**PROJECT AURORA**

A proposal for an Arctic Underground Research Observatory for Resource Advancement

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**ISSUE**: Expanding Canada's presence in the Arctic to defend sovereignty is more important than ever. Energy scarcity chronically challenges this goal, but geothermal energy can provide a source of abundant and reliable heat and power for military, civil, and industrial activities across the North.

**PROPOSAL**: The Government of Canada should invest $100M to create Project AURORA, a next-generation geothermal field laboratory in Canada's North and an enhanced geothermal system (EGS) community energy project in Resolute Bay, Nunavut. Project AURORA would:

- **Establish an expert-led research facility** to unlock geothermal energy and to power the expansion of Canada's presence in the Arctic needed to defend sovereignty. Delivered under the Bureau of Research, Engineering, and Advanced Leadership in Innovation and Science (BOREALIS), funding would provide **$53M** for key infrastructure (e.g., wells, power generation, heat off-take) and **$47M** for strategic R&D (e.g., drilling, well design/completion, reservoir creation).
- **Enhance energy security in the Arctic** by developing the capability to harness the geothermal energy that exists everywhere, that does not require imported fuel, and that runs year-round with minimal operating expenses. Developing geothermal technologies would obviate the need for unproven alternatives such as small modular reactors (SMRs). A distributed network of SMRs would create security liabilities in remote communities and industrial sites, and along the routes needed to transport fuel and radioactive waste.
- **Build partnerships with key Arctic allies**. The U.S. is investing heavily in geothermal power, and the U.S. Defense Innovation Unit (DIU) is already exploring geothermal through a partnership with developers at six military bases, **including in Alaska.** Like-minded Nordic countries such as Iceland, Norway, and Finland could leverage domestic interests in geothermal energy to collaborate on Project AURORA.
- **Expand Canada's presence in the North** as innovations at Project AUROROA are replicated across the Arctic to reduce energy costs and improve resilience. The Project would support Canada's Arctic foreign policy goal of a safe, strong, and thriving future for residents by:
    - Providing a more reliable source of low-cost energy for military operations.
    - Improving the economics of industrial activities (e.g., mines for critical minerals).
    - Creating new economic opportunities for communities (e.g., trade, food production).
    - Expanding civil operations (e.g., infrastructure, public services, and scientific research).
- **Contribute to Canada's defence spending targets,** such as the 1.5 percent infrastructure tranche of Canada's 5 percent commitment. Funding for geothermal projects could be counted as a dual-use investment and would provide the energy infrastructure needed to pursue other strategic projects, including ports, airports, and telecommunications.
- **Target a cost of energy of $400 per Megawatt-hour (MWh) or less,** which is below the cost of diesel. Deploying Canada's world-class energy expertise in the world's most challenging environment will enable Canadian firms to provide turnkey hard-rock drilling solutions in a global market worth over $2 trillion by 2050. As innovation drives down Arctic energy costs, it will simultaneously create spillovers that make geothermal more viable **across all of Canada**.

**RATIONALE:** Canada is at an inflection point in the Arctic. Canada's Arctic neighbours are becoming more assertive, while rising temperatures boost the value of the Arctic for transport and resources. Canada must now increase its military and economic activity to reinforce its sovereignty. But energy is a chronic barrier, as costs in Canada's Arctic are amongst the world's highest.

Geothermal power offers a transformative solution. By drilling kilometers deep into the Earth's crust and circulating water to harvest massive quantities of heat, geothermal energy can be harnessed for heat and power nearly anywhere. It provides secure baseload electricity available 24/7, and plant performance is enhanced in cold climates such as those in Canada's Arctic. Since most of the infrastructure is located underground, geothermal facilities can be built close to the airports these communities need, unlike wind turbines, and are more resilient to extreme weather.

However, next-generation geothermal technologies suitable for the North require innovation. Canada is uniquely positioned to realize this opportunity. The skills and expertise needed for a geothermal project are much the same as those that propelled Canada's oil and gas sector to global leadership. **By redeploying this expertise to geothermal innovation, Canada can both address its northern energy and sovereignty challenges and enhance its competitive edge to become a clean energy superpower.**

The Canadian Armed Forces are well placed to lead the way. Groups such as Defence Research and Development Canada and Defence Construction Canada could spearhead a new era of military-led innovation. Just as the U.S. Army Corps of Engineers built world-renowned capabilities in bridges, dams, and waterways, Canada has the chance to define a new frontier of military engineering. By pairing military logistics and construction capabilities with Canada's deep subsurface expertise, Project AURORA would establish Canada as a world leader in geothermal.

Resolute Bay is the ideal location for this goal. The community hosts an air base, faces high energy costs, and has a strong geothermal resource (i.e., a good heat gradient). Local conditions present significant challenges, particularly given the area's hard rock geology. But this is a feature, not a bug. *Challenging conditions compel the development of advanced solutions that, once proven in the Arctic's most difficult conditions, can be exported to other markets around the world.*

The local benefits would be large. Project AURORA would eliminate dependence on imported diesel and its waste heat; it could support greenhouses for food security. As costs fall, broad deployment of next-generation geothermal systems would catalyze a northern economic revolution in mining, research, defense infrastructure, and community development—even in tourism. The associated activity would dramatically expand Canada's presence in the North, helping to simultaneously enforce Canadian sovereignty, drive increased productivity, and create spillovers for Canada's broader geothermal and energy industries (oil and gas, critical minerals, carbon management).

**NEXT STEPS:** The Government of Canada should convene key experts to solicit views on a path forward, including alternative sites, logistics, project design, and R&D agenda. An initial investment of $10.25M could fund an exploration well to generate the data needed to design the full facility.

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## ANNEX: PROJECT AURORA TECHNICAL DETAILS

**Methodology:** CI-GEO modeled the costs of an enhanced geothermal system (EGS) at Resolute Bay, NU. Analysis was led by Gordon Brasnett, a CI-GEO fellow, and underpinned by research in Resolute Bay from the Geologic Survey of Canada. Modelling was executed in Geophires, an geothermal modeling tool developed by the U.S. Department of Energy.

**Resolute Bay Technical Characteristics:**
Geothermal gradient**:** 34°C / km
Target depth: 3.5 km
Bottom hole temperature: 104°C
Production temperature: 101°C
Number of wells: 2 (each with 8.5" casing)
Flow rate: 60 kg/s
Capacity factor: 95%
Project life: 40 years
Average ambient air temperature: -15°C


**Energy Output**
**Electricity:**
Resolute Bay peak demand: 0.81 MW
**EGS average net power output: 0.91 MW**
Resolute Bay annual demand: 4.4 GWh
**EGS annual generation: 6.5-8.1 GWh**
**Heat:** EGS will also generate 0.09 $MW_{thermal}$ (0.72GWh per year or 2592 GJ per year), enough energy for space heating of approximately ~1500 $m^2$ of area.

**Cost Estimates:**[1]

| Upfront Capital Investment | | Ongoing Costs / Benefits | |
|---|---|---|---|
| Exploration and mobilization costs: | $10.25M | Wellfield maintenance: | $0.49M/yr |
| Drilling and completion costs: | $24.36M<br>*$12.18M/well* | Makeup water: | $0.03M/yr |
| Reservoir engineering: | $7.55M | Powerplant maintenance: | $0.48M/yr |
| Surface facility & power plant: | $7.96M | **Total annual operating costs:** | **$0.98M/yr** |
| Field gathering system: | $2.52M | Note: CI-GEO estimates Resolute Bay requires 1.76 million liters of diesel annually, at a cost of ***$2.52-2.63M/yr***. | |
| **Total capital costs:** | **$52.64M** | | |

EGS at Resolute Bay has an estimated levelized cost of electricity of **$615/MWh**, below the full cost of diesel-fired power, estimated at up to $650/MWh. Ultimately, the proposal targets <$400/MWh, which is the current cost of diesel and O&M for power generation. Achieving costs below this threshold will produce significant and immediate savings.[2]

[1] Estimates are based on cost correlations from industry and CI-GEO experience. To account for additional costs stemming from construction in a remote, arctic community, estimates were conservative and included mobilization costs. We note that LCOE estimates would be lower under similar conditions for a community that is less isolated. Full assumptions associated with this modelling available on request.
[2] Based on estimates from 'Specialized Pricing Strategy for Renewable Energy Suppliers to QEC', InterGroup.