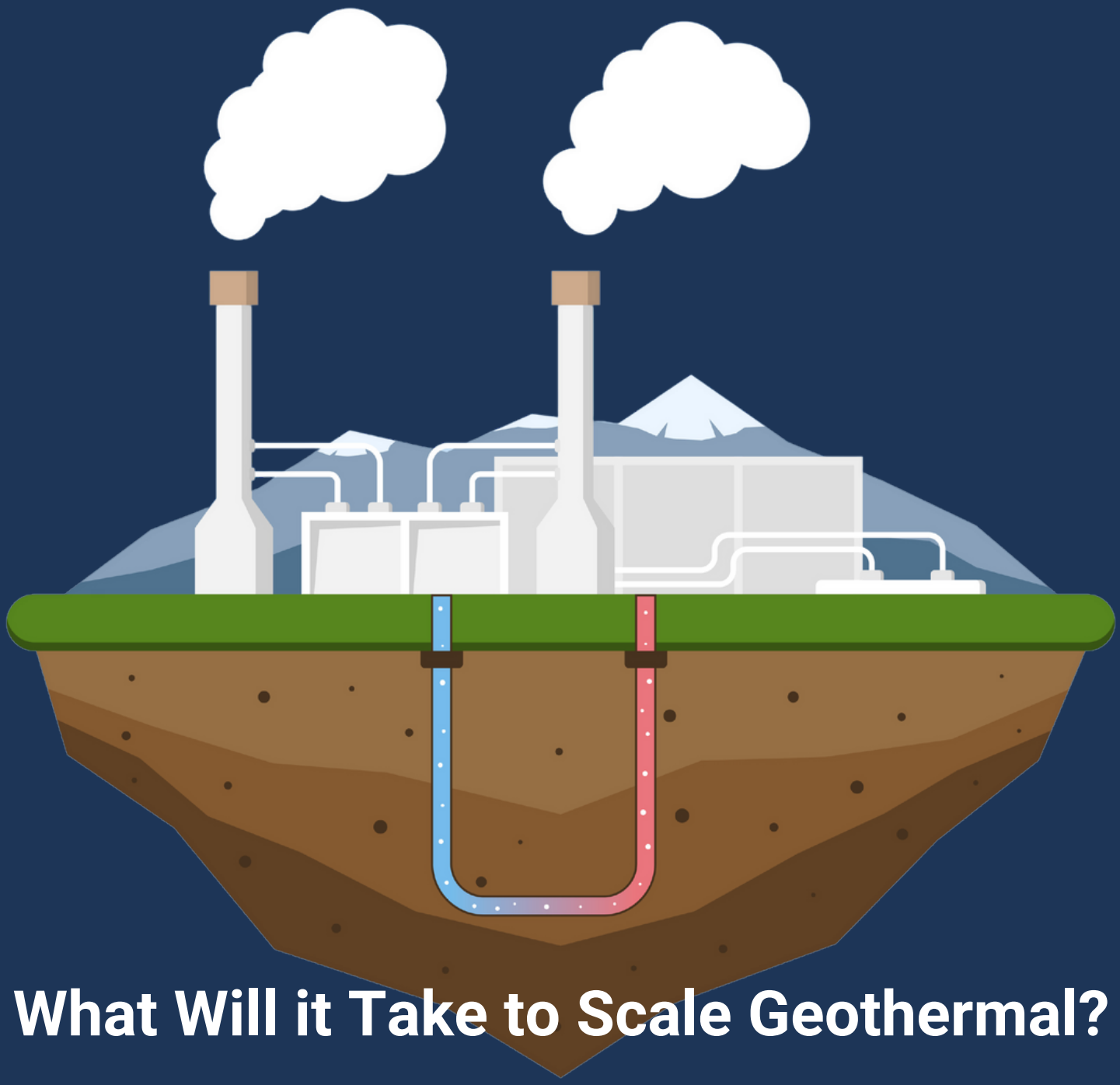
Geminus | CELSIUS ENERGY



What Will it Take to Scale Geothermal?

The role of models in the future of geoenergy

Decarbonizing with Geothermal Technology

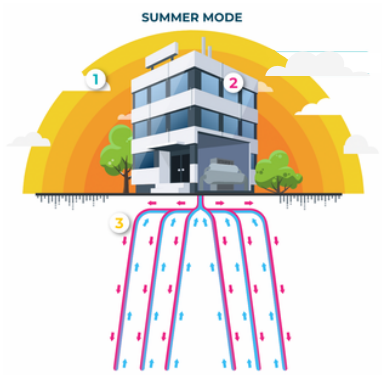
As the world continues to push towards a carbon-free future, we will need to rely on a mix of renewable energies to ensure energy security. Geothermal technology is a critical part of that mix. Able to provide baseload power regardless of wind or sun, geothermal energy can provide a stable, sustainable, and low-carbon energy supply. Shallow geothermal, or geoenergy, offers a particularly significant opportunity to reduce the carbon impact of heating and cooling buildings. 25% of the energy produced worldwide is used to heat and cool buildings, making this process a massive carbon emitter.

While historically geothermal technology has been expensive – even risky – the global focus on decarbonizing economies has propelled this renewable energy to the forefront of climate tech. Many countries are offering financial incentives and tax benefits, funding technical research, and de-risking investment in renewable technologies. The US Department of Energy has committed $46 million to the Frontier Observatory for Research in Geothermal Energy (FORCE) project in Utah. The International Renewable Energy Agency (IRENA) predicted the output of geothermal in Europe could increase eight-fold by 2050. France is turning to geothermal energy as a key component of their national energy plans, making substantial investments and launching France Géoénergie, a collective that aims to make the environmental and financial relevance of geothermal more visible. In response, we've seen companies big and small, including Fervo Energy, Shell, and Quaise emerge to commercialize geothermal solutions.

This movement has been crucial for companies like Celsius Energy, a geoenergy solution for building heating and cooling. Celsius Energy has seen strong results from combining and optimizing existing proven processes, reducing CO_2 emissions from buildings by up to 90%. So, what can be done to help companies like Celsius Energy gain traction globally?

Models Will Scale the World, and Geoenergy

What sets Celsius Energy's technology apart is their emphasis on the scientific accuracy of their design and system operation. The Celsius Energy team invests heavily in the system design to match the needs of the building, ensuring the most economically viable solution. This process uses a highly accurate scientific model of the subsurface, based on public and on-site data. They also rely on models on the operational side that describe how the geoenergy installation is performing.



The models that geothermal solutions – and other renewable technologies – rely on, while powerful, still face an uphill battle. They're computationally intense, slowing design cycles and prohibiting real-time optimization and decision-making. In some cases, they may not capture the necessary details, like the minimum temperature that a particular design and loading scenario will produce within the ground, to assess the feasibility of a design. New AI solutions have emerged that would improve model efficiency, but Inês Cecilio, Business Development Manager at Celsius Energy, explained that "advancing these techniques through a commercial off-the-shelf tool that can be applied directly in industry is challenging. If our R&D guys wanted to take the equations that were in these papers and implement them in Celsius Energy products, there's the whole technology readiness level ladder that we would need to go through. It would take us years."

Geminus has developed a multimodal AI solution that promises to accelerate the adoption of geothermal energy solutions, like Celsius Energy. By fusing information sources like physics-based simulations, measured data, and existing models, Geminus creates AI models that provide real-time feedback with high accuracy.

> The technology from Geminus is promising to improve our models, make them faster, make them more robust. We expect they will give Celsius an extra boost in terms of CO_2 savings and cost of installation reduction.
>
> **Inês Cecilio**
> Business Development Manager, Celsius Energy

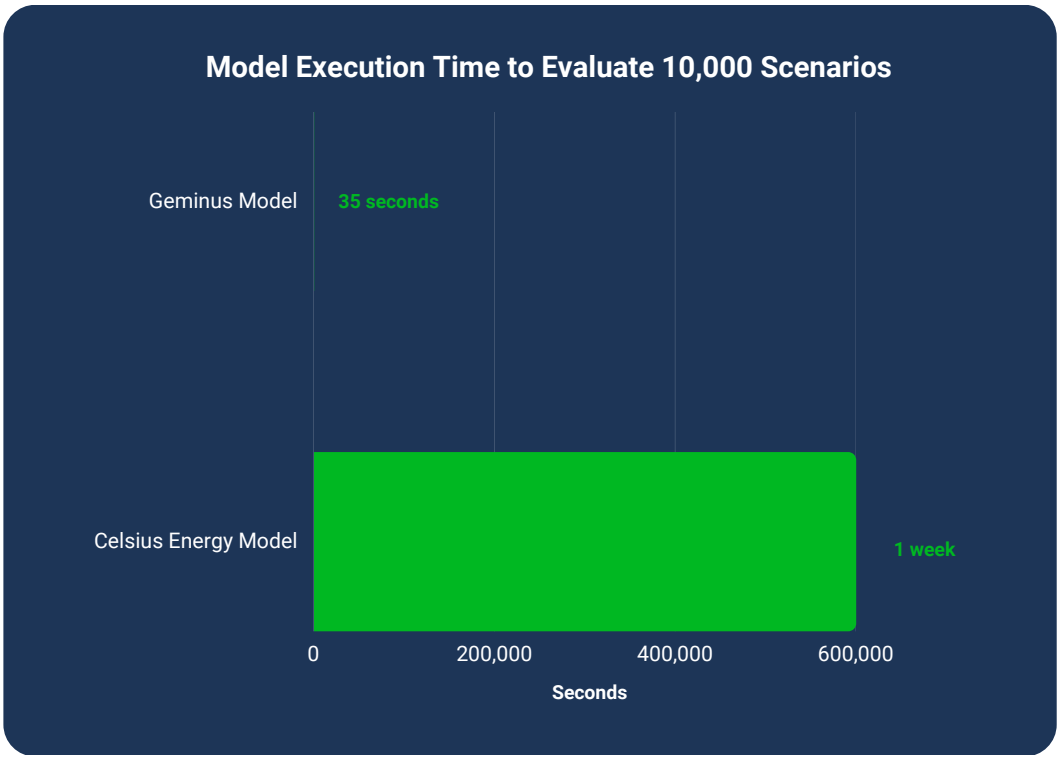
Let's look at two examples of how Geminus and Celsius Energy could work together to scale geothermal solutions.

Example

Accelerating Design and Planning

For every new client, Celsius Energy designs a custom solution that fits the needs and parameters of the building. This design process is critical to developing an accurate recommendation that minimizes both cost and CO_2 emissions. Geminus models can help the Celsius Energy team to explore and optimize design performance in real-time by adjusting key inputs like bore length, formation thermal conductivity, and formation heat capacity. This would provide a faster understanding of the impact of these design parameters and better inform the design process.

By adding Geminus to the workflow, Celsius would dramatically shrink their model execution time. The Geminus Platform uses sparse data, which lowers the computational time needed to create the model. Where Celsius Energy's model took 10 minutes to run one prediction, Geminus took just a fraction of a second. This kind of speed enables rapid exploration and design iterations.



By enhancing simulation with AI, Geminus maintains the accuracy of the model.

Example

Optimizing System Control and Equipment Monitoring

Geminus can also help to improve system productivity and efficiency and monitor equipment health and degradation over time. In this use case, the Celsius Energy team would be able to confidently predict 25-year ground temperatures as a function of building heat loading, external temperatures, and external temperature variations, in a fraction of the time of their original simulation.

The acceleration of rigorous models makes simulation insights – deep knowledge of physics and behavior otherwise unavailable from data – accessible in real-time. With these, Celsius Energy can respond to changes in building requirements, external climate, and equipment degradation as the system is operating. Geminus models also provide quantified uncertainty, which is essential for efficient training & updating, anomaly detection, root cause analysis, and control optimization. With enhanced system monitoring and control, Celsius Energy would be able to maximize the effectiveness and longevity of their installation.

Geminus

Geminus has taken a different approach to industrial AI, swapping purely data-driven techniques for the latest developments in computational science. Our next-generation predictive intelligence solution fuses measurement data and physics to power resilient and efficient decision-making in a fraction of the time. Enabling the optimization and decarbonization of existing infrastructure, while scaling tomorrow's net-zero solutions.

Get in Touch: info@geminus.ai

CELSIUS ENERGY

Celsius Energy is a scale-up of SLB, the worldwide leader in subsurface drilling and development. Celsius Energy has been recognized by the UN as one of the 50 most promising solutions for the future of climate worldwide. They have created a solution that reduces the carbon footprint of buildings by making energy accessible from the earth. By combining and optimizing existing proven processes, it can reduce CO_2 emissions from buildings by 90% and energy consumption by 75%.

Get in Touch: hello@celsiusenergy.com