



EXECUTIVE SUMMARY

- ◆ **This techno-economic analysis models costs and energy generation for enhanced geothermal systems (EGS) at four locations in western and northwestern Canada.**
- ◆ **Present-day costs and levelized cost of energy (LCOE) estimates for EGS are already competitive with other options for baseload electricity generation, especially in areas with hotter geothermal gradients such as the Northwest Territories and British Columbia.**
- ◆ **Modelling indicates that LCOE reductions in the range of 40-50% are achievable in a future innovation scenario with reasonable advances and efficiencies in key project aspects.**
- ◆ **EGS can provide firm, clean, cost-competitive electricity in western and northwestern Canada.**

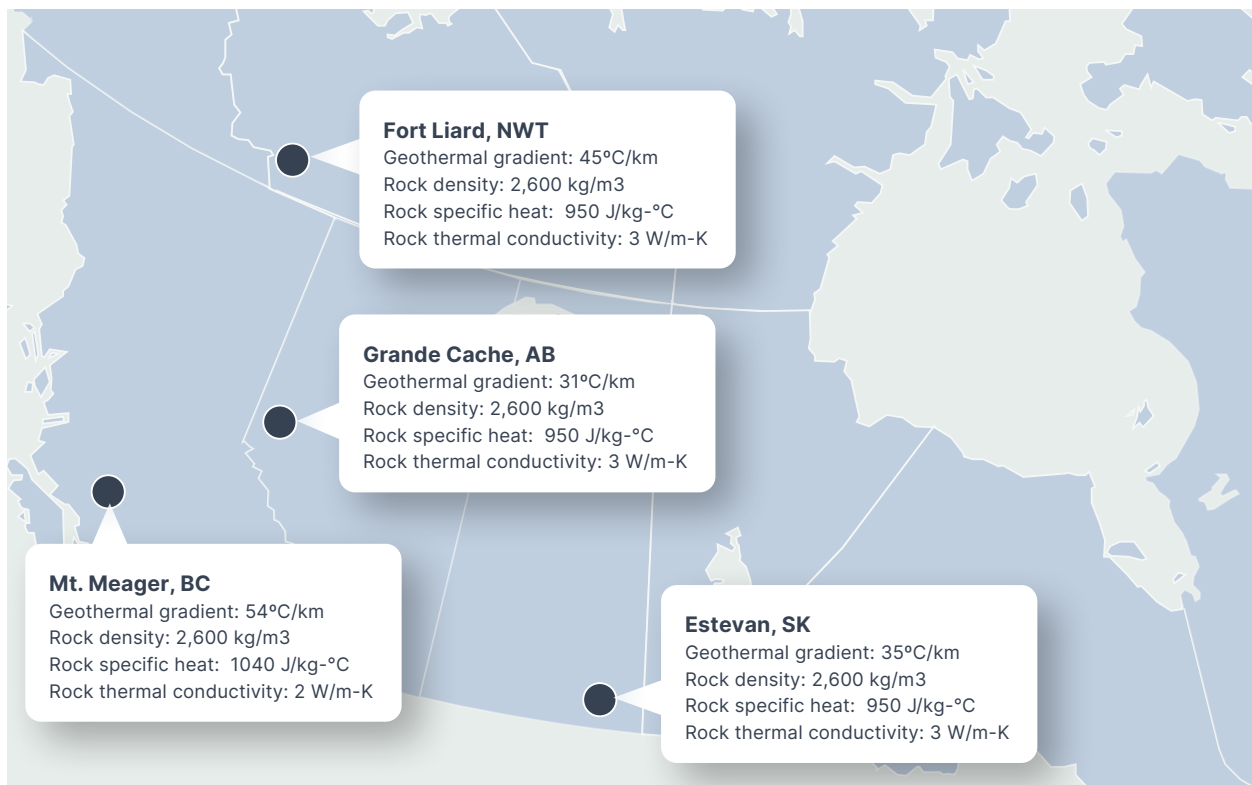
Enhanced geothermal systems (EGS) could offer a viable pathway to firm, clean electricity in Canada, especially with recent advances in drilling and reservoir stimulation and continued innovation in the space. However, because it is an emerging technology that has not yet been deployed in Canada, EGS's costs are poorly understood and can vary depending on local subsurface conditions, meaning the technology is often left out of energy-economy models and electricity system planning. This report seeks to improve understanding of EGS project costs and of the role that geothermal power can play in Canada's energy future.

The Cascade Institute conducted techno-economic analysis to model costs for developing EGS to generate electricity at four nominal project locations with representative geothermal gradients in Alberta, British Columbia, the Northwest Territories, and Saskatchewan. This analysis estimates capital and operating expenses and calculates levelized cost of energy (LCOE) at each location for two scenarios: *present day and future innovation*. We used the Geothermal Electricity Technology Evaluation Model (GETEM) within the System Advisor Model (SAM), an industry-recognized tool developed by the U.S. Department of Energy's National Renewable Energy Laboratory (NREL). All cost estimates are presented in U.S. dollars and do not include any subsidies, tax credits, or incentives.

This report presents a first-of-its-kind model of EGS power costs for four sites in Canada, drawing on the best available data and adapting established methodologies to Canadian conditions. Energy system analysts can use these estimates as inputs for electricity and energy-economy models to better understand the competitiveness of EGS power relative to other baseload technologies, as well as its stabilizing role in a decarbonized energy system.

FIGURE A:

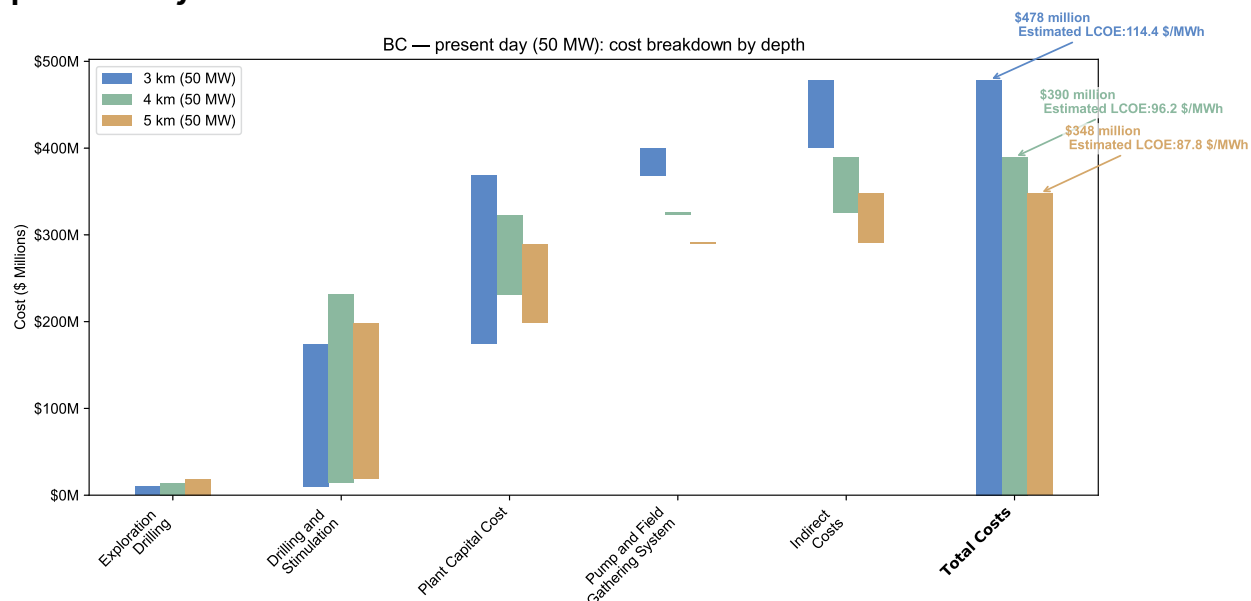
Resource parameters at selected sites in Alberta, B.C., Northwest Territories, and Saskatchewan.



For the purpose of this study, we selected sites based on locally available geothermal gradient and heat flow data, but did not account for infrastructure proximity, permitting constraints, or environmental factors.

FIGURE B:

Deeper is cheaper—cost and LCOE estimates for a 50 MW EGS project under present-day conditions

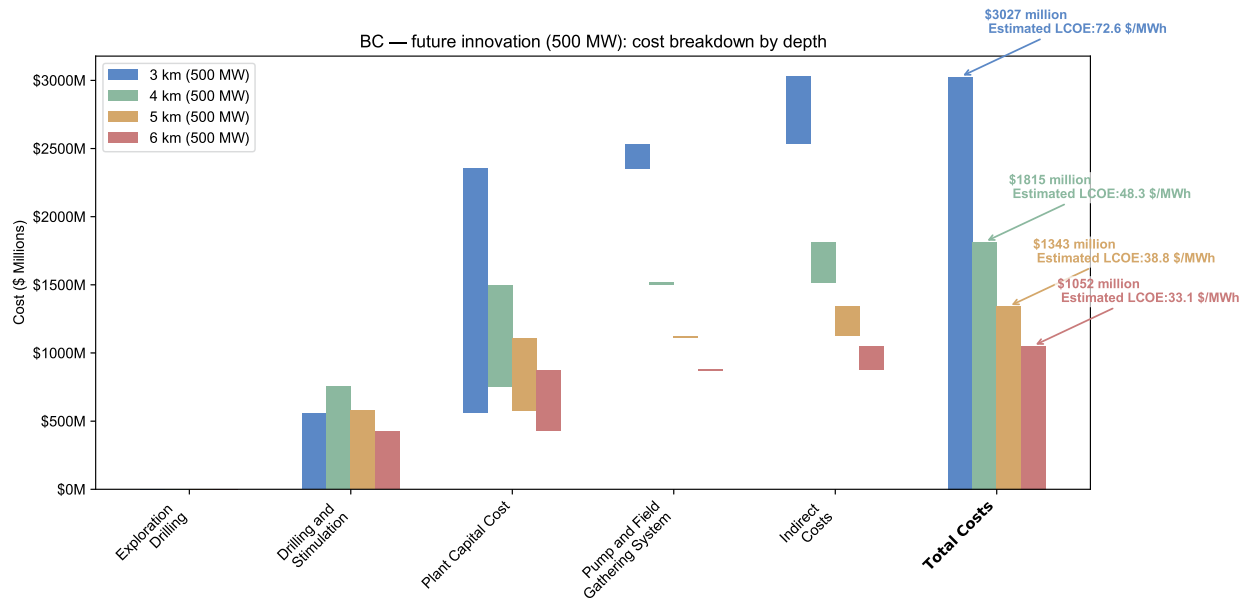


Capital cost estimates for a nominal EGS project at different depths in the Garibaldi Volcanic Belt in British Columbia under the present-day (50 MW) modelled scenario. Note the reductions in LCOE and overall project costs (in spite of higher costs per well) when targeting deeper, hotter geothermal plays due to larger energy output per producer-injector well pair. All costs in U.S. dollars.

The future innovation scenario models costs in U.S. dollars and energy outputs based on:

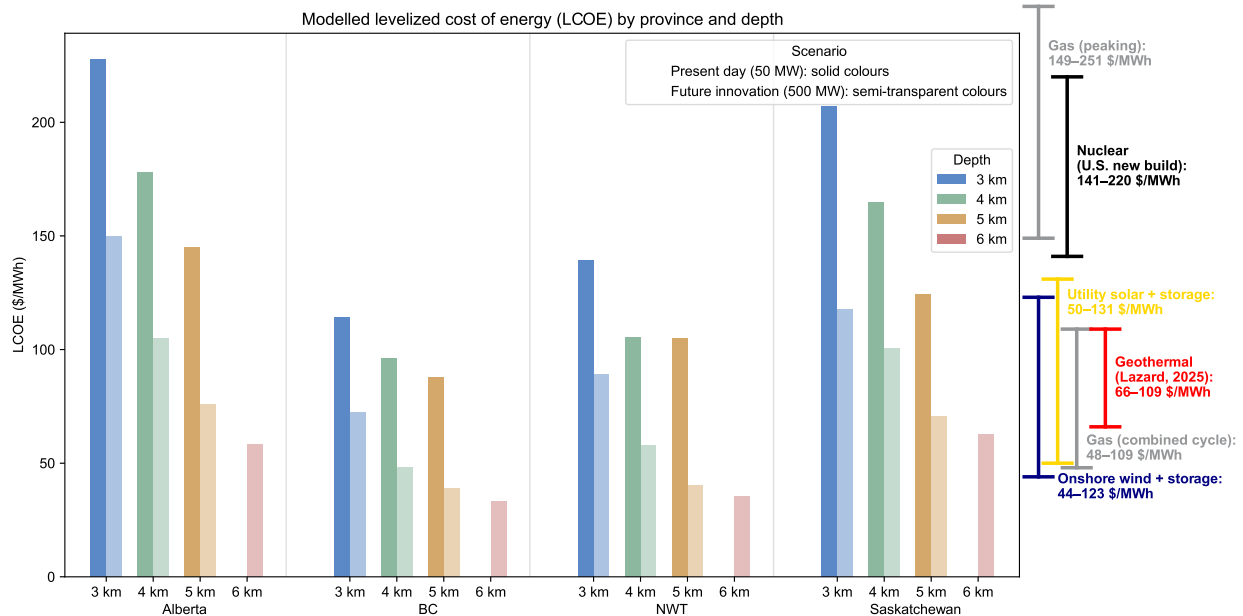
- ◆ advances in geoscience and well engineering to reduce the number of non-productive wells drilled when developing a project;
- ◆ improvements in reservoir engineering allowing for higher sustained flow rates per producer-injector well pair;
- ◆ continued improvements to high-temperature and high-pressure tools that aid in targeting deeper geothermal reservoirs;
- ◆ cost efficiencies such as lower \$/kW operating expenses from larger-scale development; and
- ◆ reductions in drilling costs to align more closely with drilling rates recently achieved by EGS project developers in the United States.

FIGURE C:

Depth and innovation drive down EGS costs in a future innovation scenario

Capital costs for an EGS project at different depths in British Columbia under the future innovation (500 MW) modelled scenario. Note that achieving a depth of 6 km results in LCOE more than 50% lower than at 3 km. All costs in U.S. dollars.

FIGURE D:

How EGS stacks up against other power sources at various depths, now and in a future innovation scenario

Calculated LCOE (\$/MWh) for EGS projects at varying depths for present-day and future innovation scenarios at each of the four locations modelled in this study. For comparison, published LCOE ranges from Lazard (2025) for other comparable forms of generation: gas generation (peaking and combined cycle), new build nuclear, utility solar with storage, onshore wind with storage, and geothermal are shown as range bars on the right-hand side of the plot. All costs in U.S. dollars.





EGS shows significant promise as an optimal provider of clean, secure, and affordable baseload electricity generation in western and northwestern Canada.

This analysis shows that LCOE estimates for EGS in western and northwestern Canada are already cost-competitive with other baseload technologies in some scenarios. We find that, based on present-day capabilities, an EGS project at Mt. Meager, British Columbia, or in Fort Liard, Northwest Territories, could deliver electricity with a lower LCOE than a gas peaker plant or new nuclear development. In a future innovation scenario, these already-competitive costs fall by a further 40-50%, making EGS cheaper or cost-competitive with utility solar with storage, onshore wind with storage, and combined-cycle gas at each of the four sites.

Continued investment in drilling, stimulation, and well-field optimization offers high-leverage gains that would help scale low-cost EGS development. These advances would also benefit other subsurface energy projects, including conventional and deep closed-loop geothermal. Continued R&D and new demonstration projects can help Canada overcome the remaining technical and economic barriers standing in the way of significant cost declines. With continued innovation, EGS shows significant promise as an optimal provider of clean, secure, and affordable baseload electricity generation in western and northwestern Canada.

