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America's New Energy Resource: How the Earth's Heat Sources Could Reduce the Nation's Growing Carbon Footprint

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A Synapse Series: Green Energy



America's New Energy Resource

How the Earth's Heat Sources Could Reduce the Nation's Growing Carbon Footprint

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Illustrated by Adriana Baker*

 Our country's ever-growing rate of energy consumption is a major contributor to global warming and cannot be slowed by individual efforts. Commercial industry, government, and military contribute to at least 70% of all energy consumption in the United States (U.S.) every year, most of which is fueled by petroleum and natural gas.

Over the past 50 years, all end-use energy sectors have been replacing their coal sources with electricity sources. On the surface, it appears to be the greener option, but many do not think about how this electricity is generated. The majority is done through mechanical energy produced by steam turbines, typically using non-renewable sources to generate the steam. In 2019, nearly 63% of domestic electricity generation came from steam turbines powered by fossil fuels, with coal being one of the top two contributors. The time has come for a renewable, versatile, low-emission energy source for the U.S. to rely on.

A resource that has been largely overlooked by the U.S. is geothermal energy, which utilizes the Earth's natural heat to provide heat or electricity. For economic viability, geothermal plants must be constructed in naturally occurring tectonic hotspots, which are limited in the United States. Our few conventional geothermal plants reside in Nevada and California, which produce the world's largest geothermal-installed power generation capacity. However, they only account for 0.5% of our net electricity generation. Because of this, geothermal plants have developed a reputation for being weak and unreliable.

In 2005, a panel from the Massachusetts Institute of Technology evaluated the potential of Enhanced Geothermal Systems (EGS) to become a primary electricity resource for the U.S. EGS is a man-made underground reservoir constructed in high-temperature rock with low natural permeability and fluid saturation. While conventional geothermal energy is limited by location, EGS can be installed almost anywhere, and the benefits it offers are exactly what we are looking for in achieving a future with sustainable energy.

To create an EGS, fluid is drilled into pre-existing cracks of the rock deep underground, causing them to further fracture and increase permeability. The fluid gathers heat from earth, circulating it through the fractured rock, and returning it to the surface through a production well, generating electricity upon reaching the power plant. Since the electricity is produced by heat, EGS operates continuously at a minimum level of power demand, thus needing no means of power storage. Once produced, electricity is sent straight to the consumer.

After analyzing decades of research, the panel found that there are very few physical barriers or limitations in using EGS. Initial concerns about EGS, such as water loss, geochemical impact, and inducing earthquakes, are now solved or manageable through proper operation and care. However, these risks have not yet been reduced to a point where investors feel comfortable funding installations.

The largest setbacks of EGS are the cost and lack of drilling and piping technology, both of which are directly correlated to the lack of

data and physical research on the subject. An estimated \$800 million to \$1 billion is needed to produce EGS power plants at a rate to be viable candidates in domestic electricity supply by 2050. Though this may seem like a massive amount, it is lower than the cost of installing and maintaining a coal power plant. In addition to the cost, installation requires advanced engineering and technical knowledge that many engineers have not mastered yet. Without proper research and development, projects will remain expensive and will not yield enough power to be profitable. With funding and technological improvements, EGS sites could increase their amount of economically extractable energy from 0.5% to over 10% of U.S. electricity generation.

While private investors are not ready to fund EGS, energy markets and future government policies could influence investors' interest in developing the technology. To accomplish this, the government will have to fully support EGS development and implementation; only then will the private sector take over.

For EGS to succeed in the competitive electricity sector, positive policies must be granted on the state and federal level, similar to those

Technologies developed and researched by public research organizations are fundamental in moving towards a low-carbon society.

of oil and gas reserves. Several high-grade EGS resources should also be under development within the first 15 years of approval. We must also continue to actively participate in international EGS studies.

The Department of Energy (DoE) sees a lot of potential in geothermal energy and has been aware of it for years. In 2016, DoE funded a \$29 million geothermal energy research grant to the Frontier Observatory for Research in Geothermal Energy (FORGE) in Utah. DoE also has been discussing EGS with other countries who have begun research and development on the topic.

Recently, the potential for EGS usage in the U.S. has grown. President Joe Biden is expected to take action in energy management by decarbonizing the energy sector. Biden is not the only one interested in renewable energy: it is estimated that the largest area of energy industry spending this year will be in renewable power projects, surpassing the spending for oil and gas for the first time. Additionally, FORGE began drilling their first experimental EGS resource in October, 2020. Even with all these elements, it is unlikely that we will see EGS as a major contender in electricity generation anytime soon. The government needs to see at least another decade of development before they will feel confident supporting it. Because of Biden's decarbonization initiative, EGS research may get funded, and geothermal energy might get the attention it deserves. ●●●