

Solar Thermal Geothermal Hybrid

(STGH)



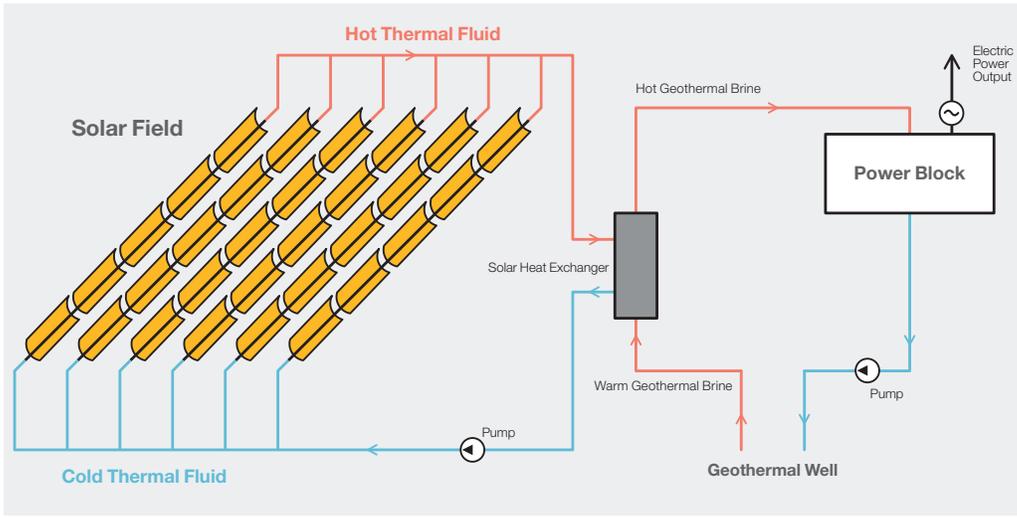
A solar thermal collector system can boost both the efficiency and output power of a geothermal plant by increasing its operating temperature and/or mass flow rate. SkyFuel's parabolic trough technology can be scaled to operate with any new or existing geothermal facility, making it ideally suited to this application.

STGH Concept

Geothermal wells can suffer from temperature and flow rate degradation over time, impairing the ability of the plant to operate as originally designed. In addition, high ambient temperatures decrease the capacity of the air cooling system, causing efficiency losses in summer months. The power block is thus underutilized and revenue may be lost. A solar field produces heat in a closed loop that is transferred via a heat exchanger to either the geothermal brine or directly to the power cycle working fluid. This heat exchanger can be integrated with the geothermal system in a variety of ways to effect higher temperatures or greater mass flow – or a combination of the two. The desired temperature is maintained by modulating the flow rate through the solar collector field. Three possible configurations are shown in the schematics on the next page.

Advantages:

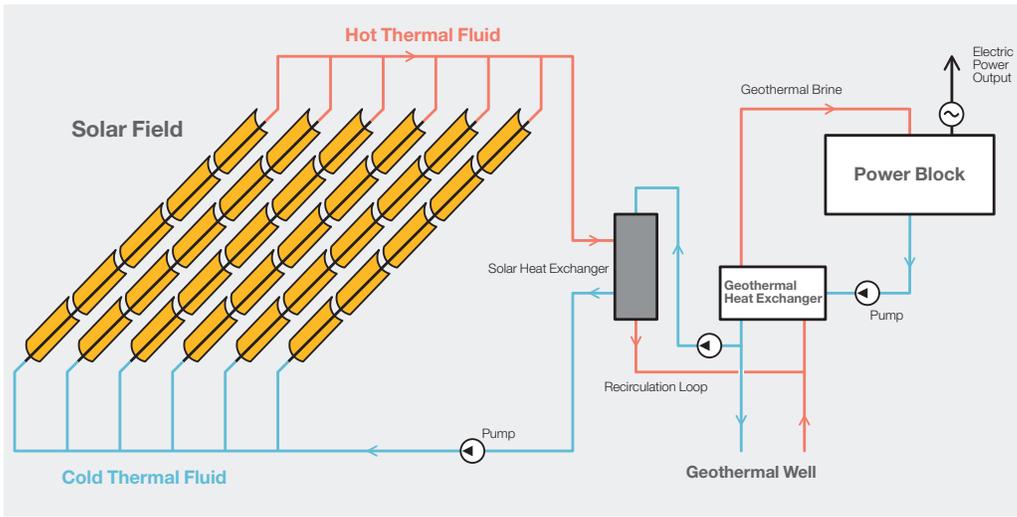
- Geothermal power plants are often located in areas with excellent solar resource, making them well-suited for the addition of a parabolic trough solar field.
- The addition of a solar field to an existing geothermal plant enhances utilization of the turbine and related infrastructure, increasing financial return on the asset.
- The straightforward design of the solar field and integration with the power block minimizes technical risk and can be executed with no interruption to the existing plant.
- Geothermal resources typically do not have access to water wells appropriate for cooling towers and must use air cooled condensers. During day time operations cycle efficiency is reduced from lack of cooling power. Solar augmentation increases efficiencies during times when geothermal plants are operating at their least efficient.



Application #1

Increase geothermal brine temperature in an existing plant

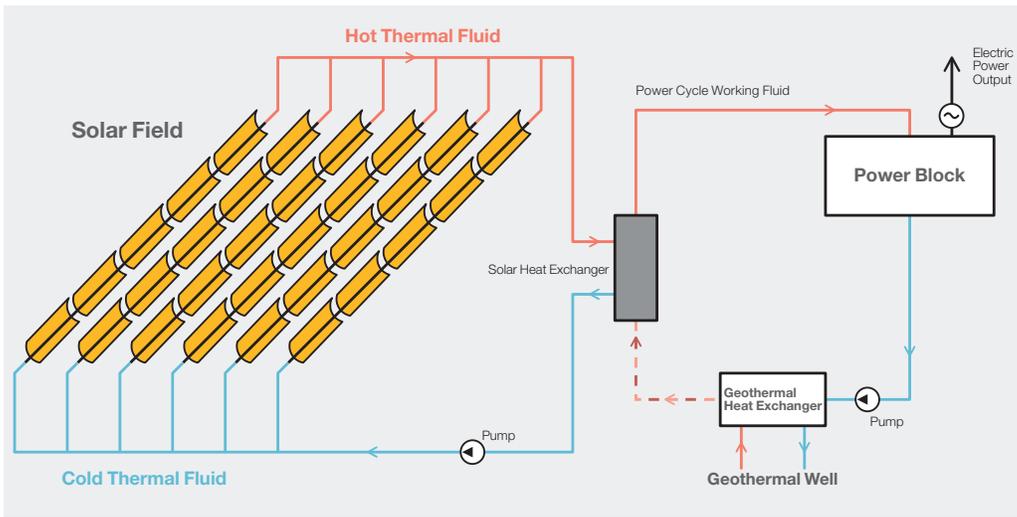
Brine from the geothermal well is circulated through the solar heat exchanger to increase its temperature to match the design rating of the turbine, thus increasing efficiency and electrical output of the plant.



Application #2

Increase geothermal brine mass flow rate in an existing plant

After the geothermal brine has given up its heat to the power block, a portion is circulated through the solar heat exchanger to increase its temperature to match that of the brine from the geothermal wells. The solar heated brine is then mixed with the bulk flow of brine from the wells to achieve the desired inlet flow rate and delivery temperature to the existing power plant, thus increasing the output of the plant.



Application #3

Increase temperature of organic working fluid in a new plant

Heat from the solar field is transferred to the organic working fluid of the power cycle to match the design rating of the turbine, thus bringing the output of the plant up to installed conditions or better.