# Executive Summary

The Public Utilities Regulatory Policies Act (PURPA) in 1978 established a market for geothermal energy that led to rapid growth of the industry through the 1980s and into the early 1990s. Geothermal energy generation became the largest non-hydro power source of renewable energy in California during this period. While PURPA was beneficial to the geothermal industry, the PURPA contracting mechanism led to some misconceptions that persist to this day. PURPA implemented a compensation mechanism that led geothermal developers to focus on geothermal project's base-load generation capabilities. Changing electric system needs and improvements in geothermal generation technology currently allow geothermal projects to be designed to meet the needs of today. For example, geothermal projects can ramp up and ramp down electricity generation output quickly so geothermal projects can provide flexibility and ancillary services to serve some of the vital needs confronting entities such as the California Independent System Operator (CAISO).

Unfortunately, geothermal energy is underutilized and under-procured today for two reasons. First, the misconception that geothermal energy can only provide base-load service is prevalent and utilities, regulators, system operators and even some geothermal developers have been slow to recognize the full suite of generation attributes that geothermal possesses. Second, renewable energy procurement processes have tended to compare renewable energy resource alternatives against one another on a cost per kilowatt-hour basis without considering the attributes that competing technologies offer or the full range of system costs that the competing technologies impose.

Most geothermal energy projects in operation today were developed to serve as base-load generation and serve today as base-load generation. Therefore it is not surprising that the myth that geothermal energy projects can only serve a base-load function persists. Aspen worked with Ormat Technologies, Inc. engineers to produce Appendix 1 to this report that seeks to dispel that myth. Appendix 1 shows that modern geothermal facilities can have all the benefits of base-load generation if one chooses to operate a project as base-load. However, unlike other base-load sources like coal fired and nuclear generation, geothermal generators can ramp generation output down very quickly and they can also resume full generation capacity very quickly. Appendix 1 further demonstrates that geothermal units need not be relegated to base-load operation exclusively. Geothermal generation can be built to

provide Ancillary Services and can serve as a flexible generation source. Contracting mechanisms could be envisioned to maximize the value of a geothermal generation project by tapping the project for its highest value use as system conditions change. Given the electricity system challenges the utility industry faces today, it is a pity that geothermal projects are underutilized and under-procured.

The procurement processes used in the western United States and the renewable energy project valuation methodologies utilized in those processes is the second reason that geothermal energy is underutilized and under-procured. The failure of geothermal energy projects to compete in recent renewable energy solicitations is partly due to an evaluation process that unduly focuses on the simple cost per kilowatt-hour of energy sales and unduly minimizes resource integration cost issues. While it should be acknowledged that geothermal projects have disadvantages relative to other technologies that explain some of the difficulty faced by the industry, the fact remains that geothermal projects have attributes that are currently ignored. Geothermal resources are currently at a disadvantage because:

- Geothermal resources have positive attributes that are not counted in their favor; and,
- Geothermal resources avoid costs incurred by several other renewable technologies that are not explicitly counted either in geothermal projects favor or against those competing technologies that impose extra costs.

Geothermal energy projects can provide base-load electricity services and they can also be built to provide flexible electricity services. Geothermal projects can actually be custom built to provide the services of greatest need to the procuring entity and thus geothermal projects can provide highest value of service tailored to the operating environment and operational needs of the utility or reliability organization. The fact that geothermal energy can be used predominantly as a base-load facility but can be called upon to provide high value services in times of critical need means that geothermal energy projects possess significant option value.

Geothermal projects also avoid system costs that some competing generation technologies impose. For example, as variable generation market penetration increases, variable generation resources will require additional infrastructure or additional flexible generation resources to ensure system reliability is maintained. While significant effort is underway to transition the electric system to a much more flexible and robust electric system so that the costs of integrating large quantities can be mitigated, the fact is that today the system is not flexible or robust enough to handle large penetrations of variable

generation without significant, incremental system expenses. Further, it should be noted that the need for a more robust and flexible system is partly driven by the transition toward high penetrations of variable generation. Therefore, from a procurement perspective, it seems fair that some version of "cost causers pay" is appropriate and the costs of transitioning the system should be reflected in the costs of those resources that are driving the need for system investments. The paper shows that avoided integration cost, avoided transmission cost and avoided gas system cost are each relevant in arriving at a robust value and cost comparison among renewable energy and conventional energy resources in competitive solicitation processes.

Geothermal energy is an underutilized and under-procured resource in western energy markets and ultimately consumers are paying extra for unbalanced generation portfolios. Giving the consumer the best value for her investment dollar will require that procurement processes be fixed. Fixing procurement will require two simple steps. First, the full value of all attributes offered by geothermal resources should be included in energy resource cost comparisons. Second, all of the costs avoided by geothermal projects should either be counted as an added value provided by geothermal projects or should be counted against projects that impose system costs.