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Geothermal Innovation, Intellectual Property, and the Prospects for Canada

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Canada's geothermal sector faces a defining challenge

While the country sits atop vast geothermal resources, foreign firms control 96 percent of geothermal intellectual property (IP) filed in Canada, and no Canadian company ranks among the world's top 100 patent holders. This brief maps the global IP landscape, diagnoses Canada's position within it, and makes the case for a coordinated national strategy that treats patents, data, and know-how as critical infrastructure. **Getting this right is essential: IP is the mechanism that turns innovation into prosperity, and without it, the economic returns from Canada's clean energy transition will continue to flow abroad.**

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Intellectual property is a legal mechanism that turns innovation into prosperity

The core function of innovation is to generate new knowledge in the form of new technologies, services, and goods that improve people's lives. As this new knowledge spills over across the economy, workers can become more productive and living standards can rise.

However, firms will not invest in innovation if they are not able to capture the economic benefits of their efforts.

Intellectual property allows firms to do this by granting them a limited monopoly on the results of their work, allowing them to appropriate their competitive advantage. However, a balance must be struck. If innovations are too rigorously protected, the knowledge that underpins them cannot proliferate across the economy. As a result, certain societies will pay for new technologies, while others will capture the rents on new technologies.

Moving forward, Canada must navigate this balance and become a nation that captures value from intangible assets. Creating an IP framework that rewards both innovation and collaboration can ensure that Canada's leading companies are able to accelerate innovation, establish leadership in global markets, and generate returns that outweigh the risks. Because of Canada's resource base and drilling expertise, efforts to drive geothermal innovation could be the tip of the spear in Canada's renewed approach to IP.

Perhaps most importantly, Canada must learn to use IP to do more than defend existing innovations to the benefit of foreign economies. To truly thrive in the 21st century, Canada must enable its innovators to use IP to shape the future and position themselves in globally leading roles.

IP is the Achilles' Heel of Canada's industrial strategy

As geothermal energy shifts from a niche resource to a foundational component of a clean, cheap, and secure energy mix, IP considerations are becoming impossible to ignore.

Next-generation geothermal relies on advanced drilling methods, subsurface modelling, materials science, data analytics, and control software, all of which are highly patentable and increasingly contested. In a global energy system where more than 92% of corporate value now sits in intangible assets such as patents, trade secrets, data, algorithms, and software, those companies that own the underlying IP will be the ones to deploy geothermal at scale.

For governments, investors, and firms hoping to build a globally competitive Canadian geothermal industry, IP is not a legal afterthought but a key accelerator for next-generation geothermal. This brief maps the global geothermal IP landscape, situates Canada within it, and identifies the implications for innovation, commercialization, and policy. This analysis is intended for technology developers, investors, and policymakers seeking to understand how IP will shape the future of geothermal—and what Canada must do to avoid repeating past failures where domestic innovation translated into foreign-owned value.

Geothermal innovation is accelerating

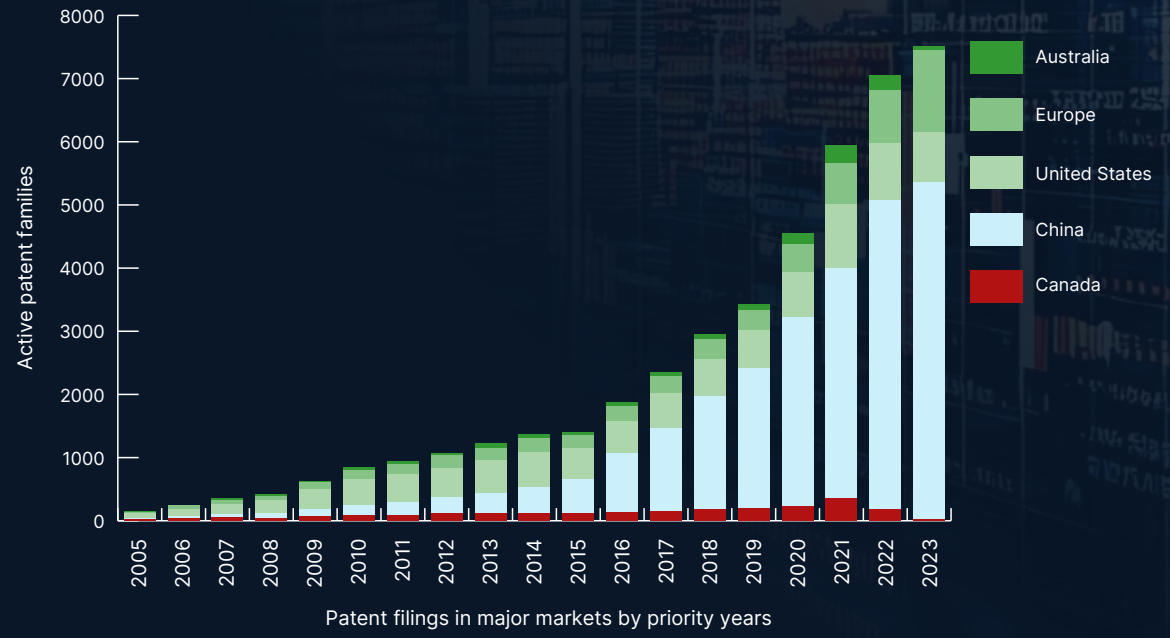
Geothermal technology

Exponential growth in global innovation

Geothermal patent filings between 2005 and 2025:

52,057

active patent families



OWN INNOVATION

Data source: Orbit

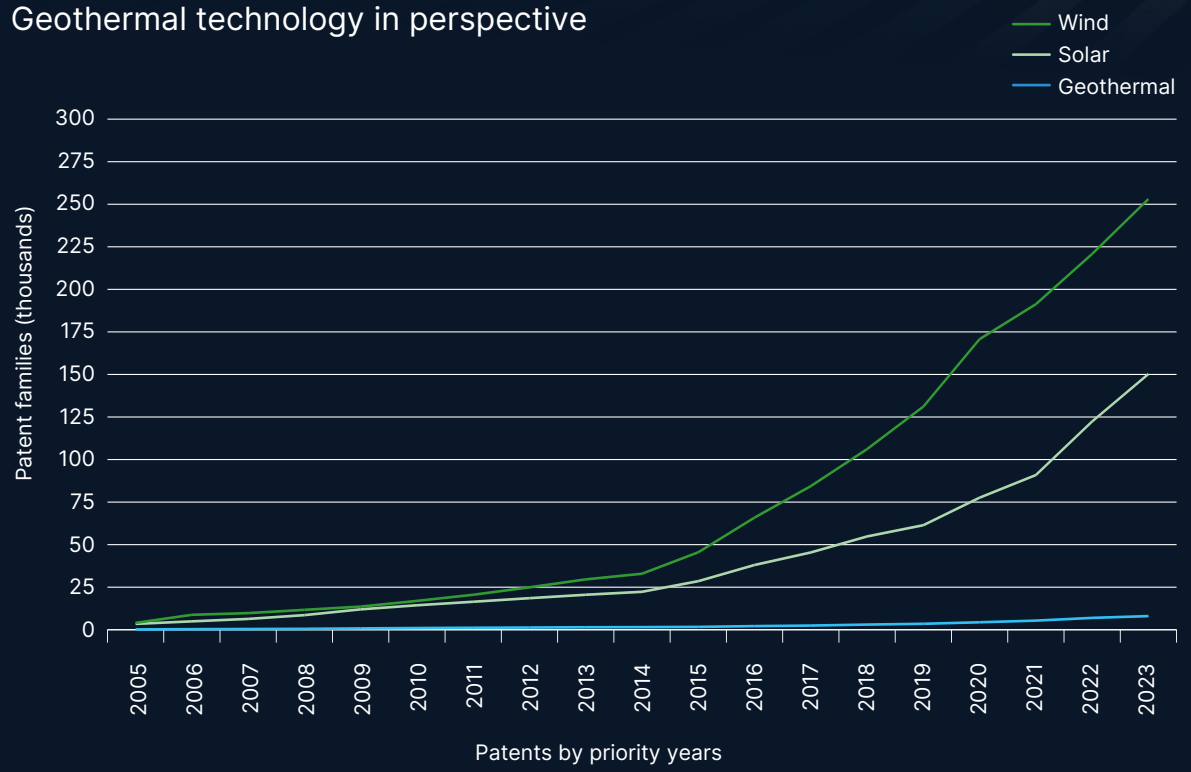
- **Geothermal IP is surging:** Global geothermal patenting has accelerated sharply over the past decade, now reaching 7,000–8,000 new patent families per year—adding up to roughly 50,000 patents over the past 20 years.
- **China is driving the surge:** The rapid growth in geothermal patents is overwhelmingly led by China, reflecting the country's strategic push to secure energy technologies in the absence of domestic oil and gas resources.
- **Ownership shapes markets:** These patents define who controls geothermal technology globally. You can't commercialize what you don't own, and important chunks of the geothermal IP landscape have already been claimed.

But geothermal innovation still has lots of room to grow

- **Innovation is highly concentrated in wind and solar:** Geothermal has relatively lower patent filing volumes, which represents a strategic whitespace opportunity for Canada to establish itself as a leading holder of geothermal technology patents.
- **Geothermal remains an open technology frontier:** Despite recent growth, geothermal patenting lags far behind other clean energy technologies, with thirty times as many patents being filed for solar and nearly fifty times as many for wind.
- **Canada's moment—if it acts:** Canada has the resource base and drilling expertise to lead in geothermal, but its current IP position is weak. Realizing this opportunity requires deliberate action, now.

Major clean energy resources

Geothermal technology in perspective



OWN INNOVATION

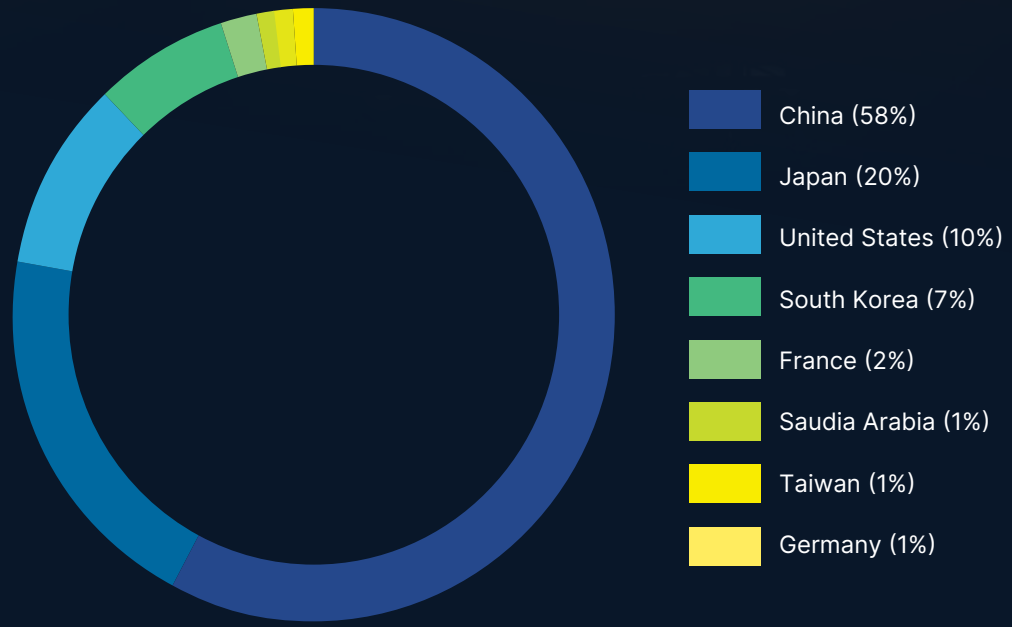
Data source: Orbit

China leads in geothermal IP, Canada lags

- **China is dominating the geothermal patent race:** China is responsible for 58% of global geothermal patent ownership. No Canadian firms rank in the global top 100 patent holders, and Canadian firms own less than 1% of global geothermal patents.
- **Value is flowing out of Canada:** Patent owners file in target markets, allowing them to generate rents across the world and move profits back to their home jurisdiction. In Canada, 96% of geothermal IP is owned by foreign firms, sending most economic returns abroad.
- **Weak IP position limits commercialization:** The absence of Canadian anchor firms limits freedom to operate, making it difficult for domestic companies to scale, compete, or retain value once technologies reach market.

Top 100 patent owners by HQ location

Canadian companies own less than 1% of geothermal patents



OWN INNOVATION

Data source: Orbit

Even in Canada, foreign multinationals dominate geothermal patents

- **Global incumbents own the Canadian market:** Multinationals like Halliburton, Schlumberger, and Baker Hughes are among the top geothermal patent filers in Canada, using strong IP positions to siphon IP rents out of Canada.
- **A steep IP imbalance**: The combined geothermal IP holdings of Eavor, Suncor, and Cenovus remain a fraction of those held by multinational firms active in Canada.
- **An IP strategy is the path forward for Canada:** Competing globally requires a coordinated Canadian IP strategy—one that prioritizes ownership of data and technology, not just physical deployment, and equips firms to retain long-term economic value.

Top patent owners and R&D investment

Rank	Top patent owner	Country	Patent families
*Top ten **global** patent owners*			
1	China's major state-owned energy enterprises	China	1639
2	Halliburton Energy Services	US	800
3	China University of Petroleum	China	367
4	Schlumberger Technology	France	344
5	China University of Mining and Technology	China	291
6	Baker Hughes	US	260
7	Southwest Petroleum University	China	248
8	Toshiba	Japan	246
9	Xian Jiaotong University	China	222
10	Huaneng Clean Energy Research Institute	China	165
*Top three **Canadian** patent owners*			
1	Eavor Technologies	Canada	25
2	Suncor Energy	Canada	11
3	Cenovus Energy	Canada	6

The U.S. is using test centres to FORGE ahead

- Test centres have a proven track record of convening coalitions to accelerate innovation by taking smart risks.
- The US Department of Energy invested $140M in the Frontier Observatory for Research in Geothermal Energy (FORGE), which provides a hub to convene industry, academics, and others to collaborate. FORGE uses an IP framework that protects existing IP, encourages data sharing, and sets out a process of allocating rights to new IP.
- Firms such as Fervo, a US EGS company, are collaborating with FORGE to achieve major breakthroughs in drilling cost and performance.
- In recent filings, Fervo has reported costs of $7,000 per kilowatt, which is cheaper than nuclear, and is targeting costs as low as $3,000 per kilowatt.

Drilling times at DOE FORGE demonstration site

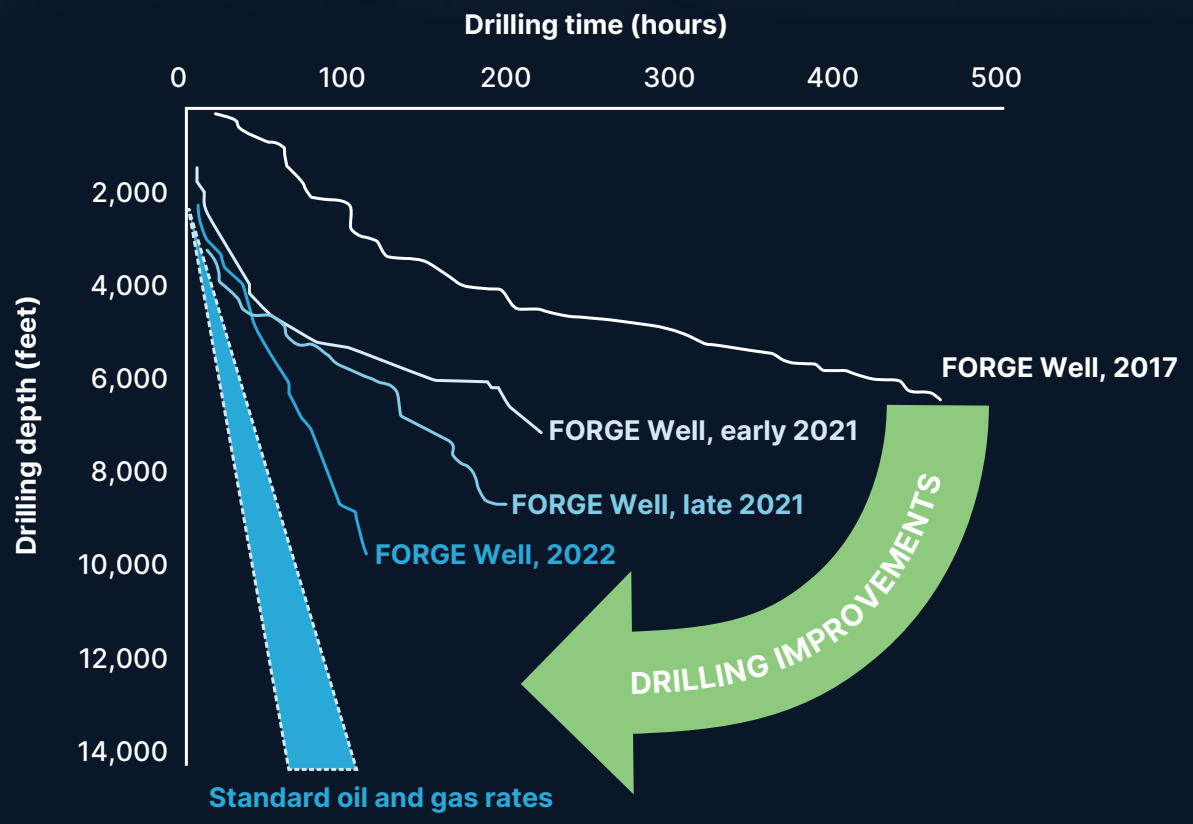


Figure adapted from U.S. Department of Energy, ScottMadden.

Alberta used test centres to drive oil industry innovation

Total bitumen production from mining and in-situ, thousand BBL/day

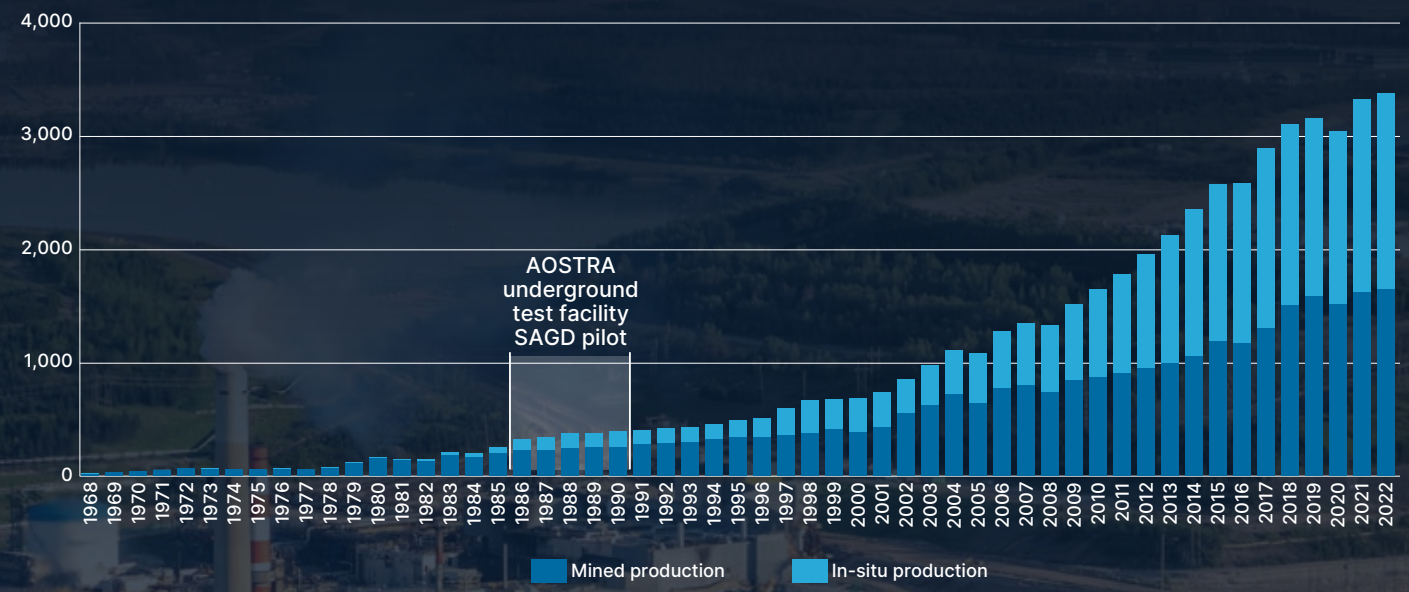


Figure adapted from Oil Sands Magazine.

Data source: CAPP and AERR

- The Alberta Oil Sands Technology and Research Authority (AOSTRA) transformed Alberta's oil industry by convening industry, the public sector, and academia to unlock the potential of the oil sands.
- AOSTRA used an innovative IP framework to ensure collaboration between sectors. It allowed participants to access IP, ensuring that rewards justified the risk.
- By funding and de-risking high-risk projects like the Underground Test Facility and adopting a shared funding model with industry partners, AOSTRA advanced disruptive technologies, most notably, steam-assisted gravity drainage (SAGD).
- SAGD not only unlocked previously inaccessible oil reserves but also generated substantial economic returns and established Alberta as a global leader in oil sands technology.
- AOSTRA kickstarted a technological revolution in Alberta that remains a continuing source of prosperity.

Canada needs a geothermal IP strategy to bring home the benefits of innovation

- **Make IP a strategic priority, not an afterthought:** Canada needs a coordinated national geothermal IP strategy. This strategy should treat patents, data, software, and know-how as critical infrastructure—on par with wells, rigs, and power plants. It must view IP as a strategic tool to create and shape new markets—not simply to defend positions in existing ones.
- **Support firms to compete globally:** Canadian geothermal companies require targeted support for IP development and protection—patents, trade secrets, software, and data assets—so they can operate and scale alongside well-capitalized multinational incumbents.
- **Learn from AI blunders:** Despite investing nearly a billion dollars in Artificial Intelligence, only ~7% of resulting IP has been retained by Canadian industry. Repeating this model in geothermal would again export value while domestic actors bear the cost.
- **Retain value from public investment:** Other major economies including the U.S. are tightening control over publicly funded IP. Canada must ensure geothermal innovations funded with public dollars translate into Canadian-owned assets.
- **Tie geothermal strategy to productivity:** With the OECD projecting Canada will remain the lowest-performing advanced economy on productivity for decades to come, owning innovation—not just developing it—is one of the few viable paths to long-term economic renewal.
- **Leverage Canadian expertise:** Many of Canada's most valuable patents are in relevant technologies for related industries like oil and gas.

A geothermal test centre could power Canadian prosperity with IP ownership

- Investing $550M in a Canadian Geothermal Science and Technology Research Authority (GEOSTRA) could accelerate the innovation needed to access greater depths at lower costs.
- Cascade's GEOSTRA proposal includes four connected experimental test sites across Canada; collaboration with federal, provincial, and academic labs; and public/private benefit sharing.
- GEOSTRA would leverage an innovative IP framework to facilitate collaborative innovation, create and maintain made-in-Canada IP. The framework would treat IP as an asset, not an afterthought. Key elements would seek to:
  - **Develop Canadian-made IP** in strategic areas that help Canada shape the future.
  - **Balance incentives** to ensure existing IP is protected as firms work together.
  - **Emphasize data sharing** to facilitate future innovation.
  - **Provide capacity** to firms as they seek to transform cutting-edge IP into commercial advantage.
  - **Deliver returns** on public investment by retaining IP in Canada.