CARBON OFFSETS FOR FARMERS

REPORT | OCTOBER 2023

Smart Prosperity Institute

co-operators

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KEY MESSAGES

- This report is intended to help farmers understand the current status of carbon offset opportunities in Canada, the process for engaging in the market, the barriers and limitations to participation, and themes to watch going forward.
- Sustainable management practices on Canadian farms can help address the twin climate and biodiversity crises. Farmers, however, need support and economic incentives to optimise these practices. Today's volatility in global markets and climate conditions mean that some farmers are looking to new revenue streams to diversify and manage risk.
- Carbon credits offer a proven avenue to generate income for climate-friendly projects and activities, with financial opportunities through both the global voluntary carbon market, as well as federal and provincial compliance markets in Canada. Canada's carbon pricing regime offers a very attractive environment for carbon offsets, with prices on an upward trajectory.
- Meanwhile however, there is limited application of carbon offset projects in Canada's agriculture sector to date, pointing to several challenges related to costs, system complexity, and ensuring quality greenhouse gas mitigation outcomes.
- Although the financial attractiveness of carbon offsets is increasing, farmers will need help navigating the administrative and practical requirements of each system, where this could be provided by credible and trustworthy service providers. Farmers should be aware of the administrative process in generating carbon offsets in order to help choose what level of service they wish to pay for, compared to performing those tasks themselves.

Various pathways exist to tap into carbon markets, but these opportunities are not always clear to stakeholders in the farming community. For this reason, the Smart Prosperity Institute in partnership with Co-operators has produced this report on agriculture-related carbon markets, providing a comprehensive assessment of related opportunities in Canada across voluntary, regulatory, and forthcoming carbon offset systems. The guide will help farmers navigate the complex and often opaque world of carbon markets, aiming to provide a concise but comprehensive summary of the state of play in Canada and opportunities to watch.

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CARBON MARKET KEY TERMS

Carbon offsets – A certificate with monetary value representing one tonne of CO2e reduced, avoided, or sequestered.

Carbon pricing – Carbon pricing attempts to reflect the true cost of carbon pollution on the environment and society by assigning a price to carbon emissions. See "Canada's federal backstop carbon price" definition for more detail.

Compliance carbon market – A specific market supporting a government regulation that aims to limit greenhouse gas (GHG) emissions, such as a cap-and-trade programme or emissions trading scheme. In some cases, regulated industrial emitters may be able to use carbon offsets as a flexible compliance option.

Voluntary carbon market – A broad and fragmented series of programmes and initiatives generating carbon offsets, spearheaded and administered by the private sector. There is no authoritative marketplace, and the voluntary market remains generally unregulated, though this is beginning to change.

Project proponent/project developer/participants – May include anyone wishing to receive financial compensation for their GHG emissions improvements. In the agriculture sector, participants may include farmers, ranchers, and forest landowners, as well as aggregators/service-providers working for them.

Aggregators/service providers – These providers facilitate the participation in carbon markets of small-scale and other farmers and landowners by pooling projects together for carbon credit issuance, and offering a variety of professional services that advise farmers on required investments and changes in practices.

Purchasers – Anyone wishing to buy a carbon credit/offset, and may include individuals wishing to offset emissions related to their own travel or other lifestyle choices, or businesses using offsets to reach voluntary GHG mitigation targets, or complying with regulatory schemes.

Protocols – Documents laying out the rules and methodologies to follow, specific to individual GHG mitigation practices. Protocols also standardise the measuring, reporting, and verification (MRV) requirements for generating carbon offsets through that activity type.

Voluntary programmes/administrators/registries – Participants may apply to have their GHG mitigation results recognised under a specific programme. Programmes usually provide certain requirements for approval, including demonstrating that participants have followed an approved methodology/protocol for measuring, reporting, and verifying their emissions results. Large certifying programmes in the voluntary market include Verra, Gold Standard, American Carbon Registry, and the Climate Action Reserve.

Government certification programmes/administrators/registries – Participants may apply to have their GHG mitigation results recognised under a specific government-run offset programme. Programmes usually provide certain requirements for approval, including demonstrating that participants have followed an approved methodology/protocol for measuring, reporting, and verifying their emissions results. Examples of certifying programmes in compliance markets include Canada's federal carbon offset programme, California and Quebec's offset market under their linked cap-and-trade scheme, or the provincial offset programme run out of the province of Alberta.

Registries – Private or government-run initiatives that track the ownership of carbon offsets, and provide information related to credit origin, project type, issuance dates, specific vintage year, jurisdiction, and other information related to the carbon credit. Registries are vital in ensuring that GHG mitigation results are not counted or used more than once, and that there is a clear line of ownership. Most reputable offset registries are made public, and many engage blockchain technology to ensure data security.

Measurement, reporting, and verification (MRV) – A multi-step process to measure the improvement of GHG caused by a specific activity, with this mitigation measured over a period of time, verified to be accurate, and reported in a pre-defined format.

Third-party verifiers – Individuals who are trained and certified under public or private offset schemes, and who verify that participants correctly implemented carbon offset protocols.

Canada's federal backstop carbon price – A minimum carbon price set by the federal Government to ensure consistency across the country. Carbon pricing policies from provincial and territorial governments to manage their own emissions must demonstrate adherence to the backstop price. The backstop price is currently $65 per tonne of carbon dioxide equivalent, and will rise in $15 increments to $170 by 2030.

CONTEXT

Canada's farmers are important stewards of the land and are already leaders in many sustainability practices. Farmers play a critical role in helping to address the global climate and biodiversity crises through a range of stewardship activities that provide positive outcomes for cropland, forests, and other natural landscapes, including through activities that help reduce and sequester carbon.

Sustainable farming practices provide benefits to all Canadians, by contributing to climate change mitigation and adaptation, protecting ecosystem services, and guarding the health of our soil for generations to come. Meanwhile, Canada's agriculture and agri-food sector provides one in nine jobs in Canada and generates close to 7% of Canada's GDP.

Recognising these public benefits, Canada's federal and provincial governments have provided a variety of agriculture-related incentives and subsidies, including the Sustainable Canadian Agriculture Partnership, and support is likely to be a feature of the new federal Sustainable Agriculture Strategy. It should be noted however, that the proportion of these support payments have been declining over the last several decades.

These publicly-funded payments are constrained however, compared to the size of the opportunity for the sector to contribute to GHG mitigation efforts. Total GHG emissions from the agriculture sector, including on-farm fuel use, increased by 33% between 1990 and 2020, and now represent over 10% of Canada's GHG emissions. The sector is responsible for 30% of national methane emissions and 75% of national nitrous oxide emissions, both potent while shorter-lived GHGs — meaning that reductions could have a faster, significant impact on global warming. In addition, mitigation strategies often result in important co-benefits such as clean water, climate resilience, or biodiversity improvements.

The sector's potential to contribute to environmental objectives warrants an exploration of all the policy tools in the toolbox, including any opportunities to leverage investment and financing beyond the public purse. Tapping into private sector capital expands the amount of available resources in the face of finite government budgets, and will be crucial to scaling finance for farmers.

When it comes to investing in climate and nature however, private investors need a clear line of sight towards attractive returns, including those guided through policy drivers, or by expectations that the public will be willing to pay for improved outcomes. One policy tool with a well-defined value proposition for private actors is the carbon offset model, which has been tried and tested over several decades.

CARBON OFFSETS BACKGROUND

Carbon offsets — or "carbon credits"[1] — are issued based on real, quantified, and verified GHG emissions reductions/removals, with each credit representing one tonne of carbon dioxide equivalent (CO_2e) (see page 26).

Specific "protocols", which are the rules or methodologies to quantify GHG mitigation results often vary with each project type and programme. Project types vary widely internationally, from afforestation, protecting mangroves, landfill methane capture, to name just a few.

Carbon offsets create an economic value to activities that remove, destroy or avoid GHG emissions, allowing proponents to sell, trade, and buy carbon credits on carbon markets.

Carbon credits are then easy to count and compare, and their uniformity allows for a type of fungibility between units, where in a liquid market credits are ultimately bought by the highest bidder.

1 The term "carbon credit" is often preferred in the voluntary carbon market where several environmental NGOs have been vocal that corporates and other buyers should not use credits to "offset" their own emissions, but rather invest in both internal emissions mitigation and external "beyond value chain" carbon credits. This perspective is outlined in initiatives such as the Science Based Target Initiative's mitigation hierarchy.

Carbon offsets are bought and sold in both voluntary and compliance markets around the world. The voluntary market is unregulated, with private-led programmes, or "standard setters," very diverse and fragmented. These also vary considerably in their levels of credibility. There are now several independent initiatives aiming to create some standardisation and assurance within the voluntary carbon market, including the Integrity Council on the Voluntary Carbon Market, and the Carbon Credit Quality Initiative.

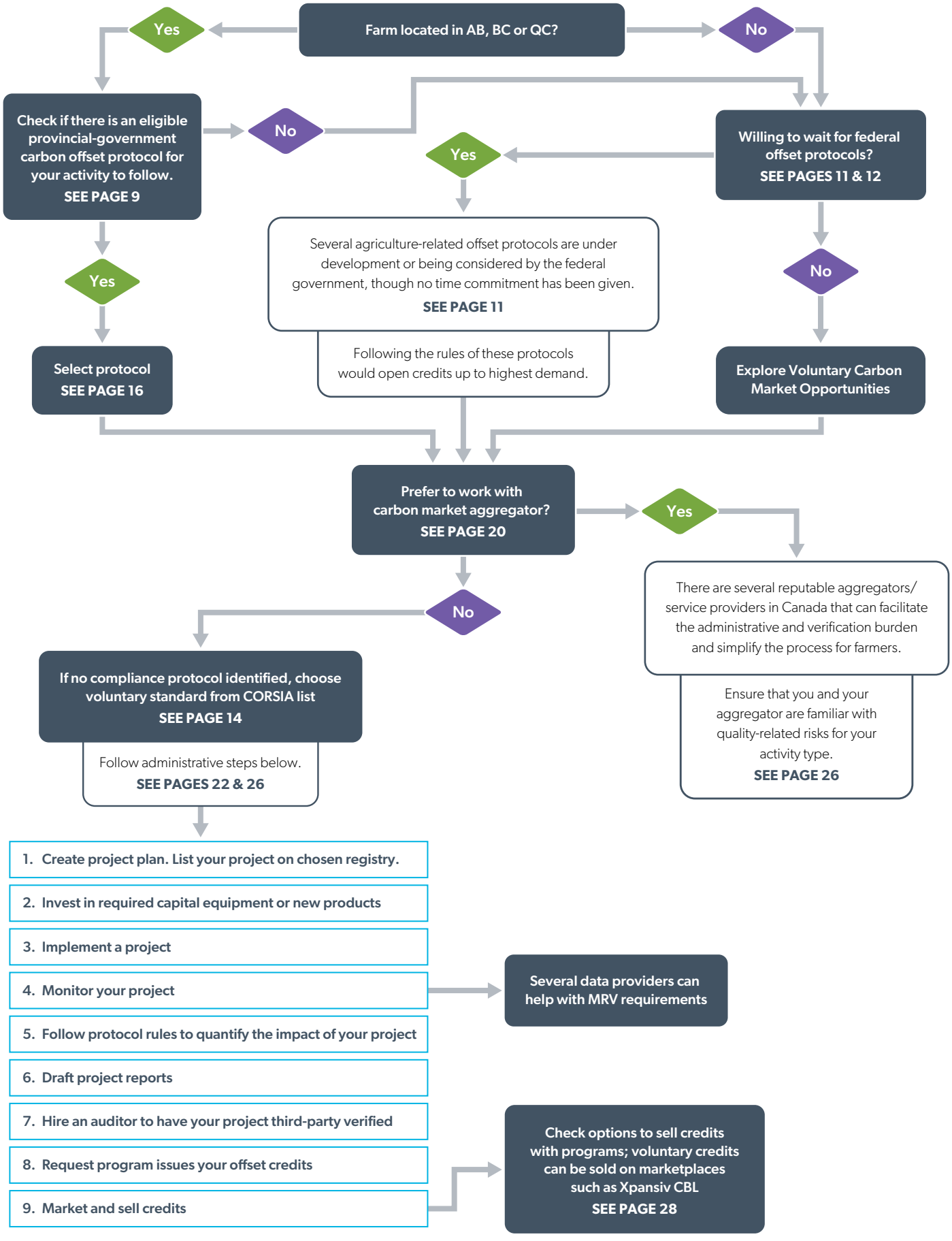
On the voluntary market, private-sector-led standards/registries publish project-specific methodologies that proponents need to follow in order to generate carbon offsets from their activities. The largest of these private standard bodies is Verra that issues credits under its Voluntary Carbon Standard, but other large players include the Gold Standard, American Carbon Registry, Plan Vivo, and the Climate Action Reserve. Over the last two decades, almost 1.5 billion carbon credits have been issued across those five major registries, with 700 million of these credits remaining available to buy on the market today.

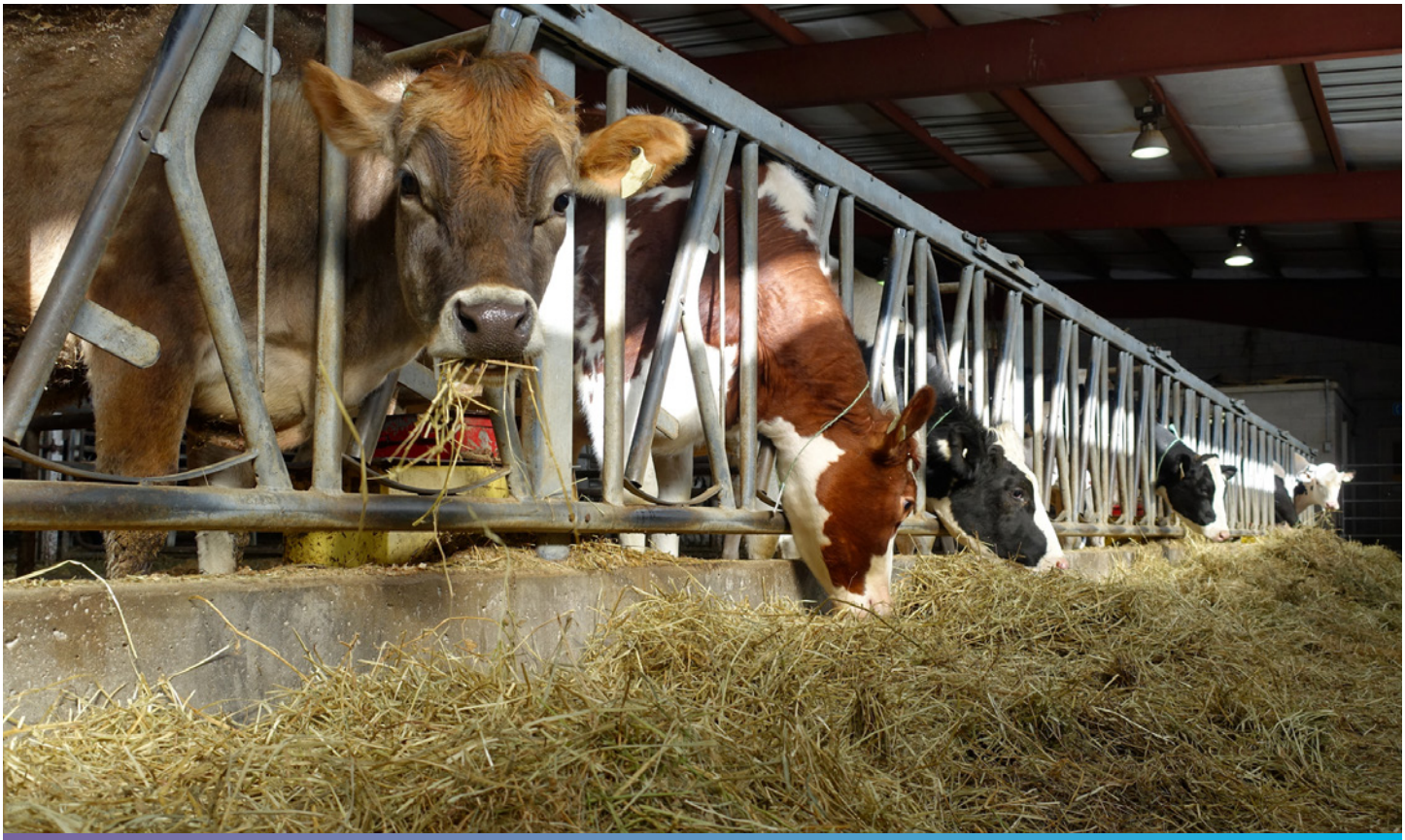
On the compliance market, many global governments have chosen to use carbon offsets to supplement climate policies under their compliance systems, including China, Australia, New Zealand, France, Colombia, South Africa, Korea, as well as in subnational schemes such as in the United States. As in these jurisdiction, Canada's carbon pricing landscape offers a global advantage to carbon offset development. This is because the policy spurs increasing demand for carbon offsets as large emitters looks for ways to avoid paying the carbon price on each tonne of emissions. Moreover, as the carbon price increases and source emissions decrease, carbon offsets will become an increasingly attractive option.

At the international level, the Clean Development Mechanism (CDM) under the UN's Kyoto Protocol was used in the pre-2021 era by countries wishing to offset their national emissions, and was also integrated into the EU's Emissions Trading Scheme. Negotiations are ongoing in the UN process to establish a new mechanism to replace the CDM for the post-2021 era, although no standards/rules have been developed to date. The Paris Agreement also allows countries to trade other types of credits, including those in the voluntary carbon market, although only bilateral government-to-government deals have been achieved to date.

Carbon offsets have emerged as a valuable tool in combating GHG emissions globally. These credits are based on quantified and verified emissions reductions or removals that can be purchased by buyers looking to make an impact on global climate action or to offset their own emissions. This demand creates value, providing an economic incentive for farmers or other project developers to adopt sustainable practices. As carbon pricing policies intensify, demand for carbon offsets is expected to rise further.

Quick guide: pathway to carbon market participation





CANADIAN COMPLIANCE OFFSET SYSTEMS

In Canada, the provinces of British Columbia, Alberta, and Quebec currently have climate change regulations that allow for the use of carbon offsets. Canada's federal government has also developed a nation-wide carbon offset system. These systems allow project proponents to certify their projects and issue credits backed by government-developed methodologies and third-party verification requirements.

Each of these carbon offset systems vary in terms of their eligible carbon offset activities, meaning that proponents need to check each list of "protocols" to determine if the sustainable activity they envision on their farm is listed. These protocols set out requirements for each particular project type, including rules for how the climate-friendly activity should be implemented, and methods for quantifying the resulting GHG emission reductions results.

British Columbia (BC)

The province of BC issued approximately 8.1 million carbon offsets between 2010 and 2021. According to provincial legislation, offsets may be used by regulated operators to meet policy requirements, or by the B.C. government to satisfy its public-sector carbon neutral commitment. At present, only liquefied natural gas (LNG) facilities may use carbon offsets as a compliance option in meeting their emissions benchmark. However, the BC government has recently announced that it will introduce an emissions cap for the oil and gas sector more broadly, where carbon offsets are expected to be eligible for use. In addition, that government announced in March that it will introduce an output-based pricing system (OBPS) for large stationary sources of GHG emissions in 2024, allowing industries an alternative to paying the province's economy-wide carbon tax, and potentially including a carbon offset element.

Currently, there are only two approved carbon offset protocols in BC:

- Fuel Switch Protocol: Applicable to projects that reduce emissions through energy conservation, energy efficiency, and switching to lower carbon fuels.
- Methane from Organic Waste Protocol: Applicable to projects that reduce methane emissions through landfill gas management or anaerobic digestion of organic wastes.

From 2011 to 2015, BC offered a forest carbon offset protocol (FCOP), and the province has indicated that it is currently updating that protocol for future release. The draft of the new protocol (FCOP version 2.0) was released in February 2023 and includes:

- Afforestation/Reforestation
- Conservation/Improved forest management
- Avoided conversion

Over the duration of the programme, BC has issued and withdrawn additional offset protocols beyond the FCOP. BC's registry lists all carbon offsets issued by the province, and includes credits from: fuel switching, energy efficiency, landfill gas, and forest sequestration projects, with results spanning 2010-20. Note that there continues to be some later-year issuances from project types that are no longer eligible under the programme, given that these projects were allowed to be grandfathered within the context of the new requirements. There have yet to be credits issued from anaerobic digestion.

Alberta

Alberta enacted the first carbon market in North America in 2007 under its Specific Gas Emitters Regulation (SGER), where a carbon price was applied to sources emitting over 100,000 tonnes of CO2 equivalent per year. Carbon offsets produced in Alberta have ever since been allowed as a compliance option under that system and its subsequent variations, including the current Technology Innovation and Emissions Reduction Regulation (TIER). More than 70 million carbon offsets have been issued within these Alberta systems to date.

Alberta has 19 offset protocols, of which three are agriculture specific, and two are indirectly related activities. These are:

- Agriculture Nitrous Oxide Emissions Reductions
- Selection for Low Residual Feed Intake Markers in Beef Cattle
- Reducing Greenhouse Gas Emissions from Fed Cattle
- Biofuel production and usage
- Biogas production and combustion

It is important to note that there may also be other protocols relevant to agricultural producers, such as the Wind-Powered Electricity Generation Protocol.

Alberta's Conservation Cropping protocol (previously the Tillage System Management Protocol) was cancelled in December 2020. Note also that the Aerobic Decomposition of Agriculture Materials protocol is now inactive, with only one related project ever registered.

Quebec

Carbon offsets are eligible compliance mechanisms under Quebec's cap-and-trade system, a carbon market linked to California through the Western Climate Initiative. Regulated entities may use carbon offsets for up to 8% of their total emissions, and must surrender permits or "allowances" equal to the rest of their emissions each year.

Quebec has approved the following carbon offset protocols, with the first two agriculture related:

- Methane destruction by covering manure storage facilities
- Carbon sequestration through afforestation or reforestation on private lands
- Landfill methane reclamation and destruction
- Halocarbon destruction
- Destruction of methane from drainage systems at active coal mines
- Destruction of methane from ventilation air at active underground coal mines

To date, over 1.3 million carbon offsets have been issued, but only from the landfill methane reclamation/destruction and halocarbon destruction protocols.

Canada's Federal Offset System

The Canadian government last year (May 2022) published a regulation to develop its own federal carbon offset system. Federal offsets can be used for compliance by large industrial emitters under the *Output-Based Pricing System Regulations* (OBPS Regulations). The OBPS regulation applies only in provinces and territories that do not have an equivalent system of their own. For provinces this currently means Prince Edward Island and Manitoba. The first two federal protocols were published in February 2023:

- Landfill methane recovery and destruction (not applicable in AB, BC, and QC)
- Reducing GHGs from refrigeration systems

The Federal offset protocols do not apply in a jurisdiction that has an offset system with an active protocol for the same project activity. This complicates the calculation for determining how many industries will comprise market demand. In addition, regulated firms have other ways to comply with the OBPS besides using carbon offsets, including mitigating emissions or using other types of compliance units.

Note that, offsets from provincial systems may also be eligible for OBPS compliance in these jurisdictions, with a list of recognised protocols updated regularly. Projects must be located in Canada and have a start date of Jan 1, 2017 or later. Currently both the Alberta and British Columbia offset systems are recognised, but only Alberta has eligible activity types: aerobic composting, aerobic landfill bioreactors, emissions reductions from pneumatic devices, emissions reductions from fed cattle, low residual feed intake in beef cattle.

Carbon offsets generated under the federal system could, in theory, be used for other purposes such as voluntary purchases from corporates or event organisers wishing to offset emissions associated with their venue and attendees travel, for example. The federal government may also consider the use of offsets under its Greening Government Operations Strategy or proposed oil and gas sector cap.

Environment and Climate Change Canada, who administers the programme, is developing additional protocols on an ongoing basis, and has signalled the following protocols are currently being considered:

- Improved Forest Management on Private Land
- Reducing Enteric Methane Emissions from Beef Cattle (draft released)
- Direct Air Carbon Dioxide Capture & Sequestration
- Enhanced Soil Organic Carbon
- Avoidance of Manure Methane Emissions through Anaerobic Digestion & Other Treatments
- Improved Forest Management on Public Land
- Bioenergy Carbon Dioxide Capture and Sequestration

Other provinces

Carbon offset programmes may eventually emerge in other Canadian jurisdictions, though it should be noted that these systems typically take years to develop and publish initial protocols.

For this reason, farmers located in regions of Canada outside of AB, BC, and QC, may choose to turn to the federal offset system, which is further along in developing agriculture-related protocols.

This is a dynamic time across the Canadian carbon offset landscape, with this report capturing the state-of-play as of May 2023. Would-be project developers and interested farmers are advised to stay abreast of emerging compliance-based protocols, which will be published through the following links:

Alberta	British Columbia
Quebec	Federal

OFFSET PRICES

There are several advantages to participating in compliance-based carbon offset systems compared to the voluntary carbon market. Compliance-based eligibility offers greater demand for your credits because those credits can be used to meet regulatory requirements, and in addition may be used by voluntary buyers — which means a better price for the same level of GHG mitigation effort.

Ultimately, the price offered for a carbon offset will depend on the supply and demand dynamics in the market, and therefore cannot be predicted with certainty.

Factors such as the stringency of the programme and ease of emissions reductions will ultimately determine the price you can receive for your offset credits on the market.

That being said, the price of carbon offsets generally tracks the cost of other compliance options in a regulated system. Regulated entities may choose to purchase carbon offsets rather than paying a carbon price, buying permits, or reducing their emissions at source.

Under Canada's federal output-based pricing system, the price of offsets is likely to track the price of other compliance units, with the price of those units tied to the stringency of the regulation's benchmarks. One important feature of the system is that regulated entities can always choose to pay a price for their emissions directly to the government rather that surrendering credits. This essentially caps the compliance cost at that of the current backstop carbon price — currently $65 per tonne and rising to $170 per tonne by 2030 — meaning that carbon offset prices will also fall below this backstop price, but under a well-designed system would track this trajectory closely.

Provincial compliance systems also offer advantages in terms of demand certainty. In Alberta, the price of Alberta Emissions Performance Credits (EPCs) under its Technology Innovation and Emissions Reductions (TIER) programme finished the first quarter

of 2023 at C$53[2]. Regulated entities may also pay into a tech fund to comply with the TIER regulation, which effectively caps the price of allowances and offsets. That excess emissions charge is legislated to rise from the current $65 per tonne, to C$170 per tonne by 2030, in-line with Canada's federal backstop carbon price. As a result, some trades for advance carbon offset delivery have shown sizable price premiums.

The price of allowances in the joint Quebec-California cap-and-trade system has been strong in the first half of 2023, averaging between U.S.$30-32 (C$40-$43) per credit. These prices are expected to increase as California is in the process of revamping its programme under a current Scoping Plan. Quebec has issued only some 1.3 million offsets to date under its cap-and-trade system, compared to 245 million issued in California.

The government of British Columbia is currently reviewing its approach to purchasing carbon offsets and exploring options for an updated offset procurement process.

Despite these price benefits, political risk should be considered in any decision to participate in compliance-based offset systems. New governments could change the system. An example of this occurred in Ontario in 2018, when the new government suddenly cancelled the provinces' cap-and-trade system and budding offset market.

Meanwhile, the cost of carbon offsets on the voluntary carbon market varies considerably from a few cents to hundreds or even thousands of dollars per credit. Price variations represent differences in project type, certifying body, vintage (year that the emissions improvement took place), and other factors such as the project's score from independent ratings agencies. As with any market commodity, prices are then determined by the overall level of demand and supply existing in the carbon market. A mix of financial speculators and corporate buyers comprise demand, while the supply of credits has been steadily increasing across the market.

Demand, and therefore prices, on the voluntary carbon market are mostly tied to corporate voluntary action as well as demand stemming from airlines under the UN's aviation body's CORSIA offsetting scheme. A surge in corporate net-zero commitments has been tied to an expected boom in demand for carbon offsets going forward. However, it should be noted that a "mitigation hierarchy" is now widely recognised, where carbon offsets are the least preferred option, including under groups that look to ensure credibility in net-zero commitments, such as the Science Based Targets Initiative and the United Nations Secretary-General High-Level Expert Group on the Net-Zero Emissions Commitments. It should also be noted that even if corporates use offsets as part of credible mitigation pathways that respect the hierarchy, there is likely to be significant scrutiny around the quality of those offsets,, imposing reputational, and possibly regulatory risk to these firms.

The annual value of voluntary carbon market transactions skyrocketed to nearly $2 billion in 2021, according to research organisation Ecosystem Marketplace's State of the Voluntary Carbon Markets report, far and away the largest annual transaction value since the organisation began keeping records in 2005, and vastly exceeded the $520 million market size in 2020. Even in this environment of bullish market activity, the annual global weighted average price per tonne reached only $4.0 for all transactions.

Since 2021, market activity has significantly slowed, with bundled units (N-GEO) of nature-based offsets trading on the CBL Xpansiv marketplace at $1.75 in April, up slightly from the historical low close of $1.70 recorded in early February 2023.

Yet these average prices represent credits across the market, and are often not assured for the environmental integrity or other factors of quality. Many voluntary buyers are willing to pay significantly higher prices per tonne for what they see as "quality" carbon credits. For this reason, certain types of credits will trade much higher, with buyers such as Microsoft and Apple demonstrating that they will pay prices surging to the hundreds for the right type of carbon credit.

Specific cases are often used as proxies for what carbon price sellers may hope to achieve on the voluntary carbon market. A good example for Agriculture is carbon credits originating in North America under the Climate Action Reserve programme last June (2022), issuing the first credits from the "soil enrichment" protocol, with developer Indigo Ag offering U.S-based units at $40/tonne. However, it should be noted that this price was secured at a time that the voluntary market was experiencing a higher demand boom.

2 Carbon Assessors

Box 1: CORSIA – How to choose a voluntary certifier/programme

The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) is an agreement established by the International Civil Aviation Organization (ICAO) to help airlines reduce their carbon footprint.

Under CORSIA, participating airlines agree to offset their carbon emissions above a historical benchmark by purchasing carbon credits from the voluntary carbon market. Recognising that there are scores of voluntary programs existing internationally — with some more credible than others — an expert panel approves a list of what they deem to be credible programs. Credits issued under these programs are then eligible for use under CORSIA.

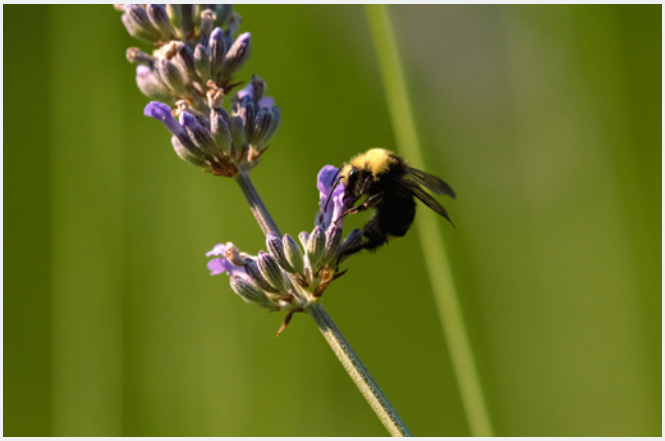
Supporting this list, the Integrity Council on the Voluntary Carbon Market (IC-VCM) recently announced that it would only recognise programmes that have been approved to issue credits under CORSIA.

Programmes currently eligible under the CORSIA programme are:

- The American Carbon Registry (ACR)
- The Architecture for REDD+ Transactions (ART)
- China's voluntary emissions reduction programme
- The Clean Development Mechanism
- Climate Action Reserve
- Forest Carbon Partnership Facility (FCPF)
- Global Carbon Council (GCC)
- The Gold Standard (GS)
- Verra's Verified Carbon Standard (VCS)

It should be noted, that this list is currently being updated, with only the ACR and ART thus far authorised for use under the 2024-26 compliance period.

Box 2: Biodiversity credits



Biodiversity offsets exist under regulatory schemes that require private actors to counter their negative impacts on nature during infrastructure projects. Many countries have mandates for biodiversity offsetting when economic activity disturbs nature, requiring project developers to restore or protect an equivalent area of habitat elsewhere.

Canada has allowed for biodiversity offsets as a flexible compliance instrument under rules posed by its Impact Assessment Act, Species at Risk Act, and several other legislative frameworks. Its newly released biodiversity offsetting policy stipulates like-for-like, where the offset must have comparable attributes to the land being displaced. Counter-balancing the negative impacts of project development requires "conservation gains over and above what is already taking place or planned in the future". It also includes more localised requirements, such as if the impacted site provides habitat that promotes a certain species movement, the offset should provide the same function.

Meanwhile, biodiversity credits are a new and quickly emerging concept on the voluntary market, with the first major programmes only just beginning to release certifying criteria. Plan Vivo is the only major registry with a draft protocol for biodiversity credits, which was published in January. The largest voluntary carbon credit issuance body Verra is currently working on a new biodiversity, or "nature" credit, with related methodologies expected to roll out starting early 2024. There are very few sales of biodiversity credits, but one citable example is project developer rePlanet securing a sale for credits arising from its Cusuco National Park in Honduras with GSK Pharmaceutical company. GSK has committed to purchase the credits stemming from the project for the first 12 years, valued at $5/biodiversity unit and $10/CO2 outcome. The sale will help protect some 18,000 hectares of some of the most biodiversity-rich habitat on the planet that has been quickly shrinking due to illegal clear cutting.

A key difference between voluntary biodiversity credits and compliance-based offsets is that many experts have been clear that biodiversity credits should not be used to negate or counterbalance negative impacts on nature, a concept underpinning biodiversity offsets administered under several global government-led schemes. These credits are complicated by the fact that there is no single metric to measure improvements in biodiversity outcomes over time. Many emerging standards, based on scientific working groups, are looking to overcome this challenge.

Once these methodologies are finalised, it will likely be possible for project proponents to "stack" biodiversity credits onto their existing carbon credit projects, meaning that they receive credits for both CO2 improvements as well as biodiversity outcomes stemming from the same activities. This is important, because farmers will need to be assured that their efforts to instigate sustainable activities are matched with an attractive financial return, where stacking offers an opportunity for revenue coming from two or more sources. Examples of project types where this ability to "stack" credits will be fundamental to the business model, include wetland re-wetting and certain types of afforestation.

It should be noted that in the absence of more mature biodiversity markets, carbon markets can still help propel biodiversity results. Many corporate or other buyers of carbon credits on the voluntary carbon market look for co-benefits such as biodiversity outcomes. Carbon credits from activities such as grassland conservation or afforestation with clear biodiversity gains are likely to fetch higher prices on the market.

ACTIVITY TYPES

There is a variety of approaches to reducing GHG emissions or increasing sequestration on Canada's farms. The first step for farmers and landowners in participating in carbon offset markets is determining which GHG mitigation practices make sense to adopt given their circumstances.

Activities may include adopting new technologies or practices, while others approaches may involve avoiding practices that may cause negative climate-related outcomes, such as clearing forests.

It should be noted that there is considerable overlap between activities that promote GHG reduction/sequestration and what is increasingly referred to as "regenerative agriculture". It will often make sense to use this term for activities that provide GHG mitigation while also improving other environmental indicators.

Each approach is classified as a particular "activity type" with individual programmes offering "protocols" that define the related rules. Note that these protocols will differ slightly from one programme to another. Meanwhile, common descriptions of activity types can help farmers become familiar with the most common agriculture-related carbon offset protocols:

Conservation cropping

Conservation cropping is a farming technique that involves using a variety of methods to protect and enhance the soil, while also improving crop yields. The approach can help reduce soil erosion, maintain soil health, and minimize the use of chemical fertilizers and pesticides. Some of the key principles of conservation cropping include reducing tillage, using cover crops, implementing crop rotations, and managing nutrients carefully.

Conservation cropping can help tackle climate change by increasing the level of carbon stored in agriculture soil. No-till seeding techniques or conservation tillage help sequester

carbon that would otherwise be released into the atmosphere. Conservation cropping also provides many other benefits to farmers, increasing the amount of organic matter in the soil which can improve soil structure, water-holding capacity, and nutrient availability — all contributing to healthier crop yields.

There are no current compliance-based conservation cropping protocols available in Canada. The only option for farmers hoping to generate carbon offsets through this practice is to wait for a decision by the federal government on whether they will develop a related protocol. Alternatively, farmers wishing to pursue this avenue could look to participate through the voluntary carbon market.

However, on the voluntary carbon market, conservation cropping has historically produced less than 1% of carbon credits. The largest voluntary programme Verra released an updated version of its Improved Agricultural Land Management protocol under its Verified Carbon Standard in June, aiming to increase the carbon sequestration potential of agricultural land through a package of several practices, including improving fertilizer application, biomass residue and water management, cash and cover crop planting, harvesting practices, and grazing practices. The protocol has not yet been applied for agriculture projects in Canada. One widely-tracked voluntary carbon protocol is under US-based standard Carbon Action Reserve, which published its soil enrichment protocol in May 2021 with an updated version approved in May of 2022. This protocol is one to watch for Canadian farmers interested in this practice. In early 2023, it issued the first credits from that protocol, with developer Indigo Ag then offering the units at $40/tonne.

Canada has significant experience with this offset type from Alberta's experience. The Conservation Cropping protocol had once been the most popular protocol under Alberta's system, generating an estimated 600,000 to 700,000 tonnes of carbon per year at its peak, but came to an end on Dec. 31, 2021. Alberta's experience demonstrates some of the risks inherent in this type of practice, particularly around the concept of "additionality," essentially the requirement to go above and beyond business-as-usual (see page 26). Most prairie farmers in Manitoba, Saskatchewan, and Alberta (where some 85% of land prepared for seeding is located in Canada) have already adopted related practices such as no-till agriculture because of the benefits associated with soil health and productivity. Government incentive programmes had also played a role in promoting the practice, including those administered by the federal government and Quebec. Failure to meet the "additionality" test ultimately led to the cancellation of Alberta's protocol and also led to significant concerns from "early adopters" of the practice who felt that they were not adequately compensated for those efforts.

It should be noted, while there is more U.S. activity related to conservation cropping, the subnational compliance markets do not allow for offsets from soil carbon sequestration. For comparison, the California cap-and-trade and Regional Greenhouse Gas initiative (RGGI) include offset categories that reduce agricultural methane emissions: both allow for manure management with anaerobic digesters, and California's offset categories also include reduced methane in rice cultivation.

Reduced nitrous oxide emissions from agriculture fertilizer

Canada's federal government has set a target to reduce GHG emissions associated with fertilizer application by 30% below 2020 levels by 2030, with this predominantly targeting nitrous oxide. Without compromising yields, this will be achieved through practices that maximize efficiency, optimize fertilizer use, and encourage innovation.

> ***Adopting targeted practices and precision technologies can help farmers optimise nutrient management, resulting in both environmental and economic improvements.***

At a time with high geopolitical sensitivities, many farmers are looking to guard themselves against the risks associated with the international price of fertilizers, and therefore any carbon offset activity that results in a reduction of fertilizer application will offer this important co-benefit.

One of the ways to reduce N2O emissions on-farm is to adopt nutrient management practices to reduce nitrogen losses and increase the amount of nitrogen that can feed the crop. Optimal timing, rate, and placement of fertilizer application can all reduce emissions, while sourcing fertilisers from producers that measure and manage emissions is also important from a lifecycle emissions perspective. The right source also means ensuring the right product, such as coated products or products with nitrogen inhibitors.

Many farmers are already pursuing these practices, particularly working with Fertilizer Canada's 4R Nutrient Stewardship Approach: right source, right rate, right time, and right place. However, the carbon offset model could be beneficial in providing financial support for these practices, helping to pay for new equipment and products, including precision agriculture technology and use of enhanced efficiency fertilizers.

There are two relevant compliance-based protocols in Canada, one that is already active in Alberta and a forthcoming protocol under the federal system. Alberta's recently released second version (V2.1) of its nitrous oxide emissions reduction protocol (NERP) is now applicable for the 2023 cropping year on a

go-forward basis. The protocol covers on-farm reductions of emissions from nitrogen sources as well as fuel use associated with the management of synthetic fertilizer, manure fertilizer, and crop residues. GHG reductions associated with carbon sequestration in the soil and off-site emission reductions affected by the manufacture and distribution of nitrogen fertilizers are excluded from the protocol. The Government of Alberta requires that at least one member of a verification team and/or government reverification team has taken the "NERP Lite" course, offered by the Fertilizer Canada.

The federal protocol will likely build on the lessons learned in Alberta, but it should be noted that this will need to accommodate significant regional variations in fertilizer use.

Biochar

Biochar is a type of charcoal that is produced by heating organic material, such as wood, crop residues, or animal manure, in a low-oxygen environment. The activity captures carbon through a process called "pyrolysis." During pyrolysis, the organic material is transformed into a stable form of carbon, which when applied to agriculture fields, can remain in the soil for hundreds or even thousands of years. By converting organic material into biochar, carbon that would otherwise be released into the atmosphere as CO2 is instead stored in the soil. Additionally, the use of biochar in agriculture can help to reduce GHG emissions by improving soil health and increasing crop yields, which can reduce the need for synthetic fertilizers.

Importantly, biochar can be used as a soil amendment, and is believed to have a number of benefits for plant growth and soil health, including through improved water retention and nutrient availability.

Creating carbon offsets from biochar is still a novel concept, and there remain several questions related to how long CO2 will stay captured in biochar (see Table 1 related to permanence). Many farmers have noted that significant caution is warranted in applying biochar to agriculture fields as it has not been fully tested and proven in Canada. However, if biochar is proven, it could soon become one of the more successful methods for generating carbon "removal" credits. Carbon removal credits, those that sequester rather than avoid carbon, are often sought after by corporates aligning to science-based net-zero trajectories. In the voluntary market, biochar protocols have begun to emerge, including under the largest carbon standard Verra. Carbon credits from biochar projects have sold on average between $90-170 USD per credit, according to project developer South Pole, a price-tag far exceeding the market average.

Forest/grassland management, avoided deforestation, afforestation

Many farmers are also landholders of forested areas, including small family-owned forests and woodlots. This is particularly a possibility in British Columbia, Ontario, Quebec, New Brunswick, and Nova Scotia.

Carbon offsets can be generated by implementing sustainable forestry practices that promote the growth and preservation of forests. One way to do this is by avoiding deforestation, helping to ensure that the carbon stored in trees and forest-soil remains undisturbed, while additional carbon is sequestered as the forest continues to grow. Additionally, sustainable forest activities provide important co-benefits related to biodiversity.

Forest carbon offset protocols are some of the most well-known and particularly popular in the U.S. where significantly more of the nation's forest grows on private lands. In comparison, only about 6% of Canada's forest lands is privately owned, with the rest owned by provincial/territorial governments or the crown. The province of Quebec has the only current active compliance-based protocol in Canada related to forests: The carbon sequestration through afforestation or reforestation on private lands. The protocol uses an innovative 'tonne-year' accounting approach that does not require the forests to sequester carbon for at least 100-years, as is the case with most other types of forest carbon accounting.

Meanwhile, a Canadian Grassland Protocol was developed by the Climate Action Reserve in 2019. The protocol is valid when the project proponent can prove financial pressure to convert from grassland to cropland as assessed by a certified real estate appraisal. Protecting grasslands has considerable co-benefits related to biodiversity in addition to guarding the CO2 stored in soil.

Livestock feed management

Methane is a normal by-product of ruminant digestion and is released by cattle and sheep through ***enteric fermentation*** and also released from the decomposition of manure.

The quantity and type of feed given to livestock can affect emissions, both directly as well as from a life-cycle perspective.

Through feed management, farmers can reduce the amount of manure produced and therefore methane. Meanwhile, methane inhibiting feed is available to help reduce emissions from enteric fermentation, with these feed additives actively being studied and adopted in some global jurisdictions.

In the United Kingdom the government is considering a programme that would provide "methane blockers" to cattle to reduce their emissions as part of plans to achieve the country's climate goals. The government expects these methane-suppressing products to enter the market from 2025, as they are currently being trialled. The UK, however, is not considering an offset programme to encourage uptake, but instead a mandatory requirement or a subsidy programme that would help pay for the feed.

In Canada, the federal government is considering a livestock feed management protocol under its federal carbon offset system. At the provincial level, Alberta's Reducing Greenhouse Gas Emissions from Fed Cattle Protocol focuses on beef cattle located in confined feeding operations and rewards a reduction in time cattle spend at the feedlot, with a co-benefit of savings on feed. However, it should be noted that reduced days on feed can result in a lower weight when at market. Meanwhile, Alberta' Selection for Low Residual Feed Intake in Beef Cattle provides a quantification protocol that can be used to select low residual feed intake beef cattle.

Methane capture from manure storage facilities

There are several different ways farmers can reduce methane emissions stemming from animal manure, including through capture techniques. One method is to use a methane digester, which is a large, sealed tank where manure is added to decompose. Another alternative is a covered lagoon system, where manure is collected in the lagoon and sealed with a floating cover to capture the methane. This latter method can be less expensive than a digester but may require more space. It should be noted that methane can be captured where manure is stored, with this activity type likely to be less attractive for small-scale farms with smaller volumes being generated.

This activity type can also lead to a source of bio-gas, suitable for applications such as electricity or renewable natural gas production. As a result, there may be some opportunity for farmers to also receive support for biogas production and sale.

This support could be "stacked" on top of the financial support offered through the carbon offset market.

Quebec offers a related offset credit protocol pertaining to covered manure storage facilities where projects aim at reducing GHG emissions by destroying manure-related methane emissions. These projects involve installing a methane-capturing roof structure over a manure storage facility, along with a fixed device for destroying methane, such as a flare. Note that in Quebec, an analysis is currently underway to determine whether this protocol will be converted into a ministerial regulation. Quebec has also proposed a draft regulation for avoiding GHG emissions generated by the treatment of manure lagoons. It should be noted that there has been limited interest in taking up this practice under the protocols to date given cost-benefit considerations related to investment in the required equipment.

There is also a related protocol under British Columbia's compliance-based offset system, involving the capture and destruction of methane generated from the anaerobic decomposition of waste, including liquid manure storage or passive anaerobic wastewater treatment. Alberta's Anaerobic Decomposition of Agricultural Materials Protocol captures methane and CO2 from agricultural waste to help generate biogas. The activity is currently underway in two biogas facilities within Alberta.

WORKING WITH PARTNERS, INTERMEDIARIES, AND AGGREGATORS

The carbon offset model provides farmers and landowners an opportunity to generate revenue by cutting pollution or sequestering carbon on their private properties. However, carbon markets are complex, and some landowners may find it burdensome to navigate the system or engage in ongoing administrative obligations[3]. In addition, with almost 200,000 individual farms, Canadian agriculture consists of mostly small and highly diversified properties across the nation, meaning smaller financial rewards for the same amount of carbon-offset-related paperwork.

Farmers may choose to work with third-party service providers. These intermediary parties have developed the expertise to help guide farmers before, during, and after their offset project. This includes handling the entire carbon offset process outside the farm, including administrative tasks, securing third-party verification of documents and equipment, and helping to market and sell resulting carbon credits.

3 Survey data from Alberta's compliance carbon market found that farmers perceived the amount of paperwork to be too onerous when compared to the potential size of the incentive (WGB & TCAF, 2021).

Providers may bundle together smaller projects, which is why many people call these actors "aggregators." While farmers will ultimately be the ones conducting the CO2 mitigation activities themselves, aggregators can significantly simplify the process.

Most carbon crediting programmes allow for land/farm aggregation, and provide related rules to help streamline MRV requirements. The federal carbon offset system, for example, specifies that it allows registration of a group of projects located in the same province that use the same protocol and quantification methodology.

One important advantage of working with aggregators is efficiencies in measurement, reporting, and verification (MRV) costs. Aggregation may help to reduce barriers for smaller projects by streamlining MRV processes, thereby helping to reduce total costs and increase the economic feasibility of some projects.

Measuring soil organic carbon could require costly soil sampling if a farmer chose to 'go it alone,' whereas aggregators may have modelling or remote sensing techniques that can more efficiently quantification requirements. Aggregators may also offer technology to help measure climate impacts, and increasingly offer user-friendly software platforms to help farmers input, track, and report required data.

Working with aggregators however carries a cost. Some aggregators charge a lump sum or annual fee, while others ask farmers to provide a portion of the revenue generated through carbon credit sales, where this could be as high as 50% of revenue. There are some providers that may offer farmers a guaranteed price for each carbon credit generated, where the aggregator will reap any additional value from the carbon market. It should be noted that there are different services offered by third-party service providers, such as those that only offer data management, and many may not refer to themselves as "aggregators," but as "extension agents" or "farm advisors."

There are also some risks to working with aggregators. Firstly, there is limited public oversight of carbon offset aggregators in Canada, and that means that some novel or even fraudulent actors could exist. It is therefore important that farmers work with aggregators that are well established and have been recommended through trusted contacts. They should also perform due diligence before finalising any deals with aggregators, such as seeking legal advice before signing contracts. This should include an assessment of who owns the carbon mitigation rights arising on the property, fee structure, percentage of revenue retained, reporting requirements, the duration of the contract, and how farmers' data will be used and shared.

When choosing service partners, it is also important to ensure that they work through an established registry (see CORSIA box on page 14) and have experience working in the Canadian context. Established aggregators in Canada include, Bank of Montreal's Radicle Group (formerly Carbon Credit Solutions), Farmers Edge, Viresco Solutions, and Trimble (formerly AgriTrend). Many of these aggregators have been established for well over a decade and aim to make the carbon offset process as simple as possible. Radicle, Crop Production Services, Trimble, Failsafe, and Farmers Edge dominated Alberta's conservation cropping projects when that protocol was active in the province.

ADMINISTRATIVE AND VERIFICATION REQUIREMENTS

Farmers who choose to not work with an aggregator need to fulfill carbon offset administrative and verification requirements themselves, with this process described in this section. It should be noted that even if farmers choose to work with aggregators, a high-level understanding of this process is recommended.

In order to generate offset credits, project proponents must follow a set of rules outlined by the programme administrator (i.e., federal or provincial programme, or voluntary certification programme). If these rules are respected, the programme administrator will be in a position to issue offset credits. Projects will only be awarded offset credits after the emissions mitigation results have taken place, and it can sometimes take several years for the project to start generating credits.

It should be noted that depending on the programme, it is sometimes possible to backdate projects — a flexibility that allows for the recognition of past efforts.

It is also important to check programme specific rules. For example, some offset programmes have requirements that the project proponent live in the jurisdiction of the offset system, and many require assurance of property rights. In order for an emission offset project developer to register emission offsets in the Alberta emission offset system, for example, they need to submit a statutory declaration stating that they have the 'right' to generate and sell the emission offsets associated with the emission offset project. In the case of Indigenous reserves, the project proponent must have the authority from the government of Canada.

BOX 3: Administrative steps to carbon offsets

The administrative steps to carbon offset generation are summarised as follows:

1 List your project

For example, in Quebec, proponents must fill in a form that will allow the Quebec government to list the project in their database. The Alberta carbon offset system, for example, requires a project plan that outlines the intended project and details its physical location.

2 Implement and monitor your project

Monitoring involves the collection of specific data at agreed intervals that helps quantify the GHG impact of your project. The rules around monitoring are outlined in each specific protocol, and may include data collection or estimations. Note also that historical data may be required to help build the project baseline.

3 Draft a project report

Quantify your project's GHG emission reductions and fill out the required project report. Each protocol will have clear rules for how to quantify emissions results compared to a baseline and how to calculate the corresponding number of offset credits generated by the project. Most programmes provide templates and forms to facilitate this process. Examples for the Quebec programme can be found here: Template and Form for complementary project-specific information.

4 Hire an auditor/third-party verifier

Have your offset credit project report and project-specific information forms verified. The rules surrounding the types of third-party verifiers that may be used are included under each specific protocol.

5 Request issuance of offset credits

Submit an application form, along with your project report, supplementary information, and the report prepared by your verifier. If successful, your credits will be issued and shown on your registry account, at which point you are free to transfer them to any buyer that also has a registry account.

FINANCIAL ESTIMATES

Carbon offset policy and practices are quickly evolving in Canada, with several organisations currently analysing the costs of project implementation, including through the development of pilot projects. For example, RBC, Loblaw, Maple Leaf Foods, Nutrien, Boston Consulting Group's (BCG) Centre for Canada's Future — with support from Smart Prosperity Institute/Natural Step Canada, and the Arrell Food Institute — have provided the initial support to launch the Canadian Alliance for Net- Zero Agri-food (CANZA). That initiative is spearheading pilot projects in Canada to help build evidence for emissions improvements and financial benefits to farmers from sustainable projects. As another example, the AgroCarbone Grandes Cultures initiative by Coop Carbone and Sollio Agriculture co-operative in Quebec, aims to help farmers reduce and sequester GHG emissions through a variety of pilot projects, with the intention for this to lead to the development of new offset-credit protocols in Quebec's agricultural industry.

These types of pilot projects can help build the business case for engaging in carbon offset activities. This includes quantifying the GHG mitigation arising through different activity types, the number of carbon credits that can be issued, and the costs of implementing the project.

Although carbon offset project costs and credit generation will differ significantly from project to project, and are highly dependent on a multitude of factors, pilot projects can offer important lessons learned and provide a sense of the revenue pathways under different sustainable activities.

Since carbon projects often take time to start generating results, these pilot projects may therefore need time to analyse. Certain benefits from sustainable practices such as improved soil conditions of feed efficiency may result in co-benefits to farmers that only become apparent after several years.

Meanwhile, while few farmers have tapped into the voluntary carbon market in Canada, aggregator Indigo Ag has been active in the US where it works with farmers to generate credits under Climate Action Reserve's Soil Enrichment protocol. The first of these carbon offset issuances began in June 2022, with mitigation results occurring over 2018-20. The protocol covers sustainable farming practices such as reduced soil tillage and cover crop management. As of May 2023, the company's issuance has amounted to 133,614 carbon credits. The number of farmers enrolled in the programme has grown to 2,000, spanning 6 million acres.

Indigo Ag advertises a carbon payment of US$20 per acre per year, but notes that this payment will range from US$6 to US$31 depending on operational factors. The benefit is averaged on a yearly basis during the first 10 years of adopting the practice. This means that a farmer implementing practices across 1,000 acres could earn $20,249 in carbon payments each year. This benefit would be significantly reduced by the buffer pool, with a holdback rate of 20% to protect against reversals. It is also not clear if additional aggregator fees are subtracted from this total.

There are also some initial estimates available for methane capture. A paper published from the Institute of Agriculture and Natural Resources at the University of Nebraska for example, estimated that each head of swine produces on average 0.53 tonnes of GHG emissions per year through its manure. The authors highlight an example of a rancher with 2,400 hogs able to capture 85% of methane released by capturing gas over an anaerobic lagoon. Once converted into CO2 equivalent, that farmer would therefore avoid roughly 950 tonnes of CO2e per year. At a carbon price of $50, there would be potential to generate $47,500 in carbon offset revenue. However, some 50% of this revenue could flow to service providers and administrative costs, while the cost of covering the anaerobic lagoon and capturing the methane could be hundreds of thousands of dollars[4]. The financial model would become much more attractive at a higher carbon price, with a market for the captured methane emissions, and with assurance that the carbon offsets generated from the project would be valuable a decade or longer.

BOX 4: Carbon credit volume estimates from previous Conservation Cropping protocol

Lessons can be drawn from Alberta's now cancelled Conservation Cropping Protocol, which provides some indication of associated revenues. On average, farmers implementing practices under that protocol generated 0.113 carbon credits (or sequestered 0.113 tonnes of carbon) per acre of "parkland", or 0.057 carbon credits per acre in the "dry prairie". Therefore, a farmer with 1,000 acres in the parkland geographical area would have been able to generate a maximum of 113 carbon credits per year. At a market price of $20 per credit, this equates to $2,260 per year or $2.26 per acre. At a market price of $52.91 (i.e., the current price of credits traded under the TIER regulatory programme) this equates to $5,979 per year, or $5.98 per acre. If the programme had continued through 2030 – when carbon prices are slated to reach $170 per tonne – the benefit would have been $19,210, or $19.21 per acre. Note however that service fees would reduce this overall revenue, potentially by 50%, depending on aggregator- and programme-related costs.

These financial benefits would also need to be weighed against the cost of implementing the practice. In the case of Alberta's protocol, no-till practices required an upfront investment in machinery. Once that initial investment had been made however, no-till reduced the time required for seeding crops, used less fuel, and resulted in better soil health, increasing overall farm productivity over the longer run.

4 Synthetic plastic membrane cover costs for anaerobic treatment lagoons are highly variable and the authors assume a range from $4 to $8/foot. For this example they assumed a total of 171,616 square feet would be needed to cover the lagoon, for a cost of US$686,464.

QUALITY STANDARDS

Many farmers and other stakeholders are hesitant or skeptical about the value of carbon offsets to help tackle climate change. These concerns often stem from reports that certain carbon offsets do not represent the promised 1 tonne of CO2 avoided or removed. Any farmers participating in carbon markets will face these critiques, and should be aware of common challenges related to the "quality" of their mitigation outcomes.

With legitimate concerns expressed globally about how the carbon markets may go wrong — including concerns related to greenwashing — it will be important for farmers to ensure the most robust approach to market participation.

Proponents can use any carbon offset that meets regulatory requirements under compliance systems without a need to double-check quality, but in contrast, buyers in the voluntary carbon market will need to ensure that the offsets they purchase represent quality units in order to justify their purchases to external stakeholders.

To help buyers navigate quality issues in the voluntary carbon market, a series of multi-stakeholder initiatives have looked to define core principles that should underpin crediting programmes. As summarised by the Integrity Council on the Voluntary Carbon Market (IC-VCM), these core principles are outlined in the first column of the table below.

Agriculture activities face a series of challenges related to fulfilling these core principles to offset generation. Some of these challenges can be overcome with better protocol design, something that falls under the responsibility of carbon crediting programmes. For this reason, protocols are often updated through trial and error, and newer versions of protocols are often released with strengthened MRV requirements. The second column of Table 1 explains the agriculture-related challenges that these requirements are attempting to address.

Table 1: Core carbon credit principles and agriculture-specific challenges

Core Principle	Agriculture-Specific Challenges
Real and transparent – offsets should be generated using calculations/methodologies backed by science and defined under a publicly available protocol. Tracking of credits through a registry system to establish clear ownership and prevent double counting.	It is technically challenging to quantify the amount of carbon that is stored in agricultural soils, and even more challenging to measure CO2 changes when practices such as no-till farming are adopted. Estimates, rather than direct measurements, are often used to account for disperse and complex soil dynamics, though technologies are emerging to ensure more traceable measurement. In contrast, it is much more straightforward to quantify emissions through direct monitoring of a single emissions source, for example a methane digester for livestock manure.
Additionality – credits represent emissions improvements that go above and beyond what would have happened in the absence of carbon offset revenue stemming from the project/ activity.	There are a variety of reasons why farmers may choose to adopt a new management practice or develop an emissions reduction project. However, carbon credits cannot be issued if the project would have gone ahead because of economics (e.g., creates better yields), or because of other government incentives. Alberta's conservation tillage protocol was largely cancelled because of challenges related to additionality, since the practice had already been widely adopted on the prairies when the protocol was introduced. This principle also raises the question of how to reward early adopters of sustainable practices as offset credit revenue was not the motivation for initially adopting the practice. Early adopters may therefore wish to follow other avenues for support, such as payments for ecosystem services.
Permanence – emissions improvements are permanent or measures exist to reflect accurate accounting when non-permanent.	Many carbon standards require 100-year permanence of CO2 sequestered in natural systems, which can be a challenge for agricultural soils. Some programmes require "buffer pools" where a proportion of carbon credits are saved and used if there is a "reversal" event such as a forest fire or change in management. In contrast, avoided emissions, such as through methane capture or N20 management are not subject to breaking this principle.
Sustainable development – crediting programme include social and environmental safeguards, and avoid locking-in technologies or practices that are incompatible with reaching net zero GHG emissions by mid-century.	Some observers point to the need for more fundamental transitions in the global agriculture model in order to align to a net-zero trajectory, including a shift towards more plant-based diets, and the prevention of food waste. There are no carbon offset protocols in these areas to date.
Leakage prevention – leakage occurs when an activity that causes GHG emissions simply shifts to a geographical area outside the project area, such as when timber harvesting increases in adjacent lots to a protected area.	Preventing leakage may be a challenge for agriculture. Farmers may simply shift more GHG intensive practices to other areas of their land, or preserve forests in only one section of land while clearing other lots.
Third-party validation and verification of emissions results by certified actors.	The need for verification raises questions of whether there are sufficient numbers of third-party verifiers qualified to assess agricultural offset projects, and how to reduce transaction costs associated with verification. In the U.S, a federally-administered certification programme for third-party service providers and verifiers was considered under the Growing Climate Solutions Act, though this has not materialised.

SELLING YOUR CREDITS

Once carbon credits are issued, they can be sold to buyers on the carbon market. In compliance schemes, these sales are usually facilitated by the programme's registry. In the voluntary carbon market however, project proponents will need to find buyers.

This may involve bilateral deals with corporates or other businesses, where companies such as Microsoft or Apple often choose to buy credits directly from those undertaking projects.

Most sales however, occur through intermediaries, with a variety of actors existing in this space including thousands of brokers. More recently, companies such as Salesforce have launched virtual marketplaces to help facilitate carbon credit sales. These marketplaces aim to provide trusted platforms to make carbon credit purchases simple and transparent. There are now several dozen carbon credit marketplaces, including those offered by large players such as Pachama, Abatable, South Pole, and those partnered with PuroEarth.

There are also carbon market exchanges that offer bundled carbon credits from across various projects, including Carbon Trade Xchange and Xpansiv's CBL. The latter is a global exchange platform for transacting energy and environmental commodity products such renewable energy, water, and natural gas, with the exchange connecting carbon credit sellers and buyers. These exchanges provide buyers with spot and futures options, allowing participants to buy standardised carbon credits without having to evaluate disparate offset projects.

Box 5: The future of "insetting"

The concept of "insetting" is a mechanism for companies to be recognised for GHG mitigation interventions made in their supply chains. Most insetting today remains centred around projects that improve carbon sequestration in soils or improves management practices in forests. Insetting involves many of the same steps as carbon offsetting, incorporating measurement, reporting, and verification practices, and related principles such as additionality and avoiding leakage. However, insetting targets improvements in a company's own value chain rather than buying carbon credits from unrelated sectors.

Insetting would allow a food company that helped its grain producers integrate regenerative agriculture practices take credit for the resulting GHG mitigation, for example. That food company would be targeting its "Scope 3" emissions, that is, those associated with its value chain. Large agri-food companies, such as Cargill, PepsiCo, Bayer, and General Mills have all experimented with regenerative agriculture programmes in recent years that develop carbon assets to reduce Scope 3 emissions.

The obvious benefit of insetting compared to offsetting is that investments target decarbonisation within that company's value chain, a higher rung on the mitigation hierarchy of corporate climate action. But since these interventions affect more than one actor's emissions, it is more difficult to be acknowledged for individual actions, quantify the exact impact of individual investments, and avoid accusations of greenwashing when reporting results.

The onslaught of new climate change-related reporting requirements, standards for net-zero emissions targets, and emerging regulations, has shone a spotlight on value-chain emissions, with these emissions increasingly likely to be recognised under a corporates' own emissions portfolio as part of Scope 3 reporting. As a result, food companies and other agriculture suppliers are increasingly looking for ways to clean up their value chains.

But quantifying the emissions impacts from these interventions is not straightforward. The world's two largest carbon credit issuance bodies, Verra and Gold Standard have ongoing workstreams on insetting. Gold Standard has been publishing value-chain guidance for over two years and is currently working to advance sector specific guidelines, while Verra is hoping to launch its new Scope 3 programme by 2025.

More recently Gold Standard, along with partners C2ES and Neoteric, launched the Advanced and Indirect Mitigation (AIM) platform to bring together initiatives and stakeholders to develop guidance for companies on how to credibly claim the results of mitigation interventions in their value chain towards their climate targets.

The SBTi, a partnership formed by the World Resources Institute, World Wildlife Fund, UN Global Compact and CDP (formerly the Carbon Disclosure Project), allows companies in the forestry, land and agriculture sector to use a form of insetting in their net-zero plans. The GHGProtocol, which the SBTi and many companies look to for reporting private sector emissions, has included insets in its draft guidance under review for the land sector, and final guidance is expected to be published this year.

There are several benefits to insetting to farmers, including that agri-food companies generally provide clearly defined rules on the types of GHG mitigation activities they are looking for, and the types of compensation they offer. This avoids some of the pitfalls of the carbon market, including searching for buyers for the resulting carbon credits. Insetting can also support farmers who are early adopters of environmental practices. Producers are looking to make verified claims to consumers about the environmental sustainability of their products, and are less concerned about when the change in practice took place. Farmers should keep an open mind to incentives presented through insetting initiatives and keep abreast of this quickly evolving field.

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