

OCTOBER 2024

Procuring with Purpose



Canada's Opportunity to Shape
the Carbon Removal Market





ACRONYMS & ABBREVIATIONS IN THIS REPORT

AMC advance market commitment

BECCS bioenergy with carbon capture and storage

CCUS carbon capture, utilisation, and storage

CO₂ carbon dioxide

DAC direct air capture

DOE U.S. Department of Energy

DOR direct ocean removal

ECCC Environment and Climate Change Canada

ERW enhanced rock weathering

GDP gross domestic product

GHG greenhouse gas

GIGATONNE billion metric tonnes

ITC investment tax credit

LCA life cycle assessment

MEGATONNE million metric tonnes

MMRV measurement, monitoring, reporting, and verification

NMSO National Master Standing Offer

NRCAN Natural Resources Canada

PSPC Public Services and Procurement Canada

RDD&D research, development, demonstration, and deployment

RFI Request for Information

RFSO Request for Standing Offer

TBS Treasury Board of Canada Secretariat

VCM voluntary carbon market



About Carbon Removal Canada

Carbon Removal Canada is an independent policy initiative focused on the rapid and responsible scaleup of carbon removal solutions needed to meet Canada's climate goals. With team members based across the country, Carbon Removal Canada is a project of the Clean Prosperity Foundation and the first group in Canada dedicated to shaping policies and strengthening systems to build an innovative and inclusive carbon removal field.

Carbon Removal Canada

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We acknowledge with respect that this report was produced on the traditional, ancestral, and unceded territories of many nations, including the Mississaugas of the Credit, the Anishinaabeg, the Chippewa, the Haudenosaunee and the Wendat — whose deep connections with this land continues to this day.

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Executive Summary

Since record-keeping began 174 years ago, the ten warmest years on record have all occurred over the last decade.¹ Canada is warming faster than many parts of the world, roughly two to three times the global average.² This increase in planetary warming is taking an economic toll, with Canada experiencing its fourth-worst year on record for insured losses in 2023.³ Absent climate solutions, incurred economic and other damages could slow Canada's growth in gross domestic product by CAD\$25 billion per year.⁴

Removing CO₂ from the atmosphere is now recognized as an indispensable tool to help achieve global climate goals alongside reducing emissions and adapting to negative impacts. Scaling permanent carbon removal solutions to the multi-gigatonne level per year will be an immense challenge and requires a major mobilisation of funding that, historically, has been inadequate. There is no known federal funding for permanent carbon removal to date in Canada, although the recently finalised carbon capture, utilisation, and storage tax credit will provide support for direct air capture. Furthermore, challenges currently faced by carbon markets, including concerns over a lack of buyers in the voluntary market and the need for standards and protocols for integration into compliance markets, have created additional funding barriers for permanent carbon removal. Targeted government actions will, therefore, be vital to help mature and scale the industry.

Across all the different policy levers available to support the industry, government procurement of carbon removal services is perhaps the most timely and significant option given the constraints currently facing carbon markets. It can help create a sustained demand signal beyond what the voluntary carbon market can offer while laying the groundwork for carbon removal integration into compliance carbon markets and other regulatory schemes in the future. However, national governments alone are unlikely to scale the carbon removal industry to the necessary level for material climate impact. Additional funding that national governments can crowd in will need to come from the private or other public sector entities.

Canada now has a unique opportunity to leverage the combined purchasing power of public and private markets to support the carbon removal industry through procurement. The Canadian government, in its April 2024 federal budget, has signalled its interest in procurement by expanding the scope of the Low-carbon Fuel Procurement Program to include the purchase of carbon removal. This announcement created one of the world's first formal government procurement initiatives for carbon removal, enabling Canada to create an industry-defining program and shape the carbon removal market. As the Government of Canada works to develop and implement a program, it should seek to attract other public and private sector buyers into the market to establish similar procurement efforts. However, success in the carbon removal market through procurement is not guaranteed, and this report seeks to recommend design elements that can help maximise positive impact.



Section 1

Why Does Carbon Removal Require Support?

Removing carbon dioxide (CO₂) from the atmosphere is now recognized as an indispensable tool to help achieve global climate goals alongside reducing emissions (mitigation) and adapting to negative impacts. The Intergovernmental Panel on Climate Change has affirmed that carbon removal is a “requirement” to stabilise CO₂-driven warming in line with the global pursuit of net-zero CO₂ emissions by midcentury and will be “necessary” to achieve net-negative CO₂ emissions.⁵



Carbon dioxide removal from the atmosphere (carbon removal) is the intentional, human-driven process of removing CO₂ from the atmosphere and storing it through various mechanisms.



***NOTE**

Defined as carbon removal solutions that can securely store CO₂ on geologic timescales (for at least 1,000 years) with minimal risk of physical reversal.

Since climate change is a function of cumulative historical emissions⁶ and CO₂ is the major determinant of warming to date,⁷ there is no practical way to solve climate change without the removal of CO₂ from the atmosphere on a large scale.

All modelling pathways that are compatible with our most ambitious global climate goals require carbon removal at a cumulative level of hundreds of gigatonnes this century.⁸ Scaling carbon removal solutions to the necessary multi-gigatonne level per year will be an immense challenge and is comparable to only a few global industries that move physical mass at similar scales, such as concrete or steel.⁹ A major component of the scaling challenge involves mobilising requisite funding for the industry, which must happen despite the absence of a pre-existing market that values the unique societal benefits of carbon removal. Importantly, such funding must supplement, not replace, mitigation and adaptation efforts on a global scale.

Historical global funding for the carbon removal industry grew from USD\$2.5 billion in 2021 to \$5.8 billion in 2023.¹⁰ However, this capital investment pales in comparison to the anticipated USD\$3 trillion that will be invested globally in the energy sector in 2024.¹¹ In Canada, federal expenditures (executed or planned) on climate initiatives since 2015 total around CAD\$160 billion for mitigation,¹² with no known programmatic funding that has been made available specifically for permanent carbon removal.* Funding for carbon removal to date has been directed towards shorter duration storage methods such as forestry systems, including Canada's plan to spend more than \$3 billion for its 2 Billion Trees program.¹³ The recently finalised carbon capture, utilisation, and storage (CCUS) investment tax credit (ITC),¹⁴ which includes eligibility for direct air capture (DAC), will serve as the first major federal policy to support permanent carbon removal in Canada.¹⁵

Carbon markets serve as important tools to help channel funds toward permanent carbon removal solutions and grow the demand signal, but they face immediate challenges. The voluntary carbon market (VCM) had an estimated global annual value of USD\$2 billion in 2021¹⁶ and 2022¹⁷ across all credit types (emissions reduction, avoidance, and removal benefits), for which only three percent of the market currently consists of carbon removal projects.¹⁸ Despite increasing demand for carbon removal,¹⁹ the market value of the VCM dropped to USD\$723 million in 2023.²⁰ In Canada, only 14 Canadian companies are estimated to have purchased credits in the VCM to support permanent carbon removal, totalling around 150,000 tonnes,²¹ much of which did not contribute to project development in Canada. The VCM is currently experiencing several challenges, including a lack of buyers (in both absolute terms and a diversity of participating economic sectors), uncertainty around whether and how VCM credits will count toward corporate climate targets,²² and reputational risks stemming from past purchases of traditional offsets of dubious quality.²³

Conversely, compliance carbon markets were expected to be valued at more than USD\$800 billion globally in 2023.²⁴ They could help significantly scale the industry, but a lack of standards and project-specific



protocols limit market access for permanent carbon removal projects. Notably, the successful integration of permanent carbon removal methods into compliance markets will depend on demonstrating technological efficacy, safety, public acceptance, and cost competitiveness with other compliance options. This will likely lead to considerable delays for permanent carbon removal to enter such markets until later this decade or into the 2030s. In Canada, permanent carbon removal is currently ineligible in the federal and most subnational compliance offset systems (**Table A-1**).

The need to mobilise more funding is urgent, given the challenge of scaling the permanent carbon removal industry from a current estimated global capacity of 1.3 megatonnes of CO₂ per year²⁵ and the imperative for large-scale carbon removal to help limit warming to 1.5°C or 2°C above pre-industrial levels. No single funding instrument alone will be sufficient to capitalise on the carbon removal industry at scale, which will necessitate exploring different scaling options across the VCM, compliance carbon markets and programs, and novel regulatory schemes. However, some funding instruments that are currently operational face major barriers to scale. Government support will, therefore, be vital to help advance the industry in the immediate term and overcome these barriers.



OVERVIEW OF CARBON MARKETS

Carbon markets include voluntary and compliance markets. The VCM is unregulated and allows parties to buy carbon credits from projects that remove, reduce, or avoid greenhouse gas (GHG) emissions, usually for voluntary climate goals.

Compliance markets are regulated and require specific emitters to meet emission performance standards or buy permits or offsets to fulfil compliance obligations.



Section 2

How Can Governments Support Carbon Removal?

The carbon removal industry requires dedicated funding support across the full innovation spectrum, including research, development, demonstration, and deployment (RDD&D). This is due in part to the relative nascency of the industry and the need to trial a host of different carbon removal methods to better understand which have the potential to scale²⁶ in the longer term. Policies can support innovators across the RDD&D spectrum, including meeting relatively higher-risk funding needs for technology advancement and providing market demand signals for new innovations.

Funding support from governments has historically been focused on earlier-stage innovation,²⁷ but there is an emerging role to play in assisting with later-stage

technology demonstration and deployment efforts.^{28,29} Supply-push and demand-pull mechanisms can support carbon removal across RDD&D (**Table 1**), highlighting the indispensable role that public policies can play in promoting industry development. Importantly, a diverse portfolio of demand-side policies will be required for carbon removal to achieve the requisite scale, given that not every policy is likely to support all forms of carbon removal. Leveraging public policies that specifically help de-risk and unlock the mobilisation of private capital will be particularly important.³⁰



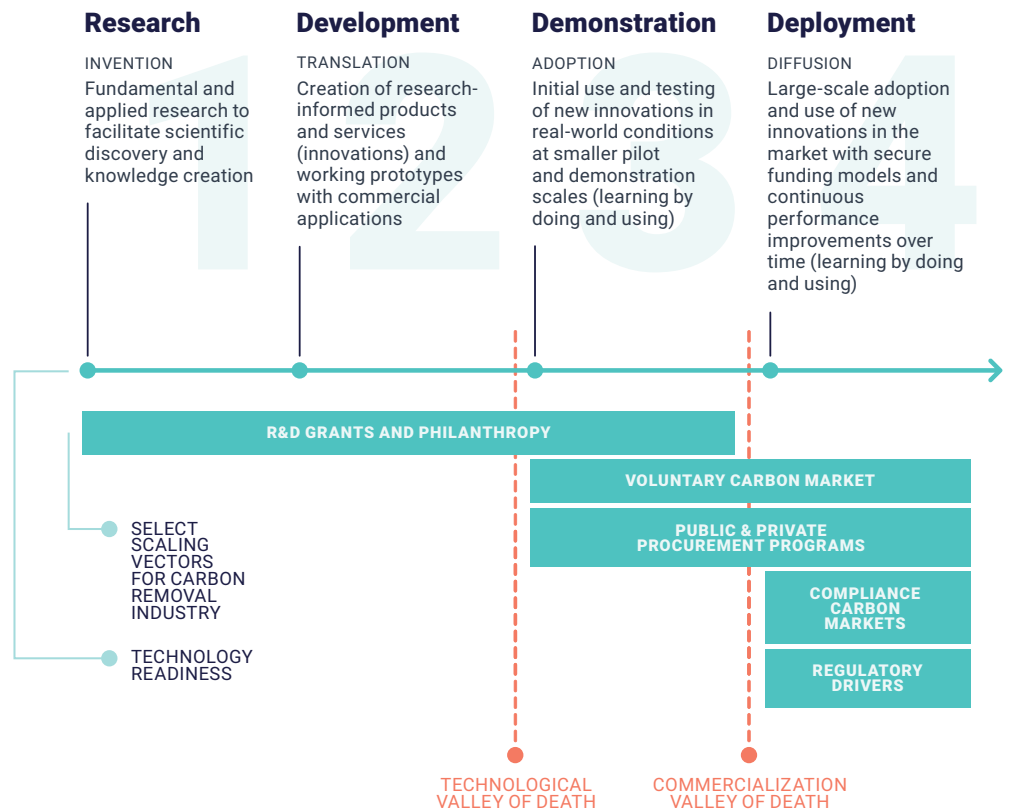
Table 1. Opportunities for Government Support of Carbon Removal across RDD&D (not exhaustive)

SUPPORT FUNCTION	RESEARCH & DEVELOPMENT	DEMONSTRATION	DEPLOYMENT
SUPPLY PUSH			
Research grants	X		
Challenge prizes & competitions	X	X	X
Tax policies such as investment and production tax credits & scientific research tax incentives	X	X	X
Debt financing		X	X
Direct loans & loan guarantees		X	X
Equity financing		X	X
Funding for shared infrastructure		X	X
Non-dilutive project grants		X	X
Feed-in tariffs			X
DEMAND PULL			
Direct procurement of carbon credits or physical materials, including market signalling from government purchases (stamp of approval) to legitimise new products and innovations		X	X
Carbon removal contracts for difference			X
Common practice or compensatory regulatory schemes ³¹			X
Compliance market & program integration			X
Emissions performance standards (at the sectoral or product level) & acceptable product claims for environmental performance			X
Trade policies such as integration into carbon border adjustment mechanisms			X
OTHER			
Performer & funder of research (including intergovernmental research initiatives)	X		
Access to laboratory space, testing facilities, equipment, data tools, & scientists	X	X	
Peer-to-peer networking systems	X	X	
Project-level protocol development	X	X	X
Standards development	X	X	X
Community benefits plans & agreements		X	X
Educational & workforce development		X	X
Public convenings, community engagement, and social awareness campaigns (incl. international)		X	X
Public-private partnerships & cost-sharing arrangements with private industry		X	X
Supportive & streamlined permitting process (including regulatory clarity for research vs. commercial projects)		X	X



The journey of technology advancement from lab to market can introduce a host of challenges for innovators in the carbon removal industry, including the need to bridge ‘valleys of death’ to achieve commercial success (**Figure 1**). Governments can play a critical role in helping innovators traverse these challenges as they move across the innovation spectrum. Government support is particularly vital for the carbon removal industry in its early market formation, as its services and societal benefits are more of a public good and do not necessarily result in creating consumer-driven physical products.

Figure 1. Journey of Technology Development from Lab to Market



SOURCE: CARBON REMOVAL CANADA, 2024. COMPILED USING INFORMATION FROM THE U.S. DEPARTMENT OF ENERGY, OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY³² AND BREAKTHROUGH ENERGY.³³



Section 3

How Can Government Procurement of Carbon Removal be Impactful?

Government procurement stands out as among the most timely and significant policy levers available to scale carbon removal solutions, especially given the current constraints of the VCM and compliance markets to grow the industry.



Governments have historically served as major customers for goods and services in the marketplace – from paper clips to aircrafts to clean energy.^{34,35} Public procurement positions governments to serve as a demand-pull force in the market and ultimately spurs economic opportunities for private industry across different sectors. In the context of carbon removal, it provides an important tool for governments as they seek to address residual emissions throughout their operations, such as national security applications.

However, national governments alone are unlikely to scale the carbon removal industry to the necessary level for material climate impact. Additional funding that national governments can crowd in will need to come from the private sector or other public sector entities and will be crucial for funding mobilisation. For example, previous Canadian government programs have demonstrated a leverage ratio of up to 9:1, meaning that for every dollar of government spending, up to nine dollars of private sector investments were attracted.³⁶

Governments should, therefore, seek to lead on this issue but do so in a manner that mobilises the private sector through partnerships and co-funding opportunities.

3.1 Growing Carbon Removal Demand

Procurement of carbon removal from both public and private actors will offer important opportunities for industry development. Public procurement of carbon removal services can be an enabling mechanism to channel more funding to the industry over time and serve as a bridge to longer-term, sustained demand between the voluntary and compliance carbon markets. These types of purchases are powerful demand-pull tools and are well-suited to provide support for public goods like carbon removal. They signal to the market and private industry that carbon removal solutions that exhibit a degree of technology readiness merit further support. Furthermore, having the government serve as an early customer can help these companies access capital for project development and attract additional private-sector buyers. Supporting carbon removal through procurement can also promote learning by doing, accelerating technology advancement to help solutions move down the cost curve. This can, in turn, support technology readiness for future integration into compliance carbon markets and market-shaping activities such as standards and protocol development.

As governments commit to carbon removal procurement, it will be important to design the programs to best catalyse purchasing by other private and public entities. One way to do this would be to co-purchase with private sector entities through similar programs such as the U.S. Department of Energy (DOE) Voluntary Carbon Dioxide Removal Purchase Challenge.³⁸ Opportunities also exist to coordinate with other entities to combine purchasing power through an advanced market commitment (AMC) or simply align best practices across different stakeholders to provide clarity and ease of purchasing carbon removal.

A recent survey found that nearly half of the Canadian organisations interested in carbon removal are more likely to make a transaction if the federal or provincial governments publicly commit to doing so.³⁷



3.2 Catalysing Economic Growth

Procurement of carbon removal has the potential to generate considerable co-benefits, with economic development standing out as a key opportunity through job creation. Notably, a company's economic impact extends beyond its direct operations to include its network of industry partners. For example, DAC stimulates demand across various industries, including clean energy, chemical manufacturing, and advanced engineering, in order to generate raw materials to capture CO₂ from the atmosphere. Additionally, the carbon sequestration phase involves industries such as drilling services that could leverage the skills of workers from the oil and gas sector, geological surveying, and environmental monitoring.³⁹ As a result, the economic benefits of carbon removal are distributed across the supply chain, which creates jobs and increases economic opportunities across multiple sectors (**Figure 2**). Previous modelling also suggests that a carbon removal industry operating at the scale of hundreds of megatonnes per year in Canada could create an estimated 89,000 permanent jobs by 2050.⁴⁰

These economic benefits are not confined to domestic borders. Procurement can act as a powerful catalyst for attracting foreign direct investment. Canada's unique geographic advantages, including abundant natural resources and clean energy potential, make it an ideal location for the development of carbon removal projects.⁴¹ Additionally, as Canadian companies mature, they may choose to export their world-leading technologies and carbon credits to international markets. This potential for increased global demand for Canadian-made innovations can stimulate the economy while still utilising domestic raw materials and capitalising on the country's strong manufacturing capabilities.

Beyond direct economic benefits, procurement plays a critical role in ensuring these gains can be fully realised. While some buyers might focus solely on the environmental attributes of the carbon credits they purchase, governments have a vested interest in procuring carbon removal services that deliver the greatest economic returns while maximising social benefits. Indeed, such considerations have been integrated into previous government procurement actions, such as those conducted by DOE,⁴² underscoring the importance of aligning economic benefits with broader social and environmental goals.

3.3 Empowering Local Communities and Unlocking Broader Benefits

Procurement can help unlock potential social and environmental benefits of carbon removal projects (**Table 2**). Community collaboration and enforcing robust standards during the planning and implementation phases of carbon removal projects is a necessity to help ensure that local voices are heard, and that carbon removal projects align with community-informed needs and values. This approach can help safeguard communities against potential harms, such as environmental degradation, while ensuring that the social benefits of carbon removal are distributed equitably, particularly among marginalised or vulnerable populations.

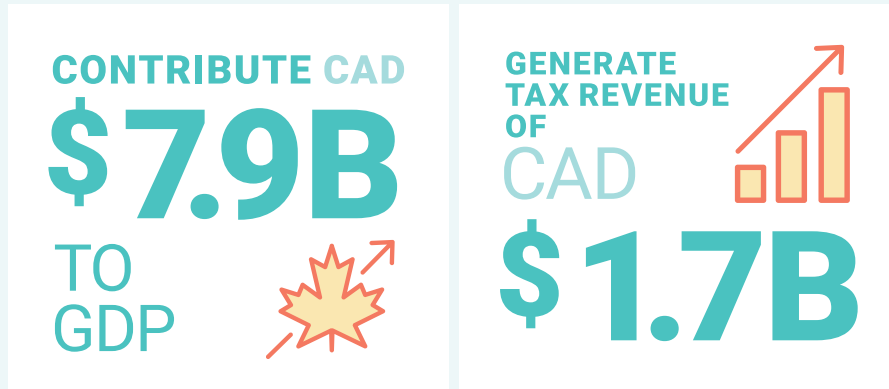


Figure 2. Potential Economic Impact of Select Carbon Removal Methods

DIRECT AIR CAPTURE

DAC typically uses liquid solvents or solid sorbents to capture CO₂ from ambient air. The captured CO₂ is then separated and purified for storage or utilisation.

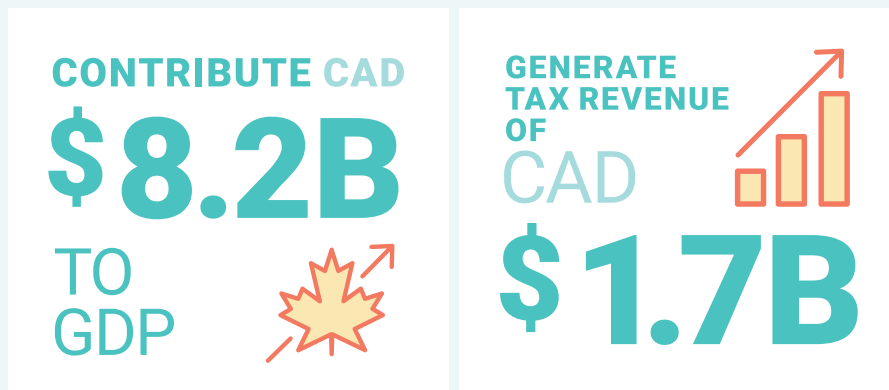
A one-megatonne per-year removal facility over a 20-year lifetime could:



DIRECT OCEAN REMOVAL (DOR)

DOR typically involves extracting dissolved CO₂ directly from seawater using electrochemical processes. The captured CO₂ is then concentrated and can be stored in geological formations or utilised in various applications.

A one-megatonne per-year removal facility over a 20-year lifetime could:



CARBON REMOVAL CANADA, 2024. COMPILED USING DATA FROM DEEP SKY⁴³



A major advantage of carbon removal that can be unlocked is the creation of new employment pathways for people trained in existing industries, including the oil and gas sector, agriculture, and fisheries industries. For example, DAC offers a strategic pathway for workers from the oil and gas sector by leveraging their expertise in managing complex industrial systems⁴⁴ as the skills required for operating large-scale facilities—such as mechanical maintenance, safety protocols, and systems engineering—closely align with those used in the fossil fuel industry. This not only secures continued employment in high-quality jobs but also contributes to economic diversification, paving the way for sustainable growth in a low-carbon economy.

Similarly, marine carbon removal offers opportunities for workers in coastal communities, particularly those affected by the decline of traditional fisheries or their seasonal nature. These workers possess a deep understanding of marine environments, vessel operation, and ecological stewardship—skills that are adaptable or directly transferable to marine carbon removal. By opening up opportunities in marine carbon removal, these workers can sustain their livelihoods while contributing to the restoration and preservation of marine ecosystems.

Land-based methods such as enhanced rock weathering (ERW) and biochar application can drive rural economic development in the agricultural sector. These methods can improve soil health, potentially increasing agricultural productivity⁴⁵ while creating a new revenue stream through the sale of environmental attributes. By supporting carbon removal, procurement can help build a more secure future for such communities while contributing to global climate goals.

Procurement can play a pivotal role in realising these co-benefits by supporting carbon removal projects designed with holistic social and environmental goals to maximise public benefits and build an evidence base for shared community learnings. By integrating criteria for co-benefits into procurement processes, governments and corporate actors can ensure that carbon removal projects contribute to broader community objectives. This approach amplifies the positive impact potential of carbon removal and can support the long-term vitality of natural and human systems.

* Assumes collection of sustainable biomass from high-risk, fire-prone areas. Note: Definitions for carbon removal methods can be found in Table A-1 of the following report: Bushman, T. & Merchant, N. (2023). Ready for Removal: A Decisive Decade for Canadian Leadership in Carbon Dioxide Removal. Carbon Removal Canada. Source: Carbon Removal Canada, 2024



Table 2. Potential for Positive Impact & Co-benefits through Carbon Removal (not exhaustive)

CATEGORY	METHOD	POSITIVE IMPACT & CO-BENEFITS
Cross-cutting	N/A	<p>Economic Opportunity</p> <ul style="list-style-type: none"> Attract foreign direct investment Create local jobs and help kickstart a new economic sector Create new competitive export opportunities (technology and carbon credits) Crowd in follow-on public & private funding Serve as an anchor customer for new clean electricity or heat generation (particularly for those methods that have substantial energy requirements) <p>Industry Formation</p> <ul style="list-style-type: none"> Catalyse public and private markets for carbon removal services and advance technology readiness Help carbon removal companies access new pools of capital for project finance through customer acquisition and market validation Inform the development or adoption of standards and project-specific protocols that will be required to incorporate carbon removal into compliance markets and other regulatory schemes Supply chain development Support further innovation in carbon removal technologies, policies, and business models <p>Knowledge Creation</p> <ul style="list-style-type: none"> Demonstrate national leadership and have such programs serve as a precedent-setting opportunity for other political jurisdictions to follow Generate knowledge spillover benefits to other economic sectors Share learnings and best practices with other actors to help spur greater interest in the carbon removal sector and promote co-learning opportunities
AIR	Direct air capture	<ul style="list-style-type: none"> Potential co-production of potable water and clean hydrogen Siting flexibility that does not require arable land (could be deployed on economically marginal lands) Skills transferability & workforce retraining opportunities for industries such as oil & gas
LAND	Biochar	<ul style="list-style-type: none"> Higher food yields and enhanced food security Improved nutrient and water retention in soils Soil health improvements Variety of end-use applications Wildfire risk mitigation*
	Bioenergy with carbon capture & storage	<ul style="list-style-type: none"> Firm, low-carbon electricity generation Production of energy products Wildfire risk mitigation*
	Biomass burial (terrestrial)	<ul style="list-style-type: none"> Wildfire risk mitigation*
	Bio-oil	<ul style="list-style-type: none"> Wildfire risk mitigation*
OCEAN	Direct ocean removal	<ul style="list-style-type: none"> Production of clean hydrogen Sustaining coastal communities whose livelihoods and economies depend on a healthy marine environment
	Macroalgae cultivation (biomass sinking)	<ul style="list-style-type: none"> Marine habitat creation Sustaining coastal communities whose livelihoods and economies depend on a healthy marine environment Water quality remediation by neutralising nutrient pollution
	Ocean alkalinity enhancement	<ul style="list-style-type: none"> Localised reduction in ocean acidification Sustaining coastal communities whose livelihoods and economies depend on a healthy marine environment
ROCK	Carbon mineralization	<ul style="list-style-type: none"> Critical mineral extraction from mining waste Production of building materials (concrete) Remediation of heavy metals or other hazardous materials
	Enhanced rock weathering	<ul style="list-style-type: none"> Higher food yields and enhanced food security Improved water retention in soils Soil health improvements



Section 4

Design Considerations for Carbon Removal Procurement Programs

Canada now has a unique opportunity to leverage the combined purchasing power of public and private markets to support the carbon removal industry through procurement.



The release of the federal budget in April 2024 included a provision that expanded the scope of the Low-carbon Fuel Procurement Program to include the purchase of carbon removal services to help reduce the emissions intensity of Canada's national safety and security fleet.⁴⁶ This announcement created one of the world's first formal government procurement programs for carbon removal alongside DOE's Purchase Pilot Prize⁴⁷ and provides Canada with the opportunity to create an industry-defining program. As the Government of Canada works to develop and implement a procurement process for carbon removal, it should also aim to attract other public and private sector buyers into the market to establish similar procurement efforts.

Given the significance of procurement as a lever to help support the carbon removal industry, this section provides design considerations for public and private actors (such as government officials or corporate sustainability leaders) to maximise the impact of such procurement programs. It is important to note that there will be a need for tailor-fitted strategies that respect individual factors, such as budgetary realities and resource availability.

The ultimate design of a procurement program will differ between actors; in some cases, it may consist of standalone programs, while others may wish to form buyers' coalitions or AMCs. Regardless of the structure, it is essential that these programs include support for permanent carbon removal. While an effective climate strategy will require support for both shorter-duration and permanent carbon removal methods, there is a significant gap in funding dedicated to permanent carbon removal methods.⁴⁸ As such, this section focuses on the design of procurement programs to support permanent carbon removal.



Importance of Permanent Carbon Removal. Permanent carbon removal is necessary to achieve net-zero CO₂ emissions, given the long residence time of CO₂ in the atmosphere. Carbon stored in the form of fossil fuels in the subsurface can persist for millions of years if left undisturbed.⁴⁹ If fossil fuels are extracted and consumed across the economy, around half of the CO₂ will stay in the atmosphere for thousands of years, while the remainder will be absorbed in the land and ocean sinks, assuming sink saturation limits haven't been breached. Permanent carbon removal is the only way to counterbalance fossil-based CO₂ emissions in a like-for-like manner.⁵⁰



Programs should establish a focused mandate to help guide implementation and define successful outcomes.

It is essential that interested parties first determine the problem they are trying to solve with carbon removal procurement: is it to make net-zero claims, to support the most promising innovations or to maximise co-benefits? These objectives are possible through targeted procurement, but a focused programmatic mandate is necessary to set realistic expectations and evaluate outcomes over time. For example, a program focused on net-zero emissions should emphasise the integrity and scientific certainty of a carbon credit to make proper compensation claims against residual emissions from fossil fuels. In contrast, an innovation-focused program may prioritise the future technical potential for carbon removal methods despite relatively higher technology performance risks. Similarly, governments and companies may have different sensitivities to risk – a government using public funds may want to ensure credit delivery and choose a procurement program focused on high technology readiness. Conversely, a private company may be more accepting of risk, assuming that the chosen projects meet all other requirements.

Regardless of the chosen mandate, there are several key principles that could be considered to help ensure overall effectiveness and alignment with industry best practices:

- 1. Transparency & accountability.** Require robust and transparent measurement, monitoring, reporting, and verification (MMRV) plans to maximise climate impact and help de-risk purchases in accordance with established industry standards and best practices.
- 2. Economic development & growth.** Prioritise projects that support good quality jobs and have the potential for scaleup and future job creation, making a simultaneous contribution to economic growth and achievement of climate targets.
- 3. Community benefits.** Require suppliers to conduct thorough engagement with local communities and demonstrate clear benefits. Any potential health and safety risks from projects should be identified and mitigated to the maximum possible extent.

RATIONALE FOR PERMANENT CARBON REMOVAL TO ADDRESS RESIDUAL EMISSIONS



Achieving net-zero requires permanent carbon removal to compensate for residual emissions from fossil fuels. Residual emissions are:

1. those that currently don't have existing processes or technologies to eliminate an emitting activity, or
2. those that are uneconomical to eliminate compared to the cost of permanent carbon removal.



Programs should consider planning procurement through a balanced portfolio of credits from carbon removal projects to hedge against a variety of risks and support innovation across the industry.

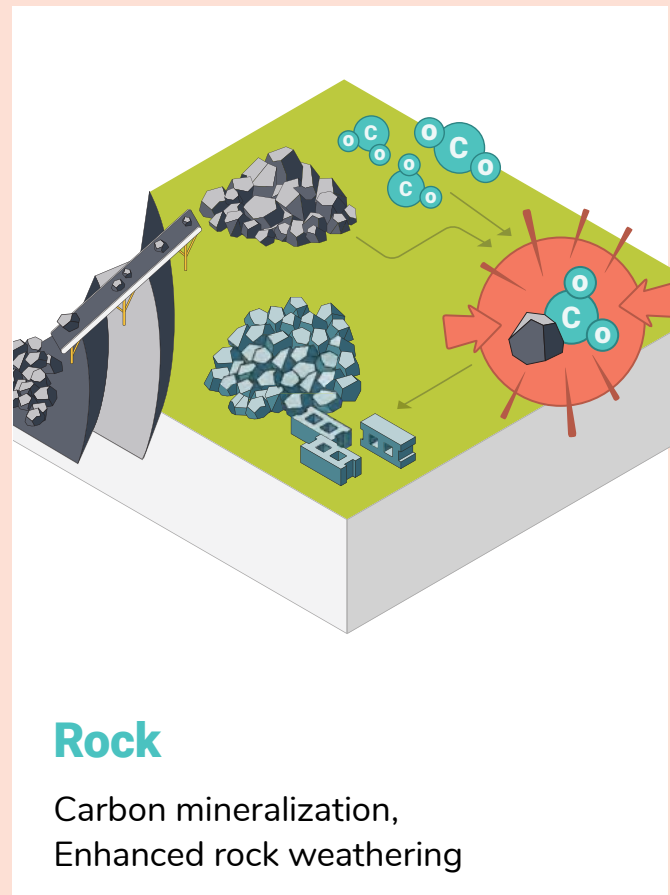
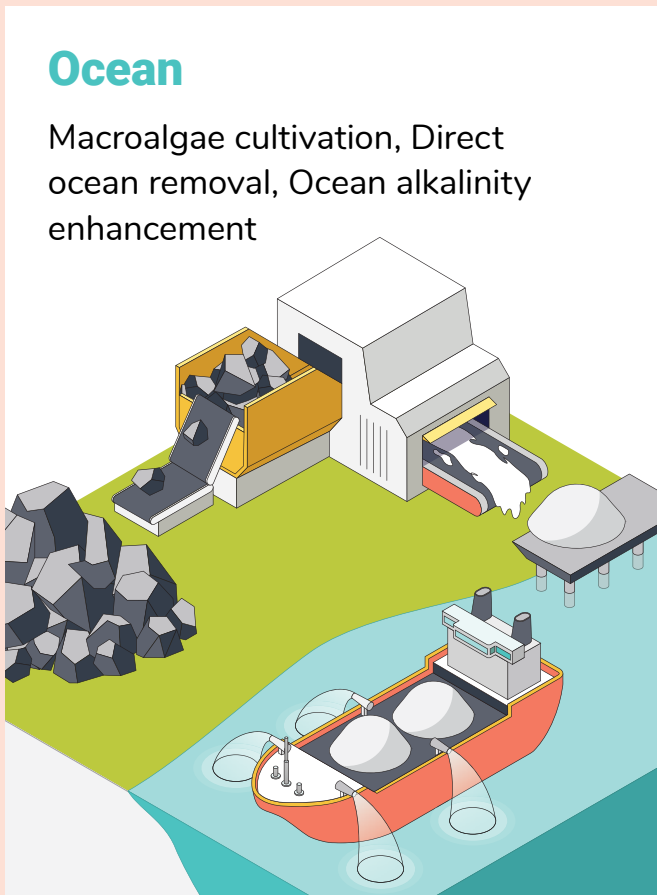
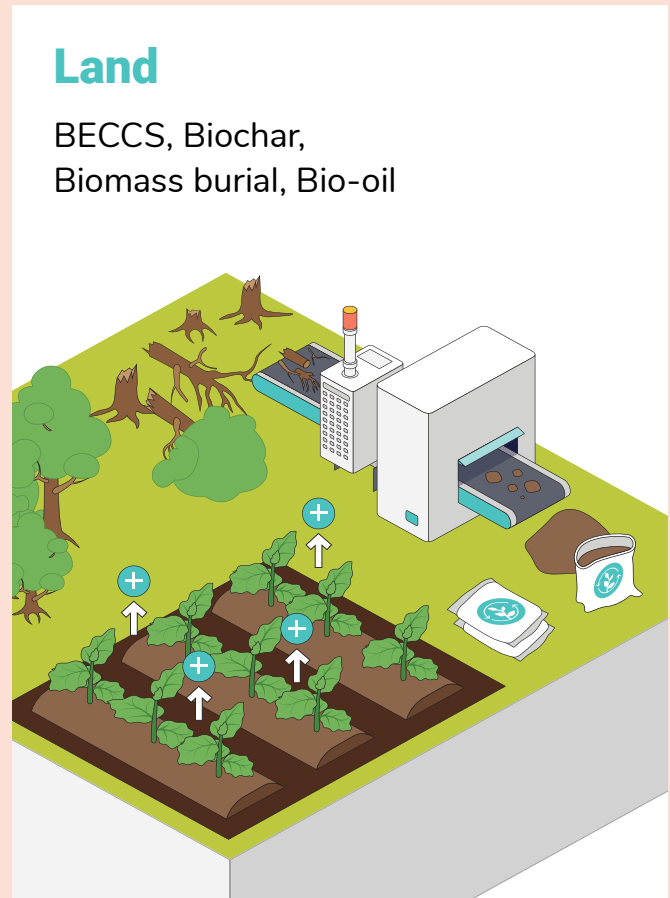
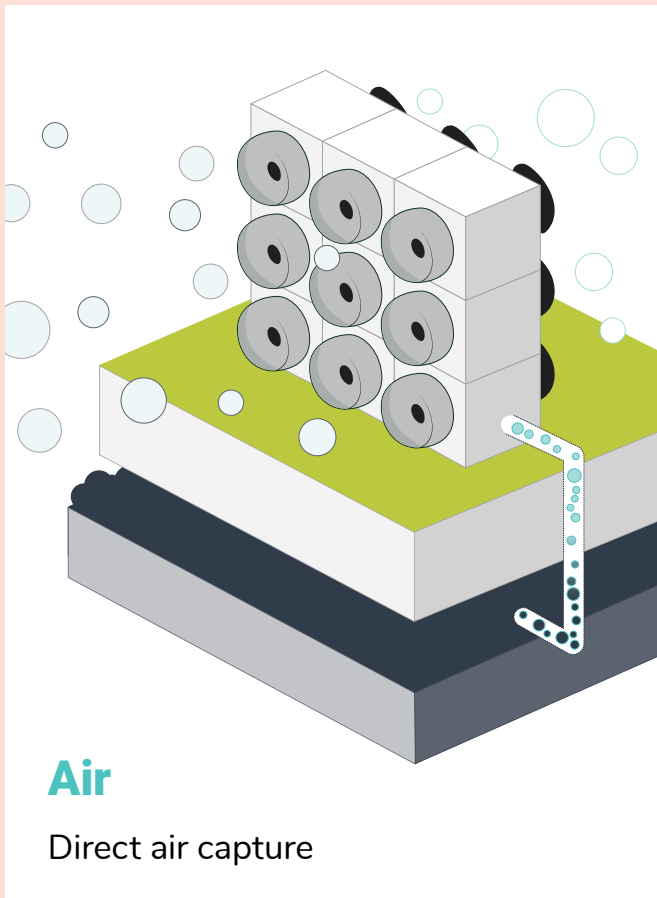
Many buyers of carbon removal tend to purchase credits through a portfolio approach. In practice, that means choosing from multiple carbon removal methods and, within each method, supporting multiple suppliers where possible. A diverse or balanced portfolio approach can reduce overall exposure to project delivery and pricing risks, especially given the possibility of method-specific bottlenecks emerging in the future as the industry scales up. Balanced portfolios can also maximise learning and knowledge creation across the spectrum of carbon removal methods, which could feed into industry advancements, such as developing formal standards and protocols.

Regardless, procurement decisions should be standards-based and seek the highest quality projects. Programs will need to determine whether to set a minimum tonnage or average price target, or to award funds based purely on market availability and scientific merit. Programs could facilitate credit purchases across different carbon removal streams (e.g., air, land, ocean, rock) (**Figure 3**) to arrive at a balanced and risk-adjusted portfolio of credits. Eligible project types could ultimately be separated into the designated streams to compete on a level playing field with

similar project types to help determine which to fund. Furthermore, programs should determine whether to establish a minimum or maximum credit amount on offer for a given proposal, with the caveat that not setting a minimum purchase amount could add administrative burdens to the project evaluation process. Programs should also consider how to best seek initial information about supplier readiness and price. For example, governments may use a Request for Information (RFI) to better visualise the market and send signals to companies and investors about upcoming funding actions. In contrast, a private company may seek a direct business-to-business approach with a more targeted shortlist of suppliers of interest.



Figure 3. Sample of Permanent Carbon Removal Methods for Consideration in a Procurement Portfolio



Programs should define clear roles and responsibilities for all participating entities to promote administrative efficiency and engender cross-cutting knowledge benefits.

In general, programs should select a purchasing model that is familiar to administrators and simplifies the procurement process to make it easier for as many individual departments or teams as possible to participate. Programs should then choose specific administrator(s) to streamline program operations and execute funding actions. Ultimately, implementation considerations will need to be tailor-fitted to the unique context of the programs.

GENERAL CONSIDERATIONS

Procurement programs will need to decide whether funding should be administered in stages based on ongoing performance (i.e., a supplier can receive multiple funding awards throughout the application process) or contracts are awarded at a single point in time and monies dispersed according to the contractual arrangements. Programs could also consider moving from smaller to larger purchases over time to serve as a longer-term demand signal for the industry and hedge against any potential risk of technology underperformance in the early years of the program (which may also help administrators purchase credits at a lower price in the future).

Programs should encourage other entities to co-purchase carbon removal alongside its procurement actions and could commit to sharing information and best practices with any interested parties, including through a carbon removal procurement 'playbook' to

promote greater learning by doing across disparate actors.⁵¹ Maximising the potential impacts of procurement funds through a public-private or public-public partnership model would help increase available capital support and share risk related to technology performance and credit delivery (i.e., cost-sharing and risk-sharing arrangement). This could be informed by the DOE Voluntary Carbon Dioxide Removal Purchasing Challenge.⁵²

CONSIDERATIONS FOR GOVERNMENTS

To ensure a successful program, governments will need buy-in from multiple departments. For example, at the federal level, there will be a need for a clear program owner who can develop the program's processes and procedures, such as the Treasury Board of Canada Secretariat (TBS). They could also likely lead general administration and inter-departmental coordination. This could include the ability for TBS to establish clear roles and responsibilities for other participating departments. Similarly, most governments have some sort of central purchasing function that will need to be included in the program development to ensure that the program adheres to formal government procedures.

This may be Public Services and Procurement Canada (PSPC) at the federal level or a provincial agency such as Supply Ontario. These departments could serve as the central authority for contracting between the government



and outside suppliers selling carbon removal credits. Technical advice to assess project quality would likely require the participation of various departments on an ad hoc basis. At a minimum, federal departments such as Natural Resources Canada (NRCan) and Environment and Climate Change Canada (ECCC) could help play a supportive role and provide expertise around program elements such as project evaluation and supplier adherence to standards and protocols. There are also various departments at the subnational level that have similar roles as NRCan and ECCC that will need to bring expertise to the procurement process. These expert roles may not entail acting as arbiters or decision makers but rather focus on providing specialised expertise to help the program fulfil its core mandate.

Governments may wish to explore a procurement structure that can exist over multiple years, such as a Request for Standing Offer (RFSO), to give suppliers a long-term demand signal and price certainty. This allows departments to purchase a specified credit amount under the pre-established terms of the National Master Standing Offer (NMSO) for credit delivery at a future date. Establishing an NMSO can reduce the administrative burden on individual departments and enable the government to take a holistic approach towards purchasing carbon credits. The RFSO could be refreshed regularly to reflect industry changes including, technology and supplier readiness. However, this should be balanced with the need to provide market certainty and continuity of expectations to existing suppliers. Governments could set annual purchasing targets on a monetary or

tonnage basis and consider awarding funds over a longer time frame to allow new projects to take off or existing projects to expand their capacity.

Departments could then determine whether carbon removal fits within their climate strategy and estimate credit needs over the course of the program. Departments could consider establishing a demand forecast for tonnage (i.e., credit) requirements based on a common template for cross-departmental use. The RFSO could ultimately establish a set of preferred suppliers at prices that are locked in for a specified period, with multiple suppliers being chosen to represent each method of carbon removal. Contracts with suppliers would be executed when departmental call-ups are made and reflect the specific department's needs and terms.



Programs should create robust project eligibility and scientific criteria to help ensure project quality and adherence to established requirements.

Program funds should focus on supporting high-quality carbon removal projects based on scientific merit and other performance standards, and should prioritise permanent carbon removal if compensation claims are made for fossil-based CO₂ emissions.⁵³ A host of considerations should be taken into account when determining company and project eligibility (**Table 3**).

Programs should develop project evaluation frameworks and associated scoring systems according to existing industry best practices. Evaluation criteria should be established prior to launching the bidding process and published as part of the bid documentation. Programs should also assemble a panel of in-house and/or outside experts to evaluate submissions based on the established quality criteria and performance standards. Sound science and due diligence at the project and company levels are the best defence against project risks.



Table 3. Considerations for Permanent Carbon Removal Procurement in Canada

TOPIC	RECOMMENDATION
COMPANY ELIGIBILITY	
Company location	Programs should allow Canadian and international companies to submit proposals.
Partnerships	Programs should allow suppliers to submit proposals via partnership(s) with other companies.
Supplier type	Programs should accept proposals from for-profit, non-profit, academic institutions, and Indigenous organisations.
GENERAL CONSIDERATIONS FOR PROJECT ELIGIBILITY	
Cost performance	Programs should prioritise projects that have the potential to drive down the cost of carbon removal over time.
First Nations & Indigenous community involvement	Programs should determine how to incorporate Indigenous procurement into their activities in line with social and economic reconciliation, which could include a preference for Indigenous-led projects and those that provide opportunities for equity positions. For governments, this could occur by incorporating the Procurement Strategy for Indigenous Business ⁵⁴ into the procurement process to include a mandatory five percent minimum of funds that are earmarked for carbon removal to go toward Indigenous businesses across the project value chain. The Indigenous procurement set-aside could be mentioned in an RFI to provide advance notice about the forthcoming business opportunities. Programs can also draw from the National Aboriginal Capital Corporations Association ⁵⁵ for further guidance on its Indigenous procurement strategy and business certification rules.
Project location	Programs should require that projects be located in Canada without exception (both the removal and storage component must occur within Canada and its territorial waters) to help grow the domestic project pipeline, establish supply chains, create local jobs, and build long-term government and community support. A domestic-focused approach to project location would also track with the stipulations set forth in the DOE Purchase Pilot Prize. ⁵⁶
Technology readiness	Programs focused on making compensation claims against residual emissions should prioritise projects that demonstrate technology maturity and deployment readiness (assuming operational safety). Those programs with an innovation focus may be in a position to take on more technology risk and prioritise projects with the greatest potential to demonstrate and/or spur new innovations.

“Indigenous nations are the ones upon whose land and waters new infrastructure and natural resource projects will be built. These projects can only proceed and be constructed with our free, prior, and informed consent.”

CHIEF SHARLEEN GALE CHAIR OF THE FIRST NATIONS MAJOR PROJECTS COALITION



TOPIC	RECOMMENDATION
SCIENTIFIC CRITERIA FOR PROJECT ELIGIBILITY	
Additionality & baselines	Projects should demonstrate financial additionality (i.e., the project would not have gone forward without funding support from the program to include any revenue from the sale of co-products), regulatory additionality (i.e., the project was not otherwise compelled to occur through regulatory or legal means), and common practice additionality (i.e., the project is not already commonly done in a business-as-usual manner within a specific geographic region). Importantly, projects that are already receiving policy support can still meet the requirements for financial additionality, assuming that credit purchases are still necessary for the project to move forward. Where applicable, baselines for greenhouse gas fluxes must be dynamic in nature (i.e., not treated as static or fixed over the project lifetime) and established in a conservative manner to help avoid over-crediting.
Durability	Projects should demonstrably remove CO ₂ from the atmosphere and store it on geologic timescales in a manner that minimises the risk of physical reversal of the stored carbon. Projects should include remediation plans in the event of intentional or unintentional physical reversals of the stored carbon (including through the potential use of insurance mechanisms).
Scalability	Projects should be given preference if they can demonstrate scalable solutions that have a reasonable pathway to commercial deployment and result in a material climate impact. Commercial deployment and material climate impact is defined as those solutions that are capable of safely operating at the megatonne or gigatonne scale while minimising energy and physical resource requirements. Projects must provide an indicative assessment of supply chain readiness to meet scalability needs.
Economic leakage	Projects should not result in emitting activities simply being shifted to a different site outside the project boundary or to another political jurisdiction because the market demand for a particular good remains unchanged (or increases).
Harms & benefits	Projects must minimise potential downside and maximise potential upside to social, environmental, and economic systems at the community level (including First Nations and Indigenous communities). This includes meaningful engagement and direct participation of the community in decision-making across the full project life cycle. Community benefits plans and agreements ⁵⁷ must be in place prior to project commencement. Programs should prioritise projects that demonstrate clear co-benefits and have plans for mitigating any associated project risks. Programs could also prioritise projects that minimise resource requirements, including arable land, fresh water, and clean energy.
MMRV	Projects must provide comprehensive MMRV plans that adhere to all requirements set forth by program administrators. In general, projects should quantify all types of greenhouse gas emissions across the full project life cycle and demonstrate net-negativity according to cradle-to-grave life cycle assessments (LCA) in accordance with industry best practices. ⁵⁸ LCAs function as a means to do 'climate math' and ensure that projects lead to net-negative CO ₂ emissions while taking into account all GHG types throughout the project (which should be additional to conducting broader environmental impact assessments). Carbon removal attributes of a project should be treated and quantified separately from any potential benefits through avoided or reduced emissions (where applicable). Project approaches and outcomes must be verified by independent third parties and fulfil transparency requirements in MMRV over the full project lifetime. All carbon credits associated with a project must be tracked and ultimately retired in a transparent manner that avoids double counting. In accordance with these requirements, programs could provide guidance on potential third-party MMRV providers and should stipulate which ones will be viewed as eligible.

SOURCE: CARBON REMOVAL CANADA, 2024



Programs should define a preferred contracting method that is best suited to the procurement of carbon removal services.

Once qualified suppliers are identified through the chosen procurement process, credits from carbon removal projects can be purchased through mechanisms such as pre-purchase commitments and offtake agreements.

PRE-PURCHASE COMMITMENTS

Buyer pays a set price upfront for a specified quantity of carbon credits to be delivered at a future date. Pre-purchase commitments are favourable for the supplier in terms of helping to cover upfront project development costs and are more common for projects in the pilot and demonstration phases. There may be a pre-purchase discount to reflect the buyer taking on relatively more delivery risk.

OFFTAKE AGREEMENTS

Buyer agrees to purchase a fixed number of carbon credits at an agreed-upon price if and when they are delivered in the future (i.e., pay upon delivery). If the supplier does not deliver the credits, there is a breach of contract, and no payment is due. Offtake agreements are preferable for more proven and de-risked carbon removal methods that have constrained scientific uncertainty to a relatively high degree. Although offtake agreements do not help cover upfront project development costs, they can serve as a demand signal that enables suppliers to more easily access other sources of capital. Frontier has made a sample offtake agreement template publicly available.⁵⁹

Several reasons for using offtake agreements to help facilitate contracting include:

- **Market validation:** A multi-year offtake agreement with major credit-worthy buyers can add significant credibility to suppliers and help them unlock more funding.
- **Precedence:** There is precedence for offtake agreements in Canada, including some of the existing carbon contracts for difference agreements that the Canada Growth Fund has signed. Program administrators may have experience signing offtake agreements in other sectors that can be leveraged to support contracting for carbon removal. Additional community resources are available to the public to better understand approaches to contracting for carbon removal.^{60,61,62,63,64}
- **Risk mitigation:** Offtakes are better for delivering reliable credits to parties that are more risk-averse. In the event of non-delivery (or under delivery), program administrators would not be obligated to pay for the credits. However, they may choose to renegotiate the contract to still allow for future delivery (perhaps with more favourable terms).

Programs could ultimately seek to enter into contracts directly with suppliers in a business-to-business, business-to-government, or third-party marketplace format.



Programs should ensure adherence to quality standards.

Proper industry standards, project-specific protocols, and MMRV plans are foundational to the integrity of the carbon removal industry and the need to promote quality before scale. While standards can establish an overarching governance framework to help define project quality, project-specific protocols must also be in place to respect the nuances of different carbon removal methods. MMRV plans are central to ensuring that a carbon removal activity has occurred and may serve as a de facto transaction receipt for the marketplace. Programs should prioritise suppliers that have robust MMRV plans.

Programs should support projects that adhere to protocols developed by federal or subnational governments, or to best-in-class industry standards and protocols already operational or under development in the VCM (**Table A-2**). Furthermore, suppliers should be allowed to monetize carbon credits from program-eligible projects within Canadian compliance carbon markets or the VCM and should not be restricted to one particular market type due to a chosen protocol. Programs should, therefore, offer maximum flexibility and approach the protocol adherence requirement as follows:

1. Suppliers may choose to follow an offset protocol that is developed by the Government of Canada or provincial and territorial governments, or
2. Suppliers may choose to follow an established industry protocol where available (**Table A-2**), for which program administrators will need to recognize protocols as being valid and scientifically robust at their discretion.

The federal government should consider developing a cross-cutting federal standards framework and compliance-ready protocols for permanent carbon removal methods that are informed by the knowledge acquired through initial procurement programs. Importantly, such efforts should promote interoperability of standards and protocols with other political jurisdictions where possible, such as the ongoing efforts announced in the European Union.⁶⁵ A cross-cutting federal standards framework that all project protocols must adhere to could be likened to the minimum national stringency requirement that the Government of Canada has put in place for subnational government designs of carbon pollution pricing systems. Standards and protocol development should prioritise adopting existing work from credible third parties in other compliance markets and the VCM to promote efficiency and industry standardisation.

Successful carbon removal procurement relies on independent verification to validate CO₂ removal claims based on robust scientific data. Verifier integrity is, therefore, critical to program success. Some buyers, such as the MaRS Discovery District contract independently with third-party verifiers, while others such as the DOE allow suppliers to choose their own from an approved list of partners while putting in place conflicts of interest checks. Whatever the approach, it will be important to ensure that it does not establish perverse incentives for the certification of credits that did not result in the purported level of CO₂ removed from the atmosphere on a net life cycle basis (including the over-crediting of projects).



Programs should involve local communities across all dimensions of project planning and implementation.

Carbon removal projects offer a unique opportunity to not only address climate change but also to generate significant community co-benefits, ranging from job creation to improved public health. At the time of procurement, programs should request suppliers to articulate their anticipated community co-benefits and monitor progress through the requirement of a formal community benefits plan and agreement.⁶⁶

Realising these benefits requires a deliberate and inclusive approach that is tailored to each project. Through procurement, there is an opportunity for programs to share their knowledge of community involvement with carbon removal suppliers and to set the standard for what 'good' looks like for the industry going forward. A generalised framework for community involvement may include the following components:

- **Planning:** Maximising community co-benefits from carbon removal projects depends on engaging community members from the outset of project planning. Suppliers should involve community members early on through public meetings, workshops, and consultations to help arrive at a plan for the equitable distribution of benefits while minimising project risks.
- **Implementation:** Suppliers should disclose project activities, risks, and safety measures to enhance transparency and accountability. All federal and subnational licences and permits must be in place before the construction of any facilities (and projects must meet all regulatory requirements throughout their operational life). Any project risks should be identified and mitigated to safeguard the community from whom suppliers obtained a social licence to operate.
- **Benefits Realisation:** Ensuring that local communities, especially marginalised groups, benefit from carbon removal projects is vital. Suppliers should prioritise local hiring, skills development, partnerships with local businesses in the supply chain, and possibly establish revenue-sharing arrangements. Periodic reviews of the distribution of benefits should be conducted with community participation.



Programs should commit to rigorous performance evaluation and reporting.

This would entail the need to set clear metrics, establish baselines, and define targets to help ensure accountability and transparency.

Monitoring of carbon removal procurement requires a specific set of performance measures. Some of these are akin to large infrastructure projects, such as project and construction milestones, performance against expected volumes, delivery timelines, and cost. Other measures are more specific to carbon removal projects, such as performance against techno-economic analyses, LCAs, and the MMRV methodologies.

Fortunately, performance measures for carbon removal are already established in the industry, and programs could use existing monitoring frameworks as a starting point.⁶⁷ Compared with commercial buyers, government-specific performance frameworks might need to emphasise economic, social, and environmental co-benefits to help deliver maximum benefits and withstand political scrutiny.

Programs could develop procurement 'playbooks' to institutionalise and share acquired knowledge and lower technical barriers to participation for other interested parties. This could be in addition to the release of an annual report that highlights the program's milestone achievements, total tonnes contracted and delivered, and lessons learned.

Programs could reserve the right to publish anonymized, aggregated data from the procurement process. Furthermore, programs could commit to the following guidelines for performance tracking and outcome reporting:

- **Performance indicators:**
 - project and construction milestones
 - credit quantity and price trends
 - LCA results
 - verification reports
- **Outcome indicators:**
 - overall impact on offsetting residual emissions
 - job creation / GDP contribution
 - co-benefits at the community level

Designing a robust performance evaluation and reporting system will be crucial to promote transparency and the continuous improvement of procurement programs over time.



Section 5

Where Do We Go From Here?

Climate change is worsening and causing adverse impacts on economic, social, and environmental systems. Canada is experiencing the consequences of a warming planet firsthand, for which damages will continue to mount absent a committed societal response to address the problem.

Carbon removal is essential to help meet climate goals and limit the damages, and Canada is fortunate to have all the right ingredients to be a major player and leader in this new industry.⁶⁸ However, success in building a robust Canadian carbon removal sector is not guaranteed and will require substantial efforts from all actors, including governments, to help deliver the industry at scale in a rapid and responsible manner.



Canada's abundant natural resource endowment, extensive land area and, coastlines and large geologic sequestration potential make it an ideal location for a wide array of carbon removal methods that can meet the needs of Canadian procurement programs. The nascency of the project pipeline in Canada means that funding mobilisation through procurement programs could result in a step change in market support for Canadian companies and lead to first-of-a-kind project development.

5.1 Procurement Partnerships to Increase Impact

The urgency of developing the carbon removal industry to a climate-relevant scale by midcentury means that public and private actions are key. Therefore, it will be necessary for all actors to consider how to best work together to crowd in additional investment and amplify the impact of procurement programs. There is an opportunity for Canada to take a coordinated approach that increases the environmental and economic impact of carbon removal through an AMC dedicated to Canadian carbon removal projects. Through convening a cohort of companies and Canadian governmental entities, an AMC could help inform better and more consistent standards for MMRV across both the voluntary and compliance markets. In addition, a unified coalition of actors could strengthen the Canadian demand signal and streamline supportive industry efforts compared to a multitude of disjointed programs that could amount to inefficient resource use.

5.2 Designing Procurement Programs for Impact

The chosen programmatic design elements of procurement programs will have a major impact on the degree of support that can be mobilised for carbon removal. It will be important to build flexibility into the program and implement it in an efficient manner without sacrificing quality for speed. The focus of procurement programs should be to support the best available carbon removal projects on the Canadian market and optimise for quality rather than price. Beyond credit procurement, programs should seek to maximise outsized value creation that supports industry maturation in Canada with associated benefits to the economy and local communities. Doing so could further solidify support for carbon removal procurement over the long term and position Canada as a global thought leader.

It is important to note that growing the demand signal for carbon removal will necessitate an adequate supply of high-quality projects to procure carbon credits. Therefore, demand creation for carbon removal through government procurement must be paired with continued supply-side support through mechanisms such as grants, tax credits, and loans to grow the pipeline of market-ready projects.

Now is the time for public and private actors to procure with purpose and help the carbon removal industry enter its next phase of growth.



Table A-1. Characteristics of Compliance Offset Systems in Canada and Support for Permanent Carbon Removal

POLITICAL ENTITY	OFFSET SYSTEM NAME	CURRENT ELIGIBILITY FOR PERMANENT CARBON REMOVAL	ADDITIONAL INFORMATION
Federal	Greenhouse Gas Offset Credit System ⁶⁹	No	The Government of Canada is currently developing a DAC protocol while bioenergy with carbon capture and storage (BECCS) is under consideration for future protocol development. ⁷⁰
Alberta	Alberta Emission Offset System	Some	Protocols for 'Energy Generation from the Combustion of Biomass Waste' and 'CO ₂ Capture and Permanent Storage in Deep Saline Aquifers', coupled together, could support BECCS. ⁷¹ Regulations for CO ₂ storage in the subsurface are in place and federally approved to support relevant carbon removal methods. ⁷²
British Columbia	B.C. Output-Based Pricing System	No	A 'Carbon Capture and Sequestration Protocol' is currently under development, which could support permanent carbon removal projects. ⁷³ Regulations for CO ₂ storage in the subsurface are in place and federally approved to support relevant carbon removal methods. ⁷⁴
New Brunswick	N/A	N/A	Currently exploring offsets as a compliance flexibility mechanism. ⁷⁵
Newfoundland & Labrador	N/A	N/A	N/A
Northwest Territories	N/A	N/A	N/A
Nova Scotia	N/A	N/A	Use of offsets authorised through cap-and-trade legislation, but regulations and protocols are not yet available. ⁷⁶
Nunavut	Greenhouse Gas Offset Credit System (federal backstop program)	No	See 'Federal' above.
Manitoba	Greenhouse Gas Offset Credit System (federal backstop program)	No	See 'Federal' above.
Ontario	N/A	No	Stakeholders have noted that they would like to see offsets included in the Emissions Performance Standards program. ⁷⁷
Prince Edward Island	Greenhouse Gas Offset Credit System (federal backstop program)	No	See 'Federal' above.
Quebec	Cap-and-Trade System	No	Up to eight percent of an emitter's compliance obligation can be met by purchasing regulated credits. ⁷⁸ There are currently no known protocols to support permanent carbon removal projects.
Saskatchewan	N/A	N/A	Regulations for CO ₂ storage in the subsurface are in place and federally approved to support relevant carbon removal methods. ⁷⁹
Yukon	Greenhouse Gas Offset Credit System (federal backstop program)	No	See 'Federal' above.



Table A-2. Overview of Carbon Removal Protocol Availability & Associated Resources (not exhaustive)

	GOVERNMENT OF CANADA	EU CRCF	ISOMETRIC	PURO, EARTH	OTHER
Biochar			Yes	Yes	Climate Action Reserve, European Biochar Certificate, Verra
Bioenergy with carbon capture & storage	Under consideration		Yes		Drax, Verra
Biomass burial			Yes	Yes	
Bio-oil			Yes		Carbon Direct & Eco-Engineers
Carbon mineralization			Yes		
CO ₂ utilisation (building materials)				Yes	Gold Standard, Verra
Direct air capture	In progress		Yes		Climeworks, Verra
Direct ocean removal			Yes		Captura, Eco-Engineers, and International Organization for Standardization (ISO)
Enhanced rock weathering			Yes	Yes	Carbon Drawdown Initiative, Eco-Engineers, and International Organization for Standardization, Verra (under development)
Geologic sequestration	Yes (Alberta, British Columbia, Saskatchewan)			Yes	American Carbon Registry, California Low Carbon Fuel Standard, CCS+ Initiative, Clean Development Mechanism, ISO 27914:2017, Puro.earth
Microalgae cultivation					Brilliant Planet's New Methodology for CO ₂ Removal from Ocean Microalgae Blooms
Ocean alkalinity enhancement			Yes		Ebb Carbon's MRV protocol, Planetary's MRV protocol
General		European Union work on carbon removal standards and protocols, Methodology development (see Annex I and Table 3 and Table 4 for more information on design elements and process)	*Note: All protocols governed by Isometric Standard		CDR Verification Framework (CarbonPlan), Reykjavik Protocol for "nature-deployed pathways"



Endnotes

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