

Geothermal Energy on Solar System Bodies

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Study Summary

As humanity expands into the solar system, power will be needed for fixed installations. For spacecraft, to date, this has meant solar panels or Radioisotope Thermoelectric Generators (RTGs)—a fission source. Each of these power sources have drawbacks; solar is subject to the inverse square law of decreasing solar flux with distance, while fission sources emit radiation that must be protected against with shielding mass and distance. One possibility with potential for powering installations on planetary bodies, particularly the outer solar system, is geothermal generation. All that is needed to produce geothermal energy is an exploitable temperature differential between a source and a sink. This technology has been producing electricity on Earth for more than 100 years from temperature differences of about 125°C or greater. On many icy bodies this differential would come from the difference between the surface temperature and a subsurface liquid body (ocean). The rims of polar region craters on the Moon offer a near-term potential geothermal development using ThermoElectric Generators (TEGs) and the ~150°C difference between the sunlit and permanently shadowed sides. While significant engineering issues remain in producing this energy, the potential, particularly on icy bodies, is on the order of megawatts of power generation per well.

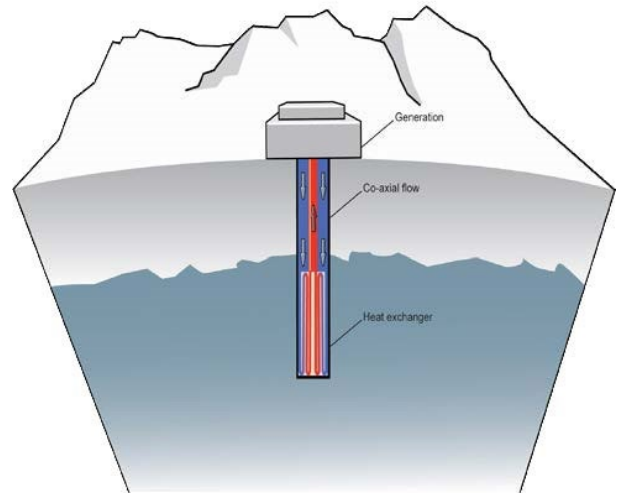


Figure 1. A geothermal well system on an icy body with a subsurface ocean. The temperature difference between the ocean and the surface is used to drive a turbine (or a TEG) and generate electricity. Many engineering options are available: shown here is a heat exchanger extending into the ocean to transfer heat to the surface.

Why is this research important and why do the results matter?

- We are becoming a solar system civilization, not just an Earth civilization. As we look to establish permanent bases for human and robotic exploration and settlement, we will need appropriate and diverse energy sources—geothermal-based energy has significant advantages for this purpose.
- The research into this energy source needs to begin now to realize humanity’s move into the solar system. Texas (and the Bureau) is the center of energy research and development as well as government and commercial space exploration. We intend to bring these two areas of innovation together at the Bureau to lead the way in space energy and resource development.

Link

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