

Climate Change Innovation and Technology Framework 2017

Advancing Alberta's environmental performance and diversification through investments in innovation and technology





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Message from the Ministers



Minister Deron Bilous
Economic Development
and Trade

It is clear the economy of the next thirty years will be very different from the economy of the last thirty. Alberta's Climate Change Innovation and Technology Framework will support Alberta as it evolves into the energy and environmental leader the world needs for the 21st century.

The Framework will support the transition to a more diversified economy – one that creates jobs while exporting competitive clean technologies across the world.

This Framework will guide the Government of Alberta's investments in innovation and technology that reduce greenhouse gas (GHG) emissions while preparing our province for the lower carbon economy of tomorrow. Investments that focus on the most tangible and timely GHG emissions reduction opportunities will be made in technology areas across multiple sectors.



Minister Shannon Phillips
Environment and Parks

Alberta has some of the most innovative business leaders, researchers and entrepreneurs in the world. The Framework will support their work as they identify opportunities for economic diversification, investment, and ways to get the province's products to market.

Through improved alignment and coordination of new and existing programs, policies and tools, the Framework will support Alberta's goal of being a global leader on climate change while generating significant economic benefits.

Working together, Albertans can create good jobs and a healthier environment, while building the diversified economy and industries we will need to prosper in the decades to come.





Executive Summary

In November 2015, the Climate Change Advisory Panel submitted its report to the Government of Alberta. The Panel identified the critical role of innovation and technology in advancing the province's response to climate change. The report recommended reducing barriers to the deployment of new technology; considering non-hydrocarbon technologies; and investing in bolder ventures. It also recommended a portfolio approach: investing in multiple technologies to manage the risk of underperformance in any one area. These investments would be supported by pricing carbon emissions.

To ensure these investments are effectively implemented, the Government of Alberta announced the establishment of the Climate Technology Task Force in September 2016. This Climate Change Innovation and Technology Framework builds on the work of the Task Force, which consulted with technology and resource representatives, academics, industry, environmental organizations, and individuals, and received online submissions. Stakeholders supported a holistic approach toward clean innovation, which embraces multiple programs and policies; supports new entrants; improves collaboration; encourages early adoption of technologies; and finds new financial resources from multiple partners.

The Framework serves as the overarching guide for the investment of funds for innovation and clean technology ("clean innovation") from the pricing of carbon emissions. The Framework will support investments in clean innovation across a number of technology areas, including hydrocarbons in the oil sands, renewable energy, green products and services, and other areas. Public investments will result in broad industry and public benefits, and will minimize the environmental impacts of technology deployment. As discoveries and opportunities emerge in the technology and innovation sectors, the Framework will enable the province to adjust accordingly.

Solutions for Alberta

Significant opportunities exist to address climate change challenges and export these solutions to the world - diversifying the economy and creating jobs. Some key technology opportunities include:

- Energy efficiency solutions;
- Cleaner extraction of oil sands with less GHG intensity and water use;
- Detection and reduction of methane emissions;
- New non-fuel uses of oil and gas;
- Lower carbon renewable electrical systems;
- Bio-based energy, fuels, and chemicals from agriculture, forestry, and municipal wastes; and
- Green building solutions contributing to less GHG-intensive building practices and operating costs.



The Framework contains a vision, purpose, strategic outcomes, and principles for implementation. Through funding, leveraged with industry, academic, and other partners, and system leadership, expertise and other resources, the government will:

- Support promising researchers who generate new ideas and businesses that turn ideas into exportable products and services.
- Advance technology development from concept to field testing, scale up and deployment.
- Develop and enhance policies that encourage effective technology solution deployment.

Adopting new technologies enables Alberta industry to reduce emissions while also creating new economic opportunities from new products and services. Through supporting actions, the Framework focuses on establishing the enabling conditions for increased innovation in Alberta. This will be achieved through specific programs, directed investments and policies e.g., new research chairs and student supports; technology development, testing facilities, and programs; and technology innovation and environmental policies.

These enabling conditions and supporting actions include:

Developing and supporting the research and innovation capabilities of researchers and their organizations.

- Strengthen research and innovation capacity in Alberta by developing scientific and technical personnel and supporting their projects.
- Advance development of technologies such as information and communications technology, nanotechnology and genomics that, when integrated, provide solutions to Alberta's climate challenges.
- Advance development of innovative lower carbon climate solutions by connecting the best ideas and technologies of researchers, innovators, policy/decision makers, technology developers and industry through knowledge hubs, networks, and research and innovation partnerships.
- Enhance access to leading-edge research facilities and equipment at post-secondary institutions to support discovery and early development of innovative solutions.





Developing and deploying technology solutions at scale.

- Support scale-up, demonstration, and first deployment projects in partnership with industry to accelerate the broad implementation of clean technology roadmap-guided solutions across industry.
- Help create and grow technology companies addressing climate challenges and opportunities through people, business development, capital, and other programs.
- Connect with national and international markets and partners to grow Alberta companies that have innovative technology solutions to global climate challenges.
- Enhance climate-related innovation facilities and equipment to undertake technology characterization, validation, verification, piloting, and demonstration in partnership with investors and industrial adopters of technology solutions.

Establishing an environment of governance, organizational, policy, regulation, communication, and evaluation mechanisms.

- Establish a Clean Innovation Office to oversee and coordinate implementation of the Framework.
- Improve investment processes for clean innovation by engaging key stakeholders and advisors through Clean Innovation Office-led planning and implementation.
- Leverage non-financial instruments such as policy, regulation, communication, and engagement mechanisms.
- Create a robust, system-wide evaluation plan for clean innovation that tracks short, medium, and long-term progress and informs adjustments to the Framework.

Alberta's Clean Innovation Office will:

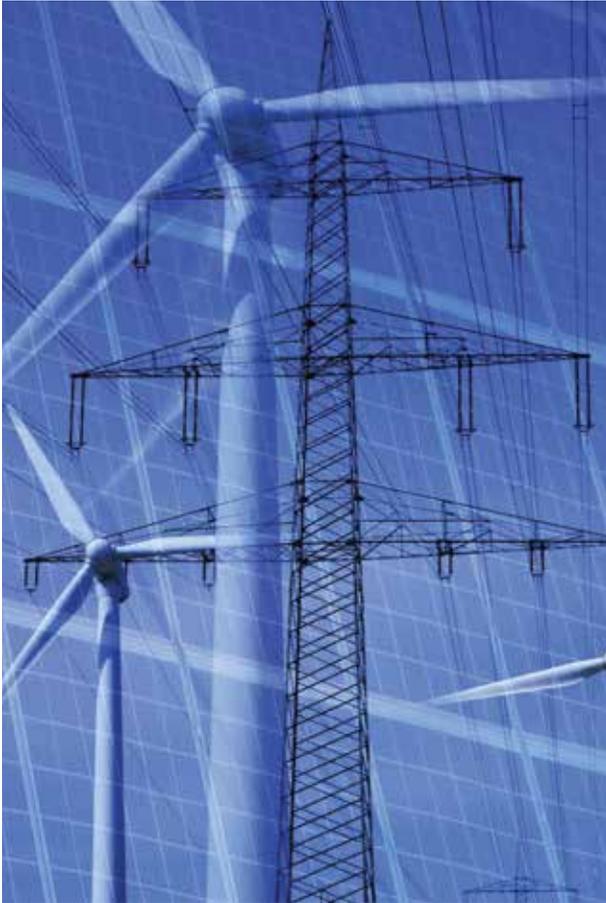
- Oversee and coordinate implementation of the Framework;
- Lead planning of new Cabinet-approved programs; and
- Lead evaluation and reporting of Framework outcomes and activities.

The Framework will be implemented through Alberta's innovation ecosystem, a group of actors that includes government, advisors, program delivery agents, and connectors. Collectively, working in a coordinated and collaborative manner, they can turn ideas into remarkable innovations and solve problems better, faster and more effectively than if they were to tackle them in isolation.





How the Framework was Developed



In June 2015, the Government of Alberta established the Climate Change Advisory Panel, which identified the critical role of innovation and technology in advancing the province's response to climate change. In November 2015, the Panel recommended reducing barriers to the deployment of new technologies, considering non-hydrocarbon technologies, and investing in bolder ventures. It also recommended a portfolio approach: investment in multiple technologies to manage the risk of underperformance in any one area. These investments would be supported by the pricing of carbon emissions.

To ensure these investments are effectively implemented, the Government of Alberta announced the establishment of the Climate Technology Task Force in September 2016. The Task Force consulted with technology and resource representatives, academics, industry, environmental organizations, and individuals, and received submissions online.

Stakeholders identified the following opportunities for the innovation system:

- A shift in thinking is required to embrace a holistic approach toward clean innovation. This shift must recognize the need for innovation, understand its scope and risks, and use best practices to evaluate progress. Time is needed for technology to be fully realized and successfully commercialized.
- Silos must be broken down through a new model of collaboration. This model must provide opportunities to new entrants, encourage early adoption of new technologies, and promote partnerships with national and international initiatives that share common interests.
- Significant new financial resources, invested effectively and efficiently, are required from multiple partners over long time periods.



The Task Force completed its consultations in the fall of 2016. It developed a report that proposed an architecture (vision, strategic goals, outcomes, and design principles) and six recommendations. Key elements of the report's recommendations are outlined below:

- **Recommendation #1** of the Task Force called for a “Team Alberta” common vision, mission, direction, and strategies leading to a low carbon economy that is prosperous and resilient. This is to be achieved through transformative clean innovation, and generating significant environmental and economic benefits.
- **Recommendation #2** stressed the importance of significant, long-term clean innovation funding.
- **Recommendations #3 and #4** called for a single-point clean innovation system “convener” – a central governance body with an arm’s length resource allocation mandate.
- **Recommendations #5 and #6** called for investments in capabilities, preparing technology for deployment, and the use of non-financial instruments (e.g., policies and regulations encouraging procurement and deployment of effective technologies, and active engagement and communication with Albertans and innovation stakeholders).

The Framework builds upon the Task Force recommendations and stakeholder advice by providing an overarching guide for the investment of funds from the pricing of carbon emissions into clean innovation. As discoveries and opportunities emerge in the technology and innovation sectors, the Framework will enable the province to adjust accordingly.





Setting Direction: Vision, Purpose, Strategic Outcomes, and Principles

Vision

By year 2030, Alberta's use of innovation and clean technology ("clean innovation") will accelerate the shift to a lower carbon economy, generating significant environmental and economic benefits.

Purpose of the Framework

The Climate Change Innovation and Technology Framework:

- Ensures coordinated, impactful investments in research, innovation and technology.
- Accelerates the development of innovative and transformative technologies.
- Engages and aligns stakeholders through partnerships with other governments, industry, not-for-profits, and academia.

Strategic Outcomes

The clean innovation ecosystem is designed to support and enhance Alberta's ability to reduce GHG emissions, promote economic diversification and transition to a lower carbon system. Developing this ecosystem will address challenges highlighted in the Task Force report, including the need for actors within the ecosystem to share a common alignment toward strategic outcomes and to enhance their ability to collaborate in a supportive manner.

Through clean innovation, Alberta will progress towards achieving the following outcomes, with priority towards GHG reductions:

Environmental Performance – GHG Reductions

- Reductions in Alberta's GHG emissions are aligned with the targets determined provincially and nationally; and
- The reduction of GHGs from investments in technology are tangible and measurable.

Economic Diversification

- Lower carbon sectors increasingly contribute to Alberta's gross domestic product (GDP); and
- Innovative and new lower carbon sectors attract more capital investments and jobs.





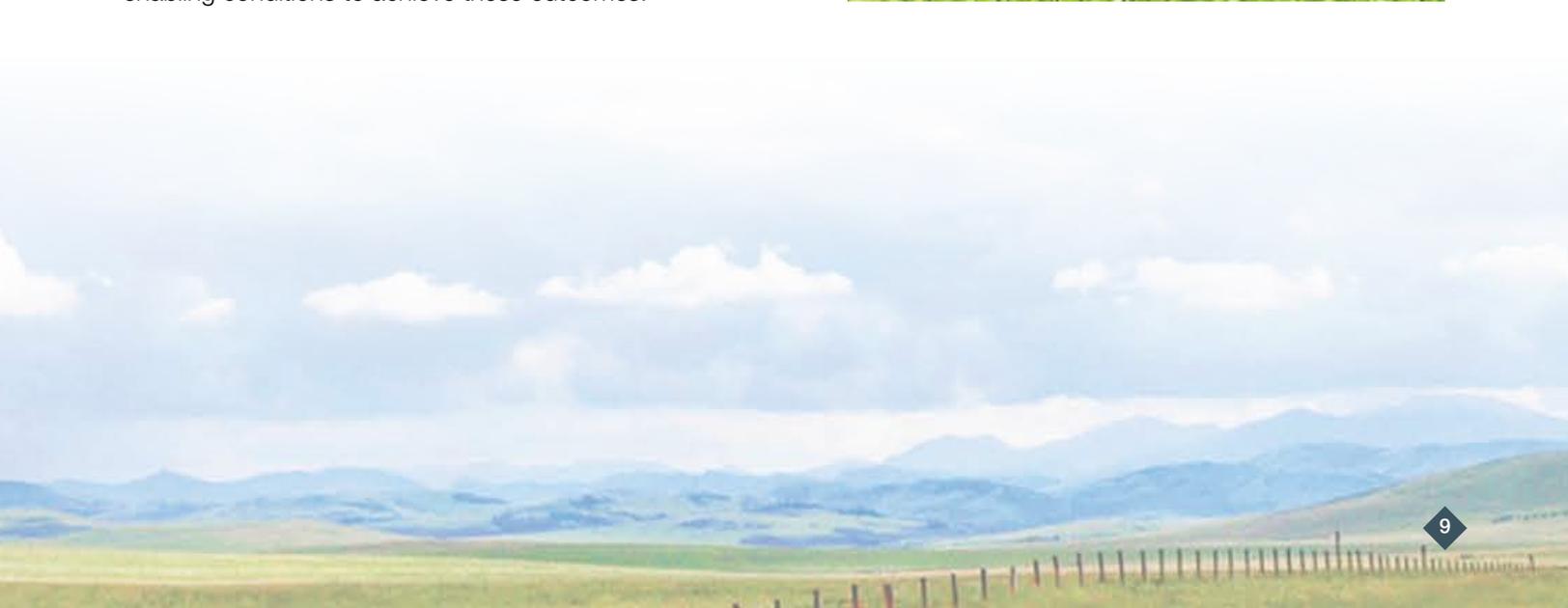
Energy Transition

- New technologies and innovation play a key role as Alberta transitions to a reliable, lower carbon electricity system; and
- Oil and gas hydrocarbon-based sectors actively pursue cost-effective, lower carbon extractive technologies, and generate products that demonstrate superior value and environmental performance e.g., non-fuel uses of oil and gas.

Innovation System Performance

- A healthy, well supported innovation ecosystem is open, and welcoming to new entrants;
- Innovation system actors align and collaborate towards common clean innovation outcomes;
- Significant financial resources, sustained through the innovation lifecycle, support promising clean innovation ideas, technologies, and processes; and
- Effective and efficient clean innovation program investments are made in projects and in necessary capability (people, infrastructure, networks and partnerships, and innovation environment).

Working with partners, stakeholders, and program delivery agents, the Government of Alberta will implement actions (through programs and policies) to establish the needed enabling conditions to achieve these outcomes.





Principles for Implementation of the Framework

These principles establish the values for implementation of the Framework:

- **Bold, aspirational, and future-oriented leadership**

In pursuit of this vision, the Framework will be bold in its reach, ambitious in commitment, and compelling to all Albertans.

- **Flexible and responsive architecture**

Alberta's transition to a lower carbon economy will require embracing innovation in not only technology and processes, but also in policy, relationships, and interactions – all parts of the innovation ecosystem. This architecture will be risk tolerant, open, transparent, and highly adaptive to disruption and re-evaluation.

- **Excellence and engagement of best expertise**

The Framework will be implemented by those with local, national and international knowledge, experience and expertise. Participation from industry, academia, government, business, and not-for-profit organizations will be encouraged. The best entrepreneurial thinking, capabilities, and networks will drive successful innovation.

- **Collaborative, inclusive, connected, and aligned innovation ecosystem**

Government, industry, academic, and not-for-profit organizations in the innovation ecosystem will need to work together, welcoming and embracing new entrants, including the Indigenous community. Collaborative (rather than competitive) behaviours will be encouraged.

- **Portfolio-based, outcomes-focused, open and agile oversight**

A portfolio approach will support a diversity of projects (in size, time to market, and funding recipients) from research to commercialization, while managing risk. Incentives and partnerships with the private sector and others will also mitigate risk.





Governance

Government

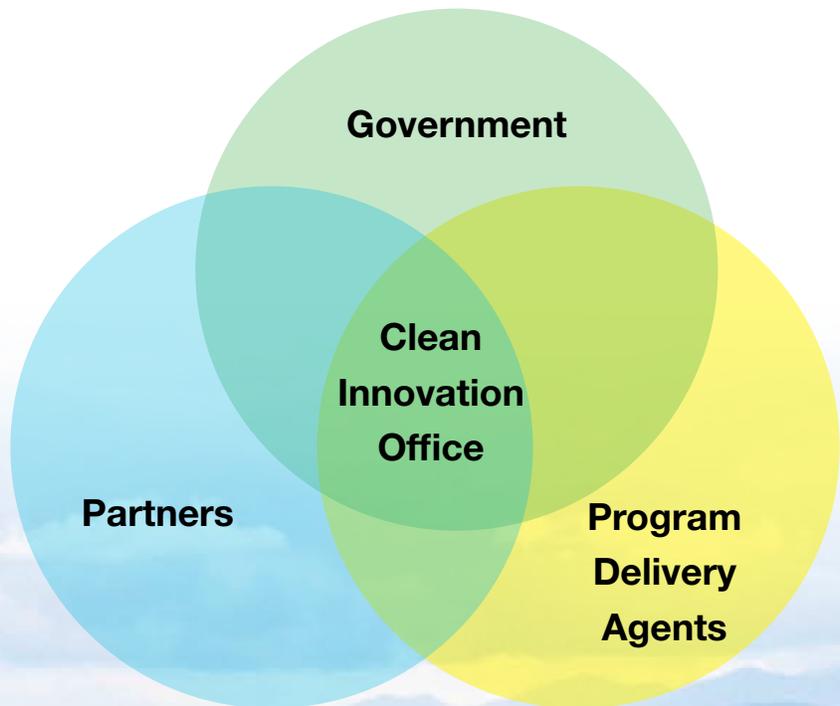
Decisions on programs and funding will be subject to Cabinet approval. Working closely with the Minister responsible for the Climate Change Office, the Minister of Economic Development and Trade will have accountability for the Clean Innovation Office and provide direction as needed. Program grants to implement the Framework actions will be managed through government processes. While some programs will be delivered directly by various government departments, the Ministry of Economic Development and Trade will communicate on the overall Framework and program results.

Clean Innovation Office

Accountable to the ministers responsible for Alberta's economic development and climate change agendas, an internal government-led Clean Innovation Office will provide single-point oversight and coordination of the development and implementation of the Framework. The Clean Innovation Office will guide developments from ideas to implementation through program and policy activities, informed by a diverse group of advisors, program delivery agents, and other partners. This office will work with program delivery agents and partners to deliver the programs within the Framework. In addition, the office will establish evaluation plans to monitor progress, review the Framework, and adjust it as needed. The Clean Innovation Office will also be responsible for coordinating resource allocation, in conjunction with private investors and partners.

Program Delivery Agents

Where program delivery is not administered directly by government, program delivery agents such as Emissions Reduction Alberta (ERA) and Alberta Innovates will work with government on detailed program design. Program delivery agents will deliver the developed programs and report results to government through the Clean Innovation Office's reporting process.





Alberta's Innovation System and the Framework

Within the innovation ecosystem, each actor, institution, and network plays a unique role in implementing the Framework. The government-led Clean Innovation Office will provide an overall system convener function. It will align and coordinate clean innovation-related advisors, program delivery agents, strategic partners, and other actors to work together to manage the development and implementation of the Framework. Collectively, they will turn ideas into remarkable innovations. The ecosystem includes:

- **Government:** It sets public policy and strategic direction; provides funding (in conjunction with leveraged private funding and investments); and establishes programs, infrastructure, and other mechanisms to support Alberta's public and industrial research, development, and deployment.
- **Advisors:** They help the Clean Innovation Office to define and develop the Framework further. These advisors could include energy and environmental groups and committees, the Alberta Research and Innovation Advisory Council, the Premier's Advisory Committee on the Economy, business leaders, researchers, and other technical experts.
- **Program delivery agents:** They collaborate with partners and performers in the innovation system to implement the Framework through policies, strategies, regulations, programs, and other initiatives and partnerships. They could include Emissions Reduction Alberta, Alberta Innovates, Government of Alberta, post-secondary institutions and federal groups. They work with industry, funders and investors, small business, entrepreneurs, and other performers (e.g., service providers, research and development centres).

ERA

ERA was created in 2016 to accelerate development of innovative technologies that reduce GHG emissions and secure Alberta's success in a lower carbon economy. ERA, previously known as Climate Change and Emissions Management Corporation (established 2009), is expected to deliver GHG reductions of 7.5 megatonnes (by 2020), 15,000 high quality jobs (by 2021), and \$1.8 billion in GDP growth (by 2021) through long term project impacts.

Alberta Innovates

By combining four previous corporations, a new Alberta Innovates Corporation was created in 2016 which includes the energy, environmental, and biological domains that are central to climate solutions. It also supports commercialization activities across the Alberta innovation system, moving ideas from the lab to company creation and industry-wide deployment.



- **Connecting individuals and organizations:** They facilitate research and innovation by linking researchers, innovators, entrepreneurs, companies, and others locally, nationally, and internationally. Emphasis will be placed on international connections, which are vital to Alberta's success.

The Framework is intended to contribute to Alberta's innovation ecosystem as it evolves by encouraging new ideas and entrants, fostering alignment and collaboration, providing resources sustained throughout the innovation lifecycle, and ensuring effective investment and capacity.





Enabling Conditions and Actions

The Task Force report identified the need for a paradigm shift within the current innovation ecosystem. The need for new technologies was identified as a critical step in decoupling GHG emissions from economic diversification.

The Framework will support investments across a number of technology areas, including hydrocarbons in the oil sands, renewable energy, green products and services, and other areas. Public investments will result in broad industry and public benefit, and will minimize environmental impacts of technology deployment.

Adopting new technologies enables Alberta industry to reduce emissions while also creating new economic opportunities from the development of new products and services. In order to generate new technologies and innovations, the Framework focuses on establishing enabling conditions that are supported by actions. Enabling conditions create an environment conducive to innovation. Framework enabling conditions include:

- Developing and supporting the research and innovation capabilities of researchers and their organizations;
- Developing and deploying technology solutions at scale; and
- Establishing an environment of governance and organizational structure, policy, regulation, communications and evaluation mechanisms.

Actions will be implemented through specific programs and investments, as well as policy enhancements e.g., new research chairs and student supports; technology development and testing facilities and programs; and technology innovation and environmental policies.





See Appendix 1 for an overall Framework placemat.

Enabling Condition	Action
<p>Clean Research and Innovation Capability: Developing and supporting the research and innovation capabilities of researchers and their organizations.</p>	<ul style="list-style-type: none"> • Strengthen research and innovation capacity in Alberta by developing scientific and technical personnel and supporting their projects. • Advance development of technologies such as information and communications technology, nanotechnology, and genomics that, when integrated, provide solutions to Alberta’s climate challenges. • Advance development of innovative lower carbon, climate solutions by connecting the best ideas and technologies of researchers, innovators, policy/decision makers, technology developers, and industry through knowledge hubs, networks, and research and innovation partnerships. • Enhance access to leading-edge research facilities and equipment at post-secondary institutions to support discovery and early development of innovative solutions.
<p>Clean Technology Solutions: Developing and deploying technology solutions at scale.</p>	<ul style="list-style-type: none"> • Support scale-up, demonstration and first deployment projects in partnership with industry to accelerate the broad implementation of clean technology roadmap-guided solutions across industry. • Create and grow technology companies addressing climate challenges and opportunities through people, business development, capital and other programs. • Connect with national and international markets and partners to grow Alberta companies that have innovative technology solutions to global climate challenges. • Enhance climate-related innovation facilities and equipment to undertake technology characterization, validation, verification, piloting and demonstration in partnership with investors and industrial adopters of technology solutions.
<p>Clean Innovation System Environment: Establishing an environment of governance, organizational, policy, regulation, communication and evaluation mechanisms.</p>	<ul style="list-style-type: none"> • Establish a Clean Innovation Office to oversee and coordinate implementation of the Framework. • Improve investment processes for clean innovation by engaging key stakeholders and advisors through Clean Innovation Office-led planning and implementation. • Leverage non-financial instruments such as policy, regulation, communication, and engagement mechanisms. • Create a robust, system-wide evaluation plan for clean innovation that tracks short, medium and long term progress and informs timely adjustments to the Framework.





Measuring Success

A performance evaluation plan will measure progress and inform changes to the Framework as needed. The evaluation plan will incorporate:

- Short-term reporting on investments, activities, actions, and programs.
- Mid-term reporting and assessment of progress (e.g., every three years) on enabling conditions. This may inform Framework or program adjustments.
- Long-term assessment of the overall Framework effectiveness and impact on advancing the Climate Leadership Plan. This requires a time horizon of five to ten years to assess change.

The Clean Innovation Office will be responsible for the overall outcomes of the Framework and for monitoring the performance of programs and of the innovation system with respect to enabling conditions. Organizations responsible for program delivery will be held accountable at a program level through grant agreements and contracts.

Through this performance evaluation plan and reporting, Albertans will see an increase in:

- Deploying technology solutions that tangibly reduce GHG emissions, starting with short-term gains and continuing with increasingly transformative impacts over intervals of five, ten, or more years, e.g., in the electrical system, the oil and gas (hydrocarbon) sector, and other sectors.
- Technology solutions deployed locally, nationally, and internationally by Alberta companies and their partners, leading to a more diverse and prosperous, lower carbon economy, which in turn generates jobs and wealth in Alberta.
- Transformative technology solutions from an innovation system that is open to new entrants, aligns actors' objectives, supports clean innovation ideas through the innovation lifecycle, and is effective and efficient.





Moving Forward / Next steps

Programs in Year One will leverage existing capacity and programs intended to address the challenges identified in the Framework. Subsequent program design and implementation will address gaps identified in the system and will likely be realized in Year Two. Program development and implementation will continue into Year Three.

Throughout the initial stages of the Framework, progress will be monitored. Course corrections and realignments will occur after Year Three as needed.

Additional activities will include development of working groups to implement the programs and policies to support the Framework, as well as to support evaluation and reporting. These activities will consider methods to build upon the strengths of existing organizations, programs, and policies.

A significant amount of Framework funding will be used to leverage the resources of the federal government, industry, and other partners in areas of common and complementary interest. The implementation of the Framework will result in the emergence of new partnerships; co-investments in programs and initiatives; and joint ventures.

Consideration will also be given to how the technologies developed through the Framework can benefit key sectors in the Alberta economy, a number of which are listed in Appendix 2.

Alberta Carbon Conversion Technology Centre

Alberta has already begun investing in leading edge climate-related innovation infrastructure with the federal government.

In 2017 the Alberta Carbon Conversion Technology Centre was announced. The new facility at the Shepard Energy Centre in Calgary will provide a venue where technology developers and research scientists from industry, academic institutions, and governments come together to:

- Collaborate on innovative carbon-use technologies at a large industrial scale; and
- Test the conversion of carbon dioxide into marketable products such as new building materials, fuels, and consumer goods.



Appendix 1 – Framework Placemat

Setting Direction

Vision

By year 2030, Alberta’s use of innovation and clean technology (“clean innovation”) will accelerate the shift to a lower carbon economy, generating significant environmental and economic benefits

Purpose

- Ensures coordinated, impactful investments in research, innovation, and technology
- Accelerates the development of innovative and transformative technologies
- Engages and aligns stakeholders through partnerships with other governments, industry, not-for-profits, and academia

Implementation Principles

- Bold, aspirational, and future-oriented leadership
- Flexible and responsive architecture
- Excellence and engagement of best expertise
- Collaborative, inclusive, connected, and aligned innovation ecosystem
- Portfolio-based, outcomes-focused, open, and agile oversight

Strategic Outcomes

Environmental Performance – GHG Reductions

- Reductions in Alberta’s GHG emissions are aligned with the targets determined provincially and nationally
- The reduction of GHGs from investments in technology are tangible and measurable

Economic Diversification

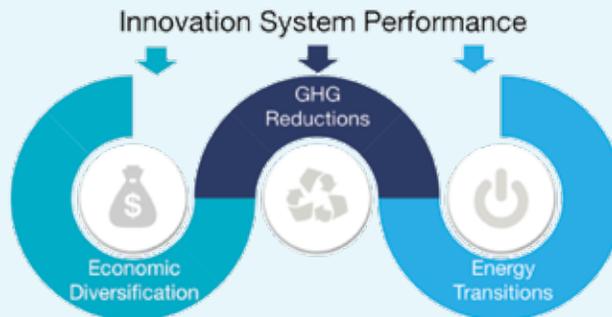
- Lower carbon sectors increasingly contribute to Alberta’s GDP
- Innovative and new lower carbon sectors attract more capital investments and jobs

Energy Transition

- New technologies and innovation play a key role as Alberta transitions to a reliable, lower carbon electricity system
- Oil and gas hydrocarbon-based sectors actively pursue cost-effective, lower carbon extractive technologies and generate products that demonstrate superior value and environmental performance

Innovation System Performance

- A healthy, well supported innovation ecosystem is open, welcoming to new entrants
- Innovation system actors align and collaborate towards common clean innovation outcomes
- Significant financial resources, sustained through the innovation lifecycle, support promising clean innovation ideas, technologies, and processes
- Effective and efficient clean innovation program investments are made in projects and in necessary capability (people, infrastructure, networks and partnerships, innovation environment)





Enabling Conditions

Clean Research and Innovation Capability (C):



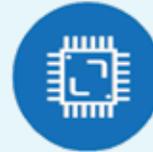
Developing and supporting the research and innovation capabilities of researchers and their organizations.

Clean Technology (T) Solutions:



Developing and deploying technology solutions at scale.

Clean Innovation System Environment (E):



Establishing an environment of governance, organizational, policy, regulation, communication, and evaluation mechanisms.

Actions

C1. Strengthen research and innovation capacity in Alberta by developing scientific and technical personnel and supporting their projects.

C2. Advance development of technologies such as information and communications technology, nanotechnology, and genomics that, when integrated, provide solutions to Alberta's climate challenges.

C3. Advance development of innovative lower carbon climate solutions by connecting the best ideas and technologies of researchers, innovators, policy/decision makers, technology developers, and industry through knowledge hubs, networks, and research and innovation partnerships.

C4. Enhance access to leading-edge research facilities and equipment at post-secondary institutions to support discovery and early development of novel, innovative solutions.

T1. Support scale-up, demonstration and first deployment projects in partnership with industry to accelerate the broad implementation of clean technology roadmap-guided solutions across industry.

T2. Create and grow technology companies addressing climate challenges and opportunities through people, business development, capital, and other programs.

T3. Connect with national and international markets and partners to grow Alberta companies that have innovative technology solutions to global climate challenges.

T4. Enhance climate-related innovation facilities and equipment to undertake technology characterization, validation, verification, piloting, and demonstration in partnership with investors and industrial adopters of technology solutions.

E1. Establish a Clean Innovation Office to oversee and coordinate implementation of the Framework.

E2. Improve investment processes for clean innovation by engaging key stakeholders and advisors through Clean Innovation Office-led planning and implementation.

E3. Leverage non-financial instruments such as policy, regulation, communication, and engagement mechanisms.

E4. Create a robust, system-wide evaluation plan for clean innovation that tracks short, medium and long-term progress and informs timely adjustments to the Framework.

Appendix 2 – Potential Clean Technology Sector Opportunity Areas

Alberta's Lower Carbon Economy - Pathways to a Cleaner Future

