



Heat Beneath Ice: Geothermal for **Arctic & Remote Resilience**



Table of Contents

Heat Beneath Ice:
Geothermal for
Arctic & Remote
Resilience **04**

Canada: Geothermal
at the Frontline of
Arctic Energy
Security
07

Iceland and
Greenland: From
Geothermal
Backbone to
Emerging Frontier **09**

The Nordic
Blueprint: How
Norway, Sweden,
and Finland Built
Quiet Resilience
11

This Month's Hot Spot



Heat Beneath Ice: Geothermal at the Edge of the Energy System

From northern Canada to Iceland and the Nordic countries, some of the world's coldest regions face the harshest energy realities. Long winters, extreme temperatures, and remote infrastructure make reliable heating not just an economic question, but a matter of resilience and security. In these environments, geothermal energy offers a uniquely powerful advantage: constant, local heat independent of fuel transport or weather conditions. This month's GLOBAL_GT feature explores how Arctic and sub-Arctic nations are using subsurface heat to strengthen communities, stabilize infrastructure, and build energy systems designed to endure the coldest conditions on Earth.





→ HEAT BENEATH ICE:

Geothermal for Arctic & Remote Resilience

In the world's coldest regions, energy is not a luxury. It is survival.

Across Arctic and sub-Arctic communities, winter temperatures regularly drop below -20°C . Heating dominates total energy demand. Diesel is flown or shipped in at high cost. Supply chains are fragile. Infrastructure is exposed to extreme weather and shifting permafrost. And yet — beneath ice, rock, and frozen ground — lies one of the most underused resilience tools of our time: Geothermal energy.

This February, GLOBAL_GT focuses on Arctic and cold-climate opportunity. Because the colder the climate, the stronger the geothermal case.

Cold regions face a triple challenge:

- Extreme and prolonged heating demand
- Heavy dependence on imported fuels
- High infrastructure vulnerability

For remote communities, research stations, and military installations alike, energy security is not an abstract policy debate. It is operational reliability. It determines whether buildings stay heated, water systems function, and critical services remain online during storms and supply disruptions.

Geothermal energy offers a fundamentally different foundation. Subsurface heat is local, stable, and independent of fuel transport. Once installed, geothermal systems are shielded from extreme weather. They reduce reliance on volatile supply chains and provide predictable long-term operating costs.

In cold climates, this is not simply a sustainability measure. It is infrastructure strategy.

Canada: Energy Security Meets National Security

Northern Canada illustrates both the challenge and the opportunity. Remote communities and Arctic bases often rely on diesel transported across vast distances. Fuel logistics are expensive and vulnerable to disruption. Emissions are high, and long-term costs accumulate.

Shallow geothermal systems — including ground-source heat pumps and borehole thermal energy storage — can significantly reduce fuel dependency. These technologies stabilize heating systems, lower operational costs, and increase resilience in isolated environments.

For Arctic operations, subsurface heat is not just renewable energy. It is strategic infrastructure. As Canada prepares to host the World Geothermal Congress 2026 in Calgary, Arctic geothermal development represents not only a technical opportunity but a leadership opportunity.



Iceland: From Survival to System Integration

If Canada highlights potential, Iceland demonstrates proof at scale.

More than 90% of Icelandic homes are heated with geothermal energy. District heating networks operate reliably through snowstorms and long winters. Electricity generation and direct-use systems are fully integrated into national infrastructure.

What began as a necessity in a harsh climate has evolved into a mature, exportable model of energy independence. Institutions such as Reykjavík Energy and initiatives like the Krafla Magma Testbed show how cold-climate geology can move beyond basic heating to advanced innovation.

In Iceland, geothermal energy is not seasonal, experimental, or marginal. It is backbone infrastructure.

The Nordic Signal

Across Norway, Sweden, and Finland, shallow geothermal systems and district heating networks quietly anchor urban resilience. Heat pumps are mainstream. Borehole storage balances seasonal demand. Hybrid systems combine geothermal with other renewable sources to ensure reliability.

Even Greenland - historically dependent on imported fuels - is assessing geothermal potential as part of its long-term energy planning.

Cold regions do not treat heating as optional. They design systems that must function every day, every winter.



Why Geothermal Performs Best in the Cold

Geothermal systems are particularly well suited to cold climates because:

- Heating demand is consistent and predictable
- Temperature differentials increase system efficiency
- Underground infrastructure is protected from extreme weather
- Baseload stability complements intermittent renewables

In short, the harsher the winter, the stronger the geothermal argument.

Arctic and remote regions are not peripheral energy markets. They are proving grounds for resilience. As geopolitical uncertainty increases and supply chains face pressure, local energy sovereignty is becoming central to national strategy.

Heat beneath ice is not a niche opportunity. It is critical infrastructure.



Geothermal as Strategic Infrastructure



Across northern Canada, energy is not simply a service - it is a lifeline. Remote communities, research stations, and industrial sites rely heavily on diesel fuel transported across vast distances by truck, ship, or aircraft. Heating dominates energy demand, and supply disruptions can quickly become operational and economic crises.

Yet beneath the frozen ground lies a reliable and local alternative: geothermal heat.

From Delivered Fuel to Permanent Infrastructure

Shallow geothermal systems use the stable temperatures below the surface to provide efficient heating year-round. Even in Arctic climates, underground temperatures remain constant, allowing ground-source heat pumps and borehole systems to operate reliably regardless of winter extremes.

This shifts energy from a delivered commodity to fixed infrastructure. Communities reduce dependence on fuel deliveries, stabilize long-term costs, and gain greater control over their energy systems.

Built for Cold-Climate Resilience

Cold regions are particularly well suited to geothermal heating. Underground systems are protected from storms and extreme weather, ensuring continuous operation when surface infrastructure is most vulnerable. Geothermal also complements solar and wind, providing consistent baseload heat during long winters.

Pilot projects and feasibility studies across northern Canada are already demonstrating how geothermal can strengthen energy resilience while reducing costs and emissions.

A Strategic Opportunity for Canada

As Canada prepares to host the World Geothermal Congress 2026 in Calgary, northern geothermal development highlights a broader leadership opportunity. In Arctic and remote regions, geothermal energy is more than a renewable option - it is a foundation for reliable, sovereign, and resilient infrastructure.

Key Takeaways

- Heating dominates energy demand in northern Canada
- Diesel dependence creates cost and supply vulnerabilities
- Geothermal provides reliable, locally controlled heat
- Underground systems are protected from extreme weather
- Geothermal strengthens Arctic energy resilience



From Natural Heat to National Strategy



Few places demonstrate the power of geothermal energy more clearly than Iceland. In a country defined by cold climate and volcanic geology, geothermal heat has evolved from a survival necessity into a fully integrated national energy system. Today, more than 90% of Icelandic homes are heated using geothermal energy, supported by extensive district heating networks that operate reliably through snowstorms, long winters, and extreme weather.

This transformation did not happen overnight. Early investments in geothermal district heating allowed Iceland to replace imported fuels with local energy, stabilizing costs and strengthening energy independence. Over time, geothermal became not just a heating solution, but a cornerstone of national infrastructure, supporting electricity generation, industry, and innovation.

From Proven Model to Regional Inspiration

Iceland's success now serves as a model for other cold-climate regions. The country continues to advance geothermal innovation through projects such as the Krafla Magma Testbed, exploring deeper and higher-temperature systems that could further expand geothermal capacity worldwide.

Meanwhile, neighboring Greenland is beginning to assess its own geothermal potential. Historically dependent on imported fuels, Greenland faces many of the same energy challenges as other Arctic regions: remote communities, high fuel costs, and fragile supply chains. Early studies suggest that geothermal resources could provide stable heating solutions for selected settlements, reducing dependence on imported diesel.

Cold Regions, Long-Term Advantage

In both Iceland and Greenland, geothermal energy addresses a fundamental reality of Arctic life: heating demand is constant, and energy systems must function reliably year after year. Subsurface heat offers exactly that—local, weather-independent energy that strengthens resilience while lowering long-term costs.

As Arctic nations rethink their energy strategies, Iceland stands as proof that geothermal can move from niche technology to backbone infrastructure - and that even in the coldest climates, the most reliable heat comes from below.

Key Takeaways

- Iceland heats over 90% of homes with geothermal energy
- District heating provides reliable, weather-independent heat
- Iceland continues to lead in geothermal innovation
- Greenland is assessing geothermal to reduce fuel imports
- Arctic regions can use geothermal to strengthen energy independence



Designing Cities Around Subsurface Heat



Across Northern Europe, geothermal energy has quietly become part of everyday infrastructure. In countries such as Sweden, Finland, and Norway, subsurface heat supports residential heating, commercial buildings, and entire district heating systems. Rather than relying on imported fuels, cities increasingly draw on stable underground temperatures to ensure reliable and efficient heating through long winters.

Unlike volcanic regions, much of Northern Europe relies on shallow geothermal systems. Boreholes, ground-source heat pumps, and underground thermal storage allow buildings and neighborhoods to capture and reuse heat year-round. These systems are invisible from the surface, yet they play a critical role in reducing fuel consumption and stabilizing energy costs.

Cities Built for Long Winters

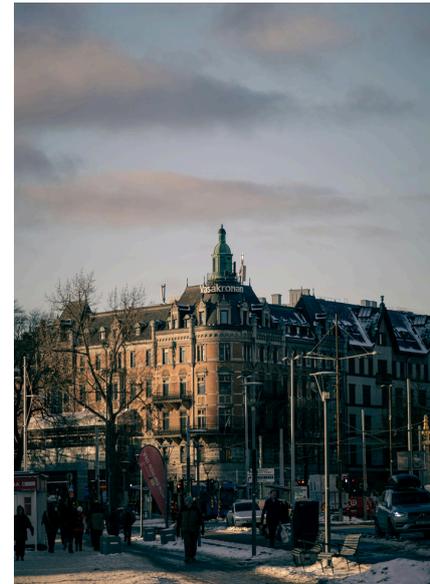
District heating networks are central to this transition. In Helsinki, Stockholm, and Oslo, geothermal energy works alongside other renewable sources to balance seasonal demand. Borehole thermal energy storage allows excess summer heat to be stored underground and used months later, improving efficiency and reducing overall energy use.

Because heating demand in these regions is consistent and predictable, geothermal systems operate at high efficiency. They provide reliable baseload heat while reducing exposure to fuel price volatility and supply disruptions.

Quiet Infrastructure, Lasting Impact

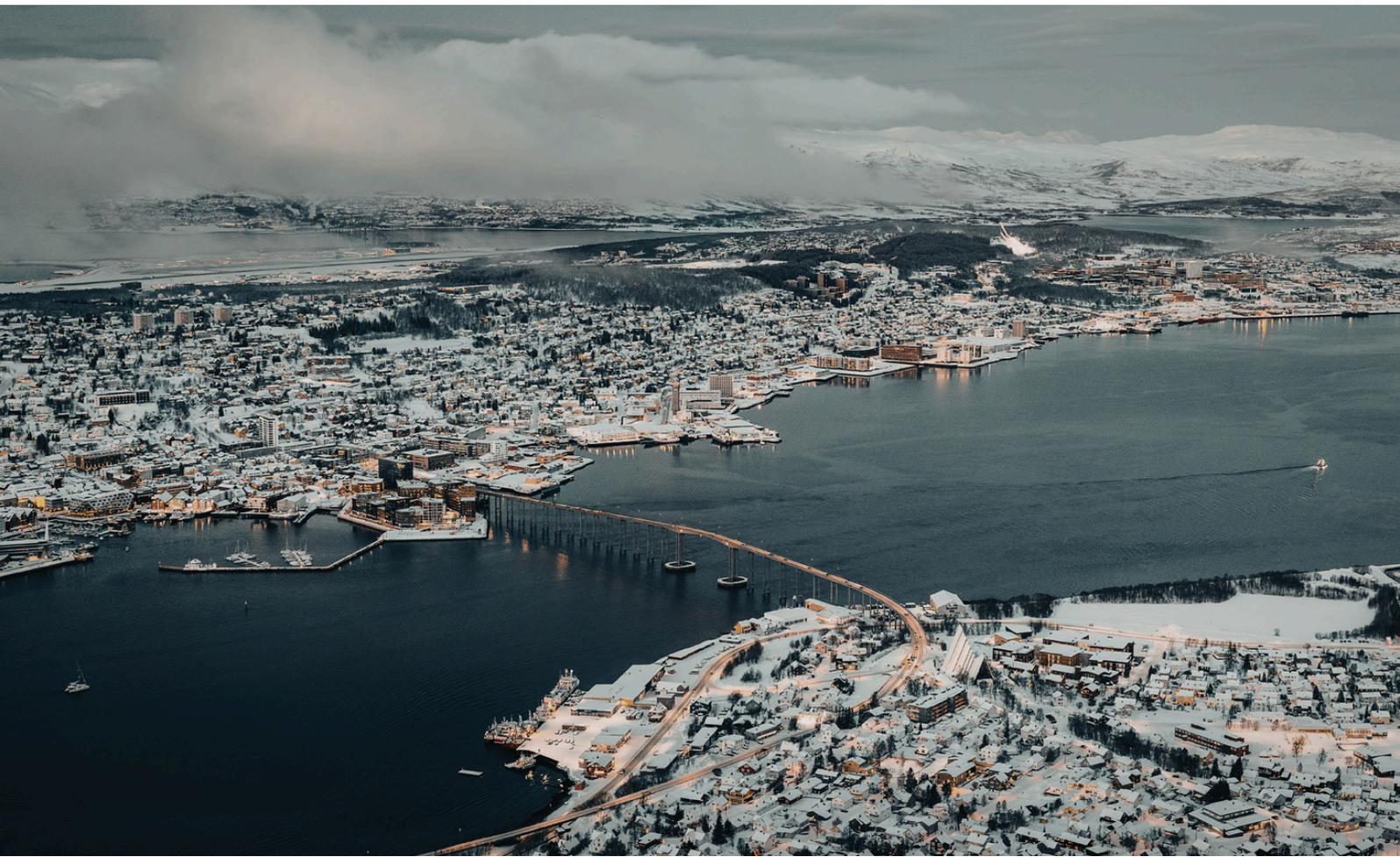
The Nordic experience demonstrates that geothermal energy does not require dramatic geological conditions to deliver meaningful impact. With careful planning and long-term investment, subsurface heat can support urban resilience even in regions without volcanic activity.

As other cold-climate regions explore geothermal solutions, Northern Europe offers a clear blueprint: integrate geothermal early, combine it with district heating, and treat subsurface heat as essential infrastructure rather than experimental technology.



Key Takeaways

- Sweden, Finland, and Norway widely use shallow geothermal systems
- Borehole storage improves efficiency and seasonal heat balance
- District heating integrates geothermal at city scale
- Systems reduce dependence on imported fuels
- Nordic countries demonstrate scalable cold-climate solutions



GLOBAL_GT



WWW.WORLDGEOTHERMAL.ORG/GLOBAL_GT

