Geothermal Resource and Synthetic Geothermal Reservoir Feasibility Study of Wyoming

Emilie N. Gentry[1], Joseph Batir[1], Kevin Kitz[2], and Hamed Soroush[1]

[1]Petrolern
[2]Kitzworks

Abstract

Wyoming is an epicenter for energy resources across the energy spectrum – coal, oil, gas, uranium, and wind. Additionally, there are surface expressions of hot springs and geothermal resources across the state, most recently assessed in 2012 as part of the National Geothermal Data System compilation project. Previous studies suggest there are limited low-enthalpy geothermal resources available for development, not including the Yellowstone super volcano. While there are geothermal energy opportunities, no public studies are available that assessed the best pathway for economic development of these resources in Wyoming.

Here, we summarize the geothermal potential of Wyoming, assess new geothermal utilization technology options, and estimate its effectiveness to decarbonize Wyoming energy production. This study generates a plan for geothermal development and opportunities focusing on known resources in the state using commercial technology to advance Wyoming's energy strategy. Furthermore, we explore innovative technologies such as Synthetic Geothermal Reservoirs (SGR) to increase Wyoming's renewable energy penetration potential.

In general, the geothermal resource across the state is limited to low enthalpy that would be best suited for direct use applications. There are approximately 1000 wells with bottom hole temperature greater than 200°F where modular Organic Rankine Cycles may be able to generate electricity, if there are sufficient water production rates. A previous example of this in Wyoming was the Rocky Mountain Oilfield Testing Center that generated an average of 175 kW net power. Still, given the low temperature nature of the resource in Wyoming, this is considered niche power potential.

As an alternative to traditional geothermal energy production, this research evaluates the feasibility of utilizing a Synthetic Geothermal Reservoir (SGR) to store the state's abundant wind resource as thermal energy in the subsurface. SGRs use the subsurface as a medium for thermal energy storage collected from various renewable sources such as wind energy or concentrated solar power to reliably produce on-demand electrical power, using the recovered heat. In this way, SGRs can provide weather- independent, renewable, baseload energy, without the traditional geothermal geographic constraints of initially hot rock. Instead, the hot geothermal reservoir is engineered by deploying the WY petroleum workforce and wind energy resources. Wyoming's wind resource is cross examined with potential SGR locations and the change in wind utilization is calculated. Results suggest SGR can turn off-peak wind generation into baseload geothermal power, which can provide WY with a unique way to "Drill to a Decarbonized Energy Future".

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