# IEA FUTURE OF GEOTHERMAL REPORT
# CASCADE INSTITUTE REACTION

On December 13 2024, the International Energy Agency (IEA) released "The Future of Geothermal Energy"

The IEA's report provides a comprehensive as well as nuanced overview of the global geothermal sector. Covering both heat and power, the report looks at the state of geothermal today, emerging technologies and their impacts, as well as key challenges and policies to address them.

**The overarching message of this report is clear:**

**The potential of geothermal power has been completely redefined by recent technology breakthroughs. We can leverage innovation and policy to realize that potential and re-shape global energy systems.**

Until today, geothermal has provided a valuable, but niche, role in power systems. On one hand, geothermal provides a source of clean, reliable, and affordable baseload power ideal for utilities. On the other hand, these projects depend on the presence of natural aquifers that are difficult to detect at the surface. This creates risk for investments and limits deployment potential.

As a result, conventional geothermal has failed to match the incredible growth of other renewables like wind and solar. Today, geothermal capacity is just 15 GW globally.

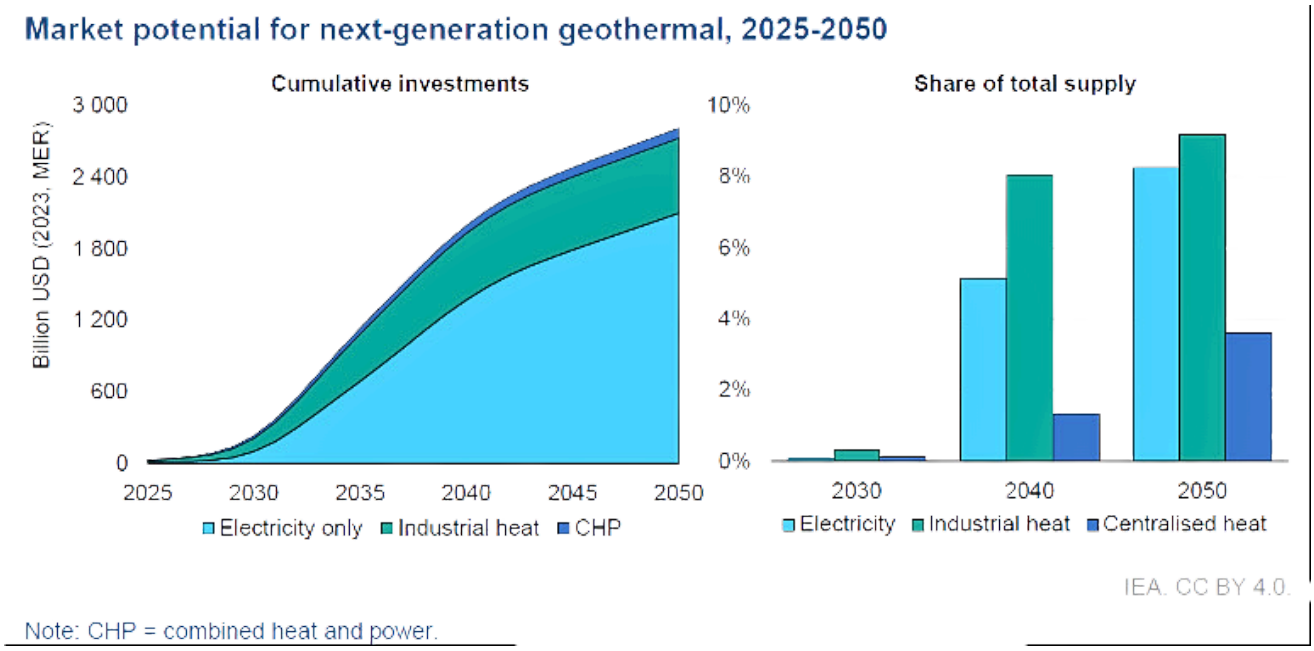
However, next-generation geothermal technologies can create artificial reservoirs to generate power, reducing risk and expanding the use of this resource beyond its current geological limits. As these technologies advance, the question is less about where geothermal resources exist, but at what depth they can be found.

The IEA found the technical potential of geothermal is nearly 600 Terawatts (TW), or nearly 2,000x conventional geothermal potential. This capacity could generate 4,000 Petawatt-hours (PWh) of electricity annually. That's ~150x global electricity demand.

This potential rises rapidly with depth. Within five km of the surface, the technical potential is 42 TW. But at 5-8 km, this increases to 550 TW. For context, global installed capacity was 8.5 TW in 2023. This underscores the importance of ultradeep geothermal.

Not all this energy is economically recoverable. The IEA found that by 2050 there could be 800 Gigawatts (GW) of cost-effective next-generation geothermal. While a small fraction of total potential, this would still provide 8 percent of the world's electricity supply in 2050. If this deployment was realized, next-generation geothermal would meet 15 percent of electricity generation growth between now and 2050, making it the third largest source of growth (behind only wind and solar).

This new role for geothermal presents a major market opportunity. Achieving this level of deployment would require US $700 billion by 2035 and US $2.1 trillion by 2050. Annual investment in geothermal could peak at US $200 billion, roughly one quarter of today's total annual investment in clean electricity.



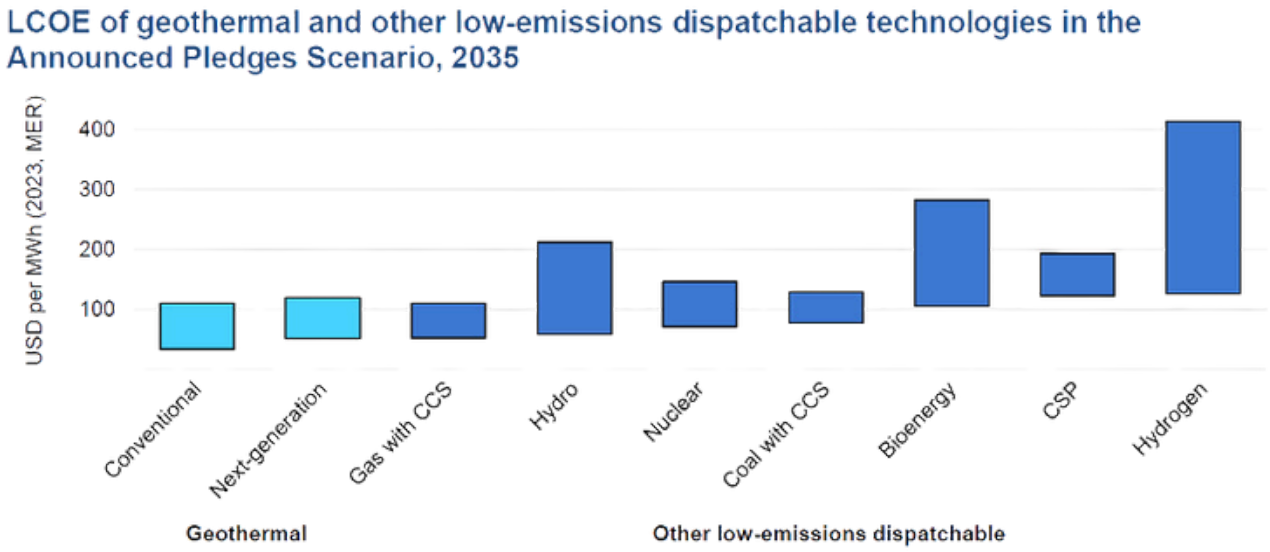

In short, the opportunity is incredible. However, we need leadership on both technology and policy to transform these projections into reality.

Technology and innovation are essential. In fact, one of the key recommendations of the report is to "expand geothermal-specific research and innovation programmes including demonstration and testing of emerging technologies." The recent announcement of the Alberta Drilling Accelerator is well-aligned with this recommendation, and a necessary step to achieve the required cost reductions.

The IEA's projections are contingent on reducing capital costs by 80 percent by 2035. This may appear ambitious, but the target is well-aligned with those set by the US Department of Energy's Enhanced Geothermal Shot, which targets a cost reduction of 90 percent.

The IEA's scenarios forecast a decline in costs from US $14,000 / kW for a first-of-a-kind (FOAK) demonstration today to US $3,000-7,000 by 2035 and US $2,000-5,000 by 2050. Cost reductions can be supported by "learning by doing," as well as a transfer of expertise from the oil and gas sector.

Since the majority of geothermal costs are capital costs, these reductions would dramatically reduce the levelized cost of energy (LCOE) of geothermal. With aggressive innovation, the IEA forecasts that LCOE could fall from US $230 / MWh for a FOAK project to US $50 in 2035 and US $30 in 2050. At these costs, next-generation geothermal would be extremely competitive with similar technologies, including unabated gas-fired power.




It's important to note the IEA's assessment excluded resources above 250C for EGS and 350C for conventional geothermal, reflecting the limits of today's technologies. However, it is possible that advancing subsurface technologies will allow us to access higher temperature resources, particularly Superhot Rock (SHR) geothermal systems (>375C). Accessing these temperatures will drastically increase the energy output per well by 5 to 10x.

While these advancements will require dedicated technological innovation, the potential of SHR geothermal suggests the IEA's current estimate is more of a floor than a ceiling.

Policy will also play a critical role beyond supporting R&D. The IEA found that only 30 countries globally have implemented energy policies that include geothermal. The report puts forward a series of policy specific recommendations, such as:

- **Including geothermal energy in national energy planning** through dedicated targets and technology roadmaps that recognize the unique benefits of geothermal. This is particularly relevant in Canada, where geothermal resources are well-documented.

- **Leverage synergies with oil and gas.** 80 percent of a geothermal project involves capacity and skills common in the oil and gas sector. Transferable skills, data, technologies, and supply chains from oil and gas can help accelerate deployment and drive down costs. Oil and gas is also a potential source of specialized skills and expertise for geothermal—another advantage for Canada.

- **Streamline permitting and develop consistent regulations for geothermal energy.** In Canada, only three jurisdictions have geothermal regulations in place that enable resource development. The Cascade Institute's Geothermal Research and Action Roadmap highlights this gap, and work is underway to develop a flexible regulation template for other Canadian jurisdictions.

- **Improve data quality and create open data repositories** to accelerate the assessment of geothermal resources and facilitate project investment. In Canada, most data used for geothermal resource development is publicly available. New technology and data interpretation methods should be applied to Canada's data to improve their quality and fully visualize Canadian geothermal potential.

- **Develop policies to de-risk project development.** Policy support can help mitigate early-stage project risk and ensure that geothermal projects are fully compensated for the firm, reliable energy they provide. Power purchase agreements, project insurance, debt financing, and geothermal supply requirements are all tools that have been used successfully.

The IEA report underscores a transformative moment for geothermal energy. With unprecedented technical potential and advancements in technology, geothermal is poised to transition from a niche player to a cornerstone of global energy systems.

Realizing this vision requires decisive action on both innovation and policy. By embracing the report's recommendations—fostering R&D, leveraging oil and gas expertise, streamlining regulations, and de-risking projects—countries like Canada can lead the charge. The opportunity is clear: geothermal energy can redefine clean energy landscapes, drive economic growth, and play a pivotal role in achieving net-zero goals.

## The time to act is now.