energyfutureslab

Alberta's Future Competitiveness and the Next Wave of Growth: Building the industries of tomorrow

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Executive Summary

Alberta is poised to enter a new wave of economic opportunity, one defined not just by its resources, but the industries it chooses to build. A portfolio of resource-based, low-emission sectors is taking shape, revealing new growth pathways that leverage the province's strengths and align with global demand. These emerging sectors — and their value chains — are set to turn Alberta's advantages into the foundation of a competitive, low-carbon economy.

Many of these sectors build upon the province's powerhouse industries: oil and gas, petrochemicals, and agriculture. This next wave of potential leverages this deep industrial expertise, infrastructure, and innovation capacity to establish low-carbon industries that build on, rather than replace, the strengths that made Alberta globally competitive. But to capture this moment means moving fast and smart — aligning Alberta's distinct regional advantages before global markets move on.

This analysis identifies 16 sectoral opportunities and introduces a set of seven analytical lenses to bring the picture into focus. From market reach, economic potential, and comparative advantage, to system interdependence, sectoral siting constraints, and resilience to shifts in U.S. policy, layering these lenses provides a system-level view of where Alberta and its regions are positioned to compete, and where new foundations are forming to build pragmatic competitiveness in the decade ahead.

Within this broader portfolio, **five sectors stand out as particularly well-positioned, hitting all the markers of a strong growth pathway:**

- **Clean energy enablers (electricity)**
- **Carbon capture and storage**
- **Green chemistry**
- **Alternative proteins, and**
- **Minerals and metals production and processing.**

Examined in detail, these sectors illustrate how the province can strategically anchor itself in global value chains as they emerge and realign.

Competitiveness, however, will hinge as much on ecosystems as on economics. Regional fit, place-based engagements, and developing strong partnerships will be critical to unlocking and realizing where opportunities can take root. This study offers practical ways to assess what is needed to create investable new growth industries.

To maintain Alberta's industrial competitiveness **this report identifies six policy priorities** critical in clearing the path for emerging industries and widening the field for Alberta to lead:

- **Modernize** Alberta's transmission and distribution system to enable industrial growth
- **Reinforce** TIER as a competitiveness tool
- **Accelerate** strategic infrastructure investments to secure industrial competitiveness
- **Treat** water as strategic infrastructure for industrial competitiveness
- **Compete** on supply chains, not just individual projects
- **Expand** regional hubs for Alberta's industrial future

Alberta's ability to capitalize on these opportunities will depend on synchronizing policy, capital, innovation, and turning strong fundamentals into strategic advantage.

Introduction

Bringing Alberta's Future Competitiveness into Focus

Across Alberta, a shift is quietly taking shape. New industries are emerging, technologies are advancing, and a picture is forming of how Alberta's resource leadership can drive new economic growth and contribute to Canada becoming an "energy superpower". While this picture comes into focus, competing narratives, fragmented priorities, and uncertainty about where to invest can make it hard to see the full landscape.

This report examines where the province already holds strengths and where greater clarity and coordination are needed. It zooms out in order to capture the wider system view, then zooms in on specific resource-based opportunities, analyzing the conditions required to activate them. It focuses on sectors with potential to open up new markets, while also redefining what it means to be a resource-rich province, building upon the industrial foundation that has long kept it globally competitive.

Many of the opportunities in this report spring from the province's existing economic powerhouses: oil and gas, petrochemicals, and agriculture. These sectors have created the workforce, infrastructure, and innovation culture that now position the province to lead. New technologies developed here not only open export opportunities but can also strengthen carbon competitiveness in traditional industries.

Why a competitiveness study matters right now

Alberta has traditionally been an export economy and is very likely to stay that way. But the terms of trade are shifting, and turbulent conditions are the new reality. Global policy changes, trade realignments, and investor expectations are redrawing the map. Rising U.S. protectionism, China's dominance in technology and supply chains, and growing concerns around food and energy security are reshaping how and where nations do business.

The global competition to secure positions in low-carbon value chains is well underway, and capital is flowing to jurisdictions that demonstrate readiness to compete. Even as major trading partners like the U.S. pull back on climate competitiveness, others are forging forward. Allies like the EU, UK, and Germany see Alberta as a "growing supplier of both traditional energy and clean technologies", as recently noted by their ambassadors. While turbulent U.S. energy and trade policy has created unprecedented market uncertainty, this has been a wake-up call, underscoring the strategic need to diversify Canadian trade while maintaining carbon competitiveness as a defining factor.

Alberta's advantage lies in leveraging its established industrial base to build out adjacent low-carbon sectors. Its traditional energy strengths can either anchor it to the past or propel it into a new era of competitiveness. Strengthening Alberta's position means building on trusted trade relationships while opening new doors. Expanding access to allied markets in Asia and Europe, and cementing Alberta's role in North American and global supply can contribute to energy security as well as economic competitiveness. And choices made today about policy, investment, and collaboration will determine whether Alberta is a contender as these value chains solidify.

Emerging value chains present concrete opportunities for the provincial economy — from critical minerals/metals and clean electricity to agri-food innovation and carbon management. But capturing these opportunities requires moving beyond resource extraction to secure higher-value roles in processing, manufacturing, and technology integration. Alberta's ability to compete on low-carbon performance will shape not only its domestic growth but also its global relevance.

Sharpening the View

This report brings together insights from across Alberta's energy system to sharpen the focus on what's next. By examining where the province's strengths align with global demand and signals of change, we can see how traditional and emerging sectors can work together to build shared prosperity. A competitiveness study helps bring that picture into focus and get clear on what to pursue, and where.

With 16 sectoral opportunities on the table, success will depend on strategy. The province's competitiveness will hinge on how clearly it defines priorities, and how decisively innovators, businesses, and communities move to capitalize on them and invest in this new wave of growth as it appears on the horizon.

With a current wave of attention on 'nation-building' projects, there's a tendency to focus on a narrow field of front-runners, but this isn't a winner-takes-all race. And with so many opportunities demonstrating strong potential, choices must be made that enable, harness and accelerate areas of comparative advantage and position the province as credible and investable. Ensuring and preserving competitiveness means getting the fundamentals right: efficient permitting, reliable low-emission power, effective carbon management, and modern trade and infrastructure corridors.

And with other jurisdictions moving quickly to define their roles in the new economy, the window of opportunity is narrow. The signals are strong and the economy isn't waiting.

Methodology

Snapshot

In our deep dive into Alberta's Future Competitiveness, the Energy Futures Lab conducted the following research and activities:

- **Mapped** 100+ reports, initiatives, and policy frameworks to establish a foundational understanding of Alberta's current competitiveness landscape.
- **Conducted** a screening to identify an initial set of 40 preliminary opportunities across the energy, industry, agriculture, and technology sectors.
- **Shortlisted** opportunities based on market pull, government programs and supports, private sector momentum, and innovation readiness.
- **Consolidated** findings into 16 viable sectors for industry development, ranging from broad-scale opportunities to emerging niche plays.
- **Completed** detailed desk research and interviews with 25 experts from across Alberta and Canada to assess the potential and policy alignment of each sector.
- **Conducted** a foresight scenario roundtable with experts and advisors that helped to surface and refine five top opportunities.

Analysis

In 2022, the Transition Accelerator and the Smart Prosperity Institute delivered a first look at Canada's low-carbon competitiveness. This new analysis of Alberta's future competitiveness builds on that foundation through a focused, provincial lens. It provides a transparent and structured assessment of competitiveness in low-carbon opportunities across economic and system dimensions: resource-base, market demand, infrastructure, policy and regulation, ecosystem capacity, and investment attractiveness. Additional filters such as export versus domestic orientation, exposure to U.S. policy shifts, and interconnections across the energy and industrial system were also incorporated to refine the analysis and further outlined in a section on lenses for gauging competitiveness.

This approach allows for a comparative assessment of opportunities and provides a nuanced view of Alberta's strengths, gaps, and conditions for success.

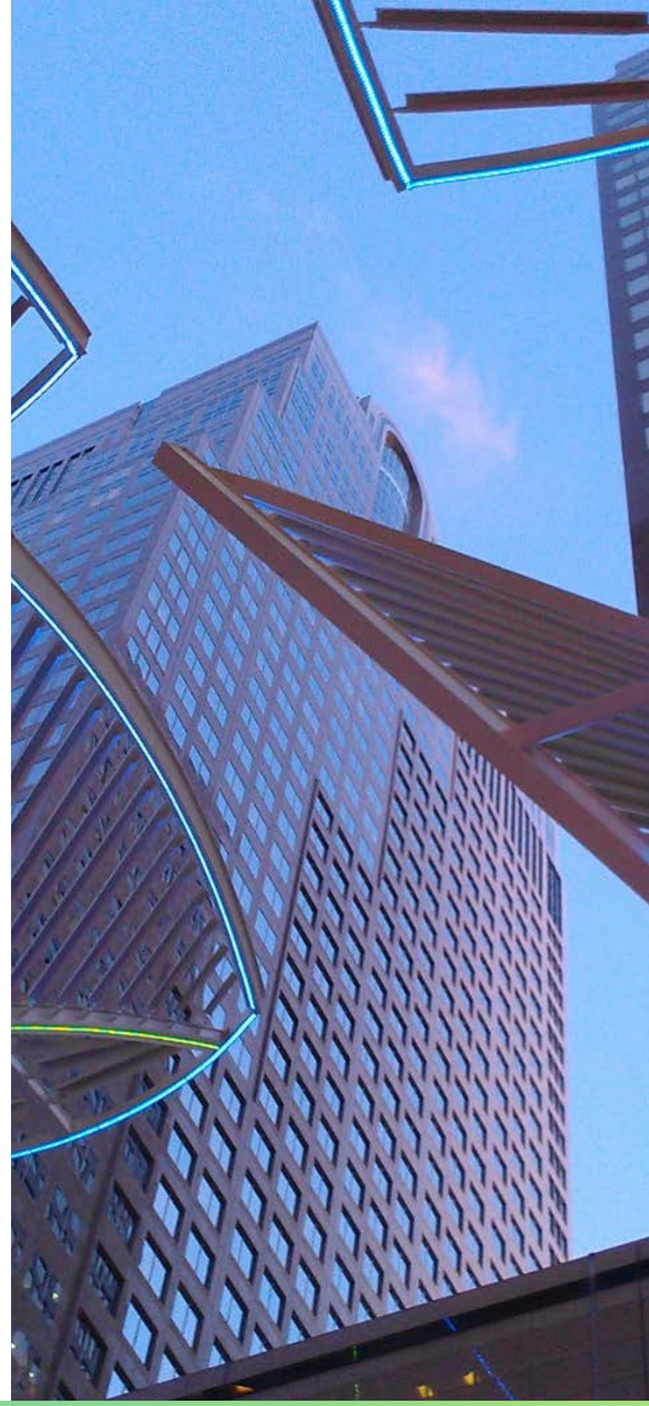
Desk Research

The analysis draws on a comprehensive review of Alberta's economic base, including sector-level data on GDP, exports, and historical performance. A systematic scan of federal and provincial policies and programs identified how existing initiatives align with Alberta's emerging opportunities. Existing studies, combined with insights from regional innovation and industry organizations, provided essential benchmarks and highlighted where Alberta-specific insights were still lacking.

Expert Engagement and Advisory Committee

To complement desk research, the project team engaged 25 experts from Alberta and across Canada with deep knowledge across industry, policy, academia, and innovation. An Advisory Committee was convened to provide an economy-wide perspective and system awareness throughout the project. The committee served as a sounding board for both methodology and findings, ensuring the assessment remained relevant and grounded within Alberta's provincial context. These expert insights informed refinements to the seven lenses and grounded the analysis in practical realities. Engagement with Regional Innovation Networks (RINs) further added perspectives on local strengths, entrepreneurial activity, and regional priorities — surfacing barriers and enablers often absent from published data.

Furthermore, the initiative brought together experts for a strategic foresight roundtable that explored which opportunities position Alberta to thrive amid future uncertainty and helped to surface the strongest opportunities.



Where foresight meets competitiveness

As part of this study, a strategic foresight roundtable was convened to examine the 16 viable low-carbon sectors identified and test them against a range of possible future scenarios.

The aim: weigh in and assess how these might perform under different geopolitical and market conditions, including potential shifts in federal–provincial dynamics, and evolving U.S. policy.

The role of foresight scenarios in assessing economic growth pathways

Exploring emerging low-carbon opportunities cannot be separated from today's geopolitical uncertainty. Understanding the dynamics of shifting trade alignments, protectionist pressures, and competing industrial strategies is essential to connecting Alberta's local strengths with evolving global markets, and identifying the opportunities best positioned for Alberta to thrive amid change.

Canadian industries remain deeply integrated with the U.S. economy, but events south of the border have impacts on the country's trade and investment landscape. And within Canada, uneven dynamics are affecting federal–provincial alignment with collaboration in some areas, but persistent tensions in others.

In this context, Alberta's best path forward is to cultivate a set of economic growth pathways — sectors and value chains that buffer the province against external shocks, reduce exposure to uncertainty, and open doors to new markets.

In terms of competitiveness given today's landscape, a strong growth pathway typically:

- Intersects multiple value chains, creating cross-sector resilience.
- Anchors Alberta in regional security-of-supply conversations, making the province indispensable to continental strategies.
- Broadens markets beyond the U.S., positioning Alberta to serve fast-growing regions like Asia and Europe.
- Proceeds or scales with modest policy support, advancing within a reasonable timeframe without relying on perfect conditions.
- Generates benefits for rural and Indigenous communities, reinforcing social cohesion alongside economic growth.

Ultimately, the strongest pathways are those that hold these qualities and continue to deliver value across multiple possible futures — ensuring Alberta remains competitive no matter how global dynamics shift.

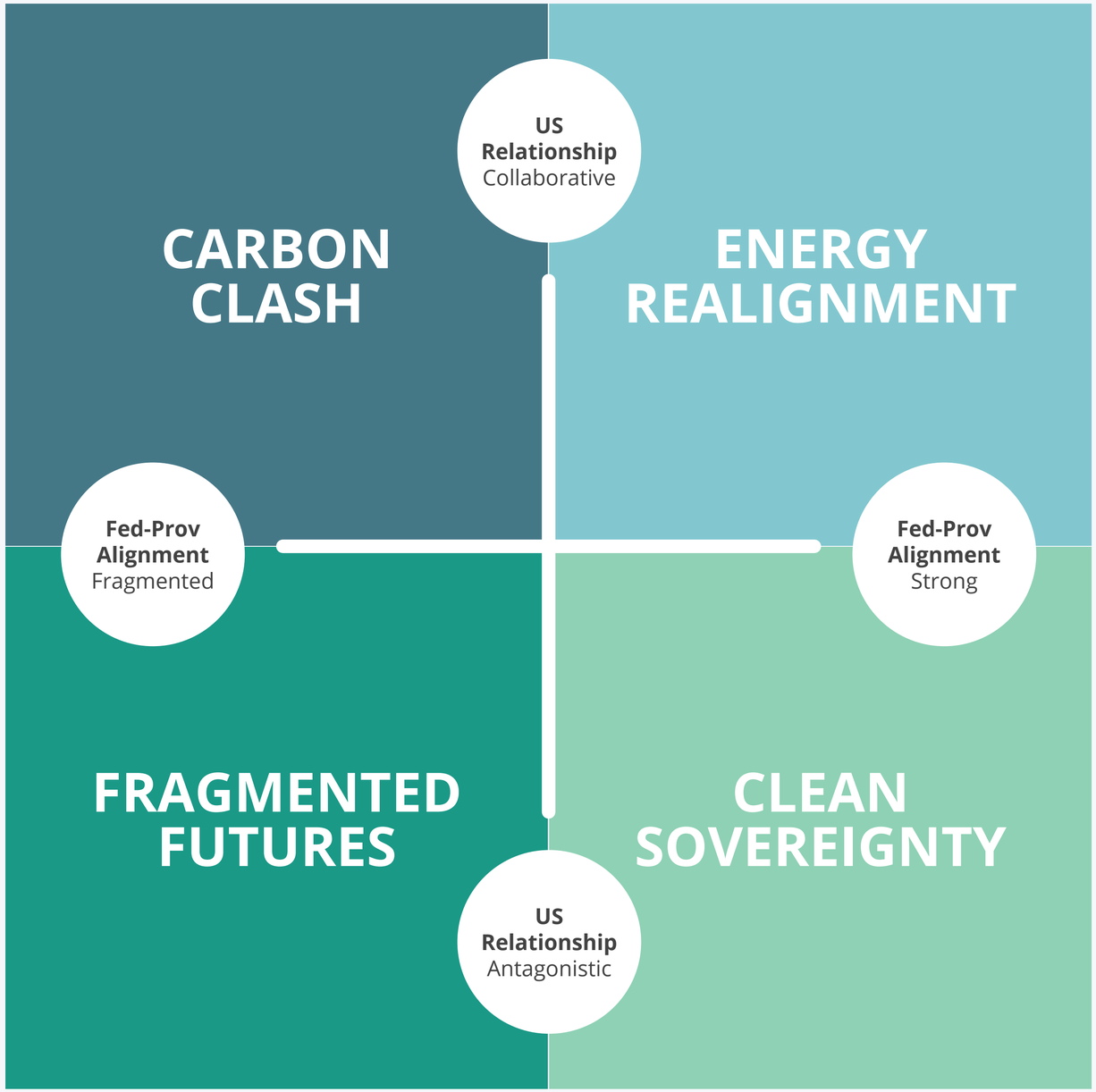
Focusing on future-fit opportunities

This study introduced four possible scenarios to highlight and examine divergent contexts Alberta may need to navigate in the coming decade. Rather than predictions, these scenarios provide a way to assess which opportunities hold up best across different strategic environments to test Alberta's competitiveness across a full spectrum of possible futures.

- **Energy Realignment:** If federal–provincial cooperation strengthens while U.S. trade stability erodes, Ottawa works with provinces to accelerate development of new export corridors to Asia and Europe.
- **Clean Sovereignty:** If U.S. market openness declines and Ottawa holds a hard line on clean energy and climate priorities to position Canada as a global clean tech leader.
- **Fragmented Futures:** If today's tensions between Ottawa and Alberta intensify, leaving little national coordination, Alberta leans more heavily on U.S. markets to sustain trade access but with greater volatility
- **Carbon Clash:** If both U.S. protectionism escalates and federal–provincial relations fracture further, Alberta becomes isolated in global trade, struggling to attract capital or scale new energy industries.

While the scenarios diverge on geopolitics and federal–provincial dynamics, they rest on a consistent global assumption: investment in cleantech is now a structural mega-trend. Since 2016, global spending on clean energy and related technologies has outpaced fossil fuels dollar-for-dollar. Today, the world invests nearly twice as much in clean energy and cleantech as in fossil fuels, and in 2023 total investment passed US$2 trillion despite higher financing costs and geopolitical headwinds. Even with potential U.S. policy reversals, the global shift toward clean technologies has reached a point of structural durability.

Together, these scenarios served to stress-test identified low-carbon opportunities for Alberta, clarifying which sectors are most likely to hold their competitive edge amid economic and geopolitical turbulence. The results of the scenarios exercise and expert feedback, combined with the lens analysis, converged on five strong competitiveness contenders that work to connect provincial strengths to global markets.



A resource-based, low-carbon portfolio

The study examined the following 16 sectors as new growth pathways for Alberta. Importantly, each opportunity has credible potential to contribute to long-term economic competitiveness, though some are further along the development curve than others — some are more niche, while others have broader potential. Further analytical detail is outlined later in this report, and in Appendix A.

Agricultural technology (AgTech) IP export: Development and export/sale of processes, products and technologies that can improve agricultural practices or yields. This category focuses on exportable technology; it does not include the export of agricultural products themselves.

Alternative protein production: Development and deployment of processes and facilities that produce alternative protein products. Most of these are plant-based, but the category also includes insect-based and lab-grown proteins.

Ammonia-as-a-fuel: Production of blue or green ammonia as a way to export hydrogen to overseas markets.

Carbon capture and storage (CCS): Development or deployment of projects to capture and sequester industrial sources of carbon dioxide. Does not include carbon utilization, which is a separate category. Direct Air Capture is also a separate category.

CCS technology and services export: Development and delivery of processes, products and technologies that can assist with CCS projects in other jurisdictions.

Carbon utilization: Net-zero aligned uses for carbon, whether produced from captured emissions or bitumen—for example, as carbon fibre, in cement, as nanomaterials or as solid carbon products.

Direct air capture (DAC): Development or deployment of projects to capture carbon dioxide from ambient air.

Geothermal energy production: Deployment of deep geothermal energy projects at a commercial scale.

Geothermal technology and services export: Development and delivery of processes, products and technologies that can assist with geothermal energy projects in other jurisdictions.

Green chemistry: Production of “greener” chemicals through use of low-emissions processes and/or sustainable feedstocks.

Hydrogen production and use: Development or deployment of green or blue hydrogen technologies or projects for use within Alberta (see the separate category of Ammonia-as-a-fuel for export opportunities).

Minerals and metals production: Production of minerals and metals via mining, direct extraction, refining/processing or waste recovery.

Solar and wind energy: Deployment of commercial-scale solar and wind projects.

Nuclear energy: Development or deployment of nuclear systems intended for production of electricity and heat.

Sustainable aviation fuel (SAF): Research, development, and production of sustainable aviation fuels using sustainable feedstocks.

Waste-to-energy (WTE): Deployment of waste-to-energy projects that produce net-zero electricity or heat.

Based on the role that each opportunity plays in the economy, the sectors can be grouped into three distinct categories, each highlighting a different pathway to value creation within Alberta’s low-carbon economy: building foundational infrastructure, capturing export revenues, and scaling Alberta’s knowledge and technology advantages.

- **Clean energy enablers:** sectors that can play an important role in reducing emissions across the province and may generate within-province economic activity. Additionally, they underpin other competitiveness opportunities and growth pathways due to the need for reliable, affordable electricity.

- **Business opportunities abroad:** sectors represent an opportunity to export technology, services or expertise to other jurisdictions.

- **Product export opportunities:** sectors with potential to export products abroad to serve global market needs.

From this range of opportunities, this report highlights a selection that are shaping up to be particularly strong growth pathways — combining clear global demand signals with local comparative advantages. These are explored in greater depth through a series of deeper dives.

Lenses to gauge the portfolio

Viewing through the lenses

To make sense of where Alberta can compete in a low-carbon economy, we need to look at how these sectoral pathways for growth can align with the province's broader economic, geographic, and policy realities. When viewed together, the seven lenses introduced here provide that structure.

The sectors examined in this report differ across key factors such as whether it serves a domestic or export market, share of market potential, geographic and regional conditions, vulnerability to changes in U.S. policy, sectoral investment, system needs, and factors affecting Alberta's comparative advantage — especially compared to other jurisdictions. The seven lenses help highlight and differentiate the value proposition for each.

Each lens reveals a different dimension of competitiveness — assessing an opportunity's strengths, risks, and conditions for success from multiple angles. Layering lenses produces a more complete picture and can act as a tool for comparative assessment — offering relevant insights that might otherwise be overlooked.

Applying the lenses

Applying a series of explicit lenses to examine competitiveness provides a transparent, adaptable framework that helps users test assumptions and draw their own conclusions. The goal is not only to reveal what looks promising on paper, but provide an analytical foundation to examine what may be strategic in practice — given today's realities, market conditions, and Alberta's current delivery capacity. It functions less as a leaderboard and more as a dashboard to guide strategic choices.

The framework provokes thinking beyond traditional sectors, and can also serve as a structured way for stakeholders and Rights holders to explore opportunities together — triangulating shared priorities and interests. It also lets users "shuffle the deck" and determine where both alignment and trade offs exist, and to ultimately determine where opportunities are most viable in practice.

The accompanying heatmap brings these insights together, showing at a glance how the sectors compare across multiple dimensions.

The below heatmap brings these insights together, showing at a glance how sectors compare across multiple dimensions.

Sector			Domestic vs. export opportunity	Market potential			Competitive advantage	Independence	Location flexibility	Investment environment	Resilience to US policy
				Domestic	North American	Global					
CLEAN ENERGY ENABLERS	Electricity	Geothermal energy production	Domestic	Medium	—	—	Medium	High	Low	Moderate	High
		Waste-to-energy	Domestic	Low	—	—	High	Medium	Medium	Moderate	High
		Solar and wind energy	Mostly domestic	Medium	—	—	High	High	High	Well-established	High
		Nuclear energy	Domestic	Low	—	—	Low	Medium	Low	Early stage	High
	Decarb Tech	Carbon capture and storage	Domestic	Low	—	—	High	Low	Low	Well-established	High
		Direct air capture	Domestic	Low	—	—	Low	High	High	Early stage	High
		Hydrogen production	Mostly domestic	Low	—	—	High	Low	Low	Moderate	Medium
BUSINESS OPPORTUNITIES		AgTech IP export	Export	—	High	High	Low	High	High	Well-established	Medium
		CCS tech/services export	Export	—	Medium	Medium	Medium	High	High	Not applicable	High
		Geothermal tech/ services export	Export	—	Medium	Medium	Low	High	High	Not applicable	High
PRODUCT EXPORT OPPORTUNITY		Green chemistry	Mostly export	—	High	High	High	Medium	Low	Well-established	Low
		Ammonia-as-a-fuel (demand for hydrogen)	Export	—	Medium	Medium	High	Low	Low	Early stage	High
		Sustainable aviation fuel	In between	Low	Medium	Medium	High	Medium	Medium	Early stage	Medium
		Alternative proteins	Mostly export	—	Medium	High	High	High	Medium	Well-established	Medium
		Minerals and metals production and processing (key energy transition minerals, except copper)	In between	Low	Medium	High	Medium	Low	Medium	Moderate	Medium
		Carbon utilization	In between	Low / Medium	Medium / High	Medium / High	Medium	Low	Medium	Early stage	Medium

Lenses for competitiveness

Lens: domestic vs. export

Purpose

This lens assesses whether low-carbon sectoral opportunities primarily generate value within Alberta's domestic economy or through exports to interprovincial, North American and global markets. The purpose is to illuminate how each sector contributes to the broader economy.

Export potential is not inherently more desirable than serving a domestic market—but the differences make specific opportunities more or less appealing to different actors.

Core approach

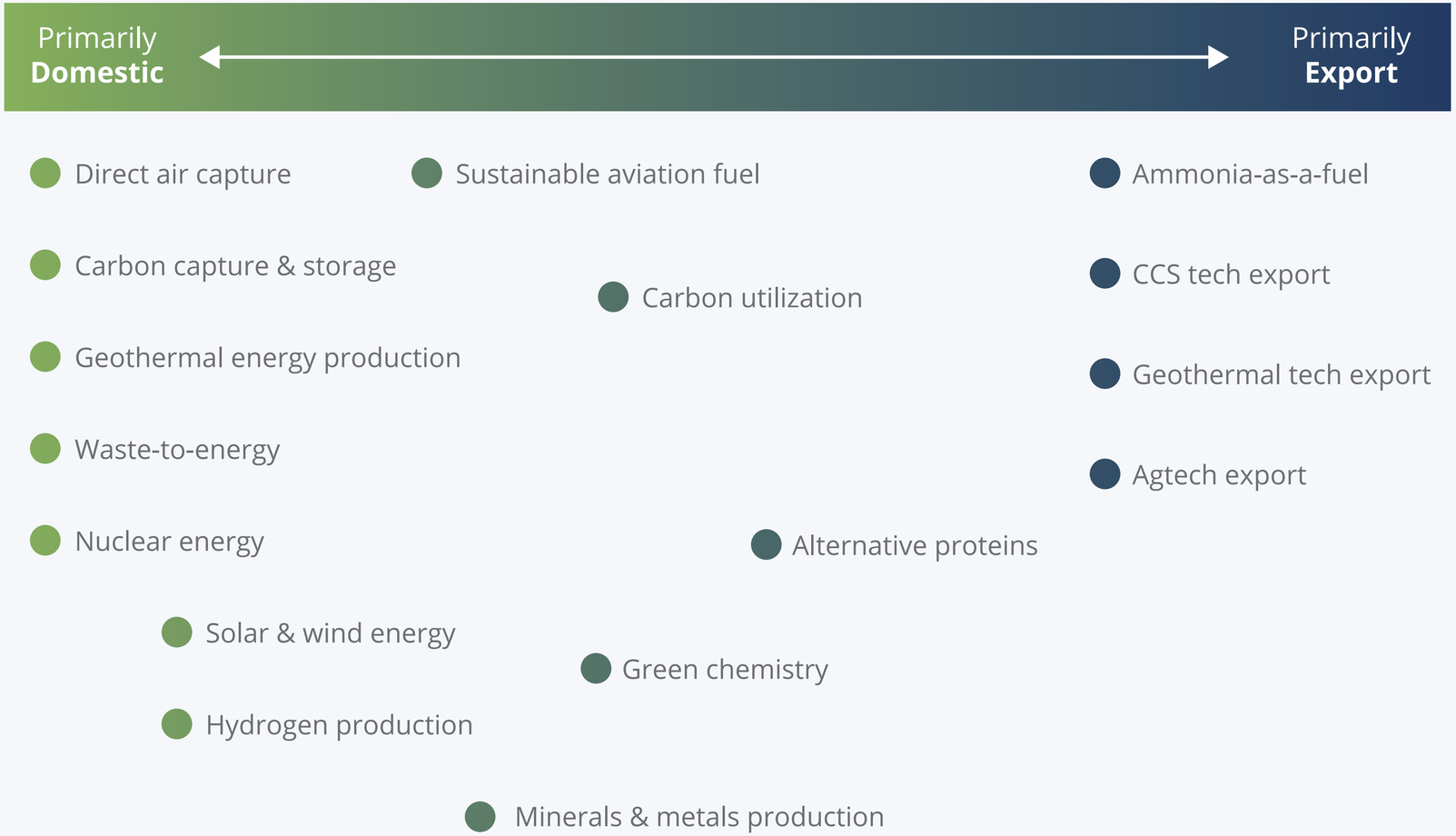
- Builds on Market Potential analysis to determine geographic demand for products and services.
- Uses qualitative categorization informed by sector studies, export data, and expert interviews/workshops.
- Maps sectors based on dominant value-creation pathways to support comparative and strategic analysis.

Rating criteria

With a simple delineation of which market is primarily served by the sector there is some degree of nuance where these overlap. The figure below shows the extent to which each sector is likely to serve the domestic (i.e., Alberta) market or whether the sector is likely to be able to export products or services outside the province.

Interpretation

This lens does not measure performance or profitability; instead, it contextualizes market exposure and strategic dependencies. It highlights which sectors anchor Alberta's domestic resilience and which depend on maintaining competitive access to foreign markets — a distinction that informs diversification and risk strategies across Alberta's opportunity portfolio.



Lens: market potential

Purpose

This lens assesses the forecasted market size for each opportunity by 2035 to provide a comparative anchor, spotlighting where global and regional demand is expanding and delineates based on the market that each sector is likely to be able to sell to whether within Alberta, across North America, or globally. Where literature and projections did not extend to 2035, the closest timeframe is referenced (specific details are outlined in the chart below).

Core approach

- Uses public forecasts, sectoral roadmaps, and investment analyses to estimate annual market value (USD) and growth trajectories through 2035.
- Applies a global scope with a North American emphasis, reflecting Alberta's integration with US supply chains and trade relationships.
- Employs a relative three-tier scaling system to enable cross-sector comparability of market size and potential.

Rating criteria

- **High:** > $25 billion annual market size by 2035
- **Medium:** $1–25 billion annual market size by 2035
- **Low:** < $1 billion annual market size by 2035

It is important to note that the rating reflects only the size of the market and not the extent to which Alberta companies are likely to be successful in capturing market share.

Interpretation

While this offers insight into where markets are heading, political and economic shifts could significantly influence these projections. The market potential for each sector could be impacted by shifts such as government climate policies, U.S. sustainability actions, and evolving trade relationships with key partners like China and the EU.

While large markets signal potential for growth, smaller opportunities can still generate significant regional benefits. Market Potential should be interpreted alongside other lenses, such as Comparative Advantage and Ecosystem Readiness, to assess feasibility and positioning.

The chart below illustrates market potential by category

	Sector / Sub-Sector	North American	Domestic/ Provincial	Global	Competitive advantage
CLEAN ENERGY ENABLERS	Geothermal energy production		Medium		Alberta market; CAD $5 billion (2026)
	Waste-to-energy		Low		Alberta market; estimates not available. Likely "low."
	Renewable Energy		Medium		Alberta market; less than CAD $1 billion in direct, indirect and induced GDP (solar and wind) (2030)
	Nuclear energy		Low		Alberta market; CAD $43 million in direct, indirect and induced GDP (2030)
	Carbon capture and storage		Low		Alberta market; CAD $379 million in direct, indirect and induced GDP (2030)
	Direct air capture		Low		Alberta market; estimates not available. Likely "low."
	Hydrogen production		Low		Alberta market; CAD $403 million in GDP across the entire hydrogen sector (2030)
BUSINESS OPPORTUNITIES	AgTech IP export	High		High	In 2020, NA accounted for 57% of the global market share NA market; US $25 billion (2030). Global market; US $44 billion (2030)
	CCS tech/services export	Medium		Medium	In 2023, NA accounted for 35% of the global market share NA market; US $6 billion (2032). Global market; US $18 billion (2032)
	Geothermal tech/ services export	Medium		Medium	In 2024, NA accounted for 40% of the global market share NA market; US $6 billion (2033). Global market; US $14 billion (2033)
PRODUCT EXPORT OPPORTUNITY	Green chemistry	High		High	In 2024, NA accounted for 34% of the global market share NA market; US $78 billion (2030). Global market; US $230 billion (2030)
	Ammonia-as-a-fuel	Medium		Medium	In 2023, 43% of global hydrogen used for ammonia production. Assuming 80% of ammonia used for fertilizers production and 20% as hydrogen carrier. NA market; US $3 billion (2032). Global Market (Asia-Pacific + NA); US $16 billion (2032)
	Sustainable aviation fuel	Medium		Medium	In 2024, NA accounted for 46% of the global market share. NA market; US $9 billion (2030). Global Market; US $20 billion (2030)
	Alternative proteins	Medium		High	In 2024, NA accounted for 38% of the global market share. NA market; US $14 billion (2034). Global market; US $36 billion 2034)
	Minerals and metals production and processing	Medium		High	In 2023, NA accounted for 9% of the global market share. NA market; US $13 billion (2030). Global market; greater than US $250 billion (2030)
	Carbon utilization	Medium / High		Medium / High	In 2023, NA accounted for 38% of the global market share. NA market; range from US $7 billion (2034) to 36 billion (2030). Global market; range from US $18 billion (2034) to $96 billion (2030)

Lens: comparative advantage

Purpose

This lens assesses how well Alberta is positioned for success in each sector compared to other jurisdictions competing in similar markets. The assessment draws on Alberta's resource base, industrial capabilities, infrastructure, and institutional environment to identify strengths and gaps. It takes into consideration both critical and supporting factors, and the extent to which these already exist or could be developed over time.

Core approach

The assessment draws from using sectoral data, supply chain mapping, and expert/stakeholder input.

Three critical factors were assessed — core assets that Alberta either has, lacks, or would require significant time to build:

- **Resource advantage:** access to required natural resources or feedstocks.
- **Existing infrastructure:** industrial and transport systems to carry out activities and reach markets.
- **Relevant experience:** sectoral or adjacent industry expertise within Alberta firms.

It also considers several supporting factors — important enablers that can enhance competitiveness over time:

- **Skilled labour force:** workforce availability with relevant sector / supply chain skills.
- **Research and development (R&D):** activity across government, industry, and academia.
- **Government financial incentives:** access to grants, incentives, tax measures, and cost-sharing supports.
- **Regulatory environment:** clear, stable, and enabling provincial or federal policies.
- **Sector roadmap or strategy:** existence of guidance for sectoral development.

Each opportunity area is benchmarked against the jurisdictions most relevant to its markets. For instance, clean energy enablers are compared to other Canadian jurisdictions, while business and product export opportunities are evaluated against domestic (if applicable), the U.S., and other international jurisdictions.

Rating criteria

Sectors are rated as strong, moderate, or limited in comparative advantage, based primarily on the presence and maturity of critical factors, with supporting factors indicating potential for scalability or improvement.

Interpretation

This lens diagnoses *why* Alberta is positioned to compete well (or not) in specific opportunities, surfacing where targeted action in infrastructure, skills, or policy could strengthen its edge. It highlights areas where Alberta can lead now versus those that require ecosystem development to become competitive over time.

The chart below summarizes the sectors and the degree to which critical and supporting factors create a distinct advantage.

Degree of comparative advantage by sector

Sector		Domestic vs. export opportunity	Comparison	Critical Factors			Supportive Measures					Overall competitive advantage
				Resource Advantage	Existing infra-structure	Relevant experience	Skilled labour force	R&D ecosystem	Govt. financial incentives	Regulatory Envt'	Roadmap or strategy	
CLEAN ENERGY ENABLERS	Geothermal energy production	Domestic	Compared to other Canadian jurisdictions		n/a	✔	✔	✔	✔	✔		Medium
	Waste-to-energy	Domestic					✔		✔			Low
	Renewable Energy	Mostly domestic		✔	n/a	✔	✔		✔	✔		High
	Nuclear energy	Domestic						✔	✔		✔	Low
	Carbon capture and storage	Domestic		✔	✔	✔	✔	✔	✔	✔		High
	Direct air capture	Domestic		n/a	n/a		✔	✔	✔			Low
	Hydrogen production	Mostly domestic		✔	✔	✔	✔	✔	✔		✔	High
BUSINESS OPPORTUNITIES	AgTech IP export	Export	Compared to the U.S.	n/a	n/a		✔	✔	✔	n/a		Low
	CCS tech/services export	Export		n/a	n/a	✔	✔	n/a		n/a		Medium
	Geothermal tech/services export	Export		n/a	n/a		✔	n/a		n/a		Low
PRODUCT EXPORT OPPORTUNITY	Green chemistry	Mostly export		✔	✔	✔	✔		✔			High
	Ammonia-as-a-fuel	Export		✔	✔	✔	✔	n/a	✔			High
	Sustainable aviation fuel	In between	Compared to other Canadian jurisdictions and the U.S.	✔	✔	✔	✔		✔		✔	High
	Alternative proteins	Mostly export	Compared to the U.S.	✔	✔	✔	✔	✔	✔			High
	Minerals and metals production and processing	In between	Compared to other Canadian jurisdictions and the U.S.		✔		✔	✔	✔	✔	✔	Medium
	Conventional mining (hard rock & DLE)				✔							Low
	Ore processing				✔	✔						Medium
	Waste recycling for minerals			✔								Medium
	Carbon utilization	In between		✔				✔	✔			Medium

Lens: independence

Purpose

This lens considers the extent to which a sector's success relies on other parts of the energy system. Some opportunities — such as solar power — are relatively independent, requiring limited coordination beyond grid connection. Others — such as hydrogen — are highly interdependent, relying on the simultaneous development and adoption of parallel infrastructure such as carbon capture and transportation, as well as customers making technological adaptations that enable them to use the hydrogen. These examples represent the two ends of the spectrum.

It helps reveal sequencing risks, coordination needs, and ecosystem complexity — key considerations when prioritizing investments or designing industrial strategies.

Core approach

- Evaluates interdependencies across infrastructure and technology (e.g., shared transport, power, or carbon systems), markets and policies, and adoption timelines.
- Draws on sectoral analysis, expert interviews, and industry studies to map dependencies between sectors.
- Assesses whether project success depends primarily on external actors, complementary technologies, or enabling infrastructure.

Rating criteria

- **High:** Sector can develop largely autonomously with minimal coordination (e.g., solar power).
- **Moderate:** Requires some concurrent developments but can advance incrementally (e.g., biofuels).
- **Low:** Dependent on major, coordinated investments or technology adoption across sectors (e.g., hydrogen).

Interpretation

This lens distinguishes "ready-to-go" opportunities from those requiring broader system alignment. While interdependent sectors can yield transformative impact, they also carry higher coordination risk, making this lens essential for sequencing actions and assessing ecosystem readiness.

Extent to which project development is independent of actions by others outside that sector

	Sector	Independence	Notes
CLEAN ENERGY ENABLERS	Geothermal energy production	High	Mostly independent of need for system changes by other actors / sectors.
	Waste-to-energy	Medium	WTE facilities need CCS infrastructure connection; and will need to work with other sectors to provide and transport a steady supply of appropriate waste feedstock
	Renewable Energy	High	Mostly independent of need for system changes by other actors / sectors
	Nuclear energy	Medium	A number of regulatory changes and permissions will be required for which existing legislation is not adequate. There is also a skills gap that would have to be filled
	Carbon capture and storage	Low	CCS requires the cooperation of different sectors and companies to effect emissions capture, transportation and sequestration
	Direct air capture	High	Mostly independent, although may require access to large volumes of water, which requires negotiation
	Hydrogen production	Low	Requires coordination across production, transportation and users and may require infrastructure changes at multiple points
BUSINESS OPPORTUNITIES	AgTech IP export	High	Service based business; does not require system change
	CCS tech/services export	High	Service based business; does not require system change
	Geothermal tech/ services export	High	Service based business; does not require system change
PRODUCT EXPORT OPPORTUNITY	Green chemistry	Medium	Mostly similar to current chemical production processes, although it will require coordination with CCS infrastructure
	Ammonia-as-a-fuel	Low	Ammonia-as-a-fuel will require infrastructure changes on the part of purchasers, and likely additional rail transportation capacity to be constructed. Low-carbon ammonia production will require CCS
	Sustainable aviation fuel	Medium	Will require coordination with other industries to provide a steady supply of appropriate waste feedstock and CCS also needed. Transportation mechanisms are established and no changes are required for airplanes to use it
	Alternative proteins	High	Mostly independent of need for system changes by other actors / sectors
	Minerals and metals production and processing	Low	Will require multiple sectors coordination actions across multiple geographies
	Carbon utilization	Low	Will require coordination across carbon production, transportation and creating of carbon products. May require changes by prospective consumers (e.g., car manufacturers to use carbon fibre in place of aluminum or plastic; changes in cement production processes.)

Lens: location flexibility

Purpose

How easily can sectoral projects be sited across the province? This lens considers geographic, infrastructure, and resource requirements that influence siting flexibility or constraints. The goal is to understand how sectoral opportunities align with regional characteristics and infrastructure.

Core approach

- Assesses factors such as access to water, rail, or CCS infrastructure; proximity to industrial clusters; and specific geologic or environmental conditions (e.g., suitable pore space).
- Uses a combination of sectoral and geospatial data, alongside expert judgment, to evaluate siting feasibility and dispersion potential.

Rating criteria

Rates sectors as high (broad provincial deployment), moderate (multiple viable regions), or low (tied to specific locations).

Interpretation

By identifying these siting patterns and constraints, this analysis supports place-based competitiveness — matching opportunities to regional strengths while identifying where targeted infrastructure or policy interventions could unlock new investment zones. While some opportunities can be developed across multiple regions, others depend on localized assets or conditions, such as access to specific industrial corridors or geological formations.

It should be noted that not every project for a given sector has the same requirements and that these are generalizations across the sectors.

Siting requirements and degree of location flexibility

	Sector	Location flexibility	Notes	
CLEAN ENERGY ENABLERS	Geothermal energy production	Low	• Specific geologic conditions	• May require access to water
	Waste-to-energy	Medium	• Sufficient land for site • Access to clean power	• Access to CCS
	Solar and wind energy	High	• Sufficient land for site	• Specific climate conditions
	Nuclear energy	Low	• Likely strong safety-based siting restrictions • Water would be required for larger nuclear but not SMRs	
	Carbon capture and storage	Low	• Specific geologic conditions • Proximity to industrial producers of CO2 • Proximity to Industrial Heartland is helpful	• Large amounts of industrial-zoned land • Access to water • Access to clean power
	Direct air capture	High	• Sufficient land for site	• Access to clean power
	Hydrogen production	Low	• Access to clean power • Land that is zoned for heavy industry	• Access to CCS • Close to consumers is preferable
BUSINESS OPPORTUNITIES	AgTech IP export	High	• No location restrictions	
	CCS tech/services export	High	• No location restrictions	
	Geothermal tech/ services export	High	• No location restrictions	
PRODUCT EXPORT OPPORTUNITY	Green chemistry	Low	• Land that is zoned for heavy industry • Could be useful to be near Industrial Heartland • Access to clean power	• Access to CCS • Access to transportation networks for product export
	Ammonia-as-a-fuel	Low	• Land that is zoned for heavy industry • Access to transportation networks for product export	• Access to CCS • Access to clean power
	Sustainable aviation fuel	Medium	• Proximity to fuel transportation infrastructure • Access to clean power	• Access to CCS • Access to water
	Alternative proteins	Medium	• Access to CCS is helpful • Access to clean power	• Access to transportation networks for product export
	Minerals and metals production and processing	Medium	• Needs differ widely across production types. Some types of production may require: • Access to clean power • Specific geology • Access to transportation networks for feedstock import and product export	• Access to water • Sited in specific location for safety (e.g., to manage waste)
	Carbon utilization	Medium	• Access to clean power • Likely needs access to water	• Access to CCS • Useful to co-locate with emitting industries or product users

Lens: investment environment

Purpose

A way of evaluating the maturity of the investment environment, this lens reflects the extent to which **public and private capital** are responding to sector growth opportunities, recognizing that Alberta's competitiveness is influenced by both provincial conditions and the broader Canadian investment landscape. This lens reviews capital flow maturity for opportunities, signaling investor response.

Core approach

- Analyzes qualitative indicators such as recent investment activity, funding announcements, and evidence of market traction.
- Considers the influence of national incentives, global capital flows, and investor familiarity with the sector.
- Draws on expert insights, sector studies, and market observation to assess the strength and maturity of capital pathways

Rating criteria

- **Well-established:** active investment flows and clear funding pathways; investors are familiar with the sector and opportunities are scaling.
- **Moderate:** emerging traction, with growing investor interest but still limited project activity or risk-sharing mechanisms.
- **Early-stage:** few active investors or deals; capital flows are limited and depend on demonstration projects, incentives, or policy support.

Interpretation

This lens identifies where investment readiness is already creating momentum and where targeted interventions could strengthen capital flows. A well-established investment environment doesn't guarantee funding for all projects, but it signals that capital pathways are functioning and have successfully connected investment with project opportunities in the sector.

For instance, investment in alternative proteins demonstrates a mature, functioning pathway connecting capital with projects. In contrast, minerals and metals processing — though less active in Alberta — remains familiar to investors and holds immense market potential.

Status of investment environment

	Sector	Investment environment	Notes
CLEAN ENERGY ENABLERS	Geothermal energy production	**Moderate**	Several projects with different proponents have been built or are under construction in Alberta. Funding has been a combination of government and private sector investment
	Waste-to-energy	**Moderate**	Waste-to-energy is a new endeavour in Alberta but Varme Energy has successfully raised $200 million for its Innisfail facility and $300 million for its Industrial Heartland facility
	Solar and wind energy	**Well-established**	Investment was successfully mobilized for hundreds of solar and wind projects that are either currently operating or late-stage development in Alberta
	Nuclear energy	**Early stage**	To date there have been no nuclear projects in Alberta to invest in, and no SMR projects across Canada
	Carbon capture and storage	**Well-established**	Investment in CCS in Alberta has already exceeded tens of billions of dollars
	Direct air capture	**Early stage**	To date, there have been no commercial DAC facilities in Canada to invest in
	Hydrogen production	**Moderate**	Several blue hydrogen projects in Alberta have reached Final Investment Decision, with several more actively under consideration
BUSINESS OPPORTUNITIES	AgTech IP export	**Well-established**	Canada is ranked #2 in the world for the number of agri-tech investors. Calgary-based Carrot Ventures is a venture studio for commercializing AgTech IP
	CCS tech/services export	**Not applicable**	Likely to be provision of services rather than commercialization of IP
	Geothermal tech/ services export	**Not applicable**	Likely to be provision of services rather than commercialization of IP
PRODUCT EXPORT OPPORTUNITY	Green chemistry	**Well-established**	Alberta's chemistry industry has already been able to secure tens of billions of dollars for green chemistry projects, such as Dow's new plant
	Ammonia-as-a-fuel	**Early stage**	Several blue ammonia projects have been proposed but none appear to have reached a final investment decision
	Sustainable aviation fuel	**Early stage**	To date, there have been no commercial SAF facilities in Canada to invest in
	Alternative proteins	**Well-established**	Protein Industries Canada works with private sector investors to create co-investment projects for alternative proteins. Their investment capacity is in the hundreds of millions of dollars, which they match with private sector investments
	Minerals and metals production and processing	**Moderate**	While few projects have been developed in Alberta, mineral and metal production in Canada is familiar to many investors
	Carbon utilization	**Early stage**	Almost no projects exist other than concrete production; this sector would be new to investors

Lens: resilience to U.S. policy

Purpose

The United States is both the primary customer and primary competitor for many sectors. Changing conditions in the U.S. can affect the competitiveness of Canadian businesses, making it essential to understand how sensitive each sector is to changes in policy or market conditions. This lens measures how sensitive Alberta's low-carbon opportunities are to shifts in U.S. policy — such as investment reversals, tariffs, or trade measures — and assesses how adaptable sectors are within a North American market context.

Core approach

- Examines sectoral exposure to U.S. legislation (e.g., Inflation Reduction Act) and other policy instruments that affect trade, investment, or market share.
- Considers both the potential benefits and risks of U.S. policy direction through expert judgment, comparative policy analysis, and industry feedback.
- Evaluates Alberta's relative positioning — whether sectors can compete effectively regardless of U.S. policy shifts, or whether alignment and adaptation are essential.

Rating criteria

- **High:** Sector strength and competitiveness are largely independent of U.S. policy; rely on localized assets/infrastructure that cannot be replicated elsewhere.
- **Moderate:** Sector shows adaptable exposure; U.S. policies influence competitiveness, but Alberta can adjust through innovation, partnerships, or domestic policy support.
- **Low:** Sector is highly dependent on U.S. alignment; changes in American policy, subsidies, or tariffs could significantly affect Alberta's viability or market share.

Interpretation

Through this lens we can see where Alberta can operate with autonomy and stability versus where competitiveness is closely tied to U.S. decisions. Sectors with high resilience, like those in the Clean Energy Enablers category, are relatively insulated from U.S. policy actions and contribute to both Alberta's and Canada's security of supply. In contrast, export-oriented sectors are more exposed due to heavy integration with U.S. markets and policy or subsidy shifts south of the border are more apt to have an outsized impact for key export opportunities. For example, roughly 87% of Alberta's chemical exports are sold to the U.S.

By making these dependencies visible, this lens helps identify where Alberta's economic strategy must account for U.S. policy as a structural factor.

The table below shows the extent to which the different sectors may be sensitive to policy direction and market dynamics south of the border.

Resilience to change in U.S. policies / actions

	Sector	Investment environment	Notes
CLEAN ENERGY ENABLERS	Geothermal energy production	**High**	Energy users will be based in Alberta, so there is almost no U.S. exposure
	Waste-to-energy	**High**	Activity mainly happens in Alberta; little interaction with U.S. policy
	Solar and wind energy	**High**	Activity happens in Alberta; only a small number of U.S. customers; little interaction with U.S. policy
	Nuclear energy	**High**	Activity mainly happens in Alberta; little interaction with U.S. policy
	Carbon capture and storage	**High**	Activity happens in Alberta; little interaction with U.S. policy
	Direct air capture	**High**	Activity mainly happens in Alberta; little interaction with U.S. policy
	Hydrogen production	**Medium**	Some hydrogen produced in Alberta could be sold to proximal states. This could be affected by U.S. hydrogen production (competition) or the development of infrastructure to use hydrogen (customer)
BUSINESS OPPORTUNITIES	AgTech IP export	**Medium**	The U.S. is a proximate and easy customer for future agtech IP sales, but other markets are also viable customers.
	CCS tech/services export	**High**	There could be some U.S. customers but most likely in other countries. This business is not trade-exposed in terms of tariffs or protectionist measures
	Geothermal tech/ services export	**High**	Customers for geothermal tech could be located in the U.S. but the U.S. has a more robust geothermal industry than Canada and the same set of competitive advantages. Canadian sales more likely outside of the U.S.
PRODUCT EXPORT OPPORTUNITY	Green chemistry	**Low**	87% of Alberta's chemicals are sold to the U.S. Changes in production, markets or tariffs would have a high impact
	Ammonia-as-a-fuel	**High**	The primary markets would be in Asia.
	Sustainable aviation fuel	**Medium**	In the short term, SAF supply would stay entirely within Canada. U.S. policies could affect extent of "economic tankering" by U.S.-based airlines. In the long term, there is the potential to sell SAF to U.S. airports
	Alternative proteins	**Medium**	The U.S. is a large customer for agricultural products, but overseas markets are also strong
	Minerals and metals production and processing	**Medium**	The U.S. will be a primary customer for Canadian minerals and metals. Protectionist measures could be applied, but the U.S. badly needs sources other than China
	Carbon utilization	**Medium**	Products produced from carbon could be subject to U.S. protectionist measures

From strength to scale: sectors enabling global competitiveness

While all opportunities offer viable pathways and have strategic merit, a subset of sectors stand out for their strong growth potential. As noted in the foresight section, strong growth pathways have a defined set of characteristics: they intersect multiple value chains, broaden markets into fast-growing regions, anchor the province in security-of-supply conversations, are scalable with modest policy support in reasonable timeframes, and generate benefits for communities — reinforcing both social cohesion and economic growth.

This report focuses on five sectors that illustrate how early coordination among policy, industry, and investment can unlock economic advantage:

- » **Clean energy enablers (electricity): a platform opportunity**
- » **Carbon capture and storage**
- » **Green chemistry**
- » **Alternative proteins**
- » **Minerals and metals production and processing**

The following snapshot offers a glimpse of these opportunities, summarizing relative strengths and indicators of stability across multiple future scenarios
(see Appendix B for further detail on scenarios)

Profile			Strength Under Future Uncertainty		Time to Deployment *	
Opportunity	**Primary Role**	**Stability Factors**	**Drivers**	**Performance across Scenarios**	**Subcategory/TLR**	**Build Out-Time***
Clean Energy Enablers low-carbon electricity generation technologies i.e., solar/wind; geothermal; waste-to-energy; nuclear.	Platform for all sectors - Alberta's clean power potential underpins nearly every other industrial opportunity	» As supply chains re-shore and decarbonize, reliable low-carbon electricity becomes a location advantage. » Scales through market investment once grid modernization enables greater system flexibility and permitting barriers are reduced.	» High As supply chains re-shore and decarbonize, reliable low-carbon electricity becomes a location advantage. » Scales through market investment once grid modernization enables greater system flexibility and permitting barriers are reduced.	Critical under both fragmented and integrated systems — ensures energy security when markets tighten and enables low-carbon exports when they open.	**Solar/Wind High (TRL 9)** — proven at scale and fully commercial	**Short-term (2–4 years)** — deployment limited mainly by grid connection queues and permitting timelines.
					Geothermal Medium (TRL 5–8) — mature for direct-use heat; early-stage demonstration for high-temperature power generation in Alberta.	**Medium-term (5–10 years)** — requires regulatory adaptation, subsurface validation, and grid or district energy integration.
					Waste to energy High (TRL 8–9) — mature technologies globally; limited local deployment	**Medium-term (4–8 years)** — contingent on reliable feedstock aggregation and municipal partnerships frameworks
					Conventional Nuclear High (TRL 9) — mature, fully commercial technology with decades of global operation	**Long-term (10–15 years)** — requires extensive siting, regulatory approvals, and multi-year construction timelines
Carbon Capture & Storage (CCS) development or deployment of projects to capture and sequester industrial sources of carbon dioxide.	Linchpin technology - builds on proven storage assets and expertise to anchor new growth industries	» One of the few tools that allows Alberta's high-emission industries to decarbonize and maintain export markets. » Prioritized by both levels of government.	Works under both federal support and provincial autonomy » Positions core industries to compete in lower-carbon value chains » Preserves export optionality	Holds value in all futures: anchors new areas of industrial competitiveness when climate ambition softens and unlocks market access when carbon standards tighten.	**Medium–High (TRL 7–9)** — mature across capture, transport, and storage systems	**Short–medium term (3–7 years)** advanced regulatory and infrastructure foundation enables more rapid deployment, final clarity on pore-space access and storage rights remains a foundational issue.

Profile			Strength Under Future Uncertainty		Time to Deployment *	
Opportunity	**Primary Role**	**Stability Factors**	**Drivers**	**Performance across Scenarios**	**Subcategory/TLR**	**Build Out-Time***
Green Chemistry production of chemicals in ways that are more environmentally sustainable.	Value-added manufacturing - builds on Alberta's petrochemical strength to capture the fastest-growing segment of the market	» Uses existing feedstocks and infrastructure » clear and consistent permitting and product classification can scale investment » Links energy, agriculture, and manufacturing to supply low-carbon materials globally.	» Builds on existing petrochemical infrastructure » Uses clean energy and CCS to meet global buyer standards » Fits U.S. or Asia-facing trade strategies	Diverse futures as producers pursue efficiency, supply security, and regulatory flexibility — qualities that green chemistry enables regardless of climate ambition	**Decarbonization High (TRL 7–9)** — commercially proven (e.g., Dow Net-Zero Ethane Cracker, CCS integration in petrochemicals)	**Short–medium term (3–6 years)** — active projects advancing in Alberta; replication possible within this decade
					Sustainable Feedstocks Medium (TRL 7–8) — established pilots but limited commercial deployment	**Medium–long term (5–12 years)** — depends on feedstock sourcing, co-location infrastructure, and sustained product demand signals
					Waste Management Medium (TRL 6–7) — proven pathways globally, but tech deployments remain fragmented in Alberta	**Medium-Long-term (7-12+ years)** — staged build-out; early hubs feasible, full network requires standards & logistics
Critical Minerals & Metals (Processing) building low-emissions processing facilities and technologies	Strategic input for allied industries - provides secure supply and processing capacity within continental value chains	» Can progress through targeted permitting, shared infrastructure, and co-investment in refining. » Anchored by allied demand for secure, transparent supply chains and supports regional participation.	» Aligns with continental security-of-supply goals » Leverages Alberta's refining expertise » Anchored in geopolitical demand (EVs, semiconductors, defense)	Secure, allied supply chains are a universal priority. » Alberta's refining and transparency strengths matter whether the world fragments into regional blocs or deepens global trade.	**Medium–High (TRL 7–8)** — commercially established but regionally nascent	**Medium term (5–8 years)** — depends mainly on establishing sites, streamlining approvals, and building supporting utilities for new refining capacity.
Alternative Proteins proteins produced non-animal sources e.g. pulses, field crops, insects, and lab cell cultures	Agri-manufacturing platform – converts Alberta's agricultural strength into processing and production capacity	» Builds on Alberta's established ag base and logistics; scaling requires light-touch incentives and processing support. » Expands exports and rural value-add in line with global food security shifts	» Builds on domestic feedstock base » Serves food security and low-carbon demand in Asia and Europe » Strong fit with regional growth and Indigenous partnership goals	Food security and ag innovation persist across all futures — supports rural economies domestically and premium exports abroad.	**Plant-Based Proteins (Processing & Product Development)** High (TRL 8–9) — fully commercial; strong global market presence	**Short–medium term (2–5 years)** — rapid deployment possible through co-location with agri-processing hubs
					Fermentation-Based Proteins (Precision & Biomass) Medium–High (TRL 6–8) — proven globally; early pilot activity emerging in Alberta	**Medium term (4–8 years)** — depends on scaling biomanufacturing capacity and supply-chain integration
					Cultivated (Cell-Based) Proteins Low–Medium (TRL 4–6) — early commercial pilots globally	**Long-term (10–15 years)** — pilots in 5–7 yrs; mass market limited by regulation & cost

** Estimated time required to construct, permit, and operationalize a representative project or facility in Alberta — assuming capital availability and policy intent are already in place.*

Competitiveness contenders

From clean energy platforms that enable competitiveness across multiple industries, to emerging value chains in chemistry, minerals, and food systems, the five opportunities outlined in this section are promising, durable, low-emission growth pathways for Alberta's economy.

Drawing on scenario analysis, expert insight, and the application of the seven lenses, these five sectors emerged as the most robust pathways for future growth and competitiveness.

Clean energy enablers for electricity

A platform opportunity

Reliable, affordable, low-emission power underpins every sector of the economy from resource extraction and advanced manufacturing to data infrastructure, hydrogen, and bio-based industries. These enablers not only create local economic activity but also allow other industries to benefit from reduced emissions, strengthening Alberta's overall value proposition for investment in new growth sectors.

Providing reliable clean electricity is a strategic asset that can unlock new industrial clusters, attract investment, and support the expansion of emerging sectors. Alberta's world-class renewable resources, coupled with existing oil and gas infrastructure and a highly skilled workforce, provide the building blocks for a diverse clean-energy platform.

Globally, jurisdictions that can provide dependable, low-emissions electricity alongside advanced carbon management capabilities are becoming magnets for industry seeking to meet stringent emissions and trade requirements. By prioritizing clean power availability and integrating it into regional industrial strategies, Alberta can drive strategic industrial buildouts and secure a durable competitive advantage for the province.

Achieving this will require both expanding generation capacity and modernizing how energy is delivered, stored, and managed. No single technology or source will be sufficient on its own; keeping all credible pathways open will be essential to power industrial growth and attract long-term investment.

This study highlights four clean energy enablers (electricity) that together, can form the backbone of a resilient energy system adaptable to evolving industrial and regional needs:

- Geothermal energy production
- Waste-to-energy
- Solar and wind energy
- Nuclear energy

While economic activity from these sectors is largely domestic given that clean electricity produces limited exportable products, each strengthens the province's ability to supply clean, dependable, and investable power — a critical enabler for industrial growth and value-added processing. The following meet the criteria for a strong growth pathway:

- They generate broad economic benefits, much of which accrue to rural municipalities.
- They create local, skilled, and specialized employment.
- They enable users (such as industrial purchasers) to reduce their own emissions, adding value to their exports — particularly where carbon tariffs or border adjustments apply, or where investors, lenders, insurers, and consumers value low-carbon production.
- Their presence can attract new industries seeking access to clean, reliable power, making the investment environment more conducive.

An additional three sectors make up the full range of clean energy enablers — two of which (direct air capture (DAC), and hydrogen production) can be found in Appendix A. Additionally, carbon capture and storage (CCS) is assessed as a separate growth pathway below.

Geothermal energy production

Overview

Geothermal energy offers a steady, non-intermittent source of heat and power. In Alberta, the opportunity lies in leveraging subsurface expertise and infrastructure developed through decades of oil and gas activity. This pathway can support both grid-scale generation and local heating networks, providing baseload energy that complements variable renewables.

Alberta's advantage

Traditionally, geothermal energy has required reservoirs with high heat, which is not what Alberta has. However, newer technologies such as enhanced geothermal systems (EGS) and closed-loop systems allow energy production from lower-temperature reservoirs. Alberta's advantage is technical readiness. The province has deep drilling experience, subsurface data, and equipment supply chains that can be redeployed toward geothermal exploration and production. Co-production models (i.e. extracting both hydrocarbons and heat from existing wells) can lower development costs and accelerate commercial viability. A growing number of pilot projects demonstrate proof of concept, particularly in southern and central Alberta, where favourable geology and community interest align.

In 2023, geothermal energy produced approximately 21.9 GWh of electricity in Alberta, from two producers: FutEra Power (Swan Hills) and Eavor Technologies (Rocky Mountain House). However, with projects that are under construction or planned, this figure is expected to rise to 166.6 GWh by 2033.

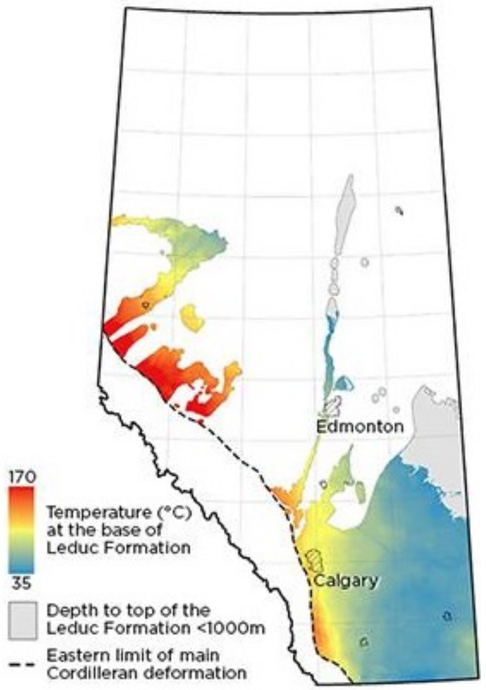
There are two distinct use cases for geothermal in Alberta:

- To provide district heat and power to municipalities that lie near geothermal resources:
  - This is most widely employed in the western United States e.g. in Boise, Idaho where a closed-loop geothermal process energy for a district heating system warms over six million square feet of building space in the city and returns the water back to the aquifer.
- To provide heat and power to industrial users that are located close to geothermal resources and seeking low-emission solutions (especially without intermittency). E.g.:
  - In Nevada, geothermal energy is used in agriculture (in vegetable dehydration) and for mining (where geothermal heat assists in ore separation).
  - For Alberta, this may include data centres for which the provincial government has encouraged proponents to provide self-sourced power solutions.

Geothermal energy production in Alberta is likely to cluster in the areas of highest geothermal potential as shown below: the northwest corner of the province and in the south close to the border of British Columbia. However, some high temperature geothermal for electricity generation are in remote areas where critical infrastructure for transmission is lacking.

Realizing the opportunity

Unlocking geothermal's potential will require regulatory clarity around heat rights, project permitting, and integration into Alberta's electricity market. Early provincial policy support, combined with de-risking mechanisms such as exploration grants or insurance models, can encourage investment. Coordinated mapping of resource potential and continued technology demonstration will help move geothermal from pilot to scalable deployment.



Waste-to-energy

Overview

Waste-to-energy technologies convert municipal, agricultural, and industrial waste into usable power, heat, or fuels. This approach addresses two challenges simultaneously: reducing landfill volumes and generating low-carbon energy from feedstocks that would otherwise be discarded. In doing so, waste-to-energy can:

- Reduce the amount of solid waste that municipalities need to dispose of in landfills
- Produce heat and/or electricity that can be used locally or sold to the grid
- Help some industries with their waste problem and upcycle the waste
- Produce carbon-neutral biofuels, such as renewable natural gas, that can be sold.

WTE technology has been in use for many decades, and in some countries the majority of waste is disposed of in this way. In Sweden, 52% of trash is converted to energy. In the UK, waste-to-energy produced over 10,000 gigawatt hours of electricity in 2021.

Alberta's advantage

Waste-to-energy (WTE) can provide a "win-win-win" for municipalities, including in rural areas. In Alberta, only 2% of municipal waste is disposed of in this fashion, leaving ample room for growth. Alberta's large agricultural and industrial sectors provide consistent and diverse feedstocks for waste-to-energy systems. Despite challenges like high capital costs and securing access to municipal solid waste streams, several large WTE facilities are in the planning or construction phases in Alberta. Varme Energy has proposed two large-scale WTE facilities that will use CCS to sequester emissions.

The first of Varme Energy's facilities, the Heartland Waste-to-Energy with Carbon Capture project in Alberta's Industrial Heartland, will be the province's first large-scale waste-to-energy facility to integrate carbon capture and storage (CCS). The project will convert approximately 205,000 tonnes of waste per year into 128 GWh of energy, while capturing and sequestering between 185,000 and 200,000 tonnes of CO annually. Currently under development, it is backed by Gibson Energy as an investor and partner, with the Canada Growth Fund holding a 40% ownership stake and additional support from Emissions Reduction Alberta. Operations are expected to begin in 2028, with a second facility proposed for future development in Central Alberta.

There are also companies operating in Alberta that use municipal, agricultural or industrial waste to produce biofuels. These include Enerkem, which operates a full-scale commercial demonstration facility in Edmonton, and Expander Energy, which is constructing a facility that will convert construction wood waste into renewable syngas.

Existing pilot facilities, such as those in the Edmonton region, have demonstrated technical feasibility and municipal partnership models. The province also benefits from established logistics networks that can support feedstock collection and distribution.

Realizing the opportunity

To scale waste-to-energy, Alberta will need clear policy signals that value emissions reductions and resource recovery. Supportive procurement frameworks and municipal collaboration can help aggregate feedstocks and provide predictable project revenue. Integration with circular economy initiatives, such as recycling and composting, can enhance both environmental and economic performance. Targeted incentives could help attract early-stage capital and enable rural or mid-sized communities to benefit from local generation.

Solar and wind

Overview

Solar and wind remain Alberta's most rapidly expanding sources of new electricity generation, having attracted record levels of national and international investment. These technologies continue to be central to Alberta's ability to deliver affordable, low-emission power and attract energy-intensive industries seeking low-emissions supply.

Alberta's advantage

Alberta is not likely to become a major player in developing, producing or exporting solar or wind products such as photovoltaic panels or wind turbines given market dominance by China — which benefits from government support for facilities, government-provided financing, extensive R&D capacity and favourable trade practices.

Alberta benefits from high solar irradiance and world-class wind resources, combined with a deregulated electricity market that supports innovation and independent power development. The province's open-market structure allows projects to advance without direct government procurement, attracting private investment at scale. Existing transmission corridors and proximity to industrial demand centres further strengthen the locational advantages for renewable buildout.

Additional strengths include developer expertise and supportive policy frameworks, such as the Renewable Electricity Act and the Technology Innovation and Emissions Reduction (TIER) regime. In 2023, Alberta accounted for over 90% of Canada's renewable energy growth, illustrating its ability to leverage these advantages. Currently, the majority of solar and wind potential is located in the southeastern region of the province (Figures a and b). Figure (c) represents recent rule changes likely to impact development.

The sector also generates substantial employment: as of 2021, approximately 121 companies were involved in renewable energy generation, providing nearly 1,200 jobs. Power Purchase Agreements from external buyers provide an additional source of revenue and demonstrate Alberta's ability to attract investment from outside the province. These include major firms like RBC, Budweiser Canada, Amazon, and Microsoft.

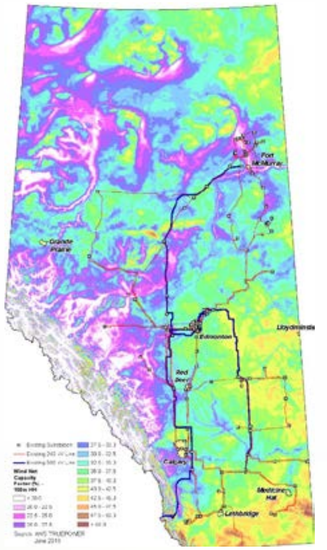
Realizing the opportunity

Alberta has been a hotbed for renewable energy development, but recent regulatory changes have caused a slowdown in investment. Clear, stable policies will be critical to reassure investors and support continued solar and wind development.

Energy storage technologies, particularly utility-scale battery storage, can enhance renewable energy grid integration. Although these technologies are commercially mature, high capital costs remain a challenge faced by many project proponents and investors.

Recent changes have also introduced new factors that are now shifting economics of renewable development in the province. For example, future growth will depend on timely project registration required through the new registration Code of Practice for Solar and Wind Renewable Energy projects and viable project economics based on the restructured energy market and project reclamation securities and costs. Enabling renewable energy to compete on an equal footing with other generation sources through investments in storage and demand flexibility will be essential to maintain affordable, reliable, and scalable renewable electricity for both industrial and community needs.

A



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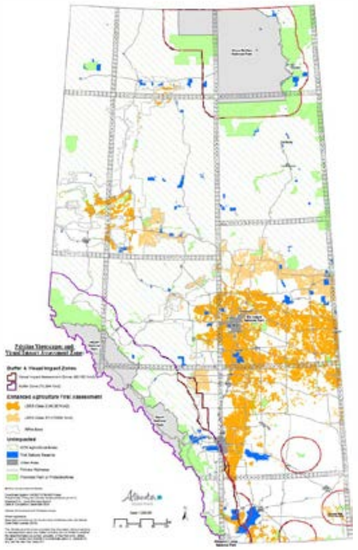

C

Nuclear energy

Overview

Next-generation nuclear, including both small and large modular reactors, offers a reliable and dispatchable source of baseload power. For Alberta's industrial economy it represents an opportunity to diversify the energy mix and provide reliable, low-carbon electricity and heat for industrial operations, including petrochemical production, hydrogen generation, and mining.

Like geothermal, waste-to-energy and solar and wind, nuclear energy production in Alberta would be a way of producing emissions-free electricity for the grid or electricity and heat for local users.

Alberta's advantage

Alberta's advantage lies in its strong engineering base, industrial demand profile, and experience managing large-scale energy infrastructure. Participation in Canada's national SMR roadmap allows Alberta to align with federal regulatory progress and shared research.

Although nascent, nuclear energy presents an opportunity to supply low-emission power and heat to industrial and regional users. Strategic deployment could complement Alberta's broader low-carbon energy portfolio, particularly in high-demand sectors like oil sands decarbonization where both electricity and heat would be valuable. Other potential applications include industrial clusters, remote communities, or regions aiming to produce excess electricity to stimulate economic development.

It is still very early days for nuclear power in Alberta; however, an agreement between Capital Power and Ontario Power Generation (OPG) was signed in early 2024 to assess the feasibility of a 300 MW reactor, with the assessment expected to be completed in 2026.

Realizing the opportunity

Alberta's nuclear potential will require careful, deliberate groundwork. Foundational steps include establishing regulatory readiness, conducting siting and environmental assessments, and creating clear pathways for project approval.

Although current discussion focuses on SMRs, conventional nuclear offers Alberta the more immediate opportunity. Alberta could draw on established Canadian expertise from provinces such as Ontario and New Brunswick to guide deployment, safety, and operational excellence.

Significant infrastructure planning and institutional capacity-building will be needed before SMRs or larger-scale reactors can be safely developed and operated.

Carbon capture and storage (CCS)

Overview

Carbon capture and storage (CCS) refers to the capture, transportation, and permanent underground storage of carbon dioxide (CO_2) from industrial sources. The growth of CCS has the potential to unlock lower emissions for a number of industries in the province, including cement manufacturing, chemistry, oil and gas, power generation, waste processing, fertilizer manufacturing and others.

The existence of a strong CCS infrastructure and system may also attract new industry to the province, especially heavy emitters in hard-to-abate sectors for whom low emissions are important.

Alberta's advantage

Alberta's experience in developing and integrating CCS projects has produced world-class technical expertise and regulatory know-how. The province's deep geological formations, mature subsurface data, and established energy infrastructure create a strong physical foundation for continued expansion. Over time, this concentration of expertise has positioned Alberta as a recognized centre of excellence in CCS design, project execution, and system integration. These capabilities are not geographically constrained; Alberta-based firms are already exploring opportunities to export their technology, provide consulting services, and supply skilled labour to CCS developments elsewhere in Canada and globally.

Alberta is a global leader in CCS, with six of the world's 57 large-scale facilities currently operating in the province, and additional projects planned or under construction. The province's CCS ecosystem includes an expanding network of industrial capture sites, CO_2 pipelines, and storage hubs. Developing this system has already required investment in the tens of billions, with the proposed Pathways Alliance CCS project alone representing another $16.5 billion in capital.

Realizing the opportunity

In Alberta CCS functions primarily as a clean energy enabler rather than an exportable product or sector. Although enormous amounts of capital are being directed towards its development, revenue is generated through users paying for disposal services. Its economic return depends on policy frameworks that govern carbon pricing, credits, and emissions reduction incentives. Strengthening these policy instruments, while ensuring infrastructure access and long-term storage integrity, will be critical for maintaining investor confidence and advancing deployment.

While CCS itself may not generate exportable products, the expertise, technology, and operational knowledge developed in Alberta hold strong potential for export as services. As such, this study also analyzed CCS technology and services export and carbon utilization as viable and connected sector opportunities with further details listed in Appendix A. This connection between enabling infrastructure and transferable expertise represents a longer-term growth path, linking CCS to emerging global markets for carbon management and utilization.

Green chemistry

Overview

Green chemistry refers to the production of chemicals in ways that have less environmental impact than traditional methods. The term is broad, and green chemistry can include lower-emissions production methods, using sustainable feedstocks, producing less waste or creating a less toxic chemical product or ideally, all of these. Examples include low-emissions ethylene and recycled polymers. While there is still a long way to go before the sector is counted as truly 'green', world-leading investment in low-emissions production is shaping up in Alberta.

Alberta's advantage

Green chemistry represents a growing shift within the $4.7 trillion global chemicals industry with demand growing nearly 9% annually, outpacing conventional chemicals. Alberta already has established export channels, abundant feedstock, and large-scale industrial infrastructure and is already a chemical production powerhouse with a $16.8B chemicals sector – with exports of $10.2 billion in 2023 alone – flowing mainly to the U.S. (89%) and China (8%). The sector employs roughly 8,600 people, and the province benefits from:

- **Established industrial clusters** such as Alberta's Industrial Heartland, one of the largest ethylene and polyethylene complexes in the world.
- **Abundant feedstock** with some of the lowest prices in North America
- **Existing rail and pipeline infrastructure** connecting to export markets.
- **A skilled and experienced workforce** in chemical and petrochemical production.
- **Policy incentives**, including the Alberta Petrochemicals Incentive Program (APIP), which provides grants covering 12% of capital costs for eligible new facilities.
- **Access to CCS infrastructure**, which can reduce production emissions and help companies meet the carbon-intensity standards of global buyers.

This foundation positions Alberta well to become a preferred supplier of low-emissions chemicals and materials, securing market access under emerging carbon border policies like the EU CBAM and ESG-driven procurement requirements.

Investment activity is already signalling confidence in Alberta's green chemistry future:

- Dow's $11.5 billion Path2Zero project is slated to create the world's first net-zero ethylene cracker and derivatives facility, although paused due to tariff uncertainty.
- Nutrien's Redwater and Joffre facilities are capturing CO_2 and shifting from natural gas to byproduct hydrogen.
- Shell's Polaris CCS is under construction and will cut emissions from its chemical complex by 30%, with a lifetime storage capacity of ~300 millions tonnes CO_2.
- Interprovincial Fuel Solutions is developing a $600 million low-carbon gasoline facility in Grande Prairie using CCS.
- Marubeni and Pembina plan to produce 1 million tonnes per year of low-carbon ammonia, while Itochu and Petronas explore similar ammonia and methanol projects.
- Northern Petrochemicals' $2.5 billion carbon-neutral ammonia and methanol facility in Greenview Industrial Gateway south of Grande Prairie proposes to create 4,000 construction and 400 permanent jobs.
  - The Grand Prairie region has high potential with a number of petrochemical processes identified including methanol, urea/ammonia and formaldehyde.

Realizing the opportunity

Despite significant investments in green chemistry, the opportunity for Alberta faces a number of challenges:

- **Energy constraints:** Many low-carbon industrial processes require large, steady sources of low- or zero-carbon electricity which will require more generation to come online.
- **Feedstock access:** Limited availability of recycled or bio-based feedstocks constrains green production.
- **Market pressures:** Overcapacity in global production is depressing near-term prices; reduced appetite for risk is also causing delayed investments such as Nauticol's $4 billion methanol project was cancelled in 2023).
- **Geopolitics:** Uncertainty around tariffs have seen major projects paused (e.g., Dow's Path2Zero).
- **Economic substitution risk:** If new facilities merely replace existing ones, GDP impacts may be neutral.

Despite these hurdles, green chemicals represent a smart, strategic opportunity for Alberta — a province already recognized as a chemical production powerhouse. With strong assets and global demand accelerating for low-emission products, Alberta is well positioned to capture the next wave of growth in this expanding market.

Alternative proteins

Overview

Alternative proteins are derived from non-animal sources such as plants, insects, or lab-grown cells and represent one of the fastest-growing segments in sustainable food systems. They serve human food, pet food, feed, and nutritional supplements while helping reduce global agricultural emissions and are cited as a way to cut global agricultural emissions by almost a third by 2050 (by displacing beef and other meats). Globally, the market was valued at roughly US $16 billion in 2024 and is projected to exceed US $36 billion by 2034, growing at over 9% annually. North America currently holds about 38% of global market share, with rapid growth expected in Asia-Pacific. Plant-based proteins dominate the market, while insect and cell-based proteins remain more emergent. Canada holds a 39% share of the global pulse market.

Growth in the alternative protein market has been fueled by a number of factors: customers seeking alternative food options, people looking to have lower impact on the environment and climate, a rise in vegetarianism and veganism, and an increase in demand for alternative protein sources for animal feed to lower costs.

Alberta's advantage

This sector builds on Alberta's strong agricultural base and expertise in pulse production. Alberta is exceptionally well-positioned in this space, with a focus on sustainable agriculture that acts as a comparative advantage to other jurisdictions. The province grows approximately 40% of Canada's dry peas and cultivates 2.4 million acres of pulses, having the second largest share of lentils and chickpeas giving it abundant access to high-protein feedstock. Yet most crops are exported raw, limiting value capture; processing them into high-value protein ingredients offers a major economic opportunity. Alberta also has an emerging opportunity in cellular agriculture and biomanufacturing, as noted in a recent market analysis summary.

The province's existing export channels to India, China, Japan, South Korea, Europe, and the United States align with rising global demand for sustainable protein sources. BioAlberta estimates that even conservative growth could support five or more new large-scale processing plants, each with a capacity of 5,000–10,000 metric tonnes per year.

Alberta's strategic advantages include:

- Low-carbon production potential, enhancing global competitiveness under sustainability criteria.
- Alberta companies are able to access funding and assistance from an industry-led consortium, Protein Industries Canada which partners with aspiring plant protein producers to help them gain access to customers, markets, and partnerships that they could not access on their own. And also the Alberta Agri-Processing Investment Tax Credit, which offers a 12% credit for agri-processing investments over $10 million. Strategic logistics through rail, road, and air links for export.
- Applied R&D leadership through the University of Alberta's Faculty of Agricultural, Life & Environmental Sciences, which supports product innovation and commercialization.

Recent investments totalling over $435 million have built out protein processing capacity, supported by the Alberta Agri-Processing Investment Tax Credit and Protein Industries Canada partnerships. These investments indicate strong momentum:

- PIP International operates a $20 million pea-processing pilot facility in Lethbridge, with capacity for 126,000 tons of yellow peas annually.
- More Than Protein Ingredients Ltd. opened a $160 million facility near Bowden for plant-protein processing.
- Phytokana Ingredients (formerly Phyto Organix) is investing $225 million in a wet fractionation facility near Strathmore.
- Lovingly Made Ingredients, near Calgary, produces textured plant proteins for export to the U.S., EU, and U.K.
- Botaneco, in Calgary, extracts protein and oil ingredients from canola and other oilseeds and was the first Alberta recipient of Protein Industries Canada funding.
- Future Fields, based in Edmonton, develops lab-grown protein and media, supported by $2.2 million in venture funding and multiple patent filings.

Realizing the opportunity

The above examples demonstrate how Alberta's agricultural and innovation ecosystems are evolving toward a diversified, export-oriented protein economy. However, scaling remains a challenge. Many producers are startups with novel processing technologies that face difficulties attracting investment and customers. Large-scale facilities require in the range of $200–$600 million in capital, and financing remains limited.

A significant investment strategy is needed to attract investment or financing to invest in facilities at the scale required to capture a bigger share of this growth market. Additionally, as global competition increases, achieving differentiation through carbon intensity, product quality, and traceability will be key.

Minerals and metals production (processing)

Overview

Increasing electrification and digitization has sparked surging demand for critical minerals and metals used in batteries, renewable power, defence, semiconductor technologies and nearly all applications used in daily life. These include lithium, copper, nickel, cobalt, graphite, and rare earth elements, of which Canada holds abundant resources, but lacks processing capacity. While China currently dominates global processing and refining it ultimately controls supply. This dynamic has led trading partners to seek out secure, conflict-free, and low-carbon alternatives.

The future potential of the global minerals and metals market is tremendous. The International Energy Agency (IEA) estimates the market for energy transition minerals (excluding copper) will reach US $220–$290 billion by 2030, with North America's share around US $13 billion. While Alberta is not among Canada's top mining jurisdictions, its processing potential could unlock a multi-billion-dollar niche within this growing market.

Alberta's advantage

Alberta's geologic resources include several transition minerals and metals, such as cobalt, nickel, graphite, uranium, and rare earth elements — along with industrial metals like iron and lead. However, where Ontario and Quebec lead in conventional mining, Alberta's comparative advantage is in the midstream — industrial-scale upgrading and refining: transforming raw materials from within Alberta or nearby jurisdictions such as British Columbia into higher-value products for exports and/or integration into supply chains.

Alberta's opportunity also lies less in end-use manufacturing (e.g., EVs or solar panels)

This midstream opportunity builds on Alberta's deep expertise in upgrading and refining from decades in the province's powerhouse sectors — oil, gas, and petrochemicals. It leverages proven chemical engineering capacity, world-class industrial infrastructure, and clusters such as Alberta's Industrial Heartland and Grande Prairie — both with rail access, power, and skilled labour. Paired with clean-energy pathways and carbon capture and storage (CCS), Alberta could emerge as a low-carbon processor of critical minerals.

Enhanced activities focused around processing and mid-stream opportunities position Alberta to move up the value chain from resource extraction to high-value, low-carbon processing and recycling.

Turning refining into regional advantage
Alberta already had strong technical expertise and infrastructure to process and refine critical minerals, metals, and industrial waste (for mineral recovery). For instance, nickel and cobalt refining already occurs using ores from other jurisdictions, demonstrating the province's technical readiness. Expanding this capability has potential to include materials from B.C., Western, and Northern Canada to be refined locally, adding value before exporting to other markets.

At the same time, there are a number of different ways that minerals and metals could be sourced, produced and processed in Alberta, primarily: direct lithium extraction (DLE) from brines, water reuse, and waste recovery technologies. Fuller write-ups on the first two are included in the Appendix A.

Overall, existing strengths include:

- Proven chemical engineering expertise from decades of hydrocarbon processing.
- World-class chemical processing capacity, and access to industrial clusters and infrastructure.
- CCS and clean-energy pathways to enable low-carbon processing
- Stable governance and regulatory clarity, supported by new frameworks like the Brine-hosted and Rock-hosted Mineral Resource Development Rules.
- A concentration of service companies that have complementary expertise in drilling, geosciences and environmental management.

Realizing the opportunity

This is a rare sectoral opportunity where Federal and provincial strategies are well-aligned, and where multiple actors, from rural and Indigenous communities through to international partners, can participate in and benefit from Alberta's contributions towards a Canadian value chain.

Despite Alberta's strengths, the minerals and metals ecosystem remains early-stage and fragmented. Unlike oil and gas or petrochemicals, this emerging sector lacks the institutional scaffolding, scaled infrastructure, anchor projects, and coordinated leadership. Activities are dispersed across junior exploration firms, research initiatives, and small-scale pilots rather than coordinated within a cohesive industrial strategy.

While Alberta's commercial-scale mining activity of critical minerals remains nascent, the province is taking steps to define its role through innovation and regulatory modernization. Frameworks and regulatory instruments including the *Metallic and Industrial Minerals Tenure Regulation, Brine-hosted Mineral Resource Development Rules* (2023) and the *Rock-Hosted Mineral Resource Development Rules* (2024) signal a provincial ambition to become a preferred destination for investment.

Incentives and investment supports further strengthen Alberta's landscape such as Alberta Innovates' Energy Storage and Minerals program, and federal Critical Mineral Exploration Tax Credit which provides funding, technical support, and additional financial certainty for early-stage projects.

By building on this base and focusing on processing and refining, Alberta can capture more value than from raw exports alone. Markets are increasingly rewarding secure, traceable, and low-carbon supply chains — and Alberta's blend of industrial expertise, regulatory clarity, and environmental performance can meet that criteria.

Looking forward, Alberta can apply a **framework for industry development** to translate these scattered strengths into a coordinated, investment-ready ecosystem.

"We have expertise to work with extremely harsh raw commodities and turn them into refined materials that are necessary for the fundamental ingredients of our future economy."

Policy enablers for industrial competitiveness

Recommendation 1: Modernize Alberta's Transmission and Distribution System to Enable Industrial Growth

The case

Meeting Alberta's emerging industrial demand will require expanding generation and modernizing the grid that delivers it. Transmission and distribution infrastructure is the bridge between investment and opportunity — the system that determines how quickly new industries can connect and scale. Transmission congestion and distribution bottlenecks now delay or derail industrial projects — from upgrading substations to securing interconnections.

While the province is reforming its market design through the Restructured Energy Market (REM), changes so far have focused on wholesale dynamics, not the infrastructure and processes that determine whether new facilities can connect quickly and affordably. Modernizing Alberta's transmission and distribution systems can convert a growing liability — slow hookups, inconsistent tariffs, and localized congestion — into a competitive advantage built on predictable access, optimized reliability, and faster industrial expansion.

Industry impact

- **Connection timelines:** Industrial projects often face long waits for substation upgrades. Allowing non-wires solutions at the distribution level frees capacity sooner, enabling timely expansions.
- **Process flexibility:** Many industrial processes (electrolyzers, refrigeration, irrigation, pumping) can shift or modulate demand — but only if market rules and utility tariffs recognize and reward it.
- **Cost competitiveness:** Optional rate structures for interruptible or flexible loads lower operating costs, making Alberta more attractive for energy-intensive investments.

Policy considerations

- **Integrate transmission and distribution modernization into REM implementation**
  Ensure Alberta's ongoing market reforms explicitly address transmission congestion management, flexible interconnections, and distributed energy participation — not just wholesale pricing.
- **Pilot non-wires and flexibility solutions for industrial nodes**
  Launch time-bound pilots in high-demand zones with clear cost-recovery pathways. These could include optimization of existing assets, dynamic line ratings, aggregated demand flexibility for industrial users.
- **Develop standardized interconnection pathways and data access**
  Develop standardized interconnection pathways and data access, building on work already underway by Alberta's distribution utilities. Create province-wide interconnection templates and shared visibility into grid capacity so that industrial proponents can assess connection feasibility early and uniformly across service territories.
- **Advance industrial tariff flexibility beyond REM elections**
  REM's new LMP and load settlement options create the foundation for flexible industrial rates. Alberta should build on this by co-developing tariff structures — such as interruptible, locational, or time-differentiated options — that reward load flexibility and lower delivered costs for large users.

Recommendation 2: Reinforce Technology Innovation & Emissions Reduction system (TIER) as a Competitiveness Tool

The case

With TIER Alberta has established a baseline of credibility with investors and trade partners, providing a market-based foundation that allows regulated facilities to manage emissions while driving technology investment. In a global context, strong, clear, and stable regulation is increasingly a competitive advantage. Minimizing TIER would raise Alberta's risk profile, increase capital costs and exclude producers from premium trade segments - those buyers and markets, particularly in Europe and Asia, where verified emissions performance and traceability are now embedded in procurement, financing, and supply-chain standards.

Ensuring TIER remains credible and interoperable with global carbon frameworks — especially in Europe and Asia — will be critical as Alberta's trading relationships diversify and emissions performance becomes an explicit factor in market access.

Industry impact

- **Market access:** Ensures Alberta products remain eligible for CBAM-aligned jurisdictions and clean procurement programs.
- **Operational alignment:** Across sectors such as cement, steel, hydrogen, and fuels, carbon intensity is increasingly embedded in contracts and supply chains. A credible pricing system enables Alberta firms to compete on verifiable emissions performance and provides a reference framework for alignment across other energy-intensive industries.
- **Financing:** Reduces Alberta's perceived risk premium, lowering the cost of capital for major industrial and agri-processing investments.
- **Investment attraction:** Signals to multinationals that Alberta can host low-carbon production platforms, influencing long-term siting decisions.

Policy considerations

- **Protect long-term predictability and transparency:** The 2024 amendments confirmed Alberta's commitment to TIER and renewed equivalency, providing a stable foundation for compliance and investment. The focus now is on preserving predictability while strengthening the credibility of the signal—clear timelines, consistent credit rules, and transparent guidance on benchmark updates—so abatement investments remain economically viable even when market conditions shift.
- **Strengthen offset credibility:** Streamline and update offset protocols to align with emerging global standards (ISO 14064, ICVCM). Prioritize third-party verification, transparent registries, and digital MRV systems so offsets can be recognized in global transactions — turning them into an exportable asset class.
- **CBAM-readiness:** Expand facility-level emissions reporting and traceability within TIER, allowing Alberta producers to demonstrate verified carbon intensity to secure access to premium export markets.

Recommendation 3: Accelerate Strategic Infrastructure for Industrial Competitiveness

The case

Alberta's growth potential is constrained not by resources, but by the pace of infrastructure delivery. Transmission bottlenecks, permitting delays for CO_2 and hydrogen corridors, and uncertainty around industrial zones are already slowing private investment. Competitor regions — from the U.S. Gulf Coast to Saskatchewan — are moving quickly with ready corridors and investment-ready hubs.

If Alberta cannot demonstrate timely, reliable access to power, transport, water, and storage, it risks losing investment not because it lacks resources, but because investors cannot count on infrastructure being in place when they need it.

Industry impact

- **Investment speed:** Pre-permitted and serviced sites reduce lead times for capital deployment, lowering Alberta's risk premium.
- **Cost certainty:** Coordinated infrastructure corridors (power, CO_2, water, logistics) de-risk multi-billion-dollar projects and avoid duplication.
- **Trade positioning:** Strategic infrastructure platforms anchor Alberta as a secure North American hub while creating option value in emerging markets such as CCUS, hydrogen, and advanced manufacturing.

Policy considerations

- **Strengthen delivery institutions:** Expand the mandate of Invest Alberta, the Alberta Industrial Heartland Association, or a new Strategic Infrastructure Office to coordinate permitting, funding, and cross-governmental alignment — drawing lessons from FAST-41 in the U.S., the EU's Net Zero Industry Act, and Asia's strategic platform development models (e.g., Singapore's industrial development boards,China's special economic clean technology zones).
- **Fast-track priority corridors:** Alberta's first CO_2 trunk line (ACTL) proved that shared infrastructure can work but remains limited in scale. Expanding to multi-use corridors — spanning CO_2, hydrogen, power, and water — would de-risk industrial investment and anchor Alberta in continental clean growth. Corridors should be designed and governed as economic platforms, not single-use assets — enabling multiple sectors (energy, bioproducts, industrial processing, trade) to plug in and share capacity. Alberta can pre-permit rights-of-way and align Crown land access, positioning multi-use corridors as midstream assets that complement other jurisdictions' low-carbon priorities. Priority areas should include connections to northern transport and resource corridors, where road, rail, and port infrastructure are essential to unlock broader market access.
- **Pre-permit industrial zones:** Corridors only unlock value if they connect to investment-ready zones. Designating pre-permitted industrial zones — with power, water, and transport access in place — would create "investment-ready" platforms where multiple sectors can cluster. Coupling corridors with zones moves Alberta from proof-of-concept to full ecosystem, reducing investor risk and accelerating industrial siting decisions.

Recommendation 4: Treat Water as Strategic Infrastructure for Industrial Competitiveness

The case

Water is a shared and finite asset that underpins nearly all of Alberta's top economic opportunities. From critical minerals and hydrogen to CCUS, fuels and agri-food, most growth sectors are water-intensive or depend on reliable water services. Fully allocated southern basins and climate change mean supply is tightening. Without predictable access and credible governance, investors will view water as a hidden risk premium. While Alberta already has strong frameworks for water management and allocation, these were designed for stewardship, not competitiveness. The next step is to integrate water supplies directly into investment, corridor, and industrial planning — so that water becomes a managed advantage rather than a perceived constraint. Doing so must build on Alberta's collaborative water-planning foundations while addressing implementation gaps, to ensure municipalities and Indigenous communities are active partners in securing long-term water access for sustainable industrial growth.

Industry impact

- **Investment certainty:** Reliable water access reduces hidden risk premiums and ensures projects can scale without interruption.
- **Industrial siting:** Clear governance around water use, alongside power and land, makes Alberta more attractive as a location for large-scale facilities.
- **Capital access:** Global investors increasingly assess water stress in project finance; credible management lowers Alberta's perceived risk profile.
- **Trade competitiveness:** Secure, sustainable water use underpins long-term participation in export-oriented value chains, from food to fuels to advanced manufacturing.

Policy considerations

- **Modernize allocation systems:** Alberta could evolve FITFIR rules and basin caps to account for new low-carbon industries while protecting agricultural and municipal needs. This could include setting aside an "innovation pool" of water rights for hydrogen, CCUS, and minerals projects.
- **Enable reuse and efficiency:** Alberta has pilots for water recycling and reuse, but they remain limited. Clear approvals and targeted incentives could scale technologies like brine treatment, greywater loops, and water reuse in food and biotech processes — easing basin pressure and giving investors confidence in long-term supply.
- **Integrate into growth platforms:** Tie water access directly into corridor and industrial zone planning, so when Alberta markets a site as "investment-ready," water security is already part of the package (alongside power and land).
- **Signal leadership:** Launch a Water Security and Allocation Strategy to position Alberta as a credible jurisdiction. This would shift the narrative from water as a constraint to water as a managed, investable advantage — signaling to global buyers, investors, and allies that Alberta can sustain growth responsibly.

Recommendation 5: Compete on Supply Chains, Not Just Projects

The case

Alberta's industrial strategy has often been framed around attracting single large projects. But in global markets, competitiveness is shifting to **entire supply chains** — from inputs and logistics to processing, certification, and end-use integration. Countries like Korea and China win market share not by outbidding for a single plant, but by building reliable ecosystems where suppliers, logistics, standards, and financing are aligned. If Alberta continues to treat each project in isolation, it risks being leapfrogged by jurisdictions that can deliver full supply-chain solutions to buyers and investors.

Industry impact

- **Export credibility:** Buyers (e.g., auto OEMs, defence contractors, utilities) want reliable supply, not one-off facilities.
- **Integration benefits:** Supply-chain visibility lowers costs, improves resilience, and enables Alberta firms to plug into global value chains.
- **Investment stickiness:** Firms are more likely to scale and stay when they see a supportive ecosystem, not just a standalone site.
- **Trade leverage:** Coordinated supply chains position Alberta as a partner in North American and Indo-Pacific deals, rather than a marginal supplier.

Policy considerations

- Develop an **Alberta Supply Chain Competitiveness Framework** that maps inputs, logistics, processing, and certification across priority industries.
- Support **supply-chain integration hubs** where upstream, midstream, and downstream actors can co-locate or coordinate (critical minerals, hydrogen, ag protein).
- **Partner with federal trade bodies** and allies (e.g., U.S., Japan, Korea) to align Alberta supply chains with global buyers' procurement standards.
- Launch a **supply-chain transparency initiative** (digital tracking, certification, carbon intensity reporting) to make Alberta products verifiable and competitive in premium markets.

Recommendation 6: Expand Regional Hubs for Alberta's Industrial Future

The case

The buildout of Alberta's next wave of low-carbon industries is increasingly clustered in the Edmonton–Calgary corridor and Industrial Heartland. This concentration provides scale and efficiency but also creates geographic risk: delays or constraints in these hubs can ripple across the province's investment pipeline. Meanwhile, other centres across Alberta are beginning to attract interest in emerging industries—from bio-products to advanced manufacturing — offering a chance to diversify growth and reduce reliance on a single corridor. Diversifying growth across Alberta means building on the advantages of multiple regions, so new opportunities can take root wherever market interest emerges.

Industry impact

- **Risk management:** A more distributed industrial footprint reduces exposure to bottlenecks in transmission, permitting, or land access within a single geography.
- **Regional advantages:** Communities beyond the core corridor can offer lower-cost land, renewable resource potential, or proximity to specific feedstocks and markets.
- **Talent attraction and retention:** Regional opportunities spread employment growth and skills demand, making it easier to attract and retain workers across the province.
- **Resilience in global markets:** A broader map of investable regions signals that Alberta can flexibly host projects across multiple geographies, strengthening long-term competitiveness.
- **Industrial acceleration:** Expanding a network of industrial clusters will help fast-track project development and diversification across multiple regions, leveraging Alberta's digital and innovation ecosystem to speed technology adoption.

Policy considerations

- **Infrastructure readiness through alignment:** Instead of building from scratch, integrate regional transmission, transport, and water planning with provincial corridor development so that when projects emerge in secondary regions, baseline capacity is already in place.
- **Permitting consistency:** Standardize environmental review and interconnection requirements across the province. Right now, processes can be less predictable in smaller service territories than in the core hubs, raising perceived risk.

  Regional investment platforms: Support municipalities, Indigenous communities, and regional economic alliances to package and market "investment-ready" opportunities (land, utilities, zoning). Alberta already funds some of this via Invest Alberta and REDAs (Regional Economic Development Alliances), but the focus is uneven.
- **Transparent siting data:** Expand and standardize province-wide datasets (power availability, land servicing, workforce pools, water licenses) so investors can assess regional options with the same clarity as the Heartland.

Linking policy to action: a playbook for industrial development

The imperative of expanding regional hubs for Alberta's industrial future underscores the importance of coordinated, place-based approaches to building competitive sectors. To translate this policy direction into practice, we introduce the ***Industrial Development Playbook***. It presents a phased approach to sector development, detailing for each phase the system requirements, pathways to competitiveness, and critical risks to address. As a sectoral example, this playbook focuses on the development of a critical materials value chain for Alberta and Western Canada, including minerals and metals production and processing.

By connecting policy recommendations to actionable steps, the playbook provides a roadmap for translating Alberta's industrial potential into concrete, scalable outcomes.

Conclusion: from analysis to action

Alberta's emerging superpower: the next wave of industrial growth

Alberta has enormous potential across a range of low-carbon, resource-based opportunities. The opportunities identified in this report are more than promising ideas — they represent concrete pathways to securing Alberta's future economic competitiveness.

These opportunities span emerging low-carbon industries, industrial clusters, and resource-based markets poised for global growth. But this is about more than observing potential. It's about taking deliberate action while the opportunities are still visible and attainable.

Successfully capturing them could position Alberta not merely as a supplier of raw materials, but as a hub for value-added production, innovation, and clean-energy industries.

With global supply chains quickly forming, there's no time to lose, and delays risk missing windows of opportunity. Proactive investment, aligned policy, and ecosystem-building can secure Alberta's place at the forefront of resource-dependent, low-carbon development. The province's ability to act decisively now will determine whether it leads or is left on the sidelines in shaping the next generation of industrial growth.

The lenses in this report provide a practical framework to navigate through complexity and uncertainty, highlighting where regional fit, resource availability, and comparative advantage converge. But these opportunities cannot thrive in isolation. Coordinated infrastructure, investment-ready corridors, industrial hubs, and policy tools to de-risk capital are essential to foster collaboration among private investors, governments, and Indigenous partners.

Success depends on identifying what makes strategic sense; what works in one region may not work in another, and that's okay. Collaboration and alignment with local priorities and existing advantages is key, and top-down approaches no longer suffice. And regional priorities will inevitably vary; what works in Grande Prairie may not be a fit for Lethbridge or Innisfail, and factors like job creation, resilience to policy shifts, emissions reduction, or Indigenous participation will be determining factors in addition to economic potential.

Several sectors have already developed — or are developing — roadmaps that detail what is required to succeed and the potential returns if these steps are executed effectively. And enabling policy in this context must understand roadblocks, and deploy the right tools to unlock success.

Beyond economic gains, these actions can generate social, environmental, and community benefits, including meaningful Indigenous leadership and participation. It's about more than just the numbers, it's about developing supportive and enabling ecosystems.

Alberta has the resources, expertise, and emerging infrastructure to meet growing global demand.

The next steps will determine whether this potential is realized as thriving industries, resilient communities, and durable economic advantage — or whether it remains untapped.

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Authors and contributors

Keren Perla

Junan (Jacob) Rao

Marla Orenstein

Colleen Kaiser

Ailsa Popilian

Production

Jordan Joseph Wagner, Graphic Design

Disclaimer and limitations

This report reflects a collaborative effort led by the Energy Futures Lab, with contributions from staff, researchers, advisory committee members, Regional Innovation Networks, and other engaged stakeholders. The ideas and input shared through this process were invaluable in shaping the analysis presented here.

The findings and recommendations do not represent a unanimous view, nor do they necessarily reflect the positions of all contributors. Any errors or omissions remain the responsibility of the Energy Futures Lab. When referencing or reproducing this report, please include appropriate attribution and, where possible, a link to the full document.

This study provides a landscape assessment of Alberta's emerging low-carbon opportunities and does not capture the full range of perspectives or regional nuances across the province's diverse landscape.

While a dedicated analysis of Indigenous participation and leadership was not within the scope of this study, future work must more fully integrate Indigenous perspectives and recognize that Indigenous partnership is not peripheral to Alberta's low-carbon growth — it is a defining condition of success. Future work should more fully integrate Indigenous perspectives within regional approaches grounded in co-development, respect for Indigenous Rights and Title, and Free, Prior, and Informed Consent (FPIC), while also considering principles such as OCAP® (Ownership, Control, Access, and Possession) and Indigenous Intellectual Property given their importance as new technologies and value chains take shape.

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Appendix A

Additional Sector Assessments

Direct air capture (DAC)

Overview

Direct air capture (DAC) is a specific type of carbon capture, utilization and storage system. Rather than capturing carbon from industrial point sources (as is the case with CCS), DAC removes carbon from ambient air. This means that DAC is less constrained in terms of where it can be located—it doesn't need to be co-located with high-emissions industries but can instead be placed almost anywhere.

While DAC has been discussed for years, few commercial-scale facilities have been built, in Canada or globally. The primary challenge has been the comparatively high cost of capturing atmospheric CO2 via DAC. Estimates place the cost of capturing one ton of CO2 somewhere between USD $100 and $540, compared to about USD $15 to $120 per tonne for CCS.

The opportunity

Despite these cost challenges, DAC is beginning to gain traction in Alberta, where expertise in carbon management and storage provides a strong foundation for innovation. In August 2024, Deep Sky announced plans to build "the world's first carbon removal innovation and commercialization centre" in Innisfail. The lab, now operational, allows different DAC technologies to be tested and deployed. Eight DAC technologies had been confirmed for inclusion by the time of the announcement.

Hydrogen production

The potential to convert hydrogen to ammonia for export overseas is discussed later in the opportunity section for Ammonia as a Fuel below.

Overview

Alberta is already Canada's largest producer and consumer of hydrogen, with strong potential to expand its leadership in this emerging field. The province has all the necessary components for growth: abundant natural gas feedstock for blue hydrogen, a CCS regime to manage emissions, government supports such as the Petrochemicals Incentive Program and TIER credits, and an emerging research and implementation ecosystem.

Alberta's current hydrogen production is used primarily for industrial purposes. However, there is considerable potential to expand the sector to support lower emissions across provincial economic sectors — in particular transport, heating and power generation.

- **Transport:** Hydrogen can serve as a low-emission alternative to gasoline or diesel for long-haul trucking, locomotives, and return-to-base fleets such as buses and delivery vehicles. Although demand remains inconsistent in North America, this is currently the most promising market for hydrogen.
- **Heating:** Hydrogen can be blended with natural gas (up to about 20% by volume) within existing pipelines and distributed to homes and businesses, lowering emissions without major infrastructure changes.
- **Power generation:** Hydrogen could substitute for natural gas in power plants, though the environmental advantage over CCS-equipped gas plants remains uncertain. Another approach—being tested in the U.K.—is to use surplus renewable electricity to produce hydrogen that helps balance grid intermittency, effectively acting as an energy storage medium.

The opportunity

Several Alberta-based initiatives have begun laying the groundwork for a regional hydrogen economy. The Alberta Zero-Emissions Truck Electrification Collaboration (AZETEC) has launched a pilot program to build and test two hydrogen-powered freight vehicles operating between Calgary and Edmonton, alongside the Alberta Zero-Emissions Hydrogen Transit (AZEHT) initiative. CP Rail began testing a hydrogen fuel cell-powered locomotive in Calgary in 2022, and ATCO is piloting hydrogen blending within local gas distribution in Fort Saskatchewan.

While some projects have not advanced beyond feasibility — such as TC Energy's cancelled Crossfield Hydrogen Hub following Nikola's bankruptcy in early 2025 — momentum continues across the province. Regional hydrogen hubs have been established in the Edmonton and Calgary regions, with feasibility work underway for Medicine Hat. These hubs aim to coordinate production, transport, and end-use infrastructure, helping overcome the "chicken-and-egg" challenge of scaling supply and demand simultaneously.

A key constraint to address is water use, as all hydrogen production methods require large volumes of water, creating potential competition with other high-value sectors. Managing this challenge will be essential to balancing economic growth with resource sustainability.

Despite these hurdles, Alberta's combination of technical expertise, infrastructure, policy support, and energy sector experience positions it strongly to advance hydrogen innovation. With strategic coordination, the province can leverage its advantages to transition from industrial hydrogen use to a broader, integrated regional hydrogen economy supporting low-carbon transport, heating, and power.

CCS technology and services export

Overview

While deploying carbon capture and storage (CCS) in Alberta is inherently limited to activity within the province, there is a significant opportunity for Alberta companies to export CCS technology and expertise to other jurisdictions. Globally, CCS is gaining recognition as a key tool in achieving net-zero emissions, with North America and Europe showing the most rapid progress in recent years. Other regions, including the Middle East, China, and Southeast Asia, are beginning to advance CCS as they transition toward net-zero emissions. Canada is one of only 13 countries with operational commercial-scale CCS facilities and currently ranks third globally, trailing only the United States and China in terms of the number of projects in operation.

The potential market for CCS knowledge export is large. Hundreds of projects and facilities are in the planning stage globally. The most prominent jurisdictions with **strong, sustained interest in CCS** include the U.S., U.K., Canada, and Norway. Market forecasts estimate the global CCS market at USD $6 billion in 2023, growing to USD $18 billion by 2032. North America currently leads with an estimated 35% share of the market and is projected to reach USD $6 billion by 2032.

The opportunity

Alberta companies are well-positioned to capture this market due to several competitive advantages:

- **Established leadership:** Alberta is an early leader in CCS, with Canada ranking third globally for operational commercial-scale CCS facilities.
- **Skilled supply chain:** The province has expertise across the CCS value chain, including subsurface geology, energy infrastructure construction, and pipeline transport of hazardous materials. This knowledge is distributed across oil and gas producers, engineering and environmental firms, and other specialized companies.
- **Research and demonstration capacity:** Facilities such as the Carbon Management Centre (CMC) enable testing, development, and demonstration of CCUS technologies, providing evidence of safety, reliability, and effectiveness to potential international clients.
- **Innovation ecosystem:** Alberta fosters CCS innovation through institutions like the Alberta Carbon Conversion Technology Centre under InnoTech Alberta, accelerating the commercialization of GHG reduction technologies and de-risking solutions for industry.

These strengths position Alberta to export CCS expertise and technologies globally, supporting the growing number of projects worldwide while reinforcing the province's role as a leader in carbon management solutions.

Carbon utilization

Overview

Alberta is good at producing carbon, both on purpose and as a by-product. It is brought up from the ground in the form of bitumen, and it is captured in the form of CO2 emissions from energy-intensive industries. Existing carbon utilization has been mostly for fertilizer production and enhanced oil recovery use, others are such as food and beverage, welding, and fire suppression.

Carbon utilization technologies transform captured CO_2 into valuable products—from construction materials and industrial feedstocks to fuels and consumer goods. While still emerging, these markets offer Alberta a pathway to leverage its strengths in carbon capture, materials science, and industrial innovation, creating new value chains aligned with a net-zero economy.

Because of the province's ample carbon supply, substantial effort has been made to identify whether there are large-scale opportunities to use it as an input for new, net zero-aligned opportunities. Emerging areas of recycling carbon, including carbon-derived construction materials, fuels (e.g., SAF), chemicals (e.g., green chemicals), pure carbon materials, polymers, and food.[133] CCanada is among the most active countries in carbon capture and utilization (CCU) project development and ranks fourth globally in the number of CCS-related patents filed, following the United States, China, and the European Union.

Alberta already has a head start. The province is home to leading innovators such as Carbon Upcycling Technologies, Carbonova, and Enerkem, each demonstrating different facets of CO_2 conversion potential. Established carbon capture infrastructure, technical expertise in materials processing, and access to industrial byproducts position Alberta as one of Canada's most technically ready jurisdictions to advance carbon utilization.

Cement provides the most immediate and scalable opportunity: captured CO_2 not only locks carbon into the product but also enhances its performance. Meanwhile, advances in carbon fibre and industrial materials show promise for higher-value applications, supported by initiatives like the Alberta Innovates and Emissions Reduction Alberta (ERA) Carbon Fibre Grand Challenge.

The opportunity

As of 2024, global market revenues from carbon utilization were estimated at approximately USD $5.2 billion, with enhanced oil recovery (EOR) accounting for the majority share. While the Canadian carbon utilization market is still in its early stages, growth is expected to remain gradual in the short term. Projections for the global market beyond 2030 vary widely depending on policy support, technological innovation, and end-use applications, ranging from USD $10 billion to over $100 billion by 2030. Key sectors include fuels, chemicals, and building materials.

Alberta has invested heavily in carbon utilization innovation, building institutional and technological advantages:

- Grand Challenge for Innovative Carbon Uses (ERA, 2013): $35 million competition awarded technologies that sequestered CO_2 in concrete (CarbonCure) and recovered chemicals from oil field waste.
- NRG COSIA Carbon X Prize (2015): $25 million prize encouraged global finalists to use captured carbon in cement, consumer products, and synthetic gas. Winners included CarbonCure and USA-based CarbonBuilt.
- Alberta Carbon Conversion Technology Centre (2018, InnoTech Alberta): Facility to research, validate, and demonstrate CCUS technologies.
- Bitumen Beyond Combustion Program (2016, Alberta Innovates): Supports research and commercialization of non-combustion products, including carbon fibre, energy carbons for batteries, and asphalt binder.
- Carbon Fibre Grand Challenge (2023, Alberta Innovates & ERA): $26 million initiative targeting carbon fibre production from bitumen feedstocks at costs 50% lower than current production.

Despite these efforts, large-scale applications remain limited. Cement stands out as the largest near-term opportunity, while carbon fibre, industrial materials, renewable fuels, and niche consumer products demonstrate potential for incremental growth. Continued investment, commercialization support, and integration with Alberta's carbon management infrastructure can help transform captured emissions into a diversified, value-added industry, reinforcing Alberta's technical and industrial leadership in a net-zero economy.

Minerals and metals production and processing (con't)

Overview

Alberta has emerging opportunities in the production and processing of critical minerals and metals, leveraging existing oilfield infrastructure, water reuse technologies, and industrial waste streams. Key approaches include:

- **Direct lithium extraction (DLE) from brines:** Extracting lithium from Alberta's oilfield and saline aquifers, supporting battery production for EVs and electronics.
- **Waste recovery and reuse:** Recovering metals from tailings, produced water, industrial waste, and end-of-life electronics or batteries, reducing environmental impact while generating value.

These different production pathways can be mutually reinforcing. End users and offtakers are primarily motivated by availability and low carbon intensity rather than extraction method. Collectively, these methods reinforce Alberta's reputation as a reliable, conflict-free, and environmentally responsible source of critical minerals.

The opportunity: Direct Lithium Extraction (DLE)

A number of Alberta companies are working to commercialize lithium production at scale from brine beneath the province's oil resources. The Battery Metals Association of Canada identifies ten companies in this space, including E3 Lithium and Summit Nanotech.

Lithium is essential for battery production—for consumer electronics, EV batteries and other uses. Due to high and growing demand, companies around the world are racing to scale up production. Alberta has a number of advantages: the presence of lithium in brine, complementarity with the oil and gas industry, a government eager for the sector to succeed, and clear regulations specific to brine-based lithium extraction.

However, despite the size of the prize, DLE isn't a clear or easy win. DLE has been pursued in Alberta for a number of years, but technologies are still only in the pilot stage, and the process is very energy and water intensive. The potential environmental impact could be substantial. Cost is an issue and scale-up is a challenge, as lithium is more expensive to produce in Alberta than in locations such as California or Chile where brines are orders of magnitude more concentrated or where hard-rock lithium mining is possible.

The opportunity: Waste Recovery and Reuse

Another way to produce minerals and metals is to recover them from waste products and process them for re-sale. The costs and uncertainties are large, but the advantages are that it does not create new environmental disturbance, makes use of an already-produced product, and eliminates waste disposal problems. There are a number of potential waste streams appropriate for this use. Key opportunities include:

- **Urban mining:** Reclaiming metals from end-of-life products that would otherwise be discarded. For example, **Excir** extracts gold, palladium, and platinum from electronic waste and catalytic converters, selling gold to the British Royal Mint.
- **Industrial waste recovery**: Minerals such as vanadium can be recovered from petcoke or oilsands tailings. Suncor is developing a commercial-scale vanadium recovery plant with funding from Emissions Reduction Alberta. Synthetic graphite, essential for battery anodes, can also be produced from petcoke.
- **Recycling renewables and EV batteries:** Alberta is developing programs to recover key materials such as lithium, cobalt, and rare earth elements from end-of-life solar panels, wind turbines, and batteries. These programs could serve broader markets across Western Canada and the northwestern U.S., building on Alberta's existing Electronics Recycling Program.

By leveraging DLE and waste recovery, Alberta can strengthen its role in sustainable minerals and metals production, creating value from local resources and industrial byproducts while supporting low-carbon and circular economy objectives.

Geothermal technology and services export

Overview

Like CCS, geothermal energy production requires a strong understanding of subsurface geology and management, as well as drilling techniques where Alberta companies excel. This overlap creates a sizable opportunity for Alberta firms to apply and export their technology and services to countries that are ramping up geothermal energy production.

Currently, geothermal energy only meets less than 1% of global energy demand, and is concentrated in a few countries with high accessibility and quality resources. However, if its full technical potential were realized, geothermal could meet up to 15% of global electricity demand, or 800 GW of capacity, as its market potential grows through 2050. This represents a global market potential of USD $12-16 billion by 2033.

Alberta's ecosystem is positioning itself as a leader in geothermal innovation, supported by:

- The Government of Alberta's Drilling Accelerator, Canada's first open-access geothermal test site for drilling innovation.
- A robust intellectual property base, with numerous patents across 50+ relevant technology areas, many originating in oil and gas and directly applicable to geothermal.
- The University of Calgary's Energi Simulation Centre for Geothermal Systems Research, advancing multidisciplinary understanding of geothermal systems.

The opportunity

Among Alberta's geothermal innovators, Eavor Technologies stands out as a global success story. With multiple patents and international recognition, Eavor has:

- Been the first recipient of the Canada Growth Fund, receiving $90 million
- Raised $182 million in private financing (October 2023); and
- Secured $135 million from the European Innovation Fund to support a commercial project in Germany.

Eavor's progress illustrates Alberta's competitive advantage in geothermal technology export — combining technical excellence, demonstrated field performance, and strong international demand.

While the U.S. is a competitor rather than a likely customer, sharing many of the same oil-and-gas-derived advantages, there are growing export opportunities in regions such as Europe, East Africa, Asia-Pacific, and Latin America, where investment in geothermal energy is accelerating. By leveraging its existing expertise, infrastructure, and innovation ecosystem, Alberta can play a leading role in scaling global geothermal deployment—diversifying its energy economy while exporting clean technology solutions to the world.

Agricultural technology export

Overview

Agricultural technology (agtech) encompasses innovations such as sensors, robotics, automation, and software that improve agricultural efficiency, sustainability, and profitability. Rather than focusing on agricultural production itself, this opportunity concerns Alberta's potential to develop and export intellectual property and technology solutions globally.

Agtech plays an increasingly vital role in modern agriculture, helping to improve yields, reduce waste, optimize resource use, enhance soil management, and lower emissions. Globally, the agtech market was valued at nearly USD $22 billion in 2020 and is projected to double to almost USD $44 billion by 2030. North America currently accounts for over half of this market, with the United States leading development and commercialization.

The opportunity

Canada ranks as the third most advanced country in agtech behind the U.K. and the U.S., and is home to a significant concentration of investors and research capacity. According to the Information and Communications Technology Council, Canada has the second-highest number of agtech investors globally (after the U.S.), although it is unclear whether these investments are focused on technology development, adoption, or both. Alberta's contribution to this national strength is not explicitly detailed but is supported by a growing cluster of innovation and commercialization activity.

Notable Alberta agtech firms include Verge Ag, which develops software to optimize field operations and reduce input costs, and Provision Analytics, which offers traceability and food safety software to enhance compliance and quality assurance. These companies illustrate Alberta's potential to build exportable expertise that bridges agriculture, digital technology, and sustainability outcomes.

A 2024 report by the Arrell Food Institute at the University of Guelph and the Food and Agriculture Institute at the University of the Fraser Valley published a report on the state of Canadian agtech. The authors undertook extensive research to identify how Canada compares to other countries with strong agricultural innovation systems. It found that while Canada has strong agtech assets, critical supports are needed for innovators to stay competitive globally. The study highlighted long timelines between proof-of-concept and return on investment—often misaligned with investor expectations—a challenge that likely applies to Alberta's innovators as well.

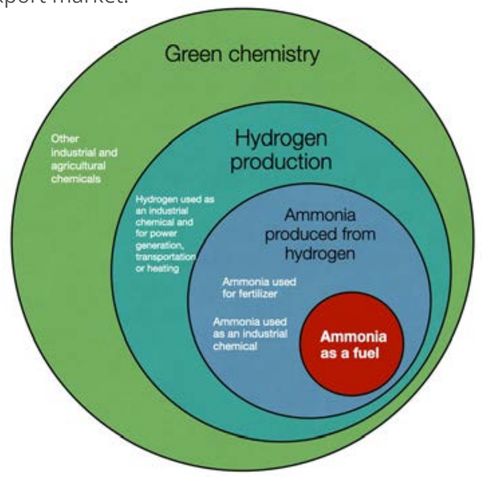
Ammonia-as-a-fuel

Overview

Ammonia offers a practical solution for transporting and storing hydrogen, which is otherwise difficult to move at scale. Produced by combining hydrogen and nitrogen under heat and pressure, ammonia can be shipped and later "cracked" back into hydrogen for use abroad. This positions it as a key carrier for exporting blue or green hydrogen from Alberta to international markets.

Ammonia sits at the intersection of the hydrogen and green chemistry opportunities. Globally, about 43% of hydrogen production goes toward ammonia, with roughly 80% used in fertilizer production and the remainder as a hydrogen carrier or fuel. While most demand today is for fertilizer, interest in ammonia-as-a-fuel is growing rapidly and particularly in Asia.

In 2023, the global hydrogen market was valued at US $160 billion and is projected to reach US $280 billion by 2032. The Asia-Pacific region—led by Japan and South Korea—will drive much of this growth. Japan expects to import three million tonnes of ammonia annually by 2030 and 30 million tonnes by 2050. South Korea forecasts needing seven million tonnes of clean hydrogen imports per year by 2040. While many European countries are also exploring hydrogen imports, Alberta's geographic position and transport limitations make Asia the more realistic export market.



The opportunity

Two major ammonia export projects are under consideration in Alberta:

- Marubeni Corporation and Pembina Pipeline Corporation, exploring blue ammonia production for export.
- Itochu Corporation and Petronas, pursuing a similar initiative tied to low-carbon hydrogen development.

Alberta holds several competitive advantages: abundant natural gas feedstock, established ammonia production capacity, a strong carbon capture and storage (CCS) regime, and supportive policies such as the Petrochemicals Incentive Program and TIER credits. Research indicates that blue ammonia produced in Alberta could cost 33–67% less to deliver to Japan than green ammonia from Australia, giving the province a clear cost advantage.

However, significant challenges remain. Japan and Korea are moving quickly to sign long-term supply agreements, and Alberta projects must move rapidly to secure a foothold. Infrastructure upgrades, particularly to rail and port systems, and coordination with British Columbia are needed to enable export volumes.

Environmental and policy uncertainties also pose risks. Blue ammonia's reliance on natural gas creates higher emissions than green ammonia, and evolving international standards for "low-carbon hydrogen" could limit market access if Alberta's lifecycle emissions exceed thresholds. Ammonia combustion can also generate nitrous oxides, greenhouse gases 273 times more potent than CO_2, underscoring the need for strong emissions management in end-use jurisdictions.

Global competition adds further pressure. China is investing heavily in hydrogen production, strengthening trade relationships across the Asia-Pacific, and positioning itself to lead global hydrogen market development. This could affect pricing and demand for Alberta's ammonia exports. Finally, ammonia's toxicity, volatility, and corrosiveness introduce safety and environmental challenges during storage and transport. Scaling this opportunity responsibly will require strict safety standards, public transparency, and ongoing collaboration between governments, industry, and trading partners.

Sustainable Aviation Fuels (SAF)

Overview

Sustainable Aviation Fuel (SAF) is an emerging but strategically important opportunity for Alberta. As aviation has limited options for decarbonization, blending conventional jet fuel with SAF is currently the only viable pathway to reduce emissions. SAF is derived from **biologic or waste-based feedstocks** such as used cooking oil, plant-based oils, forestry and agricultural residues, animal tallow, or carbon recycled from industrial or municipal waste. As with Waste-to-Energy, the choice of feedstock is important to the overall sustainability of the product.

While still in its infancy, the SAF market is growing rapidly as airlines and governments set ambitious emissions targets. Globally, SAF production has faced both technological and economic challenges, with multiple conversion pathways suited to different feedstocks and regional conditions. Costs remain higher than fossil jet fuel, but the gap is closing — from 2.9 times higher in 2020 to just 1.23 times higher by 2022.

It is difficult to quantify the size and value of the market, as this is a recently emerging opportunity. As recently as 2019 there was no SAF being produced commercially either in Canada or globally. However, the aviation sector has ambition to grow the use of SAF quickly. In 2023, the global SAF market was valued at US $1.1 billion, with forecasts projecting a compound annual growth rate of 61.5%, reaching US $20 billion by 2030, including US $9 billion in North America. Canada remains a small but active contributor, with Alberta leading due to its refining capacity, feedstock availability, and industrial expertise.

The opportunity

Alberta's potential in SAF production lies in both domestic supply and regional export across Western Canada. Conventional jet fuel refined in Alberta already supplies airports across Alberta, B.C., Saskatchewan, and Manitoba — an established distribution pathway that SAF could follow. Alberta's SAF could also be purchased by international airlines refueling in these locations, including through "economic tankering", where airlines take on additional SAF while it's available.

The Canadian Council for Sustainable Aviation Fuels (C-SAF) has set a national target of 1 billion litres of SAF production by 2030, equivalent to about 10% of Canada's jet fuel consumption. Other estimates from Deloitte Canada also published independent estimates of SAF production in Canada for 2030 and 2050, based on two sets of assumptions: those of the International Air Transportation Associations (IATA) and on the International Energy Agency (IEA).

Estimates of future SAF production in Canada

Source	Year	Litres of Fuel Produced
CSAF Roadmap	2030	1 billion litres
Deloitte Canada (using IATA assumptions)	2030	0.5 billion litres
	2050	6.5 billion litres
Deloitte Canada (using IEA assumptions)	2030	1.5 billion litres
	2050	7.5 billion litres

Several Alberta-linked projects are already underway:

- Azure Sustainable Fuels (Calgary) – Partnering with Shell to build a major SAF facility in Manitoba, expected to produce 1.17 billion litres per year by 2027, with expansion plans in B.C. and Ontario.
- Expander Energy and Cielo Waste Solutions – Developing processes to produce bio-synthetic jet fuel from forestry residuals and other non-food feedstocks.
- Cap Clean Energy (Calgary) – Exploring SAF production using wheat straw and crop byproducts, with future facilities envisioned in Alberta, Saskatchewan, and Manitoba.
- SixRing – Advancing proprietary chemistry processes for SAF and other bio-based fuels.

Alberta's competitive advantages include:

- Established refiners (Suncor, Esso, Shell) already producing and shipping jet fuel.
- Abundant feedstock from agriculture and forestry, plus strong logistics for collection and transport.
- Access to CCS and low-emission electricity to further decarbonize production.
- Skilled workforce and supply chains with hydrocarbon production expertise.
- Growing R&D ecosystem, including C-SAF (based in Calgary) and the Bressler Biorefining Lab at the University of Alberta, which received $2.89 million from NRCan to develop waste-lipid biofuels.
- The Bioeconomy Development Opportunity (BDO) Zone Initiative, which in October 2024 awarded Vegreville an "A" rating for wheat straw readiness, identifying it as an optimal region for bio-based development.

In sum, Alberta's combination of feedstock, refining infrastructure, and innovation capacity make it well positioned to capture early market share in this rapidly expanding sector. Growth in SAF would not only decarbonize aviation but also reinforce Alberta's emerging bioeconomy and aerospace industries, supporting regional competitiveness in a global clean fuels market.

Appendix B

Foresight Scenarios

Bones of the Scenarios

Primary Critical Uncertainties (axis of the matrix)

Fed-Prov Climate-Energy Leadership

This axis captures how unified, assertive, and effective the federal government (under Carney) is in steering a national energy and climate strategy

- **Strong:** Coherent national vision, alignment across provinces, bold regulatory and investment tools
- **Fragmented:** Political resistance (especially from Alberta) legal challenges, or weakened mandate erode federal authority and coordination.

U.S. Energy Strategy & Trade Relationship

This axis reflects how supportive or disruptive the U.S. is to Canada's energy goals including trade dynamics, infrastructure cooperation, and climate policy alignment.

- **Collaborative:** Stable trade environment, shared climate goals, infrastructure partnerships
- **Adversarial:** Protectionism, fossil fuels resurgence, pipeline blockages, tariffs on Canadian energy.

Supporting Drivers of Change

Global Energy Demand

Will global markets (e.g. Europe, Asia) demand Canadian LNG, hydrogen or low-carbon fuels?

Investor Sentiment & Capital Flows

Will institutional investors favour ESG-aligned projects or retreat from high-emissions jurisdictions like Alberta?

Technology Adoption Rates

How quickly will carbon capture, hydrogen, and renewables become cost-effective at scale in Alberta?

Pubic & Workforce Support

Will there be public backing and labor mobility for a fair transition?

Infrastructure Readiness

Will Alberta and Canada build out the infrastructure needed to access new energy markets (e.g., LNG terminals, transmission lines)?

Indigenous Partnership

Will Indigenous communities be partners in shaping Alberta's energy strategy?

Foresight Scenarios

Scenario Overview

	ENERGY REALIGNMENT	CLEAN SOVEREIGNTY	FRAGMENTED FUTURES	CARBON CLASH
Fed-Prov Climate-Energy Leadership	Strong, pragmatic alignment	Strong and aligned with Alberta	Contentious, strained	Polarized & confrontational
U.S. Energy Strategy & Trade Relationship	Transactional, unstable	Collaborative but competitive	Adversarial & protectionist	Hostile & punitive
Global Energy Demand	Balanced demand across sectors	High for clean fuels and clean tech	Volatile, favouring lowest cost	Constrained, fragmented markets
Investor Sentiment & Capital Flows	Mixed - traditional & clean	High ESG investment in clean tech	Risk-sensitive, hesitant	Withdrawn, minimal
Technology Adoption Rates	High (diverse tech mix)	High (CCS, hydrogen, renewables)	Moderate, uneven	Low, stalled by instability
Public & Workforce Support	Cautious optimism, regionally varied	Strong, with retraining success	Polarized, rural-urban divides	Weak, driven by job loss & fatigue
Infrastructure Readiness	Mixed readiness, some bottlenecks	Expands with clean export corridors	Slow rollout, fragmented systems	Stalled or politically blocked
Indigenous Partnerships	Key roles in strategic projects	Equity-driven and central to growth	Emerging, inconsistent	Minimal, often conflictual

Energy Realignment

SUMMARY: A pragmatic Ottawa collaborates with provinces to diversify traditional and emerging sectors and secure global partnerships, while the US unpredictably swings between an adversarial to neutral stance with Canada, prompting Canada to further diversify energy markets. Alberta advances a collaborative dual-track approach — maintain fossil exports while investing in infrastructure to reach Asia and Europe.

5-Year Outlook: Infrastructure projects underway; diversified investor interest.

By 2035, Canada emerges as a global energy superpower, with Alberta at its core. A cooperative U.S.- Canada trade deal in 2026 exempts Canadian oil and gas from tariffs, preserving U.S. market access. Carney's government and Alberta align on a programmatic energy strategy: the emissions cap is replaced with generous CCS subsidies, and a new federal-provincial agreement fast-tracks pipelines to eastern Canada and western LNG terminals for Asian markets.

10-Year Outlook: Alberta becomes a clean export hub with strong Indo-Pacific ties.

Alberta's oilsands thrive with low-carbon production, supported by Pathways Alliance's CCS network. Hydrogen exports to Europe and critical mineral mining for EV batteries boom, leverage Alberta's geological expertise. Investment pours in, with Calgary as a hub for clean energy innovation. However, environmental groups criticize the slow pace of renewable energy adoption.

Geopolitical Assumptions

Global realignment

Europe and Asia seek stable suppliers

Market Assumptions

Strong demand for LNG, hydrogen, and emissions tech.

Key Features

- **Traditional sectors:** Oil and gas exports grow, with 2 million bpd to Asia via new pipelines
- **Emerging sectors:** Hydrogen production reaches 1 million tonnes/year; critical mineral mins supply 10% of global EV battery needs; Renewables: 46% of electricity
- **Economic Impact:** Alberta's GDP grows 3% annually:
- **Emissions:** Oilsands emissions drop 30% due to CCS.
- **Jobs:** 100,000 new energy jobs created in Alberta.
- **Indigenous:** Equity stakes accelerate project approvals.
- **Technology:** CCS and battery storage advancements enhance competitiveness.

Clean Sovereignty

SUMMARY: Ottawa prioritizes decarbonization, regulatory certainty, and clean energy investment. A retrenched U.S. imposes tariffs and withdraws from global climate leadership. Alberta aligns with federal direction, investing in renewables, CCUS, and workforce transition.

5-Year Outlook: Strong green sector expansion, improving investor confidence.

U.S tariffs escalate in 2027, slashing Canadian oil exports by 20%. Carney and Alberta unite to pivot away from U.S. dependence, prioritizing energy corridors to tidewater.

10-Year Outlook: Alberta emerges as a leader in clean tech exports, but oil sector shrinks.

By 2035, Alberta exports 1.5 million bpd to Asia via new LNG and oil pipelines, displacing Middle Eastern suppliers. Federal tax credits and a relaxed emissions cap enable oil sands producers to scale CCS. Hydrogen from Fort McMurray supplies Europe, while wind and solar farms power a new east-west electricity grid. Indigenous communities hold equity in major clean energy and hydrogen projects, accelerating approvals and attracting ESG investment. Critical mineral mines face delays due to environmental reviews. Alberta's clean tech sector grows, drawing global talent. Smith's government celebrates "Alberta Sovereignty" within Canada, but growth remains modest as the province absorbs the shock of reduced U.S. market access. The pivot to clean exports is real, but uneven — with rural communities struggling through transition.

Geopolitical Assumptions

Global climate ambition rises

U.S. isolates.

Market Assumptions

Clean tech becomes cost-competitive

ESG capital flows dominate.

Key Features

- **Traditional sectors:** Oil exports shift to Asia; LNG exports triple.
- **Emerging sectors:** Hydrogen exports at 800,000 tonnes/year; renewables supply 20% of Alberta's grid
- **Economic Impact:** GDP growth slows to 1.5% annually
- **Emissions:** Oilsands production stable but emissions reductions lag.
- **Jobs:** 50,000 new jobs, but rural job losses persist
- **Indigenous:** Key to new infrastructure development.
- **Technology:** Renewable storage and hydrogen innovations drive exports.

Fragmented Futures

SUMMARY: Ottawa faces regional backlash and reduced authority. The US exploits Canadian disunity to dominate North American energy. Alberta pushes a sovereignty agenda and builds direct ties with U.S. markets and actors which further deepens provincial disunity.

5-Year Outlook: Polarized public discourse; stalled national projects.

U.S. tariffs cripple Canadian oil exports by 2028, and Alberta-Ottawa tensions boil over. Carney doubles down on climate policies, enforcing a strict emissions cap and blocking new pipelines.

10-Year Outlook: Alberta positioned as a "Texas of the North," but unstable.

By 2035, oilsands production drops 30%, and 60,000 jobs vanish. Most Alberta oil continues flowing to the U.S., but at weaker margins. Alberta's hydrogen and renewable sectors grow modestly, driven by federal incentives, but face global competition. Critical minerals projects are mired in litigation. Smith's sovereignty push sparks a referendum, narrowly defeated, further polarizing the province. Calgary pivots to clean tech, but rural Alberta faces economic challenges. Canada's energy superpower ambitions fail and global markets turn to U.S. and Middle Eastern suppliers. Environmental gains are offset by rising global emissions.

Geopolitical Assumptions

Western alliance fractures

Bilateral deals proliferate

Market Assumptions

Investment flows to politically aligned jurisdictions

Key Features

- **Traditional sectors:** Oil production falls to 2.5 million bpd; LNG exports negligible.
- **Emerging sectors:** Hydrogen at 500,000 tonnes/year, renewables at 15% of grid.
- **Economic Impact:** GDP contracts 1% annually
- **Emissions:** Oilsands production stable but emissions reductions lag.
- **Jobs:** widespread unemployment in rural areas.
- **Indigenous:** Federal push meets provincial resistance.
- **Technology:** Federally-driven innovation slowed by adoption challenges.

Carbon Clash

SUMMARY: Industrial carbon pricing continues, but political resistance weakens national coherence. In the US, diplomatic frictions with Canada persists while fossil fuel subsidies and protectionism dominate. Alberta advances a strong resistance to Ottawa, legal battles, and sovereignty assertions, while attempts to engage U.S. fail.

5-Year Outlook: Economic stagnation in oil-reliant areas; legal friction escalates

U.S.-Canada trade stabilizes by 2026, but Alberta and Ottawa remain at odds. Carney's emissions cap and Impact Assessment Act frustrate oil sands producers, who scale back investment.

10-Year Outlook: Alberta isolated, struggling to attract capital.

By 2035, oil production stagnates at 3.5 million bpd, with minimal CCS adoption due to subsidy disputes. Alberta's hydrogen and renewable projects falter under regulatory delays and low investor confidence and critical mineral mining is stalled by federal environmental reviews. Smiths "Fair Deal" panel fuels separatist rhetoric, alienating investors as creating conflicts with Indigenous communities delaying major projects. Calgary's economy diversifies into tech, but rural Alberta suffers job losses. U.S. markets absorb Canadian oil, but Alberta misses major export opportunities in Asia and Europe — including shelved LNG and hydrogen deals. Environmentalists praise Carney's climate stance, but Canada's net zero goals slip.

Geopolitical Assumptions

U.S.-Canada tensions grow

Global climate cooperation declines

Market Assumptions

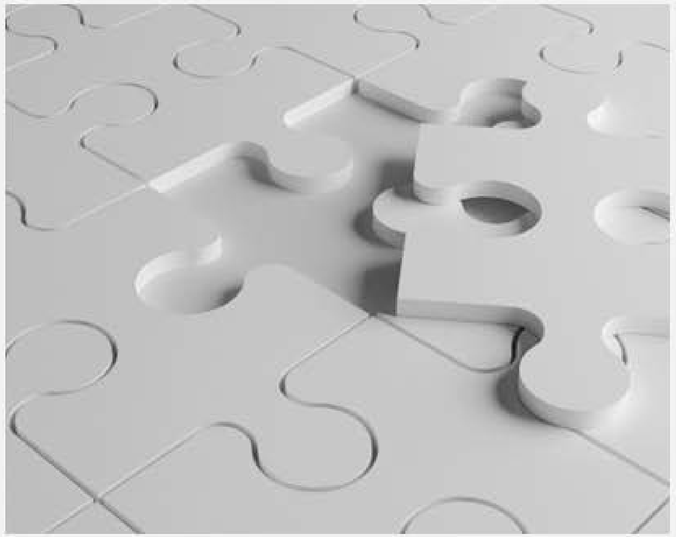
Oil volatility

Divestment pressures increase

Key Features

- **Traditional sectors:** Oil exports flat; no new pipelines built.
- **Emerging sectors:** Hydrogen and renewables grow slowly, contributing 5% to energy mix.
- **Economic Impact:** GDP growth at 0.5%
- **Emissions:** Emissions reductions minimal.
- **Jobs:** 20,000 job losses in oil and gas
- **Indigenous:** Conflicts delay projects.
- **Technology:** Limited innovation due to low investment.

Additional Food for Thought



The following is a starter set of further implications for Alberta in a future where Alberta markets are increasingly isolated.

Challenges

Political gridlock

Declining investor confidence

Missed global market opportunities

Strategic Implications

Alberta must negotiate compromises with Ottawa (e.g., emissions cap flexibility) to unlock investment

Focus on small-scale, high-return clean energy projects to maintain momentum.

Address separatist sentiment to restore investor trust

energyfutureslab

Energy Futures Lab

www.energyfutureslab.com
info@energyfutureslab.com

Mailing Address: c/o
5th Floor The Ampersand East Tower
112 4 Ave SW
Calgary, AB T2P 3G4