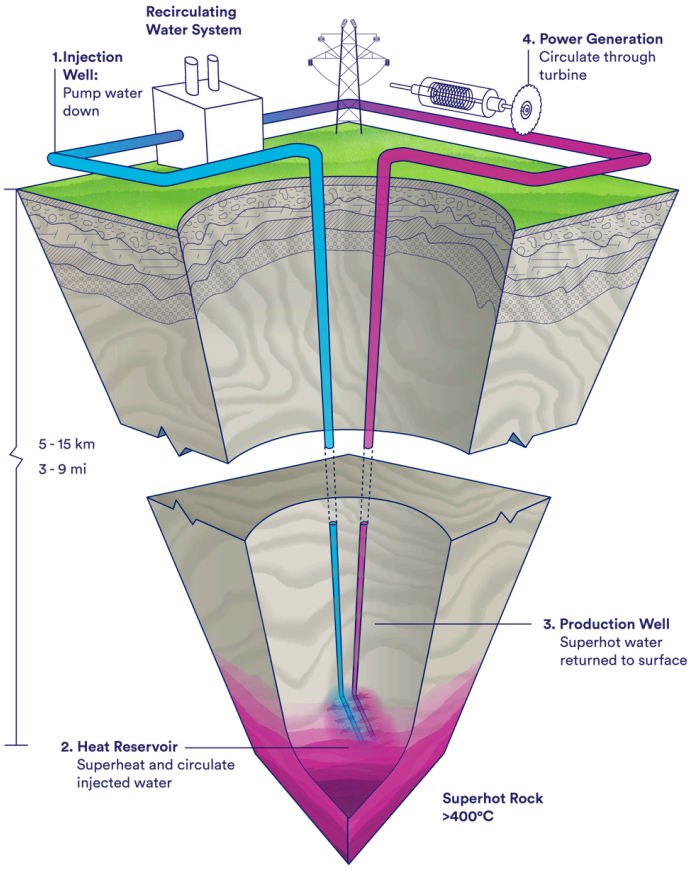
Superhot Rock Geothermal in Mozambique

A Potential Renewable Energy Gamechanger

CLEAN AIR TASK FORCE

What if there were an always-on renewable energy source with the potential to replace fossil fuel power generation and meet much of the world's future energy needs? What if that energy source could provide firm power without variability issues? What if it had a low land footprint and was available around the world, reducing the need to import energy?

This energy source is possible. It's called superhot rock geothermal.



The power of superhot rock geothermal

Superhot rock geothermal is an emerging energy source that could harness massive stores of renewable energy by pumping water deep into hot underground rocks, where it naturally heats up and then returns to the surface as steam. That steam could be used to produce carbon-free electricity, clean hydrogen, and other high-energy-intensity products.

Traditional geothermal systems in operation today only work in regions where hot water naturally exists near the earth's surface. By contrast, superhot rock geothermal systems would reach kilometers deeper into the earth and wouldn't require underground sources of water, making them viable across the globe.[1] With appropriate investment to overcome technological hurdles, superhot rock geothermal could reach commercial scale and potentially market prices.[2] If this is achieved, superhot rock geothermal could provide clean firm power at scale without the import risk and land-use footprint of other energy sources.

Superhot rock's enormous potential in Mozambique

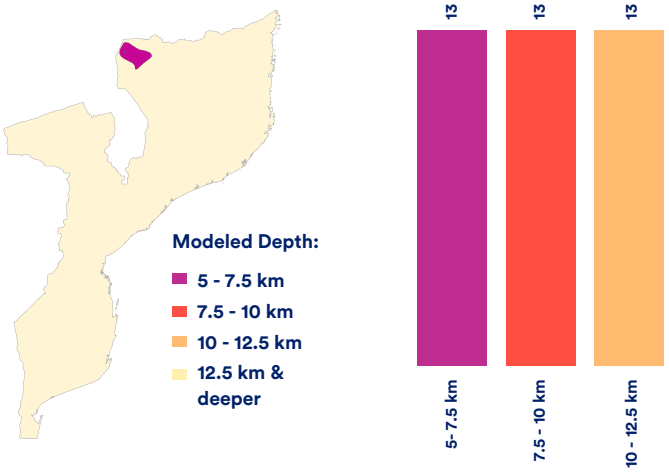


Figure 1: The potential of 1% of Mozambique's superhot rock geothermal resource (GW)

Mozambique consumed 18,860 GWh of electricity in 2021,[6] and its electricity demand is likely to rise in the coming decades due to a growing population, higher per-capita energy consumption, and increasing electrification. Just 1% of Mozambique's superhot rock potential could produce enough electricity to meet its 2021 electricity demand with over 298,048 GWh to spare for other end uses such as energy exports, desalination, and hydrogen production.

First-of-a-kind modeling from Clean Air Task Force and the University of Twente in the Netherlands estimated superhot rock geothermal potential around the world. While this modeling is preliminary, it suggests that Mozambique has significant superhot rock resources.[3] Just 1% of Mozambique's superhot rock resource has the potential to provide 38 GW of energy capacity, which could generate over 316,908 GWh of electricity. Put another way, just 1% of Mozambique's superhot rock geothermal endowment is equivalent to 186 million barrels of oil[4] or 17 times Mozambique's 2021 electricity consumption.[5]

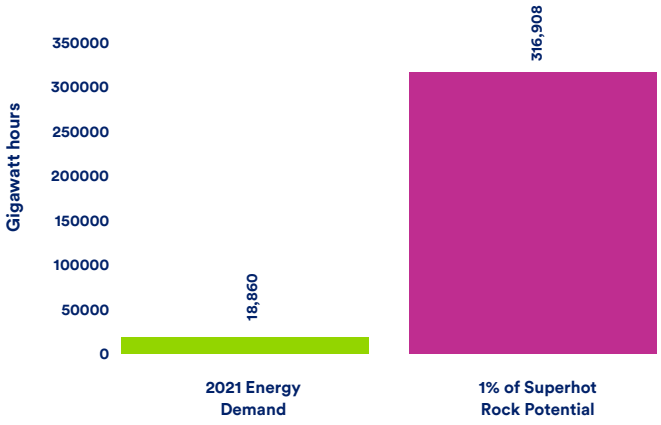


Figure 2: Historic electricity consumption compared to 1% of estimated superhot rock geothermal resource potential in Mozambique

Socio-economic development

The immense capacity of superhot rock geothermal could play a crucial role in reducing energy poverty and fostering sustainable development in Mozambique. Superhot rock geothermal projects can increase the overall capacity of the electrical grid, providing more reliable and consistent power to homes, businesses, and industries and enabling economic growth.

The development of superhot rock geothermal projects also requires a workforce, creating job opportunities in various fields such as engineering, geology, and maintenance. This can contribute to reducing unemployment and poverty rates in Mozambique. Finally, the development of superhot rock geothermal projects may attract foreign investment and expertise. Collaborating with international partners can bring in funding, technology, and knowledge, fostering a supportive environment for sustainable development.

Renewable, pollution-free energy

In 2021, Mozambique emitted 1 megatonne of CO2eq from its electricity sector.[7] Mozambique's Nationally Determined Contribution under the Paris Agreement aims to reduce emissions by 40 megatonnes of CO2eq by 2025.[8] Just 1% of Mozambique's superhot rock geothermal potential could theoretically replace all of the coal, oil, and natural gas used for Mozambique's electricity production, reducing carbon emissions by approximately 1 megatonne[9] – 4% of Mozambique's NDC goal. While superhot rock geothermal will not reach commercial scale in time to support Mozambique's 2025 climate goals, this finding illustrates its potential to enable Mozambique's low-carbon energy strategy over time. Superhot rock geothermal would also provide air quality and health benefits by reducing nitrogen oxides, sulfur dioxide, particulate matter, and other toxic pollutants associated with the combustion of fossil fuels. And excess superhot rock geothermal could play a role in producing low-carbon hydrogen for decarbonizing heavy industry.

Reliable and efficient grid

Superhot rock geothermal is available around the clock, rain or shine. An electricity system without this type of firm power requires building excess generation and transmission capacity to ensure there is always enough to meet demand. For example, a recent study of California found that an energy system that includes clean firm power would require one-third the new transmission compared to one without these resources.[10] Finally, the 24/7 production profile of superhot rock geothermal makes better use of existing grid infrastructure by operating reliably and consistently, reducing reliance on demand-side shifting and expensive backup generation.

Energy imports and independence

Even though Mozambique is a net exporter of energy to countries in the Southern African Power Pool (SAPP), the country imports 43% of its electricity.[11] Superhot rock geothermal would be a clean firm energy source, providing dependable 24/7 power that could ultimately replace fossil fuels. Just 1% of Mozambique's superhot rock resource could replace all electricity imports. These findings highlight the vast impact and energy security potential of this inexhaustible resource in diversifying Mozambique's energy portfolio and reducing import dependence.

Efficient land use

Superhot rock geothermal would be an extremely energy-dense resource, so its land requirements would be exceptionally low. Producing 1 GW of superhot rock geothermal is estimated to require roughly 12 km² of land, compared to approximately 160 km² of land for natural gas, 180 km² for solar, 520 km² for offshore wind, and 14,000 km² for biomass.[12]

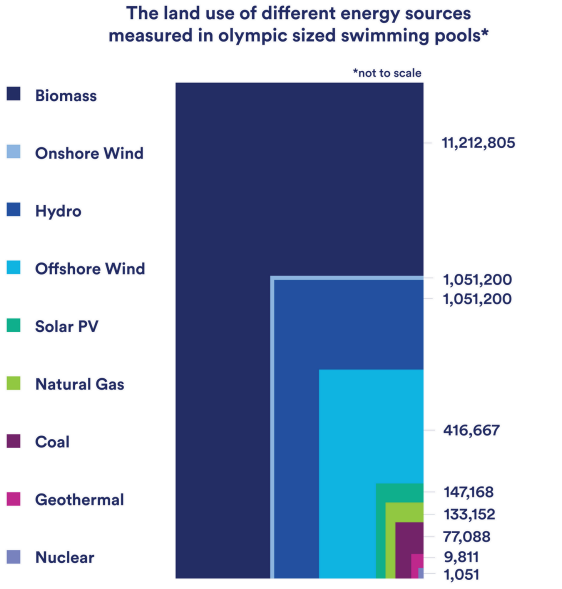


Figure 3: Estimated land use for superhot rock geothermal compared to other energy sources

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Clean Air Task Force (CATF) is a global nonprofit organization working to safeguard against the worst impacts of climate change by catalyzing the rapid development and deployment of low-carbon energy and other climate-protecting technologies. CATF's Superhot Rock Geothermal team is dedicated to decarbonizing the energy sector through superhot rock geothermal. To learn more about the policy and technology innovations required to fulfil superhot rock geothermal's revolutionary potential, visit our website at www.cleanairtaskforce.org/superhot-rock. For inquiries, contact press@catf.us.

Footnotes

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