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Submitted to the U.S. House of Representatives Committee on Natural Resources
H.R. 4026 the "Enhancing Geothermal Production on Federal Lands Act"
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Chairman and members of the committee, it is my honor to testify today on behalf of not only ORMAT Technologies, but also on behalf of the Geothermal Resource Council.

By way of introduction, ORMAT Technologies is a New York Stock Exchange registered company (symbol "ORA"). Ormat Technologies, Inc. is a leading geothermal company and the only vertically integrated company engaged in geothermal and recovered energy generation ("REG"). The Company owns, operates, designs, manufactures, and sells geothermal and REG power plants primarily based on the Ormat Energy Converter—a power generation unit that converts low-, medium-, and high-temperature heat into electricity. With 77 U.S. patents, Ormat's power solutions have been refined and perfected under the most grueling environmental conditions. Ormat has 584 employees in the United States and 762 overseas. Ormat's flexible, modular solutions for geothermal power and REG are ideal for a vast range of resource characteristics. The Company has engineered, manufactured, and constructed power plants, which it currently owns or has installed, to utilities and developers worldwide, totaling over 2,900 MW of gross capacity. Ormat's current 910 MW generating portfolio is spread globally in the U.S., Kenya, Guatemala, Indonesia, Honduras, and Guadeloupe. Ormat expanded its operations to provide energy storage and energy management solutions by leveraging its core capabilities and global presence, as well as through its Viridity Energy Solutions Inc. subsidiary. I have the pleasure of serving as Vice President of Business Development for the Americas.

The Geothermal Resource Council (GRC) is a non-profit professional association for the geothermal industry and community in the USA and abroad. Founded in 1972 and headquartered in Davis, California, the GRC has over 1,300 members from around the world working to advance our industry by supporting the development of geothermal energy resources through the communication of robust research, knowledge, and guidance. The GRC Policy Committee is a separate part of the GRC, independently funded by interested organizations, to advocate on behalf of the geothermal community. I have the pleasure of serving as Chair of the Policy Committee.

We applaud Rep. Fulcher (R-ID), for introducing H.R. 4026 "The Enhancing Geothermal Production on Federal Lands Act" which will streamline the federal permitting process, unleashing the nation's geothermal potential

Today's Geothermal Market

In 2017, for the first time, the combined energy and capacity values of geothermal energy significantly exceeded the value of solar photovoltaic (PV) resources in California. When you account for geothermal's ancillary services and operational flexibility, combined values climb to more than $40/MWh higher than solar PV. These calculations demonstrate that geothermal can compete with solar PV on a net cost basis, even as PV costs continue to decline.[1]

[1] Orenstein, R., Thomsen, P., The Increasing Comparative Value of Geothermal – New Market Findings and Research Needs, GRC Transactions, Vol. 41, 2017.
Thomsen, P., The Increasing Comparative Value of Geothermal in California-2018 Edition GRC Transactions, Vol. 42, 2018

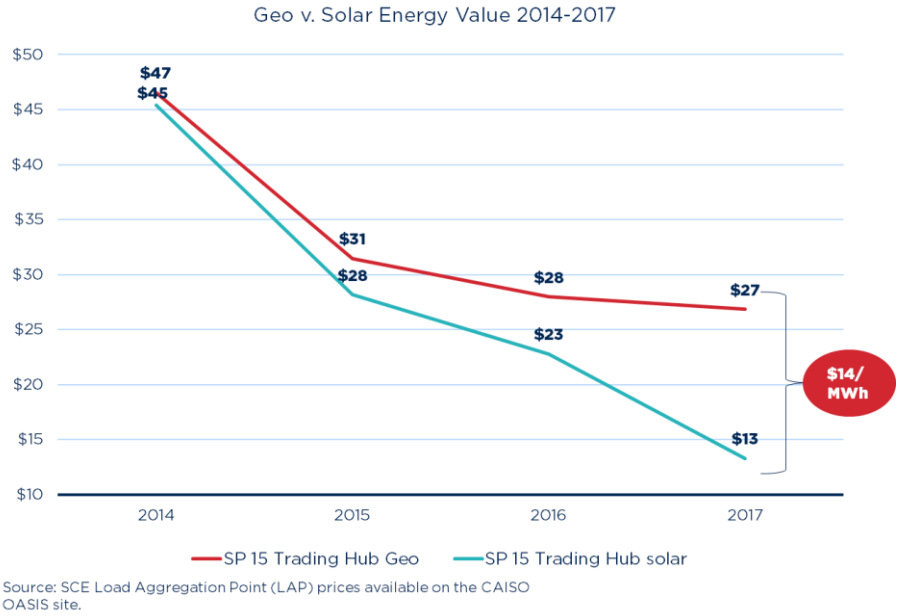
Source: California ISO OASIS

The California electric power system, like many in the nation, is undergoing many operational, reliability, and market changes due to the rapid penetration of solar PV. Solar penetration in California has increased from 500MW in 2010 to over 14GW today.[2] At low penetration levels (e.g., under 5 percent of annual energy), solar in California had high energy and capacity values because it generated during what were then the peak load hours.

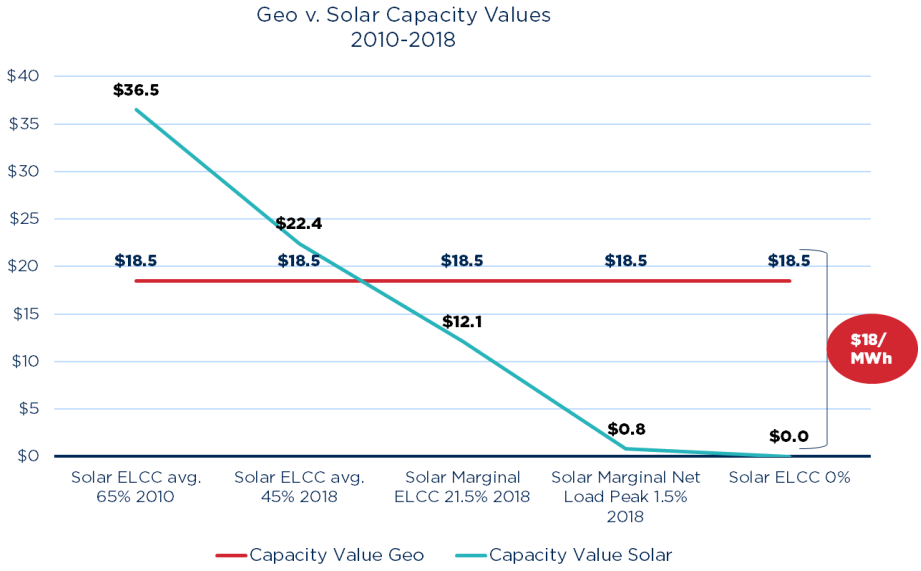
As a result of increased solar penetration—and because now solar provides energy and capacity during times of low or even negative pricing—energy and capacity values for solar have plummeted. Geothermal can obtain higher energy and capacity values because it can produce outside the solar PV production hours during the new peak load hours, illustrated by the famous CAISO "duck curve."

Thomsen, P., Geothermal Selection in California Resource Planning: Preliminary results from CPUC's IRP Tools and Recommendations for future Development and Analysis, GRC Transactions Vol 42, 2018

[2] http://www.energy.ca.gov/renewables/tracking_progress/documents/renewable.pdf



Source: Orenstein, R., Thomsen, P., The Increasing Comparative Value of Geothermal – New Market Findings and Research Needs, GRC Transactions, Vol. 41, 2017.

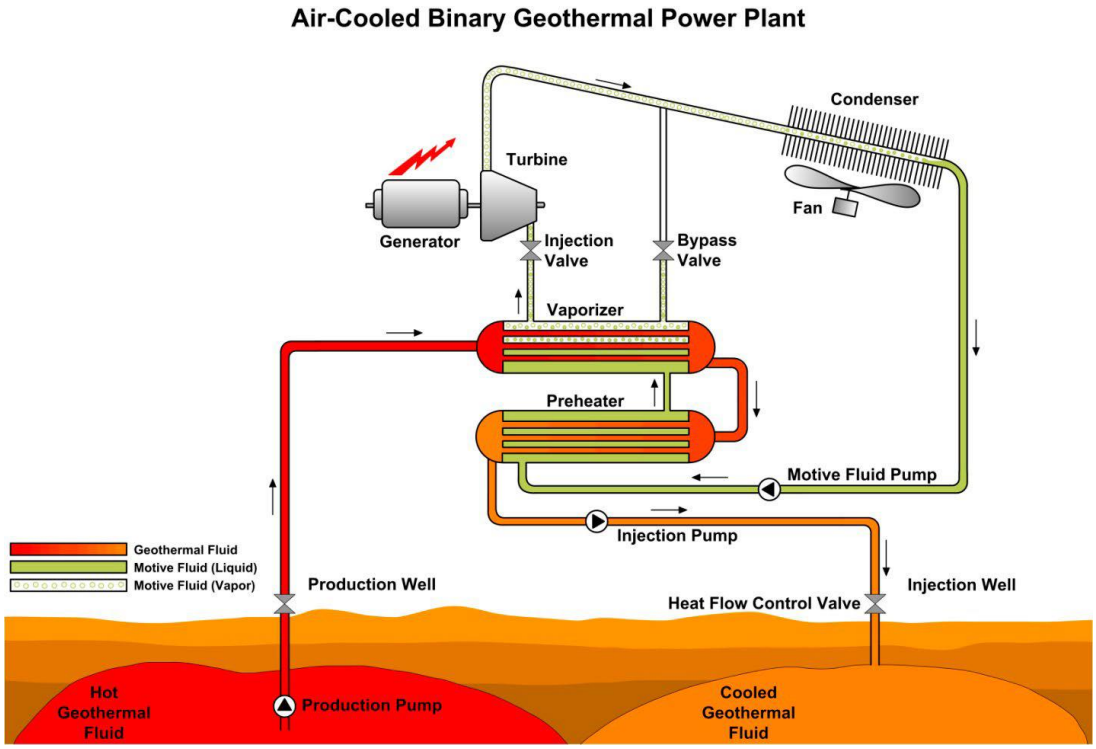


Source: Orenstein, R., Thomsen, P., The Increasing Comparative Value of Geothermal – New Market Findings and Research Needs, GRC Transactions, Vol. 41, 2017.

Geothermal's operational flexibility further enhances geothermal's value. For over 50 years, geothermal facilities have performed diligently to provide power 24 hours a day, seven days a week. So effective was the industry in marketing this attribute that many believe geothermal is solely a baseload resource. That is no longer the case. Since 2010, 96 percent of all installed geothermal facilities in the U.S. utilize a binary geothermal technology that can ramp up and down as fast, if not faster than, many "flexible" gas turbines such as the LM2500 or GELMS1003.

[3] http://www.ge.com/mining/docs/2981884_1346772682_GE_Aeroderivative_

A binary geothermal facility cycles geothermal fluid through a set of heat exchangers, where the heat is transferred to a motive fluid that vaporizes and spins the turbo-generator, while the geothermal fluid is returned to the underground reservoir. Decoupling the geothermal reservoir and well field from the power generating equipment through the use of a working fluid allows binary geothermal facilities to operate in both a baseload or an operationally flexible mode that provides 100 percent dispatchability at unparalleled ramp rates—up to 30 percent of generator nameplate per minute—and can even be controlled by the system operator using Automatic Generation Control (AGC). Geothermal power plants offer additional benefits to grid stability like voltage support and inertia. Ormat's Puna geothermal facility in Hawaii has provided these services since 2011.[4]



Source: Ormat Technologies

After years of solar dominating new renewable energy contracts in California, utilities, the CAISO and CCA's are starting to appropriately value renewable resources that provide energy and capacity value while also being operationally flexible. On June 1, 2017, the Los Angeles Department of Water and Power (LADWP) announced it had entered into a new, 26-year power sales agreement for approximately 150MW of power to be generated by a portfolio of new and existing binary geothermal power plants. LADWP explained in its press release: "In addition to producing fossil-free power, geothermal energy offers many desirable benefits. Because it can provide continuous energy generation, a geothermal plant is expected to produce power at 95 percent or more of its capacity year-round—a higher capacity than the wind or solar renewable energy resources. With its baseload predictability, geothermal energy also saves on transmission and other integration costs, as compared to variable renewables like wind and solar power."[5]

Product_and_Services_Solutions.pdf

[4] Nordquist, J., T. Buchanan, and M. Kaleikini, Automatic Generation Control and Ancillary Services, GRC Transactions, Vol. 37, 2013.

[5] http://www.ladwpnews.com/new-geothermal-project-helps-create-clean-energy-future-for-los-angeles/

Independent System Operators are now looking for flexible resources that can perform the following functions:[6]
• sustain upward or downward ramp;
• respond for a defined period of time;
• change ramp directions quickly;
• store energy or modify use;
• react quickly and meet expected operating levels;
• start with short notice from a zero or low-electricity operating level;
• start and stop multiple times per day; and
• accurately forecast operating capability.

Geothermal stands alone in providing all of those operating capabilities while assisting in absorbing more variable renewable energy resources and reducing greenhouse gas emissions. Higher renewable penetration and greenhouse gas reductions are absolutely possible when utilities, regulators, and system operators appropriately evaluate, procure, and develop cost-effective, flexible renewable resources such as geothermal to meet goals.

"Increasing Access to Geothermal Resources" *(H.R. 4026 the "Enhancing Geothermal Production on Federal Lands Act")*

Ormat and the Geothermal Resources Council Policy Committee have identified that strengthening the administrative categorical exclusion for geothermal resource confirmation will enable the geothermal industry to deploy more megawatts on public lands, creating new jobs and royalty revenues for our local states and counties. This recommendation and subsequent testimony are the result of extensive consultation within the industry, whitepapers, and a review of geothermal permitting conducted in 2013 and 2014 by the National Renewable Energy Laboratory (NREL).

"Reducing the overall project time directly attributable to NEPA, whether by reducing the time of individual NEPA processes or reducing the frequency of NEPA analysis for a particular project, can alleviate some of the major barriers to geothermal development. Reducing NEPA timelines directly decreases overall project timelines which indirectly decreases the perceived risk profile—lowering three of the four barriers to geothermal development identified by industry. Lowering these barriers is in line with one of NEPA's stated goals: to "enhance the quality of renewable resources."

H.R. 4026 the "Enhancing Geothermal Production on Federal Lands Act" strengthens the administrative categorical exclusion for geothermal resource confirmation drilling that will significantly relieve the permitting burden for the geothermal industry without undermining environmental stewardship. Executing H.R. 4026's suggested changes, many of which can be found in the geothermal title in S. 2012 (114th Congress, 2015-16), would help unlock new projects and their associated economic impacts.

In order for the geothermal industry to grow rapidly, Ormat and the GRC Policy Committee have requested that DOI or Congress issue a new rulemaking or memorandum to expand, clarify, and strengthen the administrative categorical exclusion (CX) from NEPA, to reduce the permitting burden for geothermal resource confirmation and observation. This action would immediately unlock new projects and their associated economic impacts, while allowing the hardworking BLM field staff to focus on appropriate permitting priorities.

Many geothermal resources that are commercially viable for energy production using today's technologies are located on public lands. BLM manages all subsurface geothermal resource on

[6] https://www.caiso.com/Documents/FlexibleResourcesHelpRenewables_FastFacts.pdf

federal lands, regardless of the federal agency that manages the surface estate (such as the Forest Service). Therefore, almost all geothermal development must conduct a National Environmental Policy Act (EPA) review. While geothermal is inexpensive to operate and maintain once a project is complete, during the resource discovery, phase developers must drill resource confirmation holes to determine the true quality and quantity of the underground resource. This means the industry has a disproportionate permitting burden at the "front end" of a project, before a revenue payback is guaranteed. A heavy permitting burden means a slow development cycle, and a slow development cycle means developers pay a lot for financing.

Geothermal resource confirmation wells are distinct from geothermal production wells, which are permitted and constructed differently from resource confirmation wells. Resource confirmation wells are needed for geothermal developers to assess the underground resource for project viability. While developers do what they can to determine the quality of the underground resource through mapping and surface observations, it simply is not possible for developers to characterize the resource without making physical contact with the geothermal fluid deep in the earth. At this time, most geothermal resource confirmation wells must be permitted with BLM via a detailed Environmental Assessment (EA), even though resource confirmation wells are very limited in scope, are reclaimed quickly after confirmation, and result in tiny surface disturbance. These resource confirmation wells also cannot be "repurposed" as production wells under the same permit. This means developers can't access the heat resource they need to evaluate whether a commercial project would even be viable without undertaking significant, time-consuming environmental review. A Categorical Exclusion from NEPA for select types of geothermal resource confirmation wells and other low-impact activities would help the industry tremendously, without undermining environmental stewardship. When developers are able to utilize a CX, they can avoid conducting a full Environmental Assessment and instead perform a CX review, which is far quicker and less costly. A more useable geothermal CX that allows developers to evaluate their energy resource for viability before undertaking extended environmental review could drastically improve timelines and cost profiles for project development. This step would also provide greater parity between geothermal and oil and gas, which is afforded a broad CX for exploration activities, including resource confirmation wells, under Section 390 of the Energy Policy Act of 2005.

NREL's *GeoVision Analysis Supporting Task Force Report: Barriers* analyzed nontechnical barriers to geothermal *deployment* and potential improvement scenarios. In part, this report highlighted that reducing project development timelines from 8 years to 4 years can increase resource discovery and (primarily because of improved financing costs) more than double geothermal deployment over the Business-as-Usual scenario by 2050, resulting in an additional 6.7 gigawatts of geothermal deployment.[7]

[7] Young, K., A. Levine, J. Cook, D. Heimiller, and J. Ho. 2019. *GeoVision Analysis Supporting Task Force Report: Barriers. An Analysis of Non-Technical Barriers to Geothermal Deployment and Potential Improvement Scenarios*. NREL/TP-6A20-7164. https://www.nrel.gov/docs/fy19osti/71641.pdf