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## **Suggestions relating to geothermal component of Renewable Energy roadmap document**

There are a number of additional R&D topics related to geothermal energy that are worthy of mention in the CEC Renewable Energy Roadmap document. These topics have been identified as key areas for future research in the US DOE GeoVision study (<https://www.energy.gov/eere/geothermal/geovision>). These research areas include:

- 1) Updated resource assessment for California (for both high temperature systems as well as lower temperature resources that could be utilized for direct use applications).
- 2) Improved exploration methods for identifying and characterizing hydrothermal systems - this is especially critical for finding blind hydrothermal systems (i.e., those with no surface thermal features). Improved geophysical methods (such as gravity, magnetics, magnetotellurics, seismic, thermal imaging, lidar), and integration of different data types to formulate comprehensive 3D models are needed to reduce the risk and costs for geothermal exploration.
- 3) Improved models and techniques are needed to identify zones of subsurface permeability. This would improve well success for both exploration and development drilling.
- 4) Improved well stimulation methods could assist in the use of low permeability wells and also facilitate the development of enhanced geothermal systems (EGS).
- 5) New technologies for drilling and completion of geothermal wells could increase the utilization of geothermal resources by greatly reducing the costs associated with geothermal exploration and development.
- 6) Improved reservoir models and field monitoring methods (such as microseismic monitoring systems and the use of geochemical tracers) will enable operators to better manage the utilization of geothermal resources.
- 7) The development of added value streams, such as mineral recovery from geothermal brines (such as Li from the Salton Sea) could help lower the cost associated with geothermal power generation, thus allowing for more geothermal resources to be developed in a commercially viable manner. Other value streams could include desalination, as well as direct use applications, such as district heating and cooling.
- 8) Additional research relating to flexible generation of geothermal power could help geothermal power adapt to the needs of higher contributions of intermittent renewable energy resources (such as wind and solar) to the grid.