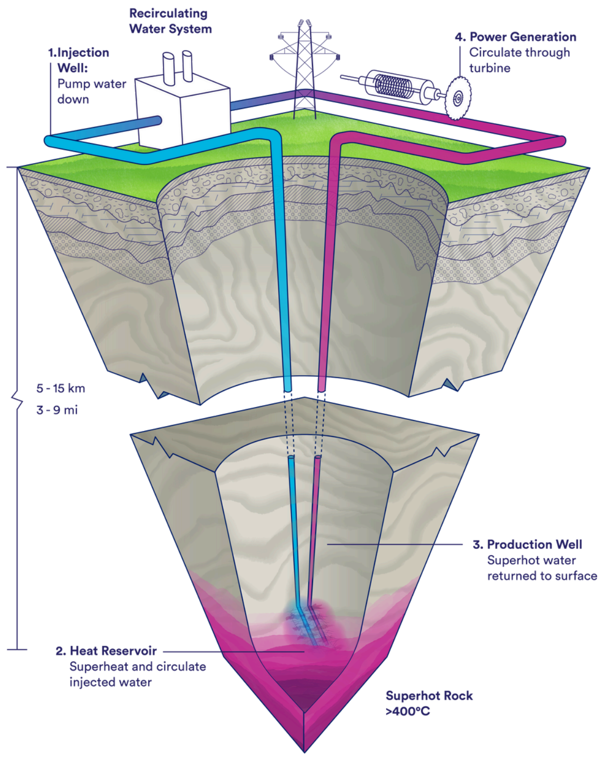
Superhot Rock Geothermal in Greenland

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 kilometres 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 Greenland

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 Greenland has significant superhot rock resources.[3] **Just 1% of Greenland's superhot rock resource has the potential to provide 23 GW of energy capacity, which could generate over 191,226 GWh of electricity.** Put another way, just 1% of Greenland's superhot rock geothermal endowment is equivalent to 112 million barrels of oil.[4]

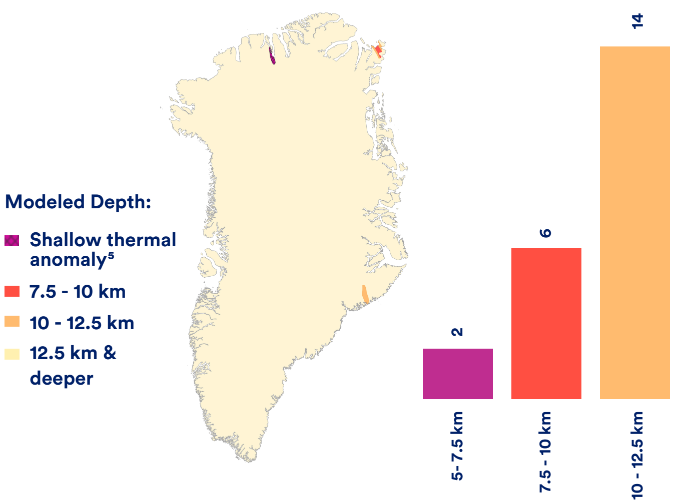


Figure 1: The potential of 1% of Greenland's superhot rock geothermal resource (GW)

Renewable, pollution-free energy

Greenland's immense superhot rock endowment has the potential to enable its low-carbon energy strategy over time. Superhot rock geothermal would also provide air quality and health benefits by reducing nitrogen oxides, sulphur 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 decarbonising 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.[6] 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.

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.[7]

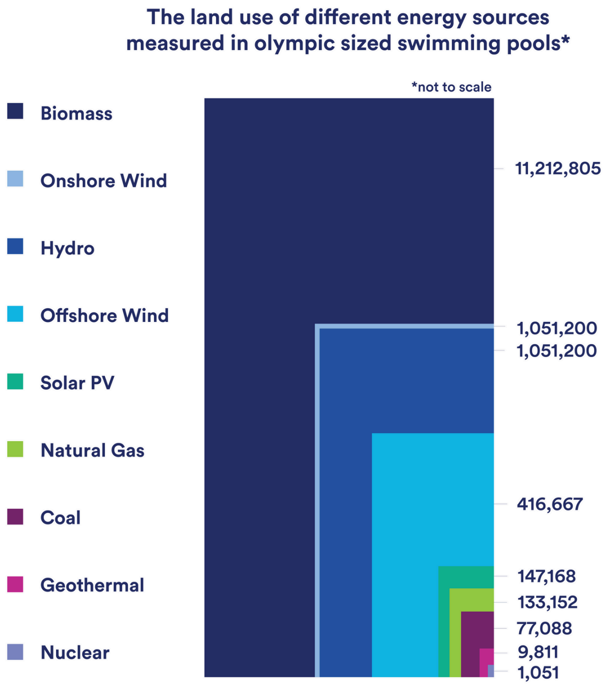


Figure 3: Estimated land use for superhot rock geothermal compared to other energy sources

Clean Air Task Force (CATF) is a global nonprofit organisation working to safeguard against the worst impacts of climate change by catalysing the rapid development and deployment of low-carbon energy and other climate-protecting technologies. CATF's Superhot Rock Geothermal team is dedicated to decarbonising 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

1. Hill, Bruce L. (2021). Superhot Rock Energy: A Vision for Firm, Global Zero-Carbon Energy. Clean Air Task Force. https://cdn.catf.us/wp-content/uploads/2022/10/21171446/superhot-rock-energy-report.pdf
2. LucidCatalyst and Hotrock Research Organization. (2023). A Preliminary Techno-Economic Model of Superhot Rock Energy. https://www.catf.us/resource/preliminary-techno-economic-model-superhot-rock-energy
3. Ball, Philip. (2025). Global Superhot Rock Heat Endowment: Methodology Report. https://www.catf.us/resource/global-superhot-rock-heat-endowment-methodology-report
4. U.S. Energy Information Administration. (n.d.). Units and calculators explained. https://www.eia.gov/energyexplained/units-and-calculators
5. Shallow thermal anomalies shown on the map are located at 5-7.5km depth. They are included in the calculations for Greenland's geothermal potential.
6. Long, Jane C.S, Baik, E., Jenkins, J. D., Kolster, C., Chawla, K., Olson, A., Cohen, A., Colvin, M., Benson, S. M., Jackson, R. B., Victor, D.G., Hamburg, S.P. (2021). Clean Firm Power is the key to California's Carbon-Free Energy Future. Issues in Science and Technology. https://www.edf.org/sites/default/files/documents/LongCA.pdf
7. Land use estimates for superhot rock geothermal from LucidCatalyst and Hotrock Research Organization. (2023). A Preliminary Techno-Economic Model of Superhot Rock Energy. https://www.catf.us/resource/preliminary-techno-economic-model-superhot-rock-energy. Land use estimates for all other energy sources from Lovering, Jessica, Swain, Marian, Blomqvist, Linus, & Hernandez, Rebecca R. (2022). Land-use intensity of electricity production and tomorrow's energy landscape. PLoS ONE 17(7): e0270155. https://doi.org/10.1371/journal.pone.0270155