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TECHNOLOGY ROADMAP

EMISSIONS REDUCTION ALBERTA

Investing in technologies that improve our environment and economy.

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Heidelberg Materials Cement Plant Near Edmonton, Alberta

MESSAGE FROM THE CEO

Ten years ago, Emissions Reduction Alberta (ERA) developed the first edition of this Technology Road Map (TRM) to outline the strategic direction for our investment. Over the decade, ERA has experienced and adapted to countless changes in the ecosystem. Markets have evolved, shaped by trade uncertainty and shifting geopolitical relationships; technologies have advanced, and new constraints have emerged – all of which are changing where and how ERA invests.

Innovation is also becoming an imperative for competitiveness and resilience. Alberta's ability to develop, deploy, and export homegrown technology solutions will be increasingly important to maintaining market access, attracting investment, strengthening domestic supply chains, and creating new economic opportunities. Through the TRM, ERA will continue to support technologies that reduce emissions and position Alberta as a global supplier of innovative solutions to emerging environmental and industrial challenges.

This edition reflects intentional changes in response to recent developments in the policy and technology landscape, including:

- The May 15, 2026 Alberta-Canada MOU Implementation Agreement and Alberta's carbon price certainty to 2040 have created a more stable investment environment
- Rising electricity demand has made firm generation, transmission, storage, behind-the-fence supply, flexible loads, and grid-enhancing technologies increasingly important
- Changes in U.S. policy and geopolitical trade have altered the outlook for some technologies while strengthening Alberta's ability to attract capital and talent
- Weaker voluntary carbon markets have made securing offtake a greater challenge for carbon removal projects
- Trade uncertainty and supply chain security have increased the strategic importance of critical minerals
- Artificial intelligence has become both a productivity tool and an infrastructure issue reshaping Alberta's electricity system.

Together, these and other significant developments reinforce the need for a forward-looking and disciplined investment approach – and they demand clear choices regarding where and how ERA can have the greatest impact. Competitiveness and market access remain central. Alberta industries are seeking to sell their products in markets that increasingly consider carbon intensity as a key metric. Technologies that improve that performance can also lower costs, reduce emissions, and help Alberta companies compete globally. That is where environmental and economic returns converge, and it's the test every investment in this roadmap has to pass.

The TRM is grounded in a "portfolio of portfolios" approach, supported by qualitative assessment criteria and a clearer consideration of technology attrition and portfolio risk. It identifies where ERA will invest and, equally important, where we will step back. Our relatively narrow mandate, paired with our flexibility and ability to pivot as market and policy needs change, are among our key strengths. The TRM is one of our strengths. It allows us to focus on technologies with credible commercial pathways and the greatest potential to strengthen Alberta's economy and industrial competitiveness.

By responsibly reinvesting funds from a variety of sources, ERA helps advance and de-risk technologies with the potential to become practical, commercially viable solutions.

Thank you to everyone who contributed their knowledge and experience to this work. I trust you will find the Sixth Edition informative and useful as we turn Alberta's strengths into future opportunities.

JUSTIN RIEMER

CHIEF EXECUTIVE OFFICER
EMISSIONS REDUCTION ALBERTA



INTRODUCTION

ABOUT ERA

Emissions Reduction Alberta (ERA) is an arm's-length, independent, not-for-profit organization created in 2009 to accelerate the development and demonstration of novel technologies that strengthen the competitiveness of industries in Alberta while reducing emissions and improving environmental outcomes. To deliver on its mission, ERA relies upon a competitive, transparent, efficient, and outcomes-focused model guided by an evidence-driven technology investment strategy: the ERA Technology Roadmap (TRM). The TRM shapes how ERA responsibly makes non-dilutive investments into pilot, demonstration, first-of-a-kind implementation, and commercial adoption projects that align with its mandate.

To learn more about ERA and our current programming, visit ***www.eralberta.ca.***

EMISSIONS REDUCTION ALBERTA

Investing in technologies that improve our environment and economy.

Alberta

Canada

HOW ERA IS FUNDED

ERA receives its funding from multiple provincial, federal, and industry sources, including:

GOVERNMENT OF ALBERTA

Alberta was the first in North America to establish an industrial carbon pricing and emissions trading system in 2007. This system is currently governed by the Technology Innovation and Emissions Reduction (TIER) Regulation. TIER encourages industrial operators to innovate to reduce emissions and invest in clean technologies, helping them stay competitive and reduce costs. ERA receives a portion of the proceeds from TIER through a Grant Agreement with the Government of Alberta, and is a key delivery mechanism for the Government of Alberta's objectives relating to TIER. The combination of regulatory pull created by TIER and the technology push supported by ERA's investment of TIER funds via grants, incentives, and other tools creates a powerful driver to accelerate technology development and implementation in Alberta.

GOVERNMENT OF CANADA

ERA also receives funds from Federal sources, including the Green Industrial Facilities and Manufacturing Program (GIFMP) and the Low Carbon Economy Leadership (LCELF) fund, funded through Natural Resources Canada and Environment and Climate Change Canada, respectively. These funds leverage provincial and private funding and are used to deliver incentive programming and strategic grants.

DIRECT INDUSTRY CONTRIBUTIONS VIA THE FEDERAL CLEAN FUEL REGULATIONS

ERA recently expanded its role by launching the Fuel Innovation Fund (FIF), a subsidiary of ERA and a federally registered emissions-reduction funding program (ERFP) under Canada's Clean Fuel Regulations. Contributing to an ERFP is one of several pathways by which primary suppliers can meet their annual carbon intensity reduction requirements. FIF's mandate is to reinvest industry ERFP contributions into projects that deliver measurable emissions reductions, strengthen industrial competitiveness, and accelerate progress on clean fuels in Canada. While ERA's Technology Roadmap is relevant to emerging technologies for Alberta's fuels and refining sectors, the Fuel Innovation Fund follows a separate investment strategy focused on Canada-wide opportunities for commercial deployment of solutions with direct, near-term emissions reductions. More information can be found at ***www.fuelinnovationfund.ca***

FUEL INNOVATION FUND



Olds College of Agriculture & Technology

TECHNOLOGY ROADMAP OVERVIEW

PURPOSE

ERA's Technology Roadmap (TRM) guides the organization's technology strategy, informing business planning, program design, and investment decisions. The TRM underpins ERA's mandate to support and advance a comprehensive roster of pre-commercial and commercial-ready technologies and solutions. This mandate works towards a vision in which a broad suite of technology solutions is de-risked to support public- and private-sector efforts to reduce emissions and environmental impacts, drive economic competitiveness, and enhance the broader economy.

The TRM identifies key areas of opportunity where ERA's unique mandate and model can have the greatest impact. It aligns ERA's efforts with government priorities, technology trends, and the broader environment and innovation ecosystem in Alberta.

In developing the TRM, ERA's own technology experts continually engage with government, industry, investors, innovators, thought leaders, and subject matter experts to ensure that its focus areas align with the strongest opportunities for achieving a lower-carbon future and creating economic opportunities for Albertans. Consulting with a broad range of stakeholders helps ERA establish a strategic vision for a balanced portfolio that accounts for uncertainty in the pace of technology development and the complexity of system transformations.

OBJECTIVES OF THE TRM

The TRM achieves its overarching purpose by delivering on the following objectives:

1. **Establish and promote a vision for Alberta as a leading jurisdiction for the development and deployment of technologies that reduce emissions and/or improve environmental performance to**:
   - attract ideas, talent, and investment to the province
   - enable Alberta's businesses to access and invent world-leading technology solutions that will help them maintain global competitiveness, explore new business opportunities, and access export markets
   - highlight how ERA's investments can contribute to a better future for Alberta and the world
   - enhance global recognition of Alberta as a leader and a hub for economically competitive emissions reduction and environmental technology innovation.
2. **Characterize the current state of play regarding emissions reduction opportunities and challenges in Alberta to:**
   - recognize Alberta's unique needs and strengths in the context of greenhouse gas (GHG) emissions, economic competitiveness, and technology innovation
   - identify the technology solutions necessary for Alberta to thrive in a carbon-neutral future and any barriers that hinder their adoption
   - ensure ERA's investment strategy is responsive to the rapid pace of change, shifting trends, and emergent drivers locally and globally.
3. **Define the optimal focus for ERA's investments to:**
   - ensure ERA's strategy is aligned and coordinated with its unique mandate and value proposition, market needs, and the interests of key stakeholders to make deliberate, focused investment decisions to drive meaningful impact
   - prioritize investment areas where ERA funding can be most effectively leveraged to target underfunded areas while achieving targeted outcomes
   - harness the power of responsibly directing public funds toward innovation and technology
   - ensure Albertans benefit from the health, social, affordability, resilience, and other advantages associated with the adoption of new technologies.
4. **Outline key guideposts, objectives, and metrics to:**
   - ensure ERA's investments deliver meaningful outcomes aligned with where Alberta can create real economic value, globally competitive industries, and environmental and economic benefits over various timescales
   - enable effective tracking, benchmarking, and reporting of outcomes to establish the key indicators of progress and commercialization success
   - support thought leadership and outreach
   - provide a clear line of sight between ERA funding and meaningful impact.

DEFINING THE ROADMAP: METHODOLOGY AND CONTEXT

DEVELOPMENT APPROACH

The TRM is a living document that is reassessed and updated biennially to ensure ongoing alignment and relevance. It is developed as part of an ongoing process to help ERA remain flexible and responsive while adapting to new information, challenges, opportunities, and uncertainties. TRM development is guided by internal research, analysis of lessons learned from ERA's existing investment portfolio, ongoing consultations with the Government of Alberta, and collaboration with key experts and stakeholders.

ERA's methodology for updating the TRM used a rigorous process based on the best-available evidence and expert input. Following initial research and content development, ERA engaged academic and ecosystem leaders through one-on-one meetings and group discussions. These sessions explored the challenges innovators face today, emerging trends and disruptions, global factors shaping technology development and deployment, organizations' innovation priorities, and ERA's existing focus areas and technology portfolio. Participants also identified Alberta's greatest opportunities for technological advancement, assessed technology readiness, and shared perspectives on the role ERA can play in accelerating emissions reductions and economic growth.

The TRM then underwent multiple rounds of refinement and was shared with strategic partners and key government stakeholders for further consultation and validation. This iterative process ensures that the guideposts, pathways, and priorities accurately reflect Alberta's industries, emissions challenges, and opportunities.

Each of these elements and how they contribute to the design of the TRM focus areas is discussed in the document.

GUIDING PRINCIPLES

ERA's mandate focuses on supporting new and innovative technologies that could one day join the roster of commercialized, bankable solutions already being deployed. ERA's TRM is built upon 7 key principles and insights that provide rationale and context for the technology focus areas in the strategy:

1. **Focusing on Alberta:** ERA's technology investment strategy targets opportunities for Alberta to leverage its strengths, including its natural resources, highly skilled workforce, and strong innovation ecosystem. It accounts for local factors such as Alberta's unique industrial mix, policy landscape, and sectoral needs, in order to focus on solutions with a strong market potential in the province and beyond. At the same time, it is imperative that the TRM recognizes the distinction between areas where Alberta is or could become a leader versus those where it is more advantageous to learn from others as a fast follower. → **The focus areas are specifically relevant to Alberta and address the local context.**

2. **Targeting innovation and de-risking solutions:** The technology landscape is constantly shifting and improving with the result that many solutions relevant to ERA's mandate are now fully commercial and whose further adoption will be mainly driven by market forces and policies. However, there is always the need to improve existing technologies, develop substitutes, create new markets, de-risk novel approaches, and accelerate adoption of newly commercial solutions in order to maximize competitiveness. Moreover, the emerging technologies that will meet the needs of 2040, 2050, and beyond require investment today to move them towards commercialization. → **The focus areas align with ERA's mandate to de-risk and accelerate novel solutions to complement the array of already-commercial opportunities.**

This edition of the TRM is informed by the valuable insights of stakeholders and thought leaders from across Alberta, Canada, and beyond. ERA sincerely thanks all contributors for their expertise and collaboration.



Chris Doornbos, President and CEO, E3 Lithium

3. **Reading the guideposts:** As a strategy to attract and develop leading emissions-reduction solutions, the TRM incorporates and reflects the most current, accurate, and reputable perspectives and insights regarding the opportunities and challenges in this space. The TRM accounts for recent technological and geopolitical trends and influences while maintaining a long-term vision that remains unaffected by the "hype cycles" frequently associated with nascent technologies. Critically, the TRM builds on more than 17 years of learning and insights gleaned from ERA's existing portfolio of investments, ensuring that past results inform future decisions. → **The focus areas reflect current technology trends and are based on best-available expert judgment and lessons learned from the portfolio.**

4. **Acting with the end in mind:** Recognizing that the investment, time, talent, and effort required to develop new technologies are finite resources, the TRM seeks to identify the highest-leverage opportunities that are aligned with its long-term objectives. The TRM focuses on a broad suite of technology areas that will all be necessary and valuable in any future scenario where carbon neutrality is achieved, rather than specifying a particular pathway. Crucially, the TRM focuses on competitiveness on both economic and environmental terms as the key driver, rather than as a byproduct. → **The focus areas embrace the need to develop a robust "toolkit of solutions" rather than an "instruction manual" for reducing emissions and point the way towards achieving a positive vision for the future.**

5. **Taking a portfolio approach:** Investment in new technologies is inherently an exercise in managing uncertainty, balancing short-, medium-, and long-term opportunities, and weighing risk versus reward. The TRM recognizes the need to support solutions at various stages of maturity, with the objective of advancing a broad set of technologies toward commercialization. Given the urgent nature of the emissions challenge, the TRM seeks to balance the need for "quick win" solutions that can deliver immediate emissions reductions by 2030, transition technologies to support reductions by 2050, and a pipeline of long-term transformative and "last-mile" solutions needed in 2050 and beyond. This approach, enabled by ERA's efficient and flexible business model, will result in a diverse portfolio that is balanced across timescales, technology readiness levels (TRLs), and technology categories. → **The focus areas are defined by a "portfolio of portfolios" approach, encompassing solutions across a diverse range of opportunities and allowing for multiple paths to success over various time horizons.**

6. **Aligning supports with market need and maximum leverage:** The TRM positions ERA to make the greatest impact in the focus areas by identifying the most effective ways ERA can support emissions reduction solutions, strengthen economic resilience and market access. The roadmap recognizes that every sector and technology has different needs when it comes to support. Additionally, the TRM appreciates that de-risking technologies and commercial rollout can take various forms, including grants for pilot projects, support for pre-construction studies, and incentives for broad market adoption. The roadmap also accounts for the different risk appetites, capital intensities, and cost structures unique to each sector. ERA prioritizes technologies that strengthen Alberta's ability to compete in global markets, improve supply chain resilience, and create export opportunities.→ **The focus areas account for the diverse needs and challenges inherent to different sectors and technologies.**

7. **Recognizing the need for complete solutions and ecosystem alignment:** As a trusted, independent validator and supporter of new technologies, ERA plays a critical role in convening technology customers, industry, policymakers, investors, and other ecosystem partners to help ensure new technologies receive the support they need. Given the multitude of factors that can either inhibit or enable a technology's success, a focus on technology alone is not enough. The TRM accounts for factors beyond technology, such as financing, policy, business models, talent, and dissemination of results that create the right conditions for success. → **The focus areas inform ERA's unique role as a convenor, responding to the need for holistic support and ecosystem alignment to drive successful commercialization of technologies**.



Aidan Mills, CEO, and Thani Rajarathinam, General Manager, at Northstar's Empower Calgary Facility

ALBERTA'S EMISSIONS REDUCTION OUTLOOK

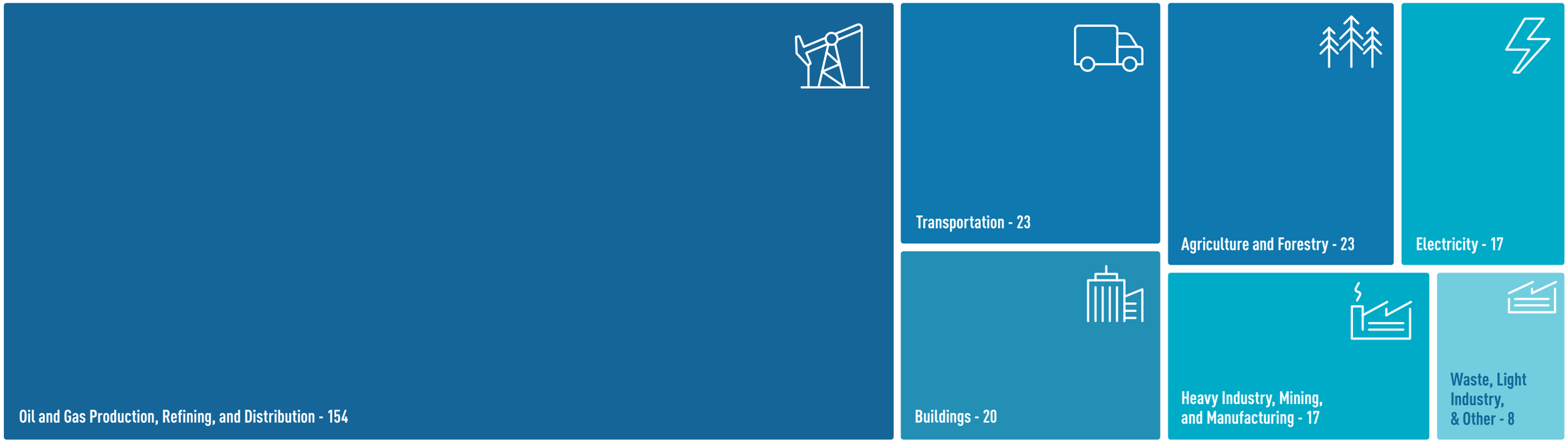
ERA's investment strategy is fundamentally based on the competitiveness gains that come from improving environmental performance. This can manifest as reduced costs to mitigate environmental impacts, reduced costs from environmental damages, improved productivity, reduced energy costs and enhanced reliability, and new product lines, among others. In designing the TRM, ERA considers a broad set of economic, social, environmental, and technological factors. Among the most critical factors are Alberta's current emissions levels, sectoral emissions profiles, and their trajectory into the future—these inform the landscape that shapes the TRM and defines the opportunity space for new technologies to have meaningful impact.

WHERE WE ARE:

At the time of writing, the most recent full dataset for provincial and national GHG emissions is reflected in *Canada's 2026 National Inventory Report (NIR)*, which includes data up to 2024. The wide variation in emissions across Canada's provinces and sectors highlights the need for policies and programs that consider local contexts and address regional and sectoral differences.

Oil and gas production and refining are the largest sources of emissions in Alberta, accounting for 59% of the province's total emissions. Other major sectors have lower and roughly equal shares, including transportation (9%), buildings (8%), agriculture (8%), electricity (7%), and heavy industry (7%), as shown below. Within each sector, there are low-hanging opportunities for near-term emissions reductions as well as harder-to-abate areas that will require further technology development.

ALBERTA'S EMISSIONS BY SECTOR $MtCO_2E$



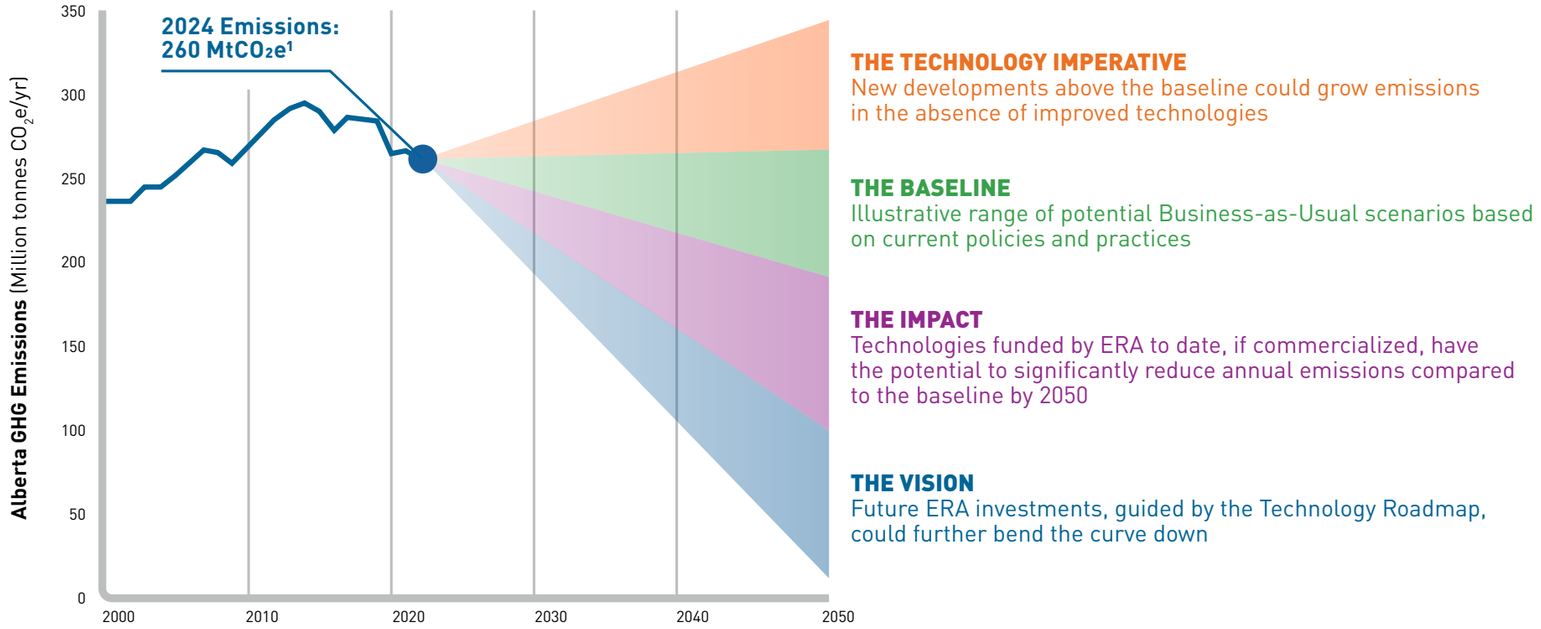
WHERE WE'RE HEADED:

The recent ***Alberta-Canada Memorandum of Understanding Implementation Agreement*** reaffirms a joint provincial-federal ambition to achieve net-zero greenhouse gas (GHG) emissions while stimulating economic growth. This explicit linkage between sustainability and prosperity has always been reflected in ERA's core ethos: that rather than making a zero-sum choice between economic and environmental objectives, the only way they can be advanced is in parallel. In addition to mitigating the real costs of environmental impacts, technologies that reduce emissions often also reduce operating costs, improve productivity, enhance resilience, preserve or expand market access, and unlock new avenues for economic growth. Making these benefits a reality will require accelerating the adoption of commercial technologies and developing nascent solutions. **This is precisely the challenge that ERA was created to solve.**

Many of Alberta's economic sectors compete in a global context that is increasingly focused on product origin and carbon intensity. In this context, TIER is a multifaceted asset to Alberta producers: it provides a clear domestic price signal, sets credible measurement and performance standards, and, via ERA, enables investment in technologies that improve competitiveness by cutting both emissions and costs. Ultimately, while reducing emissions towards the shared goal of net zero (as reinforced in the Alberta-Canada MOU) is the guidepost for ERA's investments, these reductions are not an end unto themselves. Rather, the real impact of these reductions is felt in enhanced prosperity via reducing the costs of environmental degradation, optimizing resource use, improving performance, lowering energy and operating costs, and enhancing market access.

Alberta has made considerable progress on reducing emissions to date: from 2022-2024, Alberta's annual GHG emissions stabilized at about 260 $MtCO_2e$, a 12% reduction compared to the pre-COVID high of 295 $MtCO_2e$ in 2014, and significantly below the "business as usual" levels forecasted when Alberta's industrial carbon pricing and emissions trading program was established in 2007. However, emissions remain 3.5% above the 2005 emissions level, which forms the basis for Canada's nationally binding emissions targets aligned with the net-zero ambition established in the Alberta-Canada MOU. If ERA-funded technologies are successfully commercialized and their potential impacts are realized, Alberta's emissions can be expected to decline, dependent on numerous assumptions and economic factors. At the same time, scenarios such as the expansion of oil and gas extraction and the emergence of data centres could increase emissions and environmental costs without new technologies to improve performance. As such, there remains a need to accelerate the development and deployment of emissions reduction technologies to help Alberta achieve its intertwined economic and environmental ambitions. **This is the technology imperative.**

HISTORICAL AND FUTURE GHG PATHWAYS FOR ALBERTA



[1] Most recent available historical data from Canada's 2026 National Inventory Report

THE COMMERCIALIZATION JOURNEY AND ERA'S ROLE

ERA seeks to drive commercialization by convening the right resources to accelerate the adoption and broader commercial deployment of clean technology solutions that deliver economic growth, emissions reductions, and wider environmental benefits in Alberta. However, it is essential to recognize that there are numerous pathways to commercialization, and each technology faces a unique commercialization journey. By outlining clear focus areas in the TRM, we provide guideposts for innovators to build their business plans and direct their efforts. Importantly, each focus area features a diverse range of technology types with varying commercialization pathways—there is no "one size fits all" pathway for any given focus area or technology class.

As a technology-focused organization, ERA's primary taxonomy for assessing technology maturity and progression towards commercialization is the ***Technology Readiness Level (TRL) scale***. TRL describes the stages of pre-commercial technology development on a scale from 1 (concept) to 9 (proven operational deployment). ERA's mandate is centrally aligned with the "pre-commercial" stage of technology development, wherein fundamental research, proof-of-concept, and prototyping is complete, but the technology must still be de-risked and proven in a commercial setting. This corresponds approximately to TRL 6-9 and is the primary focus of the vision outlined in this TRM, although ERA may invest at earlier or later TRLs where necessary to achieve the greatest impact.

Our mandate and TRL focus position ERA at a crucial point in the broader innovation ecosystem and are useful to define where our role begins and ends. Other funding organizations and programs exist along the TRL scale and form a cohesive end-to-end ecosystem to provide a continuum of support along the commercialization journey, ideally culminating with widespread bankability and adoption supported wholly by private investment. For example, the TRM and ERA's programming deliberately exclude low TRL opportunities such as basic research and early proof-of-concept development. Other entities in the innovation ecosystem, such as Alberta Innovates, the Natural Sciences and Engineering Research Council of Canada (NSERC), and the National Research Council Industrial Research Assistance Program (NRC-IRAP), are well-suited to support work at this level. ERA has an extensive network of partnerships across the ecosystem to foster hand-offs as technologies progress to higher TRLs and become eligible for ERA support. Similarly, ERA does not provide funding for fully commercialized, broadly deployed, business-as-usual technologies, consumer-facing behavioural change, or broad market interventions like tax credits or end-user subsidies. Support for technologies at this level is no longer primarily related to technology progression and de-risking but rather other key factors including policy, regulatory, legal, social, finance, etc. which must all be aligned in order to achieve commercial success and overcome the so-called "valley of death" between technology validation and commercial adoption. While these solutions are beyond ERA's technology-focused mandate, convening complete solutions that address all elements of commercial and adoption readiness is vitally important to achieving the TRM's vision.

The opportunities identified in this roadmap vary considerably in terms of commercial and technical readiness, commercial scale, capital intensity, and deployability. A diverse range of funding, capacity building, and other supports are needed to achieve success across the TRM focus areas; what works for one technology or sector may not be ideal for others. As such, ERA has developed numerous tools that can be deployed depending on the business or project needs. Each of these support mechanisms has a use case within each focus area; a key function of the Technology Roadmap is to inform how multiple types of support can be applied to achieve the vision within the focus areas.

ERA's annual rolling business plan operationalizes the TRM by coordinating funding opportunities with project criteria to key priorities each year to inform future programming. These include:



Capital innovation grants: large-scale non-dilutive funding to directly defray the cost and share risk on pilot, demonstration, and first-of-a-kind commercial projects of low to moderate capital intensity



Pre-Final Investment Decision (FID) study funding: non-dilutive funding to support development and feasibility assessment for large, capital-intensive technology implementation projects with lower technology risk but potentially larger regulatory and capital challenges



Deployment incentives: direct incentives to accelerate mass deployment and adoption of technologies like energy efficiency and methane reduction across many individual sites



Commercialization supports: targeted support delivered directly to innovators or through service providers to help small and medium-sized enterprises access the talent, advice, services, and resources needed to advance their technologies



Capacity building: funding for energy management training and capacity-building that improves energy performance, reduces greenhouse gas emissions, and boosts competitiveness



Strategic analysis: ERA-sponsored studies and modelling to evaluate technology pathways, assess market potential, and identify strategic opportunities

TECHNOLOGY THEMES ANALYSIS

At the core of the TRM is a set of five complementary technology focus areas that define the opportunity space within which ERA will operate. These areas are deliberately broad, with the intention of spanning the full array of potential solutions for emissions reduction, economic competitiveness, and improved environmental performance across all major sectors of Alberta's economy.

The methodology for the selection and definition of these areas was informed by the TRM objectives and principles as outlined above, a detailed analysis of lessons learned from ERA's existing portfolio, engagement with key partners, and a comprehensive literature review on existing and nascent technologies globally. Each of the resulting focus areas represents a broad cross-sectoral theme that ERA believes represents a key segment of the opportunity space. The areas are intentionally defined with some overlap to recognize the value of cross-cutting opportunities and multipronged solutions. Importantly, the five areas are positioned to avoid a "single pathway" or "silver bullet" approach; rather, they are defined based on the premise that solutions from all five areas will be necessary and valuable in any future scenario.

A thematic definition and overarching vision was developed for each focus area. These definitions were used to assign individual technologies, identified from ERA's existing portfolio and the global literature review, to the most relevant area to establish a representative solution set for each theme. The catalogue of technologies within each area is intentionally diverse, representing both sector-specific and cross-cutting solutions, as well as the full range of timescales to impact (short-, medium-, and long-term). The result is a robust characterization of each focus area that enables classification of future investments, highlights portfolio gaps, and informs key areas for future investment while retaining flexibility to accommodate emerging technologies that may not yet be included.

To help compare the focus areas and to inform the TRM's investment targets, ERA qualitatively assessed each area according to the following criteria:

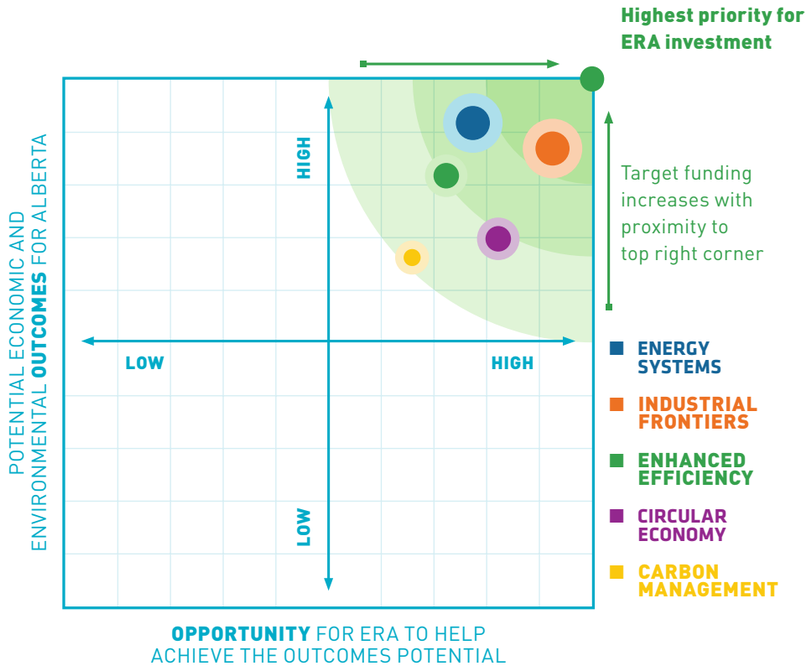
Outcomes Potential: The "size of the prize" associated with technologies in the focus area, reflecting the possible scale of benefits over the long-term once high technology maturity is achieved.

1. **GHG Emissions Reduction Potential:** Potential scale of impact on GHG emissions, based on depth (extent of decarbonization), breadth (sectoral coverage), and uncertainty.
2. **Economic and Competitiveness Benefits Potential:** Potential to deliver cost reductions, enhance competitiveness, create jobs, attract investment, increase revenues, improve market access, expand exports, benefit Indigenous communities, etc.
3. **Environmental and Additional Benefits Potential:** Potential to improve performance and outcomes relating to air, water, land, biodiversity, ecosystem services, health, safety, resilience, reliability, and other benefits "beyond emissions".

Opportunity Profile: The extent to which ERA investment in a focus area can help deliver on the Outcomes Potential.

1. **Acceleration Potential:** The relative impact that funding and other ERA supports can have on de-risking and deployment of technologies in the area, relating to factors like policy dependence, capital intensity, cost reduction trajectory, and overall risk profile.
2. **Ecosystem Alignment:** The extent to which technologies in the area are aligned with other policy, regulatory, and financial supports beyond what ERA can provide, and the extent to which the area plays to Alberta's strengths as opposed to requiring external developments.
3. **Role of Innovation:** The extent to which major technology advancements will be needed to achieve the potential in this area, relating to the level of maturity of solutions, the technical barriers to achieving the area's outcomes potential, and the potential for substantial performance breakthroughs in the area.

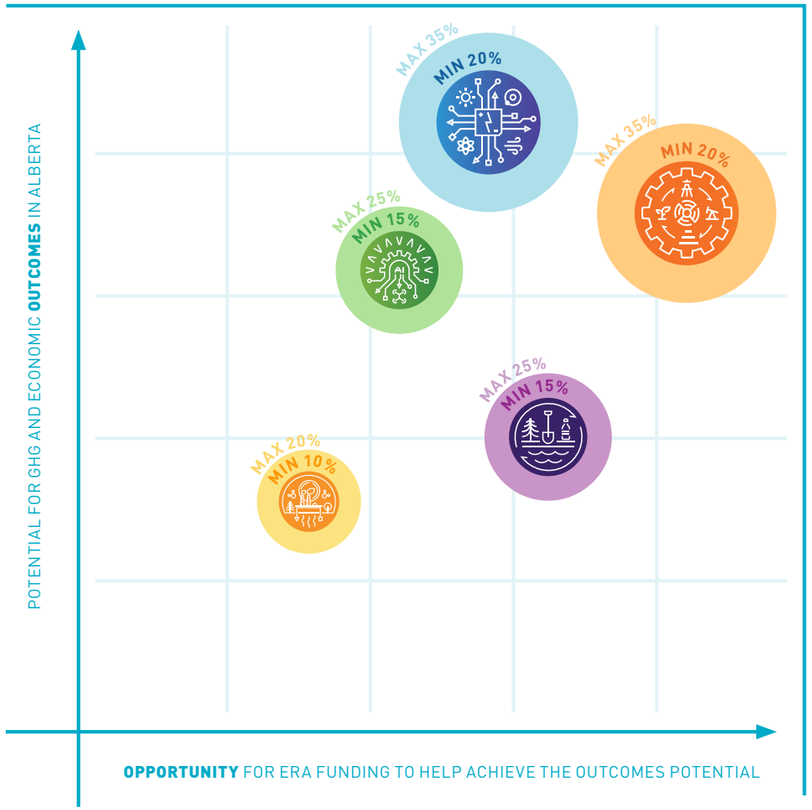
The aggregate performance of each focus area on the six criteria determines its relative placement on an "outcomes vs. opportunity" grid, as shown on page 10. Focus areas closer to the upper right corner of the grid represent the highest priorities for investment. To determine the target share of the portfolio allocated to each area, ERA considered this ranking alongside an assessment of current and future dealflow potential as well as the current weighting of that area in ERA's existing portfolio. Rather than a constraint on future investments, the inclusion of current portfolio weightings represents a "reality check" on the consistency of the TRM's vision and its application to ERA's investments and helps underscore where gaps and opportunities may exist in the current ERA portfolio to inform programming design and future investment decisions. The final target portfolio shares are described in terms of the minimum and maximum range of future investment for each area and are summarized on *Page 10*.



ERA'S TECHNOLOGY FOCUS AREAS

TECHNOLOGY FOCUS AREAS OVERVIEW

To achieve the TRM's objectives, ERA takes a portfolio approach using five cross-sectoral technology focus areas, which are summarized in the table to the right, and described in detail beginning on *page 11*.



AREA	*DEFINITION*	*SHARE OF GO FORWARD INVESTMENT*
ENERGY SYSTEMS	**Looking to the future of energy:** Reshaping how clean electricity and fuels are produced, stored, and delivered while strengthening the grid and critical energy infrastructure.	**20-35%**
INDUSTRIAL FRONTIERS	**Expanding the opportunity space:** Transforming the environmental and economic performance of Alberta's major sectors via step-changes in the processes, practices, and feedstocks they use, while also supporting development of new low-emissions products and industries.	**20-35%**
ENHANCED EFFICIENCY	**Optimizing performance and productivity:** Driving towards best-in-class management of energy and resources across the economy via improvements in productivity, optimization, and conservation.	**15-25%**
CIRCULAR ECONOMY	**Closing the loop:** Reimagining how resources, materials, products, and waste streams are managed throughout their lifecycle to reduce raw material demand, reduce or upcycle waste, and sustain and recover value while enhancing conservation, treatment, remediation, and reclamation of land, soil, air, and water.	**15-25%**
CARBON MANAGEMENT	**Cleaning up:** Natural and artificial technologies and practices to capture or remove carbon, convert or utilize it in new products, and/or permanently sequester it.	**10-20%**

ENERGY SYSTEMS

IN BRIEF

Looking to the future of energy: Reshaping how clean electricity and fuels are produced, stored, and delivered while strengthening the grid and critical energy infrastructure.

THE ALBERTA CONTEXT

- The Alberta-Canada MOU establishes a shared vision for the electricity grid as the backbone of future emissions reduction and economic development efforts. New investments in the grid represent a significant opportunity to attract investment, create economic opportunities, and improve energy security, affordability, and reliability.
- The rapid growth of artificial intelligence and electrification is creating unprecedented electricity demand growth and reshaping the grid.
- Rapid cost declines and technology improvements for renewables and energy storage solutions are accelerating adoption and expanding the business case on the grid and behind the meter.
- Alberta has a strong and growing biofuel/bioenergy industry, leveraging its energy, agricultural, and forestry expertise. Growth is expected to accelerate, driven by Canada's Clean Fuel Regulations.
- Alberta is home to all the required skillsets, talent, and supply chains for a thriving geothermal industry and is seeing a first wave of geothermal projects emerge.

A ROADMAP TO WHAT?

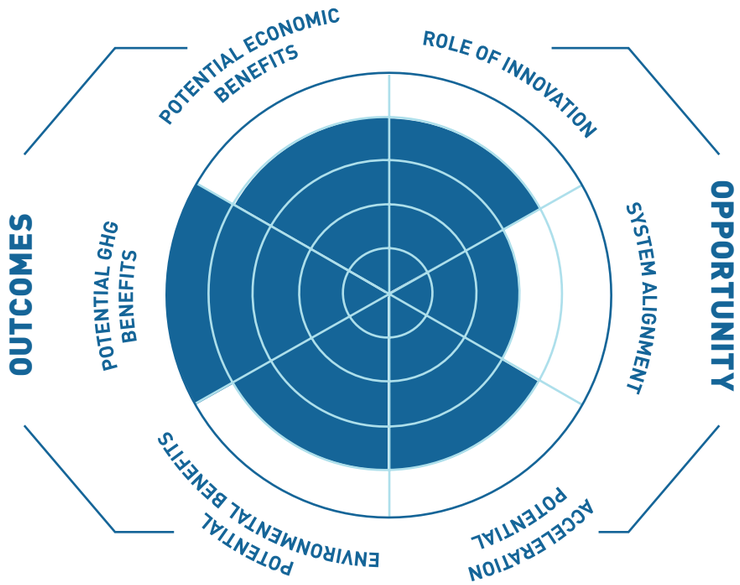
- Alberta's grid is expanded and modernized through investment across generation, transmission, distribution, services and demand-side technologies, delivering reliable, clean, affordable power that supports new economic opportunities, enables clean power exports, and meets growing demand from electrification and data centres.
- Alberta capitalizes on its existing exploration, drilling, and thermal management expertise to become a world leader in geothermal energy technologies.
- Alberta advances clean hydrogen production to reduce emissions associated with existing industrial hydrogen demand in refining and chemical production.
- Alberta combines its petrochemical and bio-industrial expertise to take a leading role in the production of sustainable aviation fuel and other renewable fuels.
- Buildings and the transportation sector benefit from the adoption of clean energy carriers and devices while enhancing their integration with the broader energy system.
- Major industries in Alberta explore the potential for nuclear energy to provide everything from power generation to zero-emission industrial heat.

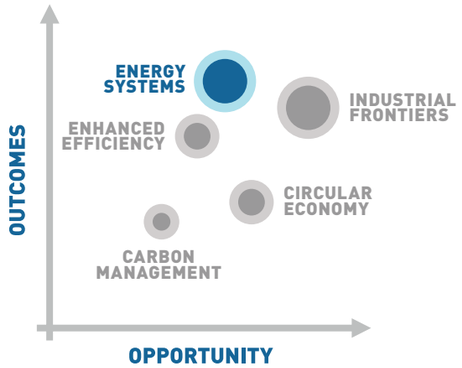
BEYOND EMISSIONS

- Improved energy production and energy systems technologies can contribute to mitigating land and water impacts associated with matching growing energy demand.
- Expanded use of clean or abated energy carriers across the economy enhances the health and air quality experienced by all Albertans by reducing pollution at the point of energy use.
- Better-integrated, optimized energy systems and grid modernization technologies can cut transmission, distribution, and other costs, ease congestion, and improve electricity affordability, reliability, resilience, and access.

FOCUS AREA ASSESSMENT

SHARE OF GO-FORWARD INVESTMENT 20-35%



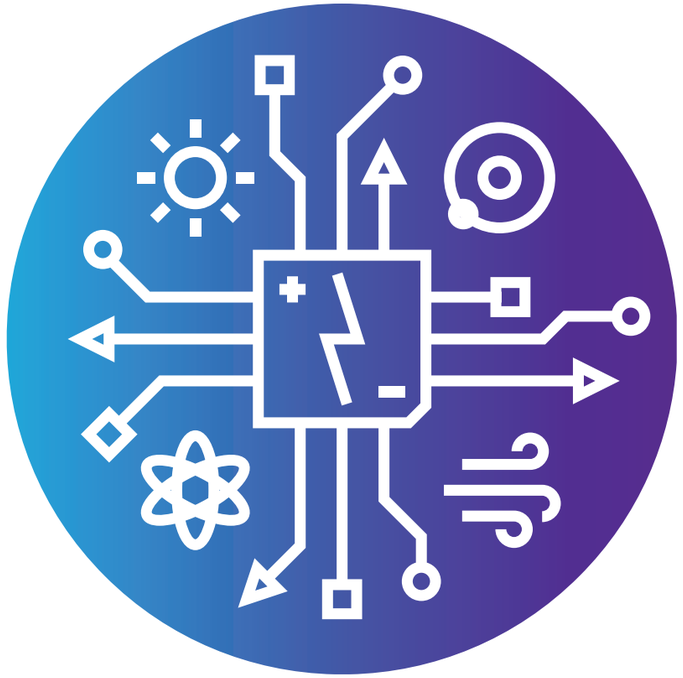


SECTORAL ALIGNMENT

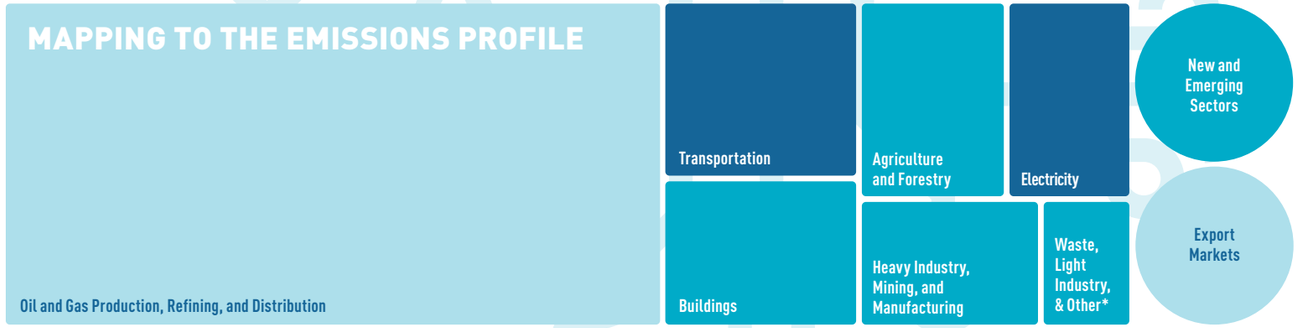
- This focus area is highly relevant to the electricity sector, which forms the backbone of future energy system development and supports new sectors like data centres.
- Integration of clean energy production, grid interactivity, and energy storage has growing potential across most sectors in the economy, with initial markets developing in heavy industry, buildings, and remote (off-grid or end-of-line) applications.
- Clean hydrogen has potential to support emissions reductions in the refining, heavy duty transportation, and heavy industrial sectors, and may play a role in other hard-to-abate segments if costs can be reduced.
- The agriculture, forestry, and waste sectors can benefit from adoption of clean, affordable energy carriers and are also poised to become key suppliers of feedstocks for clean electricity and fuels.

EXAMPLE ERA INVESTMENT OPPORTUNITIES

- Advanced geothermal and nuclear energy for production of power and/or heat.
- Grid-enhancing technologies, grid modernization, and grid optimization solutions, including transmission and distribution system upgrades, demand-side management, non-wires solutions, digital grid optimization, virtual power plants, enablers for increased interties with neighboring jurisdictions, and distributed energy resources.
- Next-generation wind, hydroelectric, and solar power generation including agrivoltaics, hybrid sites, building/infrastructure-integrated solar, low-head hydroelectricity, storage integration (e.g. grid-forming batteries and firming of renewables), and facility uprating, retrofits, and/or repowering.
- Novel solutions for grid services and load integration, including ramp rate management, frequency response, behind-the-fence and bring-your-own-generation configurations, flexible/curtailable load, and load shape management.
- Emerging energy storage solutions, including long-duration storage, thermal energy storage, novel chemistries for electrochemical storage, etc.
- Integration of clean energy production and storage with buildings and industry.
- Infrastructure and enablers for electric and hydrogen-powered vehicles.
- Low-emissions aviation solutions including sustainable aviation fuel.
- Next-generation biofuels and bioenergy.



MAPPING TO THE EMISSIONS PROFILE



Core Sector Focus

Strong Sector Alignment

Moderate/Low Sector Alignment

Existing sectors are shown according to scale of GHG emissions in 2024. See Page 6 for legend and more information.

INDUSTRIAL FRONTIERS

IN BRIEF

Expanding the opportunity space: transforming the environmental and economic performance of Alberta's major sectors via step-changes in the processes, practices, and feedstocks they use, while also supporting development of new low-emissions products and industries.

THE ALBERTA CONTEXT

- Alberta's natural resource, agriculture, forestry, and manufacturing sectors are integral to the economy but often depend on energy- and emissions-intensive processes. Achieving meaningful emissions reductions in these sectors while enhancing their economic competitiveness requires a transformative vision to adopt new technologies and processes with the potential to achieve step-changes in performance.
- Alberta is home to several world-scale industrial, energy, and agricultural clusters and has a wealth of engineering talent. These factors create fertile ground for development, piloting, and rapid adoption of new industrial technologies.
- Alberta has pioneered approaches to derive advanced materials from its bitumen resources and other hydrocarbons and is seeking to scale these products to address global demand. These products offer a distinct opportunity for Alberta to diversify its economy while strengthening its position in advanced materials manufacturing.
- Electrification of industrial processes and development of digital sectors are poised to reshape the industrial landscape and open new opportunities for industrial development.
- Critical minerals like lithium and vanadium are found in abundance in Alberta, but a technology push is needed to make their extraction viable. Alberta's strong pool of talent and expertise relating to extraction and processing of natural resources makes it an ideal place to solve this challenge.

A ROADMAP TO WHAT?

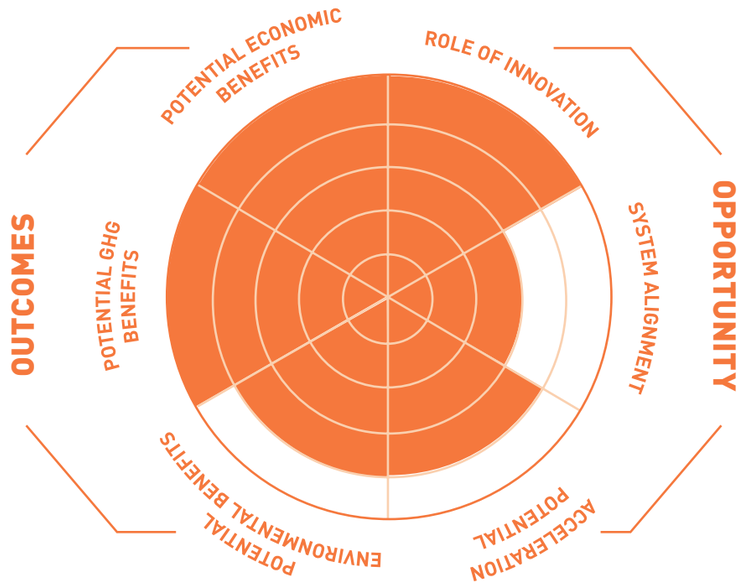
- Alberta leverages its strengths in resource development to become a major producer and exporter of lithium, vanadium, carbon fibre, and other critical minerals and advanced materials, in alignment with global market trends.
- Transformative solutions reshape the environmental footprint and economic competitiveness of major sectors including agriculture and agrifood, natural resources, manufacturing, chemicals, and materials, improving productivity and performance at home and enabling greater exports abroad.
- Novel technologies spur the creation of entirely new, inherently lower-emissions sectors to grow the economy without adding to Alberta's GHG emissions inventory.
- Alberta's oil and gas producers capitalize on new technologies to dramatically reduce emissions, enhance production cost competitiveness, mitigate environmental impacts, and maintain market access.
- Alberta's existing industrial clusters, talent, and access to clean feedstocks and affordable energy are leveraged to make Alberta a destination of choice for new investment and attraction of best-in-class solutions to the province as well as a hub for export of advanced industrial technologies to the world.

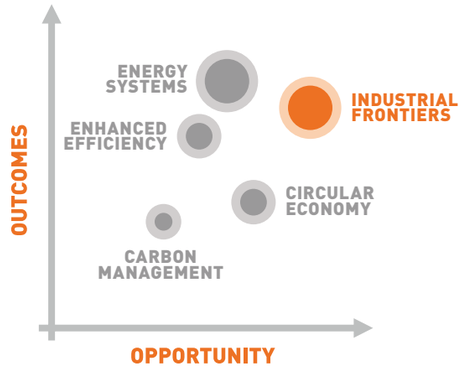
BEYOND EMISSIONS

- Improved industrial processes can deliver strong socioeconomic and environmental benefits alongside direct emissions reductions.
- Advanced manufacturing and production of critical minerals and materials closer to home can enhance supply chain security and resilience.
- Novel resource production and processing techniques can reduce emissions intensity, waste creation, land disturbance, and water contamination.
- Electrification of industrial processes can reduce pollution and improve air quality.

FOCUS AREA ASSESSMENT

SHARE OF GO-FORWARD INVESTMENT 20-35%





SECTORAL ALIGNMENT

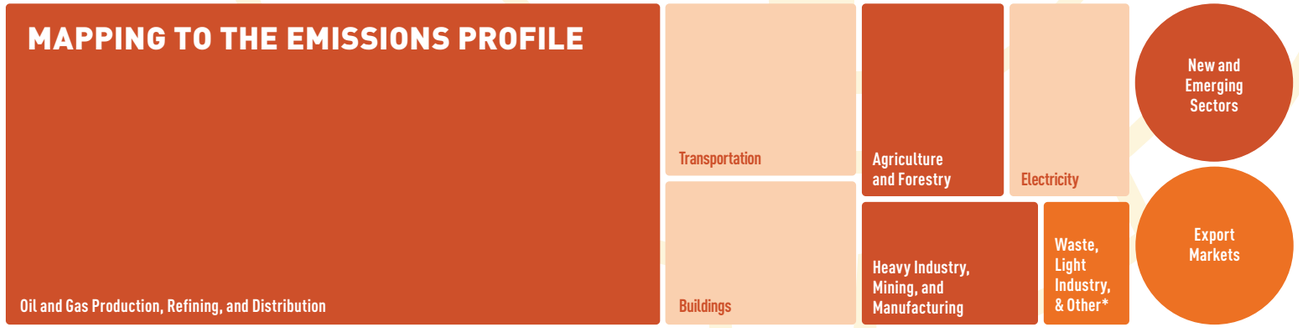
- Sectors such as natural resources, cement, and fertilizer are facing global trade pressures, growing energy costs, and increased scrutiny on carbon intensity. These sectors can benefit from new technologies to enhance their competitiveness on multiple fronts and, if proven, can export these solutions to the world.
- Alberta's agriculture, agrifood, and forestry sectors are positioned to benefit from adoption of solutions from local innovators as well as best-in-class technologies available globally.
- Alberta's oil and gas sector is pursuing novel technologies to reduce its environmental footprint and improve competitiveness.
- Global markets are seeking new, reliable, and friendly sources of low-carbon commodities, materials and products; new technologies can enable Alberta's role as a supplier of choice to these new markets.

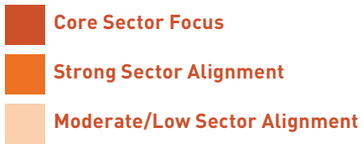
EXAMPLE ERA INVESTMENT OPPORTUNITIES

- Advanced extraction and processing techniques for oil and gas resources including novel drilling and completion techniques, in-situ solvents and steam additives, electromagnetic heating, non-thermal and non-aqueous recovery, etc.
- Production of non-combustion hydrocarbon products including bitumen advanced materials.
- Advanced materials and manufacturing for new industries/products including carbon fibre, activated carbon, battery anodes, and supercapacitors.
- Clean heat solutions for industry including fuel switching, e-boilers, heat pumps, and thermal energy storage.
- Mitigation of non-CO_2 emissions including enteric methane, N_2O, F-gases, refrigerants, and others.
- Extraction, processing, and refining of lithium, vanadium, and other critical minerals and advanced materials.
- Novel chemistries, feedstocks, and processes for heavy industries including cement, chemicals, fertilizer, plastics, etc.
- Novel processes and practices for agriculture and forestry.



MAPPING TO THE EMISSIONS PROFILE





Existing sectors are shown according to scale of GHG emissions in 2024. See Page 6 for legend and more information.

ENHANCED EFFICIENCY

IN BRIEF

Optimizing performance and productivity: Driving towards best-in-class management of energy and resources across the economy via improvements in productivity, optimization, and conservation.

THE ALBERTA CONTEXT

- As a result of Alberta's unique geography, population distribution, climate and industrial mix, energy use is a major driver of costs and emissions for Alberta households, businesses, farmers, and industrial operators. Improving efficiency and reducing energy waste has significant potential to reduce costs, enhance competitiveness, and drive down emissions.
- Alberta is a leading jurisdiction for methane management and abatement and has been the birthplace of numerous methane technologies. Continued innovation in methane detection, monitoring, measurement and mitigation can reduce emissions, improve resource efficiency and create global export potential for Alberta-developed solutions, which may be leveraged into even greater impacts in the future.
- Alberta already hosts a burgeoning digital solutions sector, which is developing home-grown artificial intelligence and machine learning solutions that are positioned to improve productivity, optimize operations and drive the next wave of efficiency improvements.

A ROADMAP TO WHAT?

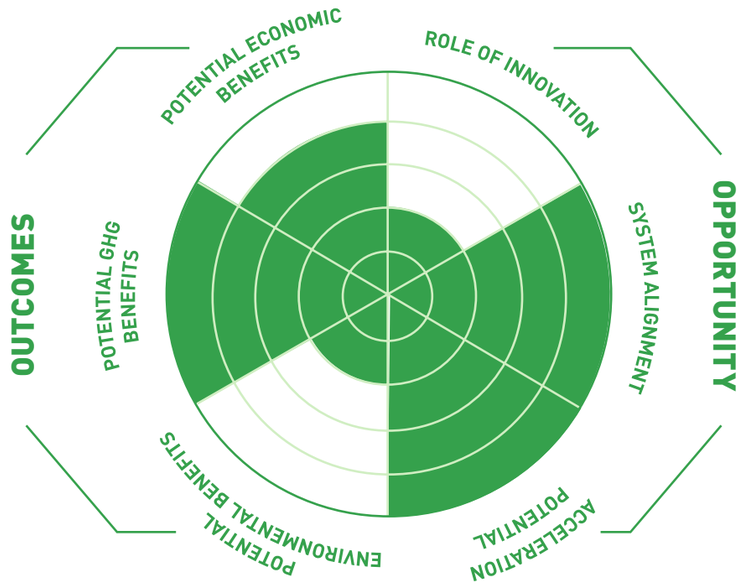
- Businesses and consumers optimize operations and manage energy use, enhancing Alberta's competitiveness by reducing energy costs and improving energy affordability, reliability, resilience, and access.
- The profitability and performance of existing assets are improved, leading to an increase in equipment lifespan and decrease in stranded assets.
- Alberta's natural resource sectors achieve best-in-class performance on methane emissions, preserving market access, reducing wasted resources, and improving the lifecycle emissions intensity of energy products—and then exporting these methane solutions to the world.
- Alberta benefits from increased implementation and integration of digital, artificial intelligence,and automation solutions, leading to rapid growth of the sector and development of capacity and export potential.

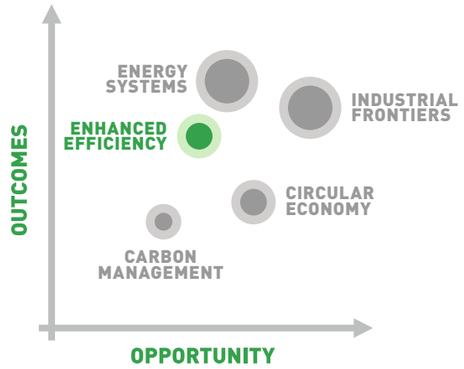
BEYOND EMISSIONS

- Enhanced efficiency delivers benefits beyond emissions reductions by lowering operating costs, improving affordability, increasing productivity, improved health and safety, and extending the life and performance of existing assets. Energy management and conservation can help mitigate recent inflationary pressures faced by energy consumers of all types.
- By reducing wasted energy and resources, efficiency can also free up capital and capacity for deployment in harder-to-abate areas.
- Improving operational efficiency and optimizing how resources are used and managed also offers environmental benefits beyond GHG reductions including better air quality, reduced water use, and improvements in land use.

FOCUS AREA ASSESSMENT

SHARE OF GO-FORWARD INVESTMENT 15-25%



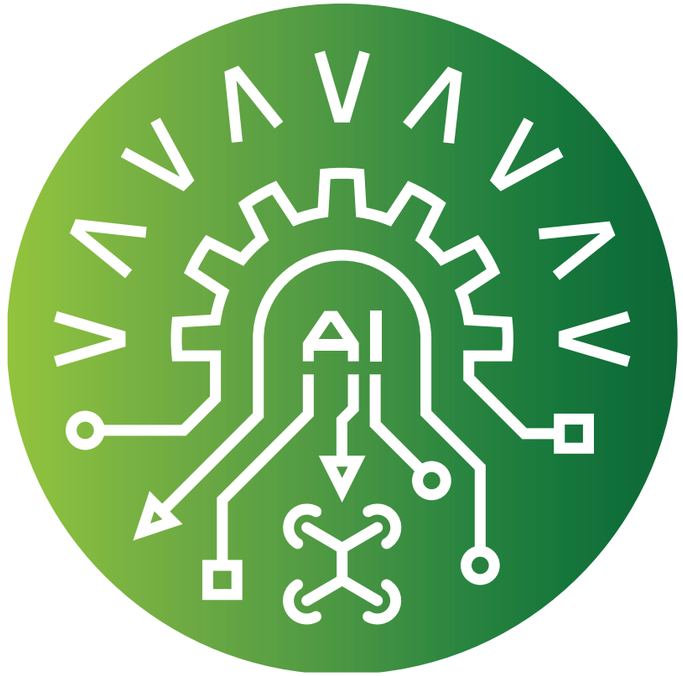


SECTORAL ALIGNMENT

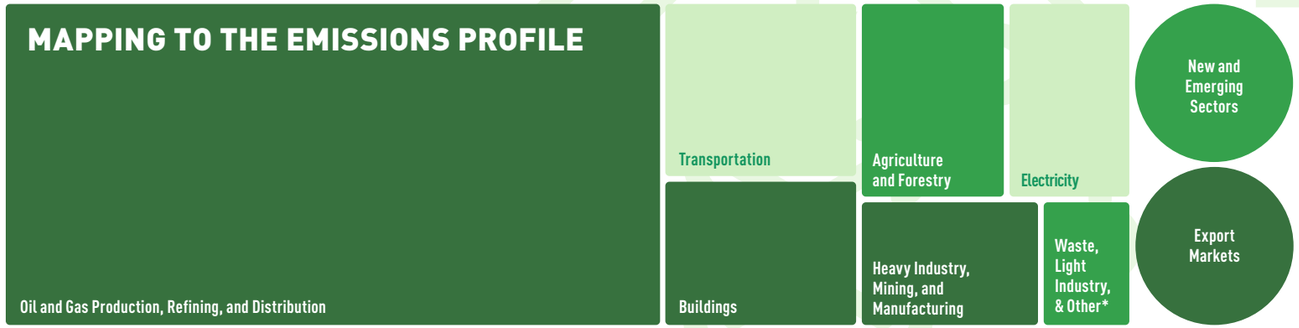
- Efficiency is a true cross-cutting opportunity that can be applied to almost any sector, with particularly significant potential for sectors like buildings, agriculture, natural resources, and light/heavy industry.
- Efficiency upgrades in the buildings, commercial, and agriculture sectors can dramatically improve the bottom line for consumers and operators while improving the quality and reliability of energy services.
- Alberta's large industrial base has significant opportunities to substantially enhance its competitiveness by improving its productivity and reducing energy consumption.
- Methane emissions represent a significant share of Alberta's total emissions. Solutions to detect, measure, and mitigate methane have significant emissions reduction potential and can support compliance with federal and international regulations.

EXAMPLE ERA INVESTMENT OPPORTUNITIES

- Digital solutions for automation and optimization, including integration of artificial intelligence and/or machine learning solutions for process optimization, monitoring and of energy use and emissions, digital twins to simulate and improve asset performance, and predictive analytics to improve reliability and reduce unplanned emissions.
- More efficient processes and practices in the agriculture and waste sectors, including precision agriculture, robotics, advanced sensing, and equipment upgrades.
- Building energy improvements, including advanced heating and cooling technologies, building automation systems and smart controls, demand management, energy storage integration, and improved building envelopes.
- Improvements in the performance and productivity of industrial processes including heating, cooling, separations, compute, and others, to reduce energy use and optimize resource efficiency.
- Improved system design, including heat integration, waste heat recovery, and district energy.
- Detection, monitoring, management, and mitigation of methane emissions from the oil, gas, mining, and agriculture sectors.



MAPPING TO THE EMISSIONS PROFILE



Core Sector Focus

Strong Sector Alignment

Moderate/Low Sector Alignment

Existing sectors are shown according to scale of GHG emissions in 2024. See Page 6 for legend and more information.

CIRCULAR ECONOMY

IN BRIEF

Closing the loop: Reimagining how resources, materials, products, and waste streams are managed throughout their lifecycle to reduce raw material demand, reduce or upcycle waste, and sustain and recover value while enhancing conservation, treatment, remediation, and reclamation of land, soil, air, and water.

THE ALBERTA CONTEXT

- Beyond the GHG emissions associated with production, there are significant emissions associated with the lifecycle, disposal, and wastage of products and materials such as construction materials, plastics, forest products, and food.
- As Alberta's economy grows, waste streams from construction, electronics, industry, and residences will continue to expand. Reducing these waste streams and more effectively managing what remains is a key challenge.
- Anaerobic digestion and waste-to-energy projects are of growing interest to waste stream owners but further technological advancement and improved feedstock/offtake markets are needed to strengthen the business case for broad adoption.
- Bioproducts and other low-embodied carbon materials are nascent but are gaining momentum both for local applications as well as export markets.
- Management, treatment, and waste reduction for water is a growing area of interest for sustainability and climate resilience.

A ROADMAP TO WHAT?

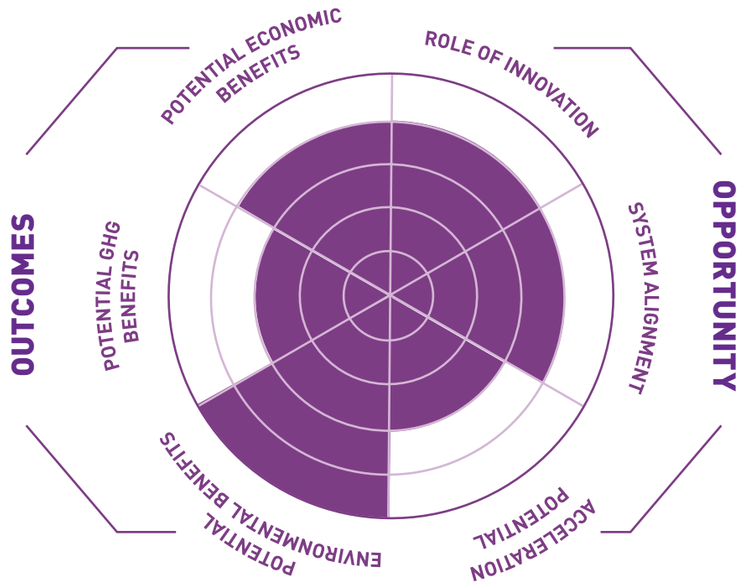
- Alberta is a world leader in plastics circularity and sustainability, ensuring ongoing market access and consumer acceptance.
- Waste streams from agriculture, food, forestry, construction, and industry are significantly reduced or are upcycled to novel, value-added products, enhancing cost competitiveness and reducing environmental impacts.
- Oil and gas operators effectively remediate contaminated soil, tailings, wells, and other affected sites, responsibly closing wellsites and returning land to productive or natural uses.
- Alberta's industries more effectively manage and remediate wastewater, reducing net impacts on Alberta's shared water resources and enhancing resilience.
- Optimization of product supply chains, lifecycles, and end of life treatment becomes standard practice. Where single-use materials are used, their production requires fewer raw materials and has a lower energy and environmental footprint.

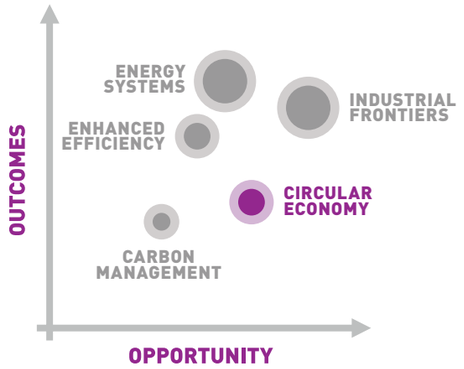
BEYOND GHG EMISSIONS

- Improved approaches to water treatment and conservation, land use and reclamation, soil remediation, and enhancement or protection of ecosystem services have the potential for significant environmental benefits.
- Enhancing how products and materials are designed, used, re-used, recycled, and managed at end of life has significant potential to deliver co-benefits such as reduced waste volumes, lower land and water impacts, lower overall costs, and displacement of demand for raw materials.
- Biogas, bioproducts, and advanced materials represent export development opportunities. Domestic production provides not just economic benefits but also increases security and resilience.

FOCUS AREA ASSESSMENT

SHARE OF GO-FORWARD INVESTMENT 15-25%



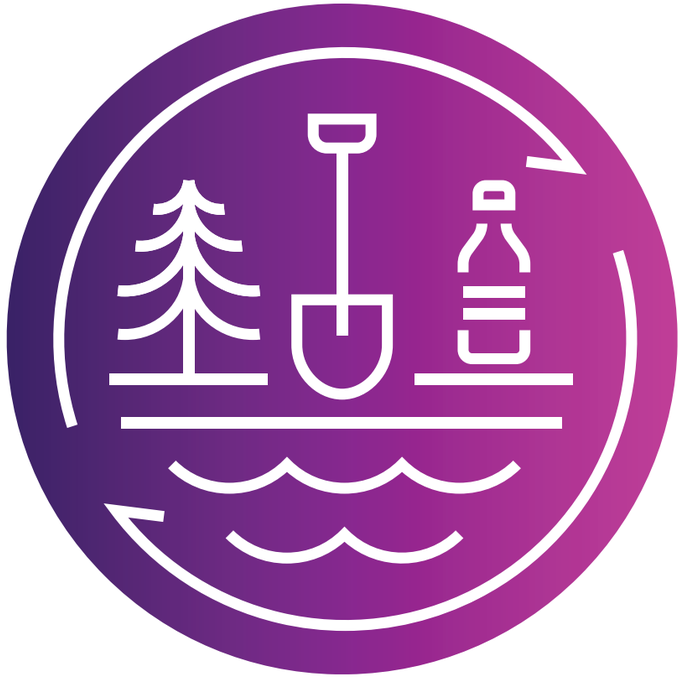


SECTORAL ALIGNMENT

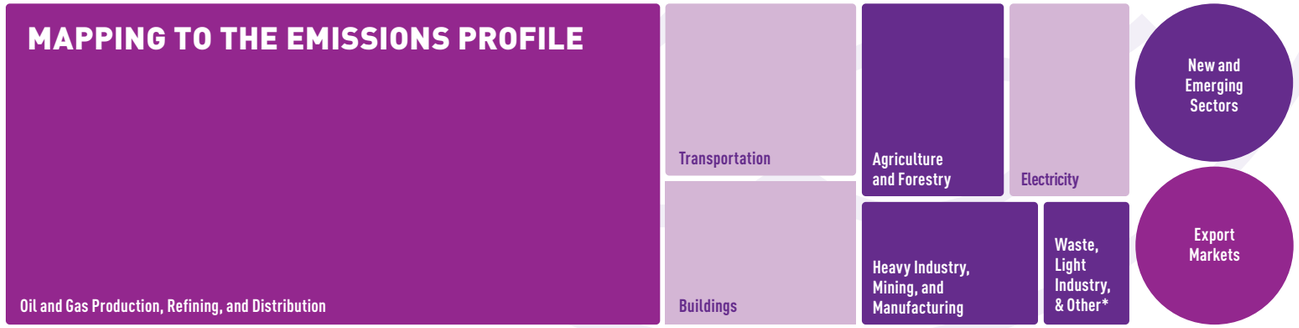
- Alberta is a major producer of plastics and petrochemicals and has Sectoral Alignment committed to becoming a circular plastics centre of excellence.
- Circular products and technologies have significant potential to convert legacy cost centers to new value streams in sectors like construction, oil and gas, food and beverage, cement and concrete, and other heavy industries.
- Alberta's oil and gas sector has significant challenges associated with contaminated sites, legacy wells, land disturbance, and tailings and produced water inventories. Reducing the cost to effectively remediate these liabilities can improve the competitiveness of the sector and accelerate cleanup.
- Alberta's forestry and agriculture sectors have unique and growing needs for waste management and are exploring opportunities to valorize and upcycle waste into new products.
- Improving water management, treatment, and recovery are key opportunities for improving the resilience and competitiveness of the agriculture sector and other water-dependent development.
- Circular economy and water and soil treatment technologies solve problems that exist all over the world, making them highly exportable once proven.

EXAMPLE ERA INVESTMENT OPPORTUNITIES

- Circular plastics, including recycling via chemical, mechanical, or other means.
- Next-generation technologies to reduce, manage, or upcycle municipal, agricultural, agrifood, and forestry wastes.
- Digital-enabled solutions for product design, lifecycle innovation, and tracking to support remediation and reclamation of legacy oil and gas facilities.
- Biogenic and/or waste-derived feedstocks for construction materials, petrochemicals, and other products.
- Enhanced industrial linkages whereby waste streams are converted to inputs, such as clinker substitutes from construction waste.
- Treatment and remediation solutions for tailings, wastewater, contaminated soil, wellsites, and more.
- Food waste reduction.
- Improved water treatment, management, and conservation solutions.
- Solutions to assess, track, and improve environmental attributes and natural capital such as water, land use, and biodiversity.
- Repurposing, reuse, end-of-life management, and material recovery and recycling for advanced energy technologies including wind, solar, and batteries.



MAPPING TO THE EMISSIONS PROFILE



Core Sector Focus

Strong Sector Alignment

Moderate/Low Sector Alignment

Existing sectors are shown according to scale of GHG emissions in 2024. See Page 6 for legend and more information.

CARBON MANAGEMENT

IN BRIEF

Cleaning up: Natural and artificial technologies and practices to capture or remove carbon, convert or utilize it in new products, and/or permanently sequester it.

THE ALBERTA CONTEXT

- Alberta is already a world leader in carbon management, with a massive pore space resource, a strong carbon hub strategy, and policy supports such as the Alberta Carbon Capture Incentive Program, TIER price floor, Clean Fuel Regulation and Alberta-Canada MOU underpinning major CCUS projects.
- ERA's prior investments in feasibility and FEED studies for industrial carbon capture have underscored the need for next-generation capture technologies to further reduce costs and increase applicability to diverse flue gas streams.
- Carbon dioxide removal technologies such as bioenergy with CCS (BECCS), direct air capture (DAC), and mineralization have progressed via initial pilots, test centres, and feasibility studies but market development is needed alongside significant improvements in costs and performance.
- CO_2 transportation and storage infrastructure is rapidly scaling. The large volume of CCS projects proposed for Alberta has highlighted the need to ensure safety, reliability, and permanence of various CO_2 sequestration methods.
- Alberta's vast areas of forests, wetlands, grasslands, and farmland present significant opportunities for enhanced carbon retention and sequestration via natural carbon sinks and reservoirs.
- ERA's early investments in carbon conversion and utilization technologies have spurred the creation of numerous new ventures in the province.

A ROADMAP TO WHAT?

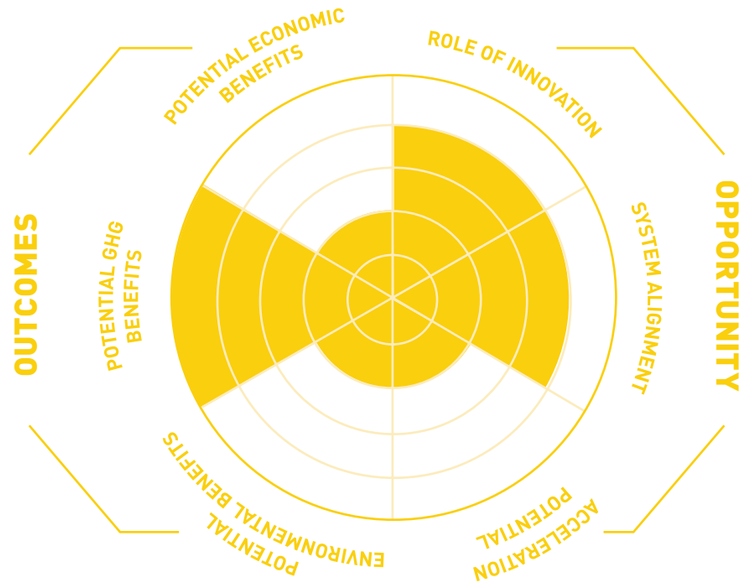
- Next generation approaches to carbon capture, utilization, and removals are developed and proven in Alberta, expanding the business case for CCUS and Carbon Dioxide Removals (CDR) and unlocking a next wave of major CCUS projects. This positions Alberta as a testbed for new carbon management solutions and drives exports of provincial knowhow and intellectual property globally.
- Carbon injection activities in Alberta are the safest and most reliable in the world, setting the standard for high-quality carbon sequestration.
- As technologies mature, new markets relating to carbon dioxide removals emerge and provide a critical resource for drawdown of atmospheric GHGs.
- Alberta leverages its early work on carbon utilization and removals, integrating these approaches with its natural resource, chemicals, and manufacturing sectors to produce new value added products incorporating captured carbon.
- Alberta's agriculture and forestry sectors become world leaders in carbon management, increasing their competitiveness and significantly driving down their net emissions while enhancing climate resilience.

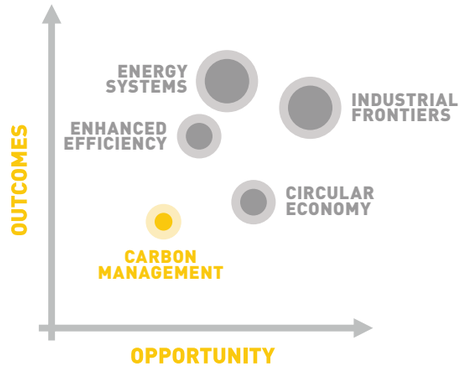
BEYOND GHG EMISSIONS

- CCUS development must be done in a manner that protects public health and safety; technology solutions for effective, safe, and durable transportation and sequestration of CO_2 are essential.
- Current generation carbon capture technologies have a range of water impacts and have potential for secondary emissions such as ammonia and nitrosamines. Resolving these potential environmental and health challenges is essential to ensuring CCUS and DAC systems can be deployed sustainably.

FOCUS AREA ASSESSMENT

SHARE OF GO-FORWARD INVESTMENT 10-20%



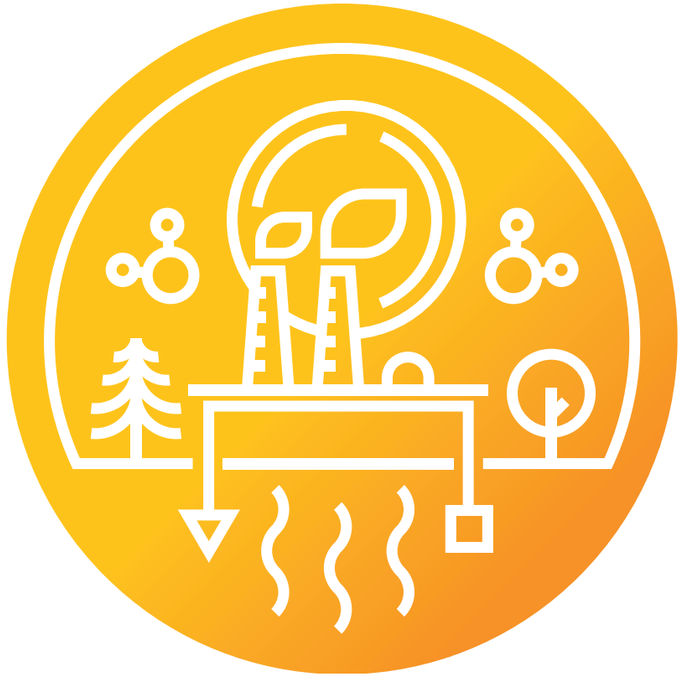


SECTORAL ALIGNMENT

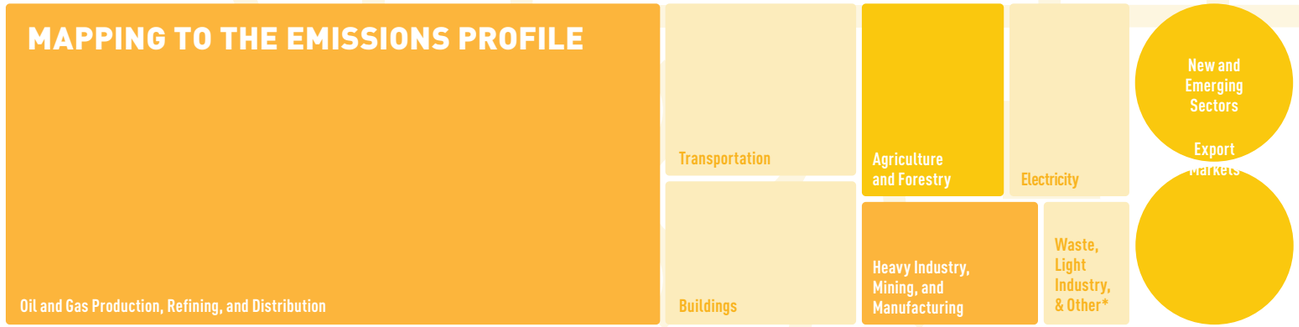
- Carbon capture has been prioritized by the oil sands sector as a major lever for emissions reductions.
- Greenfield buildout of new industrial developments with high point source emissions, such as hydrogen and data centres, enables integration of carbon capture and/or removals from day one.
- Various forms of carbon management, including point source capture and/or removals, may be necessary to achieve deep emissions cuts in hard-to-abate sectors such as concrete and cement, refining and petrochemicals, aviation, and heavy manufacturing.
- In some sectors that already handle biomass, minerals, or carbon itself, vertical integration of carbon removals and conversion has the potential to go beyond avoidance and into negative emissions.
- Alberta's natural resources sectors including agriculture and forestry are well positioned to lead on management of carbon in soils, lands, and forests and could benefit from new revenue streams arising from carbon removal and sequestration activities.

EXAMPLE ERA INVESTMENT OPPORTUNITIES

- Next-generation solutions for point source carbon capture, including pre-combustion, post-combustion, and chemical looping technologies.
- Application of CCS technologies to the bioenergy, electricity, waste-to-energy, and hydrogen sectors to deliver low- or negative-emissions products.
- Engineered and hybrid carbon dioxide removal technologies including DAC, BECCS, and biomass carbon removal and storage (BiCRS).
- Improvements to enhanced oil recovery technology to reduce emissions, increase recovery, and maximize carbon sequestration.
- New or improved pathways for carbon sequestration including mineralization, enhanced rock weathering, and biochar.
- Novel approaches to monitoring, measurement, and verification of carbon sequestration performance and performance.
- Carbon utilization and conversion into value-added products.
- Measurement, management, and enhancement of natural carbon sinks such as soil and forest carbon, including improved land and forest management and digital and sensing solutions.



MAPPING TO THE EMISSIONS PROFILE



Core Sector Focus

Strong Sector Alignment

Moderate/Low Sector Alignment

Existing sectors are shown according to scale of GHG emissions in 2024. See Page 6 for legend and more information.

MEASURING PERFORMANCE

The TRM provides a framework for ERA to evaluate progress across its technology focus areas. Developing clear metrics to measure, monitor, and communicate the impact of ERA's investments is crucial to its mandate. Each focus area's vision helps link important environmental, economic, and social metrics to project results, ensuring ERA funds projects that support its organizational goals and mandate. In tracking performance of the portfolio, ERA considers metrics in key areas such as:

Share of investment allocated to each TRM focus area and specific technology classes

- Project-level outcomes (including actual emissions reductions, leveraged investment, economic benefits, and environmental impact reduction)
- Project success rates and commercialization progression
- Potential for broader outcomes from technology commercialization (forecasted emissions reductions, Indigenous participation, economic, and environmental benefits
- Technology transfer and knowledge sharing, including IP generation and export potential
- Stakeholder awareness and collaborative partnerships.

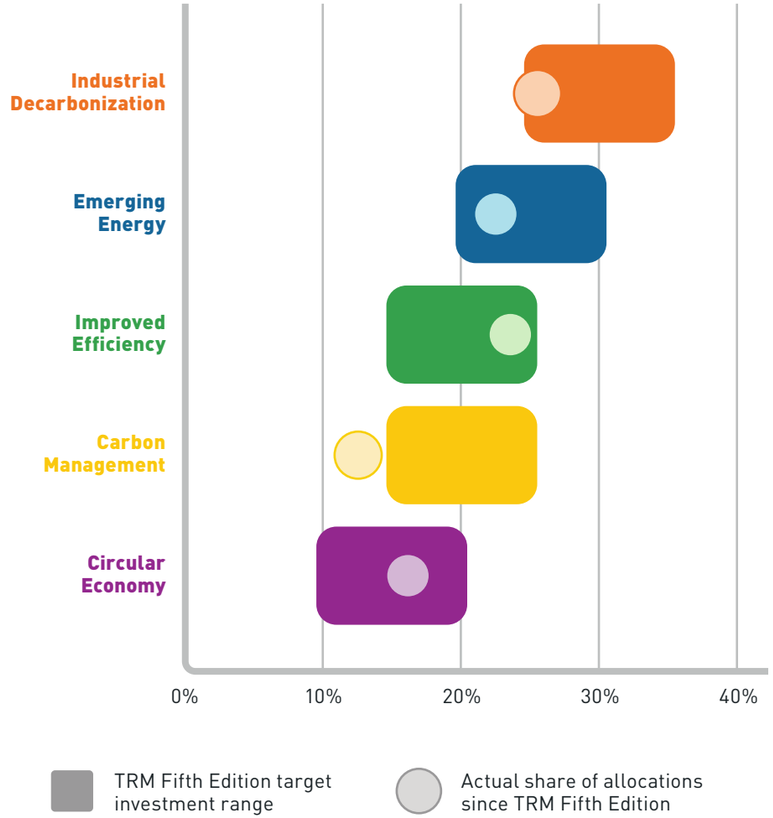
In 2024, ERA launched an open data initiative designed to make investment information from technology projects easier to access. The initiative improves the experience by using dashboards to visualize ERA's portfolio of investments, allowing users to download a file directly from the website. Users can search by sector, primary technology areas, stage of innovation and type of organization.

Access project data at ***eralberta.ca/projects***.

There is inherent risk associated with investing in technology innovation and not all of the projects that ERA selects for funding are successfully completed. For example, a technology may not work as expected or may not be found to be economically feasible. In other cases, projects may not proceed due to financial or other factors. Targeting appropriate levels of attrition (i.e. situations where project funding is awarded but not disbursed) and project success is a common facet of managing a portfolio of investments. Taking an appropriate level of risk when it comes to project success and attrition is key to ERA's success as a provider of patient capital to de-risk clean technology innovation. ERA's investment strategy accounts for attrition risk at the level of individual projects but is informed by attrition metrics from the full portfolio. Tracking project performance across the portfolio enables ERA to calibrate its investment approach, ensure its project selection processes deliver results, and address project failures with the broader commercialization ecosystem. For example, if a project failure is due to the technology itself, ERA uncovers why a technology may not have worked as planned and whether the market has found a different, more efficient solution. ERA can then revise its technology focus areas, learn from the challenges and barriers of that solution, and focus on technologies that continue to meet industry needs. Lessons learned from each project help ERA calibrate future capital allocation targets across a spectrum, from increasing investment in high-attrition areas (taking more "shots on goal" to overcome risk factors) to de-emphasizing areas in future programming (avoiding low-potential pathways).

As shown in the figure to the right, ERA achieved strong alignment with the investment targets during the term of the TRM Fifth Edition (October 2024 – Mid 2026). Investment allocations were within the target range for all areas except for Carbon Management, which fell slightly below the target range due to factors including slower-than-expected development of carbon removals markets and proposal volumes below anticipated levels.

PERFORMANCE RELATIVE TO 5TH EDITION TARGETS



SUMMARY

The Sixth Edition of the Technology Roadmap reaffirms ERA's commitment to investing in the technologies, solutions, and innovators that can deliver meaningful environmental and economic outcomes for Alberta. Built on extensive research, portfolio insights, and engagement with government, industry, researchers, investors, and other ecosystem leaders, the TRM identifies the technology opportunities where ERA can make the greatest impact through its unique mandate of innovation, de-risking, and commercialization support.

The TRM is founded on the principle that no single technology, sector, or pathway can address Alberta's emissions and competitiveness challenges alone. Instead, ERA takes a diversified portfolio approach that supports technologies across different sectors, levels of maturity, and time horizons. The five technology focus areas – **Energy Systems, Industrial Frontiers, Enhanced Efficiency, Circular Economy, and Carbon Management** – collectively represent a broad suite of opportunities to reduce emissions, improve environmental performance, strengthen industrial competitiveness, and create new economic value for Albertans.

Importantly, the TRM is not intended to be a static forecast of the future. It serves as a strategic guide for identifying opportunities, navigating uncertainty, and informing investment decisions in an environment where technology, markets, policy, and geopolitical conditions continue to evolve. ERA will continue to update and refine the TRM through ongoing analysis, stakeholder engagement, and lessons learned from its investment portfolio to ensure it remains relevant, evidence-based, and responsive to Alberta's needs.

The TRM establishes a common framework and over-arching objectives for ERA's work, and it informs program planning (future-looking) and outcomes reporting (backward looking) to government and other stakeholders. The TRM is operationalized through ERA's annual business planning process and sets long-term strategic priorities; ERA's three-year rolling business plan, updated annually, translate those priorities into targeted programming, investment opportunities, and support mechanisms that address emerging market needs and evolving opportunities. This approach ensures ERA remains focused on long-term outcomes while maintaining the flexibility to accelerate innovation and commercialization where it can have the greatest impact. Similarly, ERA's annual report describes actions taken to implement the business plan, progress toward TRM focus area outcomes, and results from ERA's investments.

As Alberta continues to prioritize economic growth, environmental stewardship, and global competitiveness, ERA remains committed to supporting the development and deployment of innovative technologies that help industries and communities thrive. Through strategic investments, ecosystem leadership, and collaboration with partners across Alberta and beyond, ERA will continue to advance practical solutions that strengthen the province's economy, improve environmental performance, and position Alberta as a global leader in technology innovation.



Jarret Stuart, CEO, and Michael Nychyk, President, of Caldera Highwood Distilling

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