

**National Geothermal Collaborative
Steering Committee
Second Review: Issue Briefs
Final Meeting Summary**

**May 18, 2004
Conference Call**

Present:

Diana Bates – Geothermal Energy Association
Gordon Bloomquist – Washington State University
Mathew Brown- National Conference of State Legislatures
Troy Gagliano - National Conference of State Legislatures
Karl Gawell-Geothermal Energy Association
Roger Hill – Sandia, GeoPowering the West
Patrick Lanie – INEEL
Marty Letourneau – WHITEPS
Arelene Rocabado – Southern California Edison

Decisions Made:

No.	Decision
	<p>Issue Briefs: Changes and edits were accepted for the second review of two issue briefs – a few key agreement/decisions include (see sections for detailed changes):</p> <ol style="list-style-type: none">1. <i>Technology and Costs:</i> The table in this brief will include a footnote to qualify the table as a snapshot in time, that the costs are levelized; define what the numbers include (the PTC is not included) and the term levelized; and note that costs depend on the quality of the resource.2. <i>Direct Use:</i> The brief accurately reflects temperature ranges. The chart included in this brief (California Energy Commission data) shows the range of options for decision makers and customers, although it is not exact.

Actions:

Direct Use Brief – NCSL will verify with Oregon Institute of Technology whether their district heating system also heats their sidewalks, streets, bridges and some homes. NCSL will also verify the numbers quoted from the Geothermal Education Office.

Meeting Objective: To conduct a second review of the Technology and Cost and Direct Use Issue Briefs to further refine the documents, focusing on those issues identified as potentially blocking consensus, or important to preserve and protect in order to reach consensus.

Changes/Discussion

For a full account of the changes accepted, editorial and substantive, please refer to the revised documents (these will be recirculated prior to the third, and final review). The following is an outline of the key substantive discussions on each Brief, including agreements, editorial changes and the relevant marked up sections. Each description includes a copy of the section of the Brief being discussed, including the subsequent changes:

- **bold** text was added,
 - ~~strikeout~~ text was removed).
 - *** Denotes decisions on editorial changes accepted by the group.
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Technology and Cost Issue Brief

Current Technology – Binary Cycle

***REMOVE isobutene, it is just another version of a binary process.

“Binary Cycle - This rapidly expanding technology uses geothermal resources with temperatures as low as 190°F. Rather than flashing the geothermal fluid to produce steam, this type of power plant uses heat exchangers to transfer the heat of the water to another working fluid ~~such as isobutane~~ that vaporizes at lower temperatures. This vapor drives a turbine to generate power, after which it is condensed and circulated back to the heat exchangers. In this type of geothermal plant, which has superior environmental characteristics compared to the others, the hot water (which tends to contain dissolved salts and minerals) is never exposed to the ~~air or to surface water~~ atmosphere before it is injected back into the reservoir. Binary power plants has were introduced in the mid-1980s and are the fastest growing technology in this sector with more than 350 MW of binary generation that exist in California, Hawaii, Nevada, New Mexico and Utah.”

Direct Use Section – Direct Heating

There was some question as to whether the district heating system was also used to heat sidewalks, streets, and bridges. ***REMOVE the idea that district heating is used to heat streets, sidewalks and bridges.

“District Heating - District heating systems distribute geothermal heat to buildings and homes that are connected through a network of pipes. Boise, Idaho, uses a district heating system, which has operated since 1892, to heat more than 350 buildings throughout the city, including the state Capitol. In addition to heating buildings, Klamath Falls, Oregon, uses this technology to ~~heat streets, sidewalks and bridges to help melt snow.~~”

Geothermal Heat Pumps

The air circulating from heat pumps, in all cases, is more than 70°F; it needs to be to maintain a room temperature of 70°F. ***CHANGE references about “heating the air” to maintaining the room temperature.

“Geothermal Heat Pumps - Geothermal heat pumps provide and efficient means of heating and cooling buildings. Heat pumps use less energy than traditional heating and

air conditioning systems because they do not need to create great changes in air temperature. For example, if the outside air temperature is 20°F a traditional system would have to ~~heat the air to~~ **maintain the temperature of** approximately 70°F for indoor use. A heat pump, however, draws on the relatively constant temperature ~~of the air~~ in the ground (usually between 50°F to 60°F) ~~and raise it to~~ **maintain a room temperature of** 70°F. Heat pumps can reduce a building's energy consumption by 30 percent to 50 percent, compared to conventional electric heating and cooling systems. Although these systems are powered with electricity, the power is used to move, not generate, heat; consequently, a heat pump delivers three to four times more energy than it consumes. More than 1 million geothermal heat pumps (with a total capacity to generate approximately 8,600 MW of heat) operate across the country.”

Advanced Technology Section

There was a discussion about whether to split the paragraph into two ideas.

AGREEMENT: Keep the paragraph in tact, there is not enough information to split the paragraph.
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There was a discussion about the correct terms use to describe the necessary depth of the resource. The existing terms, “fairly close,” might give the impression that the resource is several hundred feet below the surface, when the actual depth is in the range of 8,000 – 15,000 (with some binary plants using a resource at 1000 feet). ***Use “less than 15,000 feet. ***ADD: a sentence about advance power techniques used to create more efficient systems, and generate energy from lower depths and temperatures. ***REMOVE the words “kalian cycles;” all options should be listed or none.

“Geothermal power plants need heat, water, and ~~porous~~ **permeable** rocks located ~~fairly close~~ **less than 15,000 feet below** the surface to generate affordable electricity **with greater efficiencies and using lower temperatures**. Researchers and geothermal developers are searching for ways to enhance the productivity of geothermal reservoirs and to use areas that have ample heat but little water **or which are at greater depth**. Advanced power generation techniques may make it possible to generate electricity using much lower temperature resources while advances in drilling may allow developers to tap valuable resources located deeper underground. If successful, these advances will enable the recovery of a much larger portion of the earth’s thermal energy closer to areas where electricity customers are located.”

Cost, Price and Challenges Section – first paragraph

There were some questions about the definition of “cheap power” and what nuclear power prices reflect. The group felt the main point of this section was that geothermal prices are within the range of other energy sources. ***ADD a sentence about geothermal prices are within the range of other energy sources; ***REMOVE the last sentence, it is repetitive of the numbers in the table; and ***INSERT the table following the first paragraph.

“Unlike traditional power plants that run on fuel that must be purchased over the life of the plant, geothermal power plants use a renewable resource that is not susceptible to price fluctuations. New geothermal plants currently are generating electricity for **prices** between \$0.05 to \$0.08 per kilowatt-hour (kWh). Geothermal plants that have operated for more than 10 years tend to generate power for **prices** as little as \$0.03 per kWh to

\$0.05 per kWh, because the capital costs are paid off. **The price of geothermal energy is clearly within the range of other electricity choices available today.** ~~By comparison, modern wind turbines generate power for approximately \$0.03 to \$0.06 per kWh with the help of the federal production tax credit of \$0.018 per kWh. Coal and nuclear power plants can generate cheap power (below \$0.03 per kWh), but a number of environmental and economic concerns are associated with these plants that do not relate to geothermal plants.”~~ INSERT TABLE HERE

Table: Approximate Capital Cost for Various Power Plants

Diana Bates and Karl Gawell worked together to revise this table. The table was reviewed by NCSL. The source of the data was the California Energy Commission (CEC). There were a few questions:

Q: Does the number in the “taxes” line refer to accelerated depreciation? And is the PTC factored for in the table?

A: The table does not include the PTC and does include accelerated depreciation. The value of the data is that it is a relatively current moment in time, shows a range, is thorough and from a neutral source.

Concern/Q: The costs seem lower than other previous numbers.

A: The costs are levelized over the life of the plant. The numbers cited in a previous version were prices, not costs.

***RETITLE the table – Cost of Electricity Production; and ***ADD a footnote to:

1. Qualify the tables as a snap shot in time – that it does not reflect the recent changes in natural gas prices
2. Define what the numbers include, and that the PTC is not included
3. Qualify that the costs are levelized and define levelized
4. Note that costs also depend on the quality of the renewable energy resource

Transmission Section

It was mentioned that the transmission issues in rural areas are not just building new transmission but also upgrading existing lines. ***ADD/CHANGE the sentences to reflect that there are challenges to transmission in rural areas.

“Geothermal power plants must be located in specific areas near a reservoir because it is not practical to transport steam or hot water. Since many of the best geothermal resources are located in rural areas a developer may ~~have to build new transmission lines to connect a new~~ **be limited by the ability to supply power** geothermal power plant to the powergrid. ~~New power lines are expensive to construct and may be difficult to site in places where they conflict with other land uses such as protected parklands of populated areas.~~ Many existing transmission lines are operating near capacity and may not be able to transmit additional electricity without significant upgrades. Consequently, any significant increase in the number of geothermal power plants will be limited by those plants’ access to the power grid and whether the grid is able to deliver the additional power to market.”

Direct Use Issue Brief

The suggestion was made that the Brief needed to include reference to the ability to use geothermal resources for building cooling. Also, throughout the paper mining is used inaccurately for mineral extraction. ***ADD a reference to cooling in the introduction paragraph.

“The direct use of geothermal heat and water dates back thousands of years to when people used hot springs for cooking and for therapeutic purposes. Direct-use applications tap hot underground water and distribute the heat through pipes for various uses. These systems can replace traditional heating sources such as natural gas-fired boilers, furnaces or hot water heaters. Some cities and towns have installed large direct-use heating systems—called district heating—that heat many buildings from a common geothermal source. **Geothermal energy can also be used to cool buildings.** Geothermal direct-use also has agricultural and industrial applications. The agricultural sector uses geothermal resources to provide a stable source of heat for raising fish and heating greenhouses; industrial uses include ~~mining~~**mineral extraction**, drying timber and dyeing fabric.”

ACTION: NCSL will check with OIT about whether the district heating system heats sidewalks, streets, and bridges as well as home.

“The district heating system in Klamath Falls, Oregon, provides approximately 6 megawatts of heat to 20 commercial buildings, ~~over 500 homes~~ and for melting snow over nearly 105,000 square-feet of sidewalks and bridges. A commercial greenhouse that covers three acres recently tapped into the city's system; it is using geothermal heat to grow tree seedlings.”

AGREEMENT: There was agreement on the temperature ranges stated in the Brief.

ACTION: Verify the numbers quoted with the geothermal education office graph.

Figure 1

AGREEMENT: The chart, although not exact, adequately shows the range of options, especially for decision makers and consumers the chart.

***USE the term “typically” to address the accuracy issue.

Industrial Processes Section

“Geothermal resources also are used in ~~mining~~**mineral extraction**, timber **drying, fruit and vegetable dehydration** and textile industries. In the United States, gold is extracted using a process called heap leaching in which a cyanide solution is sprayed over ore. Using the heat of geothermal resources allows the process to continue even in the winter, when the ore would otherwise be frozen solid. This method of ~~mining~~**mineral extraction**, used primarily in Nevada, has resulted in higher rates of gold recovery. In Italy, geothermal energy has been used for centuries to process boron into boric acid. Geothermal heat also is used to dry lumber and to dye fabrics such as silk and wool.”

It is important that this brief is accepted by the Geothermal Heat Center. Gordon Bloomquist sent this Brief to John Lund at OIT for comments and will pass them on to RESOLVE.

Next Steps

1. Final Review for the initial nine Issues Briefs – Benefits and Challenges; Common Question; Direct Use; Economic Development; Environmental; Location; Policy Options; Siting; and Technology and Cost.
2. First Review of the Jurisdiction and Authority Issue Brief. This brief was reviewed by Gordon Bloomquist, Roger Hill and Paul Dunlevy. RESOLVE will send a draft of the Brief out to the Steering Committee in the next week.