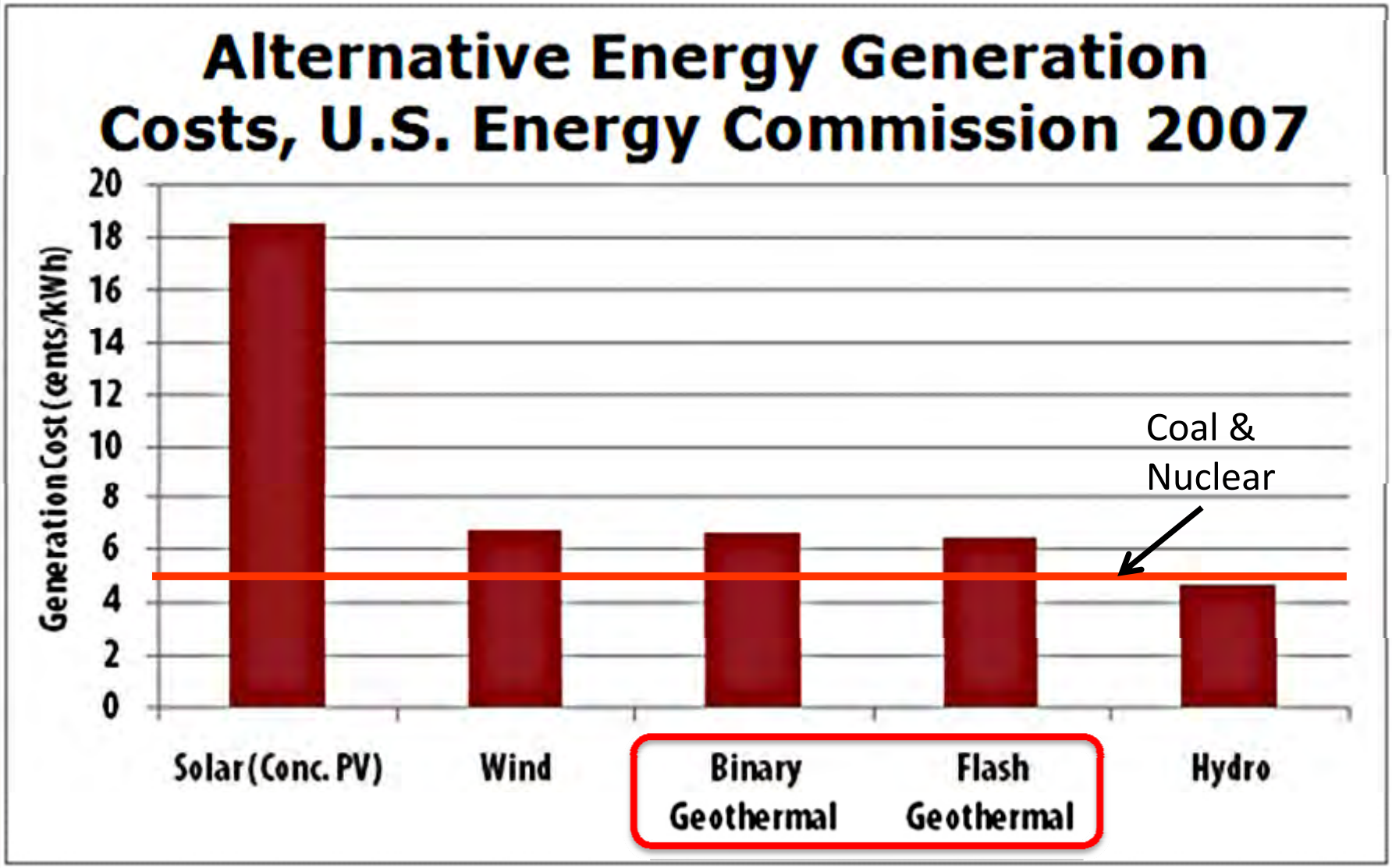
Geothermal Energy

Matthew Sares
Colorado Geological Survey

Why Geothermal?

- **Great potential in Colorado**
- **Geothermal is:**
  - ✓ **Clean** (no emissions)
  - ✓ **Safe** (no mining, no transportation)
  - ✓ **Environmentally friendly** (~ no water consumed)
  - ✓ **Sustainable** (Renewable)
  - ✓ **Distributed** (covers >1/2 state)
  - ✓ **Economical** (high upfront, but low operating costs)
  - ✓ **Baseload Power**
    - It is available 24 / 7 / 365
    - It has a very high capacity factor ~90%

Cost of Geothermal

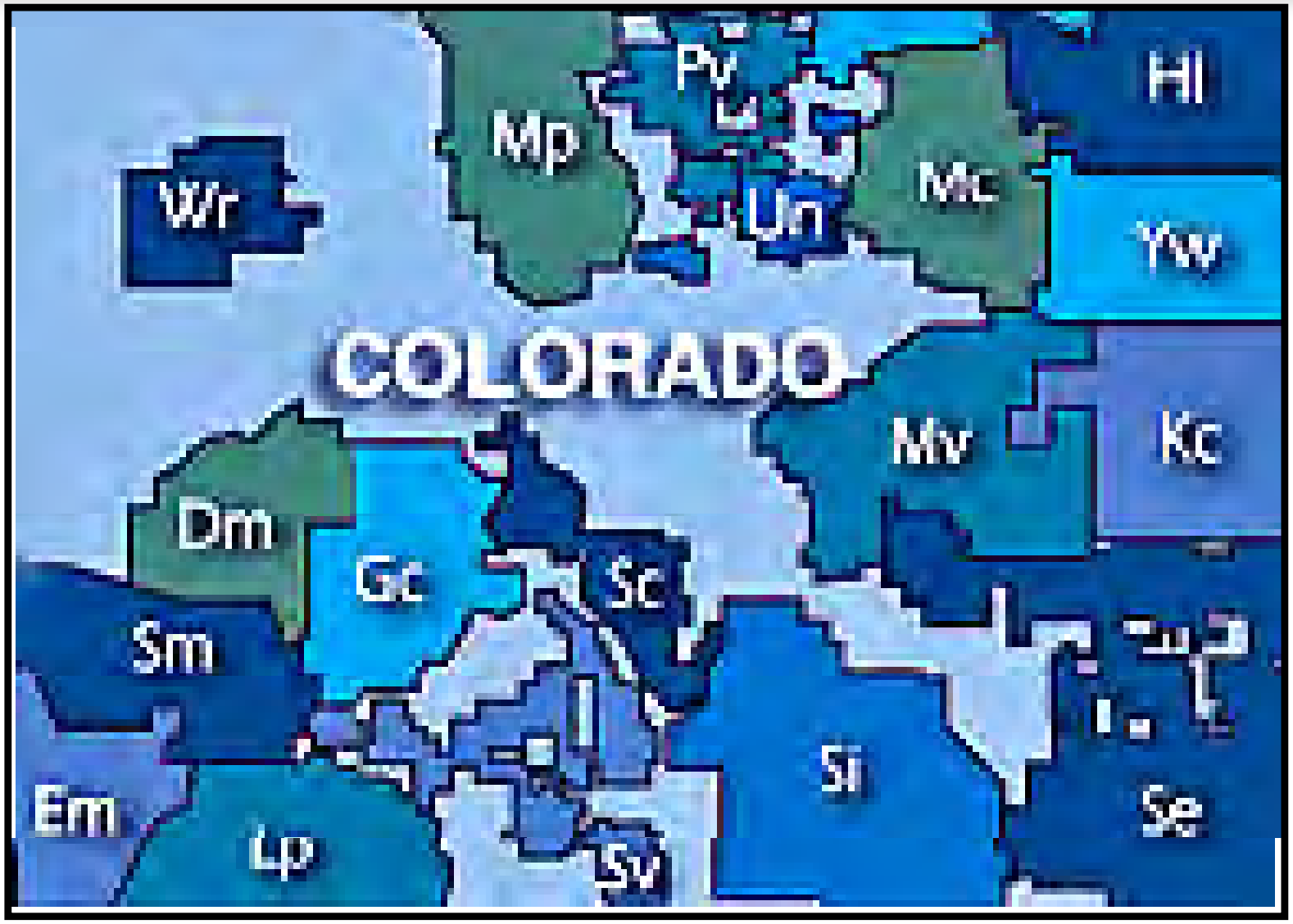


Estimated Levelized Cost of New Generation Resources, 2016.

Plant Type	Capacity Factor (%)	U.S. Average Levelized Costs (2008 $/megawatthour) for Plants Entering Service in 2016				
		Levelized Capital Cost	Fixed O&M	Variable O&M (including fuel)	Transmission Investment	Total System Levelized Cost
Conventional Coal	85	69.2	3.8	23.9	3.6	100.4
Advanced Coal	85	81.2	5.3	20.4	3.6	110.5
Advanced Coal with CCS	85	92.6	6.3	26.4	3.9	129.3
Natural Gas-fired						
Conventional Combined Cycle	87	22.9	1.7	54.9	3.6	83.1
Advanced Combined Cycle	87	22.4	1.6	51.7	3.6	79.3
Advanced CC with CCS	87	43.8	2.7	63.0	3.8	113.3
Conventional Combustion Turbine	30	41.1	4.7	82.9	10.8	139.5
Advanced Combustion Turbine	30	38.5	4.1	70.0	10.8	123.5
Advanced Nuclear	90	94.9	11.7	9.4	3.0	119.0
Wind	34.4	130.5	10.4	0.0	8.4	149.3
Wind – Offshore	39.3	159.9	23.8	0.0	7.4	191.1
Solar PV	21.7	376.8	6.4	0.0	13.0	396.1
Solar Thermal	31.2	224.4	21.8	0.0	10.4	256.6
Geothermal	90	88.0	22.9	0.0	4.8	115.7
Biomass	83	73.3	9.1	24.9	3.8	111.0
Hydro	51.4	103.7	3.5	7.1	5.7	119.9

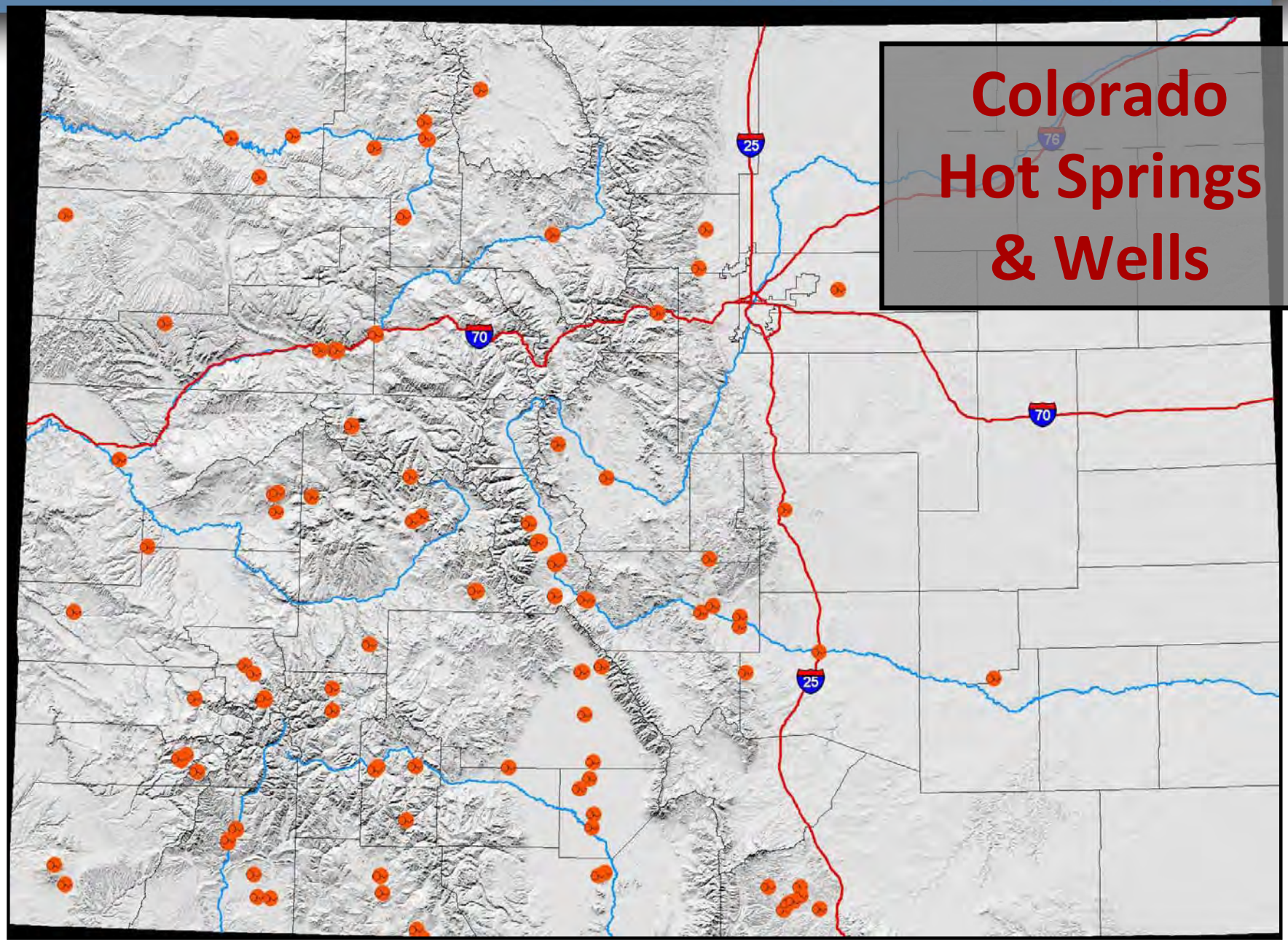
Source: Energy Information Administration, Annual Energy Outlook 2010, December 2009, DOE/EIA-0383(2009)

Geothermal Energy – Colorado Potential

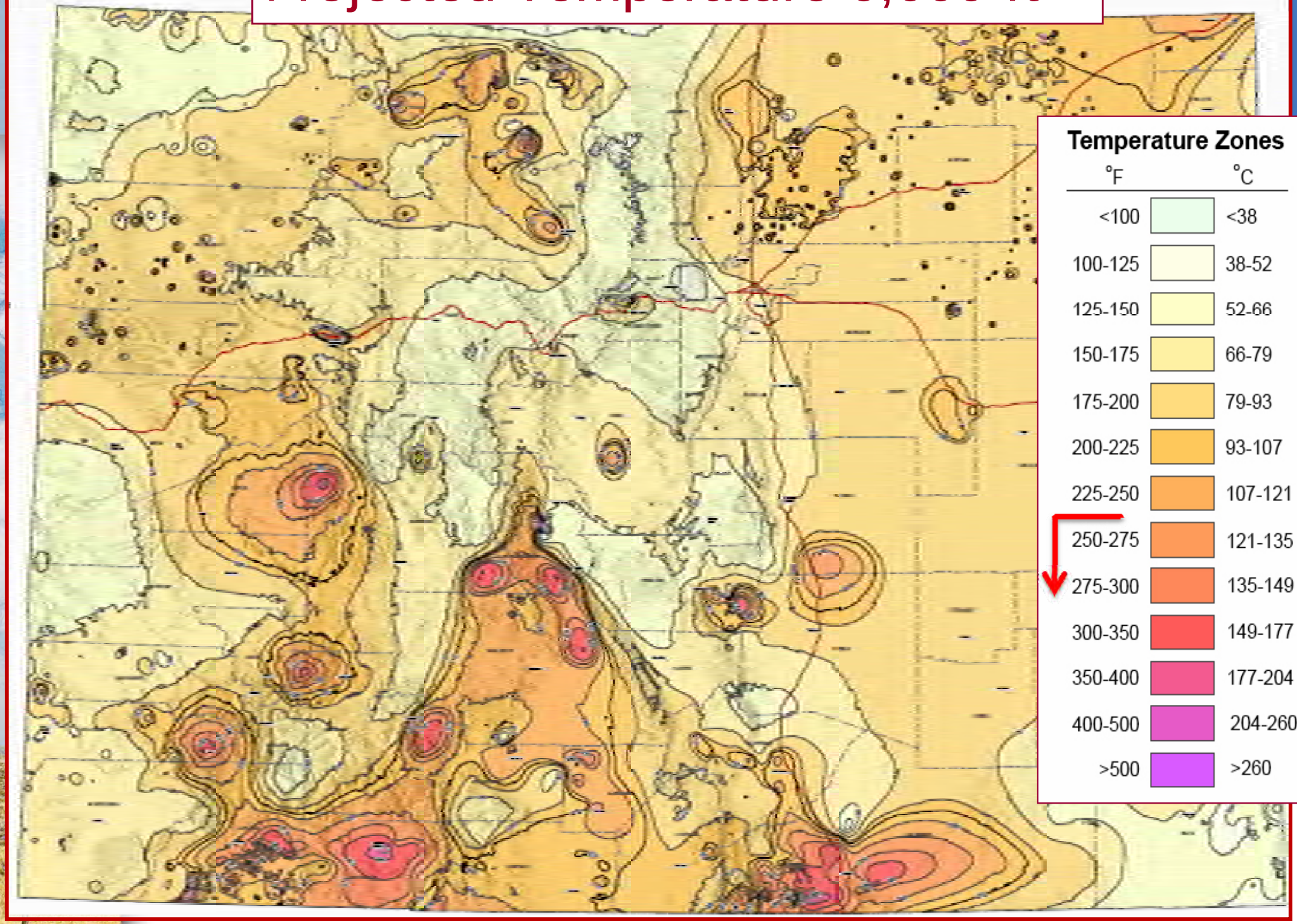


Courtesy of http://www.tristategt.org

Geothermal Energy – Colorado Potential



Projected Temperature 6,000 ft



Geothermal Energy – Potential Projects

- **Mount Princeton** (Sangre de Cristo)
  - Estimate: **10 MW**
- **Poncha Springs** (Sangre de Cristo)
- **Waunita** (Gunnison County)
- **Trinidad** (San Isabel)
- **Hot Sulphur Springs** (Mountain Parks)
- **Others:** Rico area (San Miguel), Ouray-Montrose area (Delta-Montrose)

Geothermal Energy – Statewide Potential

- **Western Governors Assoc – 2006**
  - **20 MW** by 2016 (based on 8¢/kWh)
  - **50 MW** by 2026 (based on 20¢/kWh)

- **USGS Assessment – 2008**
  - Identified Resources = **30 MW**
  - Undiscovered Resources = **1,105 MW**
  - EGS Systems = **52,600 MW**

GEO Geothermal Working Group page:

http://rechargecolorado.com/index.php/programs_overview/renewable_energy/geothermal_working_group/

CGS Geothermal web page:

http://geosurvey.state.co.us

Follow the link on our home page