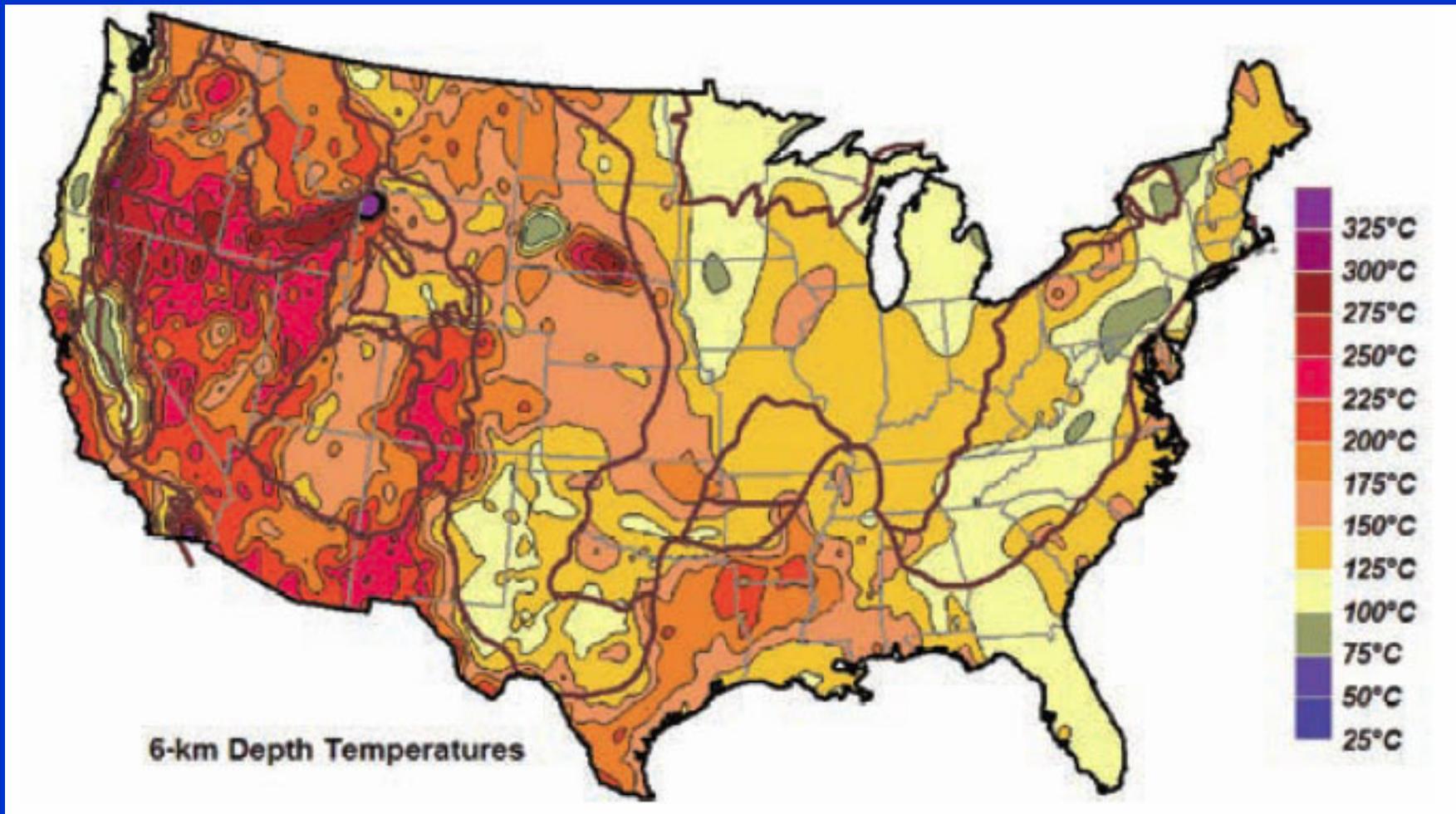
- **Need for continuous opportunities for Power Sales**
 - Need to provide incentives to utilities
 - Need to have consistent Renewable Portfolio Requirements

- **High initial Capital Costs**
 - Need for long-term renewable tax credit programs

- **Availability of Transmission**
 - Geothermal Projects are often in rural areas

Where are Geothermal Resources Located?

Estimated Earth temperature at 6-km (3.7-mile) depth. Southern Methodist University (SMU) Geothermal Laboratory. Source – National Renewable Energy Lab (NREL)

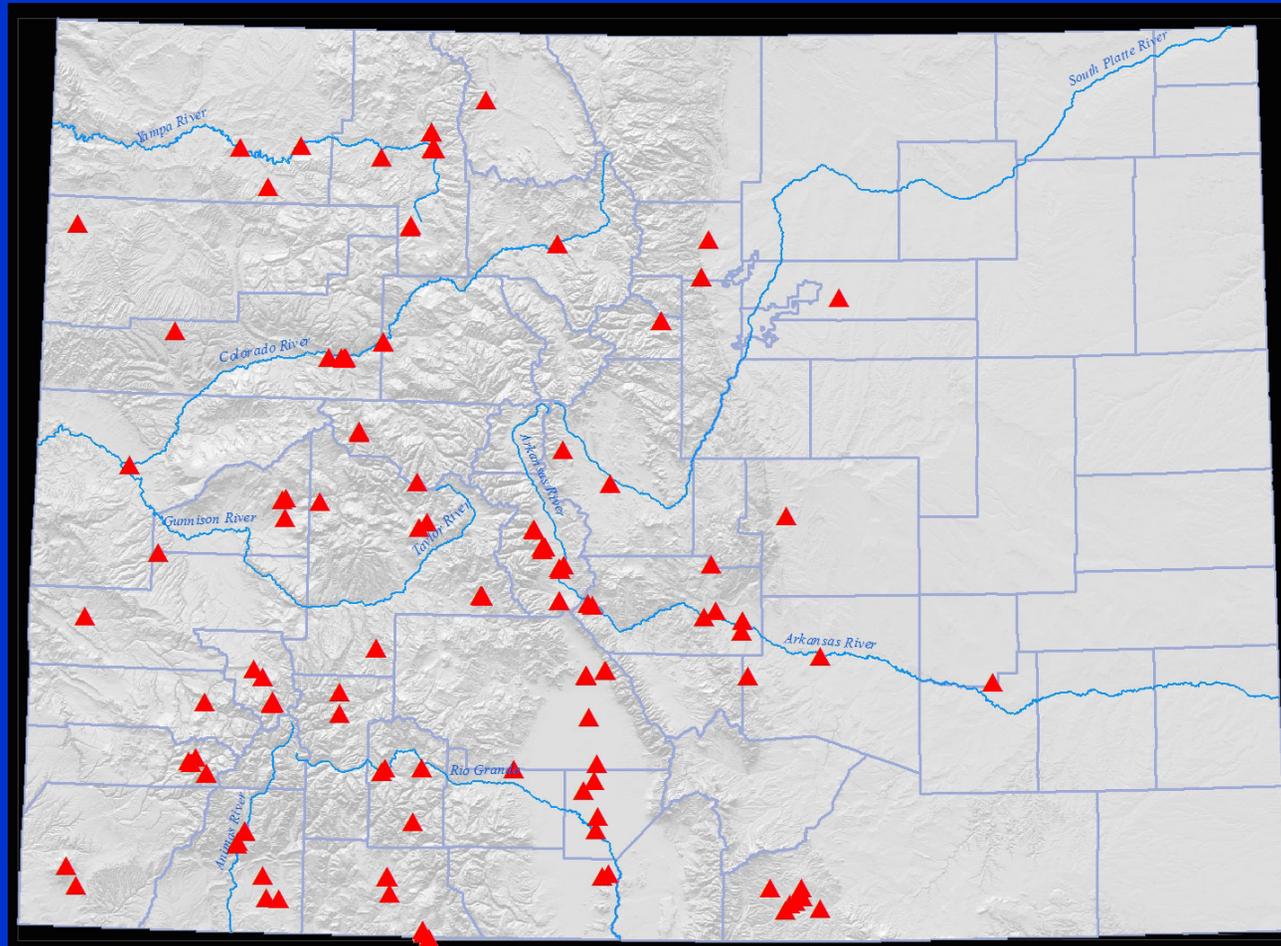


Colorado's Geothermal Potential

- Colorado Resources often overlooked (shallow gradient data thrown off by mixing with alluvial deposits)
- Historical limitations to geo-power development in Colorado include low energy costs, minimal drilling, and preference for geothermal heating projects for recreation and commercial business
- Much of Colorado's geothermal resource is in the Rocky Mountains, and exploration is not covered in existing land use plans for the USFS
- The history of mining in Colorado may reveal more data about the geothermal resource in the Rocky Mountains. Furthermore, the fact that mining has occurred shows a precedent for development in these areas
- Colorado's geology is conducive to high temperature geothermal systems
- Regionally high heat flow (quantity of heat)
- Temperatures over 149 °C (300 °F) have been measured in oil and gas wells. Up to 20 wells in the San Juan Basin have temperatures of 121 °C (250 °F) or more between 7,000-9,000 feet deep
- Geochemical data and geophysical data has identified at least 9 locations with potential for economical development of binary power plants

Colorado Hot/Warm Springs and Wells

Source: Colorado Geological Survey



HOW MUCH DOES IT COST



BUDGET FOR 20 NET MW PROJECT DEVELOPMENT

1. Exploration & resource assessment \$ 7.0 M
12 Months time frame
2. Well field drilling and development (12 wells) 20.0
12 Months time frame after completion of item 1
3. Power plant, surface facilities, & transmission 35.0
18 Months time frame with overlap of item 2
4. Financing, and “soft costs” : 8.0
 - o Financing Commitment fees;
 - o Legal, Accounting & consulting fees;
 - o Interest during construction;
 - o Debt service and operating reserve; and
 - o Project contingencies and Development Fee12 Month process, begins after completion of item 1

5. TOTAL FINANCED COST FOR 20 MW PROJECT \$70_M

To be provided as construction phase financing

6. TOTAL AVERAGE DEVELOPMENT PERIOD 36 MONTHS

Plus approximately 12 months to acquire federal or private site lease control. 16