

## DOCKETED

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## **Geothermal Energy Association Comments on Costs**

*Additional submitted attachment is included below.*



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California Energy Commission  
Docket No. 15-RETI-02  
1516 Ninth Street, MS-4  
Sacramento, CA 95814-5512

**RE: Comments on Renewable Energy Transmission Initiative 2.0 & RPS Calculator Cost Assumptions**

Dear Commission and CPUC Staff,

It has come to the Geothermal Energy Association's (GEA) attention that there is a significant amount of misunderstanding outside the geothermal sector surrounding geothermal energy's costs and price. Costs and prices have dropped in recent transactions, and these new figures should be reflected in Integrated Resource Planning or any other modeling efforts conducted by your agencies or outside contractors. In addition, capital cost figures used for modeling in California's CPUC cost calculator are unrealistic in comparison with actual projects.

This misconception arose out of:

1. The limited number of geothermal power projects to come online in recent years compared to other renewables or natural gas;
2. The economics that define geothermal projects are different from comparable renewable energy technologies. Geothermal projects are not manufactured products like wind and solar but a natural resource that becomes more or less economic at different locations depending on resource depth, resource temperature and enthalpy, project size, government incentives, price for power, technology and other related project economics or components; and,
3. Costs are often very site- and project-specific. Two projects at the same location might have very different costs. It is difficult to make generalizations to all locations or even specific projects at the same site.

*Geothermal Costs*

GEA recommends using the following ranges of capital cost for "typical project costs." While the occasional outlier project may cost more than this range to bring online, geothermal developers are unlikely to willingly start a project with the assertion that it will cost more than this range. The lower ends of these ranges are for expanding existing facilities or adding bottoming cycle binary units. The middle of these ranges are more common. These figures are extrapolated using Department of the Treasury's 1603 Cash Grant Data.



*Table 1: Typical Geothermal Power Project Capital Cost*

<i>in (\$/kW)</i>	<i>Binary plant - Low Temperature</i>	<i>Flash/ Dry Steam - High Temperature</i>
<i>Low</i>	<i>\$2,400</i>	<i>\$4,000</i>
<i>High</i>	<i>\$5,500</i>	<i>\$6,500</i>

Some guidelines on using these numbers:

- i. Expansions to existing facilities will be on the lower end of this range. This includes expansions to a facility and its associated drilled area to increase the level of power the plant produces. Many new plants to come online in the US fall in this category or bullet "ii" below.
- ii. Typically new plants on existing fields will be in the middle of this range. These are projects where development of the geothermal reservoir occurred previously or has supported plant operation in the past.
- iii. New greenfield plants are normally the most expensive, although costs are very site-specific and depend on the criteria laid out in bullet "2" and "3" above or bullet "iv" below.
- iv. Because of economies of scale, plant efficiencies, resource enthalpy, and reservoir depth, smaller lower temperature geothermal power projects are usually the most expensive, and large high temperature projects are often the least expensive per kW of generating capacity. When using any capital cost number, it is important to look at the assumptions that went into calculating that cost number. Often two geothermal cost numbers are not comparable between projects because of the unique assumptions that determined resource or plant costs.

For more information on costs, GEA recommends exploring the [Low Carbon Grid Study Phase II](#) cost numbers and assumptions. These assumptions have been peer reviewed by a large group of renewable energy sector stakeholders.

#### *Price of Power*

Data collected by GEA from publically available power purchase agreements (PPAs) found that geothermal projects have signed contracts with initial prices ranging between \$17.76- \$101.95 per MWh. Furthermore, the most common levelized power price for a new facility is in the \$75-\$100 per MWh range. Two of the most recent PPAs signed with Southern California Public Power Authority for Ormat's Don Campbell I & II facility fall in this levelized range at a price of \$81.25 and \$99.00 per MWh respectively.

These power purchase agreements are normally for base-load power contracts with the occasional more flexible power contract. The low-end prices were for a legacy, existing facilities and are likely based on California's Short Run Avoided Cost formula. The high end prices are for newer binary projects that were built on lower-temperature resources that were smaller in size.

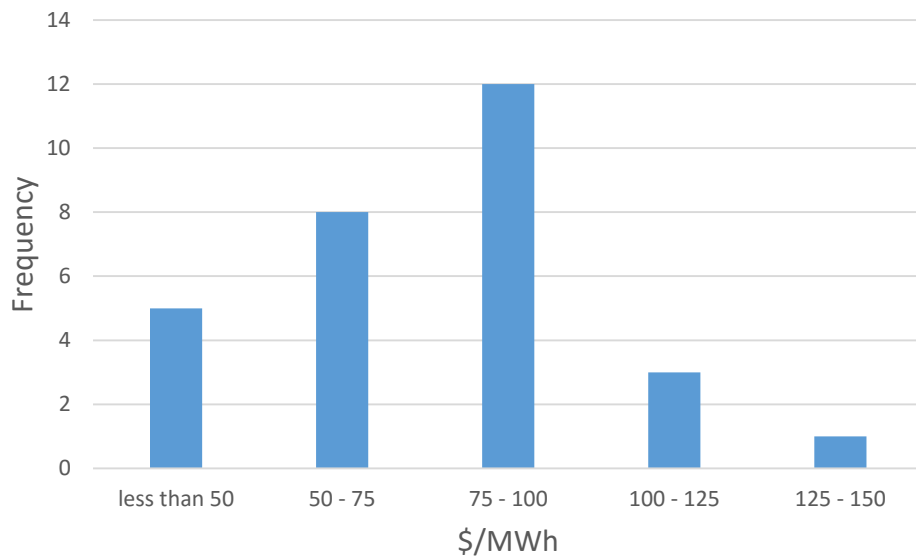
As in Figure 1 demonstrates, GEA believes that prices outside the levelized range of \$75-\$100/MWh for a geothermal contract are not reflective of a typical geothermal plant's ability to deliver competitive priced geothermal power. Prices have dropped in recent transactions, and the pricing levels in this



memorandum should be considered in any modeling conducted by your agencies or by outside contractors.

If you have any further questions please feel free to contact us at email address or phone number provided below.

*Figure 1: Twenty-Nine Levelized Geothermal PPAs Signed in the United States*



Note: Most of the recent transactions between geothermal operators and utilities fall in the \$75-\$100 /MWh range.

Sincerely,

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*The Geothermal Energy Association (GEA) is a trade association comprised of over 150 U.S. and international companies that support the expanded use of geothermal energy and are developing geothermal resources worldwide for electrical power generation and direct-heat uses.*