Bobbie Lucero

From: Matthew Birnie
Sent: Wednesday, October 22, 2014 2:21 PM
To: Paula Swenson; Phil Chamberland; Jonathan Houck
Cc: Neal Starkebaum; Bobbie Lucero
Subject: Pagosa Verde Water Presentation
Attachments: Original WATER RESOURCES PRESENTATION NOTES.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Good Afternoon,

The attached document was included with Jerry Smith's response to Butch Clark's concerns, but was not attached to the email I forwarded yesterday.

Matthew

Companion Notes

UPDATE ON PROPOSED GEOTHERMAL PROJECT IN THE GUNNISON RIVER VALLEY

For the State of Colorado Water Resources Review Committee

July 18, 2013

Pagosa Verde

Pagosa Verde Model Geothermal Power Development

The Pagosa Verde Model geothermal development in Gunnison County accommodates Gunnison's economic, environmental and natural resource priorities. Its financial model is innovative and promotes local or regional control of revenue, jobs and growth through public/private partnerships. The model provides clean power with no green house gas emissions, no carbon footprint and a negligible physical footprint. Financial risk during exploration is mitigated by a suite of innovations, but most importantly, by validating other commercially viable enterprise even if the resource does not prove capable of power production. The model enhances tourism and outdoor industries and does not impact wildlife habitat or wilderness esthetic. Gunnison benefits from four years of development of this model in Archuleta County.

The landowners in Waunita have agreed to pursue development within this model in a collaborative way. Gunnison County has provided leadership in arranging regulatory compliance at the sites. Gunnison County added a geothermal development district component to their strategic growth plan. This progress is significant and has required hard work and dedication from all parties and promises significant benefits to the residents of Gunnison County. The regional Forest Service and BLM representatives have contributed to the work and the planning encompasses protection of all natural resources, the Gunnison Sage Grouse and, especially, the water resource.

Key priorities within the model are:

1. Community education and support.

2. Creation of and retention of high paying jobs and revenue streams in the community

3. Scalable base-load technology. This allows plants to be designed for strategic incremental growth. It enables strategic financial and growth planning tuned to the state's Renewable Energy Standard and in harmony with the portfolio and transmission strategies of our utility partners.

4. The model uses a combination of innovative testing processes and low-temperature technology. This combination reduces high-risk exploration investment and puts the projects within reach of public/private partnerships on a local or regional level.

5. The wells, plant and infrastructure do not produce GHG emissions, have an almost zero carbon footprint and require minimal esthetic and physical footprints.

6. The community scale and distributed energy nature of the model provides energy security for its community, de-couples electric rates from commodity market volatility and lends itself to eventual smart-grid technology.

7. The model's binary, air-cooled system is non-consumptive of geo fluid and requires less water during its working life than other renewable sources of power.

8. It produces base-load power 24/7/365 at an industry low levelized cost.

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A Key Clarification

Many Coloradans confuse all geothermal development with the EGS (Enhanced Geothermal System) geothermal process. In 2009 the state and DOE used recovery act funding to support EGS development in Colorado. At that time it was the proven technology. However, the EGS technology does not easily conform to the Colorado cultural or renewable energy landscape.

EGS or Enhanced Geothermal Systems use lots of water, deeper wells and inject water under pressure to stimulate steam production. These systems are consumptive of both geothermal fluids and surface water. The process requires major exploration and development investment and accordingly the financial model prefers large tracts of land and focuses on large production capacities with resultant large infrastructure impacts. In many ways the EGS technical and financial scenarios resemble gas exploration and production.

The current binary technology was first proven in late 2007 and gained wide acceptance in the last few years. Binary systems use little or no surface water. They are not consumptive of geo fluid, and because they function adequately at significantly lower fluid temperature, they typically require less well depth and a smaller tract for development. Low temperature binary systems such as those supported by the Pagosa Verde Model represent a new paradigm in geothermal resource development. It is now the favored technology world-wide. Both scientific and financial innovation are underway in service to the possibilities of this maturing technology.

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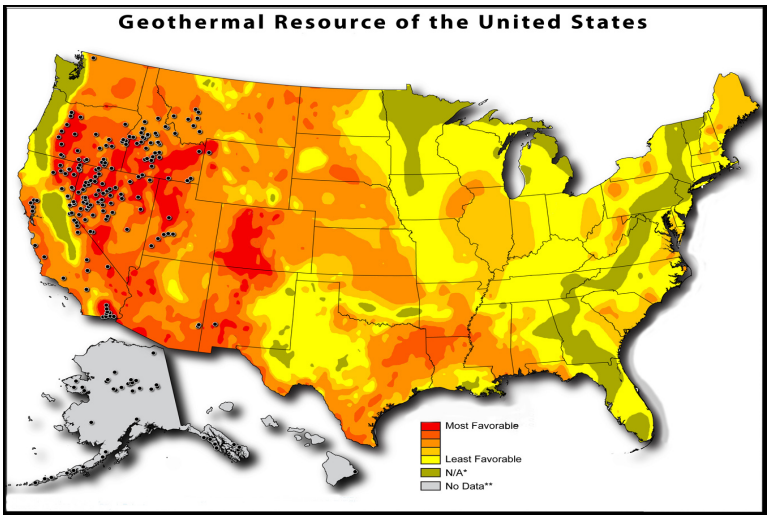
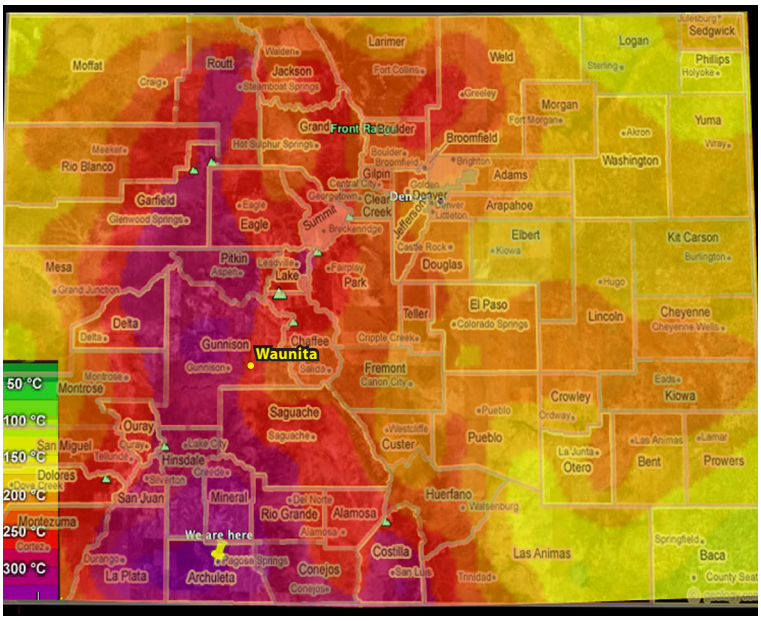
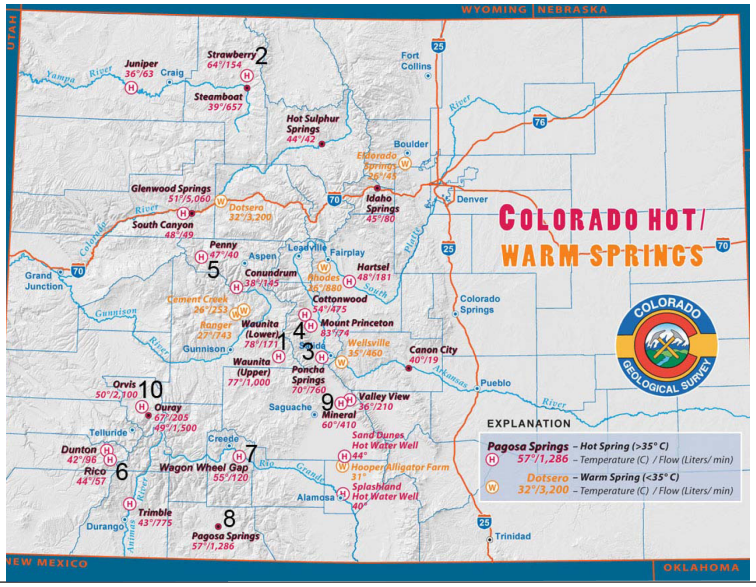


Over 100 Geothermal Plants in the Western US.
None in Colorado.
Most plants under construction or recently commissioned are binary, air-cooled plants using technology similar to the Pagosa Verde Model.



Heat flow at depth in Colorado. Waunita is the first or second most desirable site in Colorado. Average climate and temperature, surface expressions and historic geologic and geophysics analysis is promising. However, as in much of Colorado, land use, environmental impact, water quality and use, tourism, outdoor industry economies and wildlife habitat are issues to be considered in a successful development model.



The most promising areas for geothermal development in Colorado are also the most sensitive to environmental, cultural and esthetic impacts.

Additionally, mountainous or remote locales often suffer from marginal grid infrastructure and difficult local economic conditions.

On the other hand, these are the areas that benefit most from distributed, community scale projects bringing jobs, energy security and broad-based economic stimulus.

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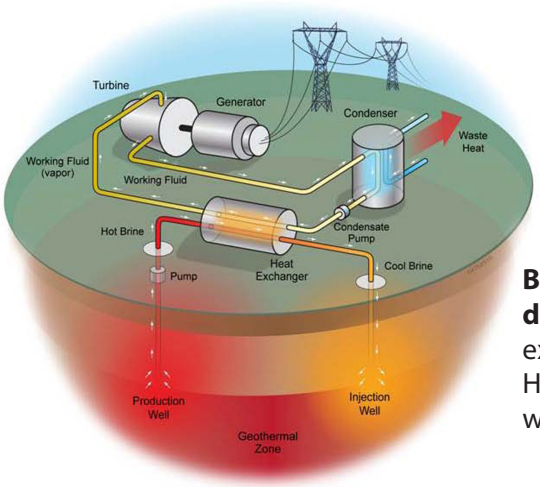
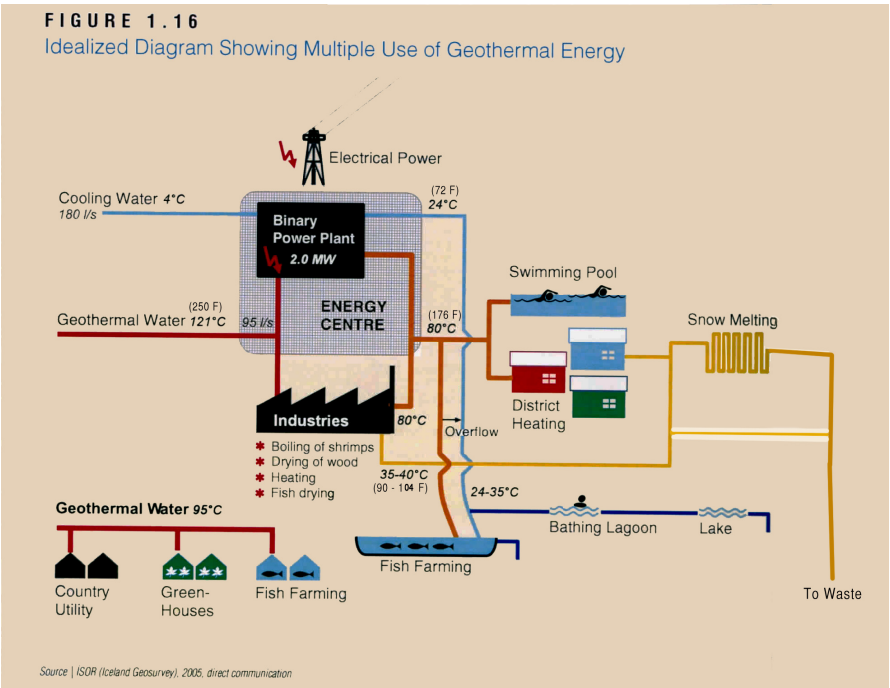
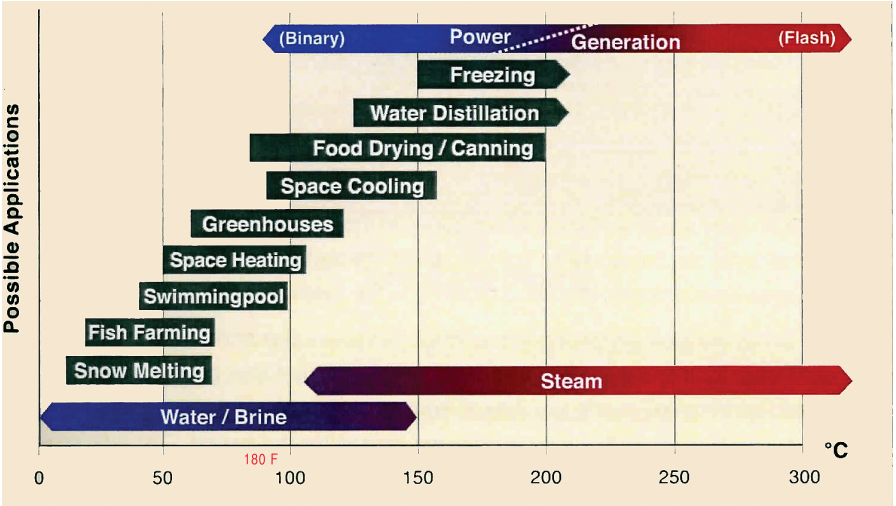


Binary System Graphic
Geo-fluid leaving the heat exchanger should then be run through subsidiary heat exchangers for support of ancillary enterprise as modeled below.

Both Waunita landowners are pursuing direct use geothermal agriculture using their existing surface resource (180º with high volume). Historically the brine has discharged into the stream with no negative effect other than warmth.





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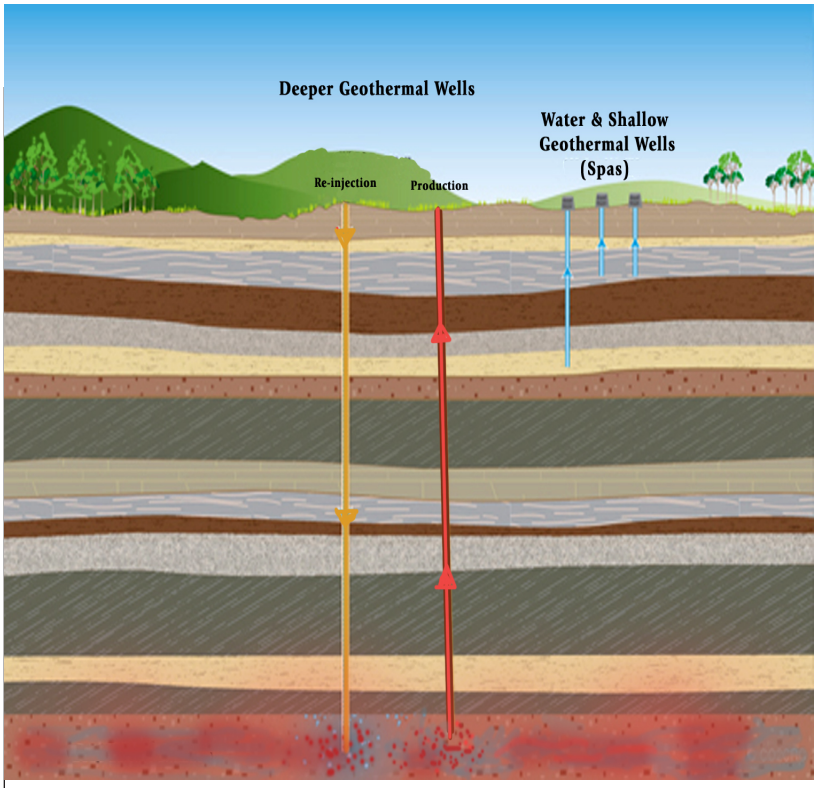
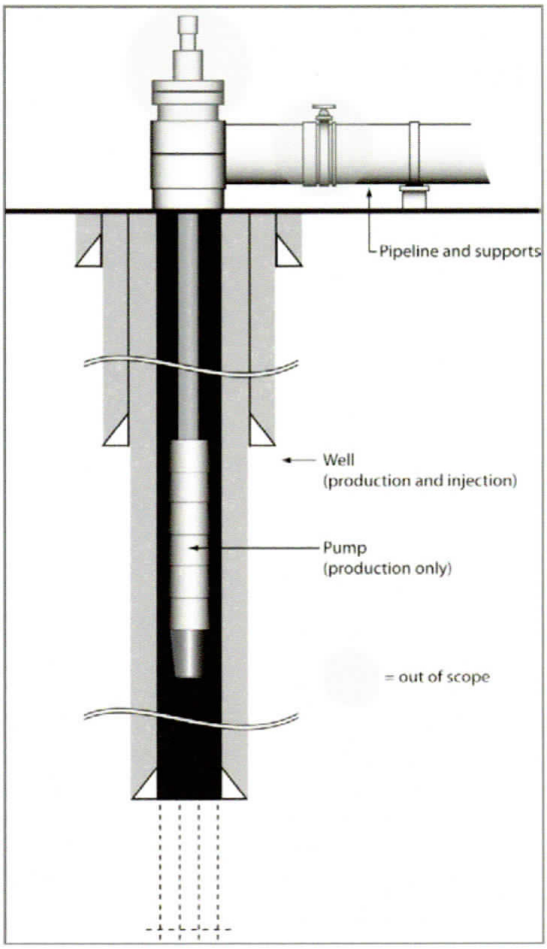


Geothermal wells access a deeper aquifer than water wells.



Type B Well permitting provides for regulatory supervision of well construction as well as NEPA permitting of site and infrastructure impacts.

Well casing is cemented in place and impervious to cross contamination with fresh water sources. Not only is this an environmental and NEPA requirement, but it is economically vital to protection of the fluid heat. Well cements and casing materials have to accommodate chemical, heat and pressure effects of brine transmission to the surface or during re-injection.

Wells are capped with a blowout preventer. Geothermal pipeline is typically above surface on concrete stanchions and insulated as shown, although it may be buried.

Well heads can be as far as one mile from plant without significant loss of fluid heat.

Water is used to mix drilling muds, cements and well cleaning during the drilling process. These fluids are typically captured and reused or disposed of according to NEPA requirements.

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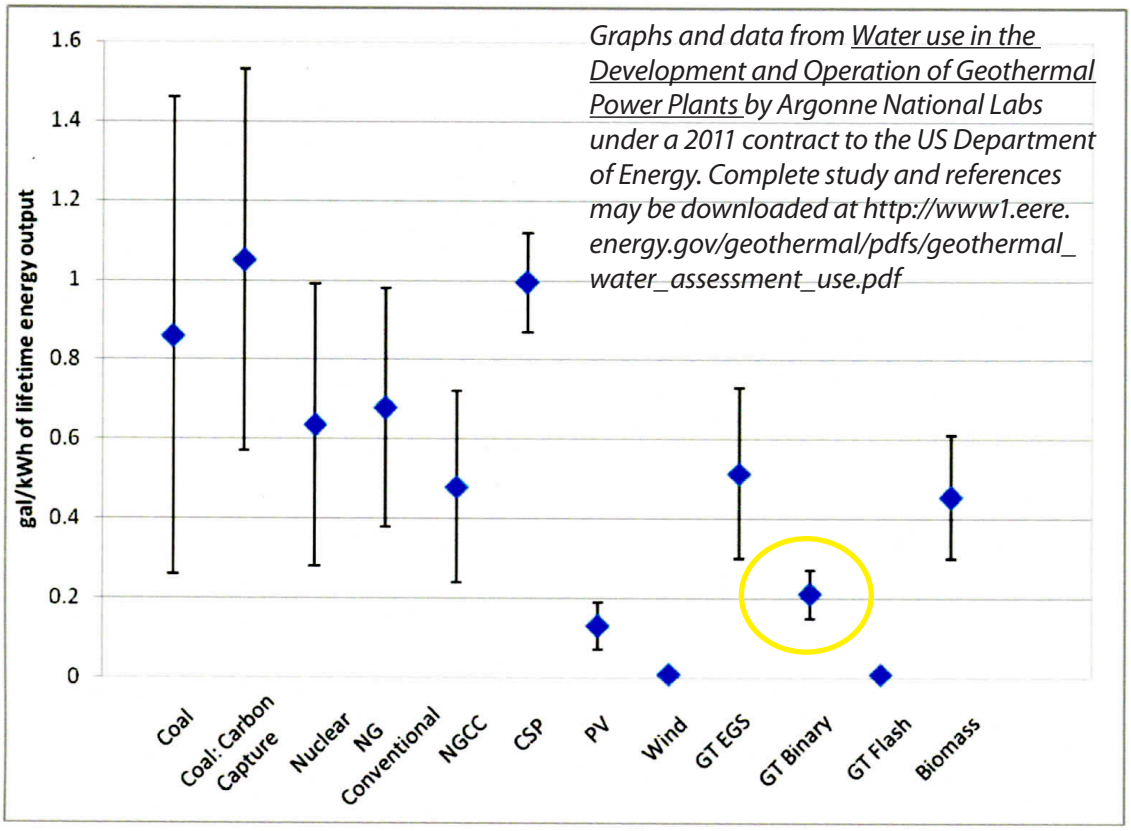

Graphs and data from Water use in the Development and Operation of Geothermal Power Plants by Argonne National Labs under a 2011 contract to the US Department of Energy. Complete study and references may be downloaded at http://www1.eere.energy.gov/geothermal/pdfs/geothermal_water_assessment_use.pdf

Water consumption for Electric Power Generation (Hydropower is not included because it is dificult to allocate evaporative losses from reservoir surfaces to electricity generation.) GT Binary and GT Flash estimates assume water consumed is makeup for operational loss and is a small percentage of total operational geo fluid loss.

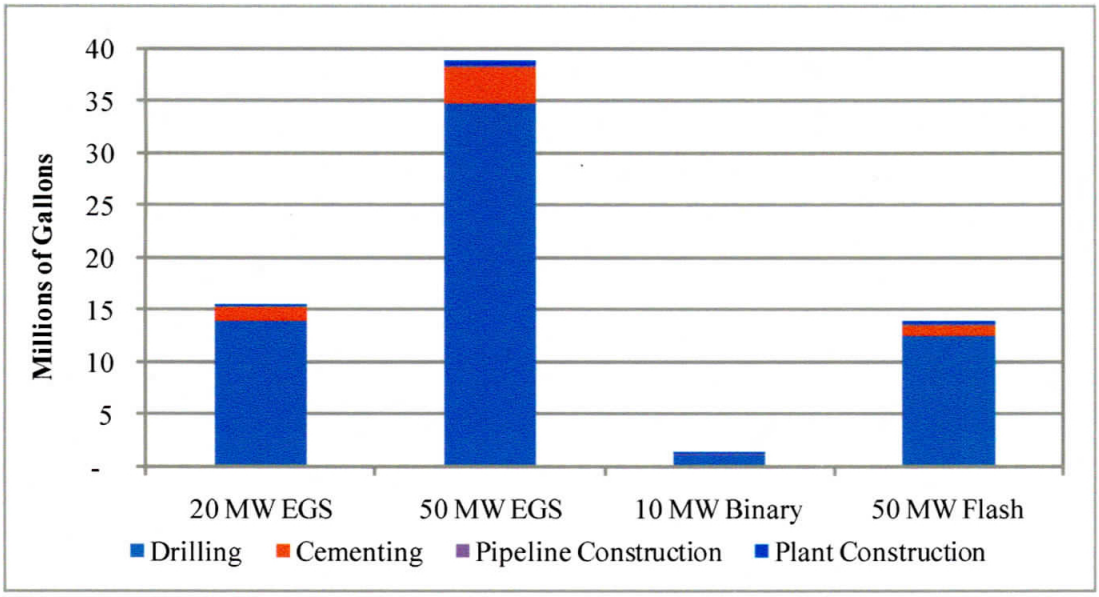

FIGURE 4-1 Volume of Water Consumed for Construction of Geothermal Power Plants according to Scenarios and Assuming Average Depth for Wells

Thoughts on state legislative support for geothermal development in rural Colorado.

1. The legislature showed great wisdom and boldness in authorizing statute 30-20-1203. This statute was clearly focused on fostering local participation in renewable energy development and plant ownership. I don't believe it has yet been used, however, it will be. The existing cap on the bond guarantee is unspecified. In order to stimulate municipal or county application of the statute for power plants, the cap should be high enough to encourage its use in the most financially prudent way. High risk investment capitol demands a punishing rate of return over the life of a project. The bond program should allow towns or counties to buy out high risk exploration investors once plant production and a PPA are operative. I've attached the statute for your convenience.

2. Large firms investing in geothermal are distracted by the new geothermal fields being developed with sovereign debt in Kenya, Indonesia and so-forth. For this reason there is little motivation for their investment in the Colorado market. However, the reality of many potential projects in Colorado argue in favor of supporting this Colorado market that promises so much.

I believe our elected bodies should consider a ***Renewable Energy Development Trust***. This would allow the state and federal government, local and regional governments and private Colorado investors to collaborate in market development through a self funding growth mechanism.

The structure for such a trust exists. Versions have supported the gas and oil industry growth for a century. Pagosa Verde has discussed and researched this with leaders of the DOE, the World Bank, private investors and Colorado economic developers. I would like the opportunity to explore its benefits as a collaborative endeavor led by our elected Colorado officials.

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Colorado Stature 30-20-1203:

(1) "Board" means the board of county commissioners of a county or a city and county.
(2) "Clean energy" means energy derived from biomass, as defined in section 40-2-124 (1) (a) (I), C.R.S., geothermal energy, solar energy, small hydroelectricity, and wind energy, as well as any hydrogen derived from any of the foregoing.
(3) "Cooperative electric association" shall have the same meaning as set forth in section 40-9.5-102, C.R.S.
(4) "Eligible applicant" means an individual property owner or a group of property owners that do not own the entirety of a cooperative electric association and that seek to construct, expand, or upgrade an eligible clean energy project located or to be located on the applicant's property.
(5) "Eligible clean energy project" means a project owned by an eligible applicant that produces or transmits clean energy for public benefit only, has a nameplate rating of no more than fifty megawatts and is not a part of a larger project with a nameplate rating of more than fifty megawatts, and is located within the certificated service area of a cooperative electric association. "Eligible clean energy project" includes transmission lines to the point of entry to the power grid of a cooperative electric association, a generation and transmission electric corporation or association, or any federal agency and any other equipment or facility, including, but not
limited to, substation upgrades needed to deliver the clean energy produced by an eligible clean energy project to a market.

30-20-1203. Eligible clean energy project financing - county approval - private activity bond financing.
(1) An eligible applicant may apply to the board of the county or city and county in which it proposes to construct, expand, or upgrade an eligible clean energy project for assistance in the financing of the project. Subject to the requirements and limitations specified in federal law, the "Colorado Private Activity Bond Ceiling Allocation Act", part 17 of article 32 of title 24, C.R.S., and subsection (2) of this section, if the board approves the application, it may provide financing assistance by issuing tax-exempt private activity bonds in a minimum amount of one million dollars on behalf of the eligible applicant.
(2) A board shall issue tax-exempt private activity bonds on behalf of an eligible applicant to finance an eligible clean energy project subject to the following requirements and limitations:
(a) The board shall enter into agreements with the eligible applicant under which:
(I) The board agrees to loan to the eligible applicant the net proceeds of the bonds issued so that the eligible applicant can finance all or a portion of the eligible clean energy project; and
(II) The eligible applicant agrees that it has the sole responsibility to pay, either directly or indirectly through the board or a bond trustee, all financial obligations owed to bondholders and that it shall provide and maintain any reserve deemed necessary by the board to ensure that the financial obligations are paid;
(b) The bonds issued shall specify that bondholders may not look to any county or city and county revenues for repayment of the bonds. The bonds shall further specify that the only sources of repayment for the bonds are revenues provided by the eligible applicant, property of the eligible applicant, or credit enhancement obtained by the eligible applicant that may be pledged to the payment of the bonds; and (c) The repayment term for the bonds issued shall not exceed ten years.
(3) Because private activity bonds are payable only from the sources specified in paragraph (b) of subsection (2) of this section, such bonds shall not be deemed to create county or city and county indebtedness or a multiple-fiscal year obligation within the meaning of any provision of the state constitution or the laws of this state, and a board may issue such bonds without voter approval.
(4) The rates charged by an eligible applicant for the delivery of clean energy produced by an eligible clean energy project shall be set to allow recovery of all costs necessarily incurred to deliver the clean energy to a market, including, but not limited to, the costs of substation upgrades, transmission lines to the point of entry to the power grid of a cooperative electric association, and any wheeling charges imposed by a cooperative electric association.
Source: L. 2008: Entire part added, p. 1316, § 3, effective May 27.
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