Deep Geothermal Superpower

Canada's potential for a breakthrough
in enhanced geothermal systems

Summary

Canada is ideally positioned to be a world leader in geothermal electricity and heat production—a technology that could play a critical role in humanity's zero-carbon energy transition. To realize this opportunity, Canada should launch a national research and development program to massively scale up geothermal power production and R&D in Canada over the next 15 years.

A Canadian geothermal breakthrough could fill the country's baseload electricity gap and bring it much closer to meeting its 2050 net-zero carbon commitment. It could also propel Canada to global leadership in exporting geothermal expertise and technology around the world, by leveraging its advantages in drilling technologies, geo-technical expertise, and oil- and gas-field logistics.

This opportunity analysis provides a plain-language introduction to geothermal electricity and heat production. It focuses on **deep enhanced geothermal systems** (or "deep EGS") that create heat-exchange reservoirs in hot, dry rock more than 5 kilometers below Earth's surface. It assesses the deep EGS opportunity, highlights important R&D gaps, and analyzes key technical, financing, and regulatory obstacles.

Our central argument is that Canada *can* and *should* become the global leader in deep EGS. But to do so, it must create strong incentives to solve the technology's core R&D challenge: *cost-effective, low-carbon deep drilling through hard (igneous and metamorphic) rock.*

A major program to develop deep EGS in Canada could contribute to national solidarity around climate action, by supporting soon-to-be displaced workers and industries in provinces highly dependent on the oil and gas sectors, without directly competing with those sectors.

Key findings

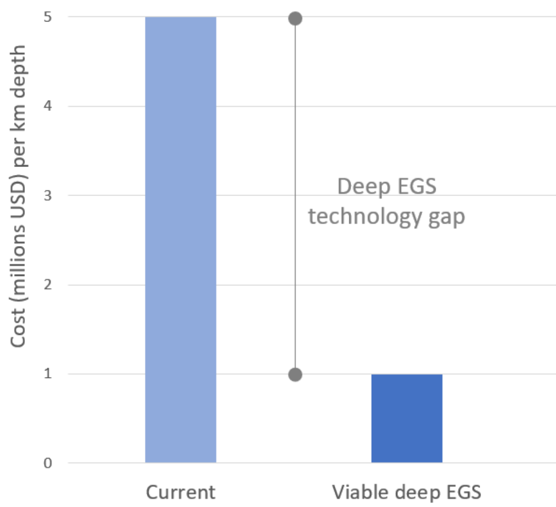
Deep EGS would complement other sources of net-zero electricity while offering several advantages.

	Hydro	Nuclear	Solar	Wind	Biomass	Tidal/Wave	**Deep EGS**
Baseload electricity	✓	✓	✗	✗	✓	✗	✓
Dispatchable electricity	✓	✗	✗	✗	✓	✗	✓
Limited impact on landscape	✗	✓	✗	✗	✗	✓	✓
Near zero- carbon operational emissions	✓	✓	✓	✓	✗	✓	✓
Resilience to climate change impacts?	✗	✓	✗	✗	✗	?	✓
Broad public support	✗	✗	✓	✗	✗	✓	✓

90% **or more of the geothermal opportunity is accessible only with deep EGS.**

In principle deep EGS could be deployed in almost any location and by itself power the global economy.

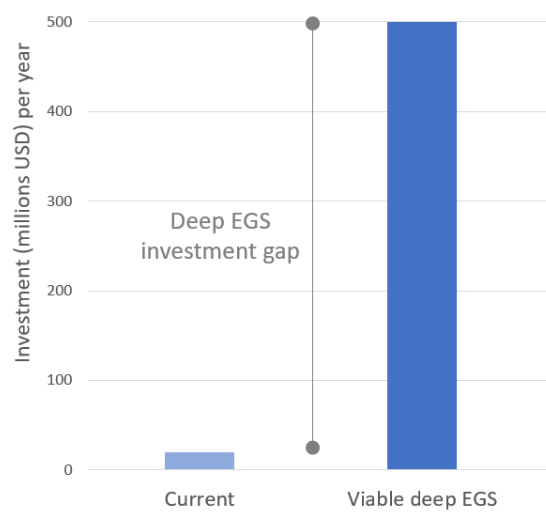
But deep EGS requires transformational advances in drilling technologies to make deep drilling technically and financially feasible.



With existing drilling technologies, it is likely feasible to drill to depths of around **10 km** through hard rock at a cost between **50 and 100 million USD** per well. These costs need to be reduced by **an order of magnitude** (to 5 to 10 million USD) to make deep EGS economically viable in the current energy market.

Emerging technologies—such as percussive, waterjet, and plasma drilling—offer pathways towards cost-competitive drilling through hard rock.

Research and development investment in deep, hard rock drilling totals about **20 million USD per year** worldwide. To achieve economic viability within a reasonable timeframe, investment must grow by more than **an order of magnitude**—to approximately **500 million to 1 billion USD per year**.



Government must take a leadership role on deep EGS financing. The federal government's support of nuclear power development provides a precedent and a model.