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GEA RE: RETI 2.0 Plenary Group Meeting On Renewable Resource Areas March 16, 2016

Additional submitted attachment is included below.

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

March 29th, 2016

RE: RENEWABLE ENERGY TRANSMISSION INITIATIVE 2.0 PLENARY GROUP MEETING ON RENEWABLE RESOURCE AREAS MARCH 16, 2016 10 AM – 4 PM

1. What renewable energy zones in California and across the West may be of most interest to California utilities and developers by the 2030 timeframe?

An area of high priority and interest to the geothermal industry is the undeveloped Salton Sea Known Geothermal Resource Area in Imperial Valley (SSKGRA). This resource is one of the largest geothermal fields in the world capable of producing an additional 1,700 to 2,300 MW of geothermal power by 2030. This power could be used in state, or exported to surrounding states. Building out resources like the SSKGRA keeps the economic and tax benefits of developing renewable energy technology in state.

Additional areas of interest include new capacity additions that could be brought on at The Geysers, several small projects in Northern California, and undeveloped resources that exist in Mono County.

2. Costs: What is the latest data regarding the costs of various renewable technologies in different resources zones? Has new technology or more efficient practices changed costs dramatically? What costs may foreseeably change significantly?

Geothermal Energy Association (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 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 for new facilities. These figures are extrapolated using Department of the Treasury's 1603 Cash Grant Data.[1]

Table 1: Typical Geothermal Power Project Capital Cost

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

Some guidelines on using these numbers:

[1] https://www.treasury.gov/initiatives/recovery/Pages/1603.aspx

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 “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.

3. Values: What is the latest data or analysis regarding the value(s) that various renewable technologies in different resources zones can provide to the utility or markets? Has new technology or more efficient practices changed the values that resources can provide to the grid dramatically? What values may foreseeably change significantly.

Specifically, adding geothermal resources to the electricity grid, reduces overall grid costs, reduces the overall amount of curtailments, increases resource diversity, and has shown to be a critical technology that reduces overall electricity rates in a post 33% RPS world. Some up to date analysis comes straight from the latest Energy Division Staff Paper on Draft 2016 Portfolios for Generation and Transmission Planning. The California Public Unities Commission (CPUC) found that *“Forcing in high-quality geothermal resources (Geothermal 2 portfolio) decreases the total generic resources needed by 2026 due to the high capacity factor of geothermal plants relative to solar PV and wind plants. Forcing in geothermal resources also decreases the PV ratio and decreases curtailment, but increases the transmission infrastructure needed for full deliverability.”*[2]

The staff paper further states that, *“Reducing geothermal costs and forcing in geothermal resources at the same time (Geothermal 3 portfolio) has the same impact on total generic resources, transmission needs, PV ratio, and curtailment as simply setting aside geothermal resources. The lower geothermal cost assumption, however, reduces the revenue requirement and rate impact relative to the default portfolio, even after accounting for increased transmission infrastructure..”*[3]

The CPUC continues to discuss how these impacts are dependent on the cost assumptions used for these portfolios. After carefully reviewing the RPS calculator, GEA has determined many of the cost inputs that impact the outcome of these scenarios are entirely incorrect and substantially more expensive than a realistic project. GEA is looking forward to working with the CPUC in the very near

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[2] http://www.cpuc.ca.gov/RPS_Calculator/

[3] http://www.cpuc.ca.gov/RPS_Calculator/

future to adjust these assumptions in order to capture the true beneficial contribution of geothermal to the electrical grid.

A study from Department of Energy that reverse engineered the Levelized Cost Of Energy (LCOE) from public Power Purchase Agreement (PPA), and estimated LCOE's for geothermal projects built in the last decade ranged from roughly $40 to $80/MWh.[4] The capital cost assumed by the CPUC in the forecasted scenarios discussed above are around ~5000/kW which generates an LCOE of around $92/kW at their lowest cost in the RPS calculator. This LCOE is higher than any contracted PPA in California in a decade, which range from $17/MWh for legacy facilities to $90/MWh for new facilities. In conclusion, the actual LCOE of geothermal projects is substantially less than the CPUC's current modeling depicts, indicating that the sensitivities where geothermal projects increase costs (Geothermal Sensitivity 2) for the ratepayer, and substantially raise revenue requirements cannot be true in reality. California's own modeling shows geothermal has substantial value to the grid when resources are procured at a very high LCOE of $92/MWh or less.

4. Utility interest: How do utility resource planners plan to supply electricity in 2030 that is at least 50% renewable, at least 40% lower in GHG, while also safe, reliable, and as low cost as possible? What types of renewable resources do they expect will be needed by their company to meet their mandates?

GEA sees few possible scenarios where increasing the amount of fossil fuel resources to backstop additionally intermittent resources could realize carbon reduction goals. A recent study by Center for Energy Efficiency and Renewable Technologies stated*, "California can achieve a 50% reduction in CO_2 levels by 2030 in the electric sector under a wide variety of scenarios and assumptions. Conventional grid flexibility assumptions and the less diverse portfolio (High Solar) led to 14% more carbon emissions than the more diverse Target portfolio with enhanced flexibility."*[5] In order to maintain a safe, reliable, and low cost grid mostly composed of renewable energy resources, a diverse portfolio will necessary.

5. Commercial interest: Where do commercial renewable interests see the greatest opportunity for responsible development? Where are they most interested in offering projects?

A December 2015 survey of geothermal developers identified the following projects by county in California and Nevada that could provide additional renewable generation to California to help it meet its 2030 target of 50% renewable consumption and GHG goals. Note, early stages projects lack specific resource estimates below. However, these are still projects that could be realistically built by 2030. The typical project built today is in 25-50 MW increments. If these resources are determined to be suitable for power generation, it's safe to assume they would be brought online in similar increments.

Project Name	Estimated Nameplate Capacity (MW)	Estimated Resource Capacity (MW)	Location (State, County)
Heber Expansion	16	16	CA, Imperial

[4] https://pangea.stanford.edu/ERE/db/GeoConf/papers/SGW/2016/Hernandez1.pdf
[5] http://lowcarbongrid2030.org/wp-content/uploads/2016/01/1601_Low-Carbon-Grid-Study-Analysis-of-a-50-Emission-Reduction-in-CA-Executive-Summary.pdf

Imperial Wells Power	85	100	CA, Imperial
Black Rock 1-2	159	235	CA, Imperial
Black Rock 5-6	235	235	CA, Imperial
Brawley (North and East)			CA, Imperial
Truckhaven	30	60	CA, Imperial
Bottlerock*	55	20	CA, Lake
Buckeye North Geysers	56.9	56.9	CA, Lake
Surprise Valley	15	20	CA, Modoc
CD4 (Mammoth Complex)		25	CA, Mono
Four Mile Hill	49.9	49.9	CA, Siskiyou
Telephone Fiat	49.9	49.9	CA, Siskiyou
Geysers Project (aka WGP Geysers)	30	30	CA, Sonoma
Wildhorse	48	48	CA, Sonoma
Beowawe			NV, Eureka
Hycroft			NV,
Baltazar			NV,
South Jersey			NV, Lander and Pershing
Edwards Creek			NV,
Harmon Lake	15	15	NV, Churchill
Lee Hot Springs	20	20	NV, Churchill
Tungsten Mountain		30	NV, Churchill
Upsal Hogback			NV, Churchill
Desert Queen			NV, Churchill
Soda Lake East			NV, Churchill
Soda Lake South			NV, Churchill
Agua Quieta			NV, Churchill

Carson Lake		20	NV, Churchill
Dixie Meadows		30	NV, Churchill
McCoy			NV, Churchill, Lander
Ruby Hot Springs	20	20	NV, Elko
Tuscarora - Phase 2			NV, Elko
Crescent Valley	25	127	NV, Eureka
Blue Mountain*	50	45	NV, Humboldt
Argenta			NV, Lander
Granite Springs			NV, Pershing
San Emidio Phase II	11	44	NV, Washoe
Gerlach	10	25	NV, Washoe

*Note Bottlerock and Blue Mountain are projects that have the goal of using the latest cutting edge EGS techniques to increase the fields' capacities to above their current resource capacity.

Sincerely,

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