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NATURAL CAPITAL

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An introduction to carbon markets for land-based investments

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INTRODUCTION

Increasing concentrations of carbon dioxide (CO_2) in the atmosphere threaten rising global temperatures with increases in the frequency and intensity of climate and weather extremes and widespread negative impacts on agriculture, forestry, and urban infrastructure. To avoid the most severe impacts from climate change, there is broad understanding that atmospheric concentrations of CO_2 need to be reduced. To address this global challenge and achieve the Paris Climate Agreement's central goal of holding warming below 2°C, as well as voluntary net zero commitments, requires emissions reductions across value chains in addition to carbon sequestration projects.

Climate scientists, along with major environmental NGOs, agree that over one-third of the cost-effective, scalable climate mitigation opportunities can come from forests, food and land (e.g., Bastin et al., 2019). These climate mitigation benefits can be realized by investing in **nature-based climate solutions** (NCS) and offer investors in land-based assets the potential to generate verified carbon credits from their investments.

The development of carbon credit markets creates a mechanism for investors in land-based assets to realize the carbon value from investments in timberland and farmland. Carbon credits can be generated through changes in timberland and farmland management that reduce greenhouse gas (GHG) emissions or sequester CO_2 from the atmosphere. To quantify the climate benefits of these changes, there are established crediting standards and mechanisms for monitoring, reporting and independent verification.

As long term efforts to decarbonize the global economy are underway, carbon credits can be used to help corporates and institutions efficiently progress toward climate targets. In the short-term, carbon credits can be used to complement emission reductions pathways, by compensating or "offsetting" hard-to-abate emissions. And in the long-term, as production systems and supply chains decarbonize, carbon credits can be used balance residual emissions in order to achieve net zero targets in 2050.

To evaluate investment opportunities in NCS and determine how carbon can be incorporated into land-based investment strategies, first requires an understanding of global carbon markets. Here we provide an introduction to carbon markets for land-based investments. We begin with an overview of carbon crediting mechanisms, supply, demand and pricing in carbon markets, and the basic process for generating verified carbon credits from land-based investments. Finally, we explore what this environmental market opportunity means for timberland and farmland investors.

PRICING CARBON

Putting a price on carbon is a market-based way to tackle climate change and advance the transition to a low-carbon economy. Pricing carbon creates incentives throughout the economy to reduce GHG emissions, encourage the growth of renewable energy sources, and increase removals of GHGs from the atmosphere. One approach to pricing carbon is with a credit system for emissions reductions (a carbon emissions tax is another market-based approach but is outside the scope of the research note).

Credit systems can be used on a voluntary basis or to complement cap-and-trade or other regulatory systems. A carbon credit is considered a "voluntary carbon credit," when it is issued on a voluntary basis through an independent market program. In contrast, A "compliance carbon credit" is issued as part of a process of compliance within a regulatory framework, where the buyer has legal obligations to reduce emissions and limited flexibility to purchase offsets. Figure 1 shows the credits issued and NCS credit types covered across a range of crediting mechanisms — independent (or voluntary) and compliance. Beyond NCS, other credit types covered in crediting mechanisms might include renewable energy, energy efficiency, fuel switching and carbon capture and storage, for example.

Credit market is dominated by independent standards
Figure 1: Credits issued and sectors covered by crediting mechanism

Name of mechanism	Credits issued in 2021 (Million tCO2e)	NCS credit types
Verified Carbon Standard	140.37	
Gold Standard	34.35	
American Carbon Registry	7.30	
Climate Action Reserve	4.61	
Clean Development Mechanism	74.00	
Joint Implementation Mechanism	–	
Alberta Emission Offset System	8.40	
Australia Emissions Reduction Fund	16.30	
California Compliance Offset Program	46.00	
Switzerland CO2 Attestations Crediting Mechanism	2.10	
Thailand Voluntary Emission Reduction Program	6.01	

Crediting mechanisms	Sector
Independent	Agriculture
International	Forestry
Domestic	

Source: Adapted from World Bank, 2021. Notes: Total credits issues are for all project types between April 1, 2020 to April 1, 2021. The Clean Development Mechanism, defined in Article 12 of the Kyoto Protocol, was the world's first international mechanism for tradable emission reduction credits but has largely been replaced by independent mechanisms.

Each crediting mechanism maintains a set of methodologies that establish procedures for quantifying the GHG benefits of a project and guidance for determining project boundaries, baselines, and additionality required for quantification of GHG removed or reduced from the project. This quantification determines the number of carbon credits generated from the project. **A carbon credit is a certificate representing one metric ton of carbon dioxide equivalent[1] that is either prevented from being emitted into the atmosphere or removed from the atmosphere.** Carbon credits are increasingly being distinguished by their GHG benefit, with removal credits currently trading at a premium to emissions reduction credits (as of 2Q 2022).

Within the forestry sector, there are three main forest management activities or carbon project types that can generate carbon credits: (1) avoided deforestation: (2) forest restoration, and (3) improved forest management. Avoided deforestation (REDD+) projects reduce emissions by halting deforestation and forest degradation, a significant source of global emissions. It is estimated that globally, deforestation and forest degradation account for about 10 percent of global GHG emissions (Union of Concerned Scientists, 2021). The second is forest restoration (afforestation/reforestation) that creates or restores forest cover. As the restored forest grows, trees remove GHGs from the atmosphere, storing carbon in, above and belowground biomass. The third activity to generate credits is improved forest management, whereby management is altered in a way that increases carbon storage in the forest (e.g., longer rotations, reduced harvesting, or by increasing conservation areas) or in long-lived solid wood products. Improved forest management may also reduce or avoid emissions by constraining harvesting.

Forest carbon projects account for the vast majority of land-based carbon credits issued to date. Between April 2020 and April 2021, agriculture made up just 0.2% of global credits issued across crediting mechanisms, while forestry accounted for 39.5%, followed by renewable energy (39.4%), waste (8.8%), industrial gases (6.8%), and energy efficiency (2.7%) (World Bank, Carbon Pricing Dashboard). While there are few agricultural carbon projects compared to forestry, the market is rapidly developing. Improved agriculture land management projects have the potential to generate climate benefits by altering management to increase soil carbon storage (e.g., cover cropping and reduced tilling) and/or reduce emissions (e.g., reduced nitrogen fertilizer application).

Figure 2: Nature-based climate solutions

Natural capital sector	Project type	GHG benefit potential	
		Reduction	Removal
Forestry	Avoided deforestation (REDD+)	X	
	Forest restoration (Afforestation/Reforestation)		X
	Improved forest management	X	X
Agriculture	Improved agriculture land management	X	X

Independent market systems

Independent crediting systems form the largest market for carbon credits and have more than a decade of transaction history. In these markets, credits trade on a voluntary basis, and public or private parties can both generate credits and purchase credits. The largest independent crediting mechanism is the Verified Carbon Standard (VCS), followed by the Gold Standard, the American Carbon Registry, and the Climate Action Reserve. Compliance schemes that use independent systems as a source of credits, like the Carbon Offsetting Reduction Scheme for International Aviation (CORSIA), the aviation sector's decarbonization program, are expected to become a growing part of the market.

As markets for carbon credits have developed and grown, standards and oversight of independent crediting systems have improved through the work of market participants as well as increased public scrutiny. For example, the Taskforce on Scaling Voluntary Carbon Markets (a coalition of market participants, nonprofits, and other stakeholders) is working to standardize offsetting globally. In the U.S., the Growing Climate Solutions Act — which passed the U.S. Senate with broad bipartisan support in June 2021 and is awaiting passage by the U.S. Congress — is meant to support carbon markets by giving the government's "stamp of approval" to the most credible independent crediting mechanisms.

Compliance market systems

Compliance markets for carbon arise when laws or regulations are enacted that limit or cap the quantity of GHG emissions that are allowed. Some cap-and-trade systems include offset provisions that allow credits from independent crediting mechanisms to be used as a way for regulated entities to meet their compliance obligations. In this way, compliance and voluntary carbon markets can be linked. For example, California's Cap and Trade system, covering about 441 million tons of GHG emissions (or 85% of the State's GHG emissions) with allowances currently trading at about USD 30/tCO2e, includes offset provisions. California's Offset Program is the world's largest compliance market for forestry offsets, allowing up to 4% of compliance obligations to be met with offset certificates. However, not all compliance market systems allow offset certificates. The European Union's Emissions Trading System (EU ETS) is the world's largest market for carbon, covering about 1,725 million tCO2e (or 40% of the EU's GHG emissions), with allowances trading in the USD 80/tCO2e range as of 1Q 2022, and does not permit NCS offset credits.

VOLUNTARY CARBON MARKETS

The value of the voluntary carbon market grew by 190% year-over-year in 2021 to about USD 1 billion, and is expected to continue growing as both demand and carbon credit prices increase (Ecosystem Marketplace, 2022). NCS credits are in high demand because they are lower cost compared to technological interventions, high-quality, and are capable of generating social and environmental co-benefits.

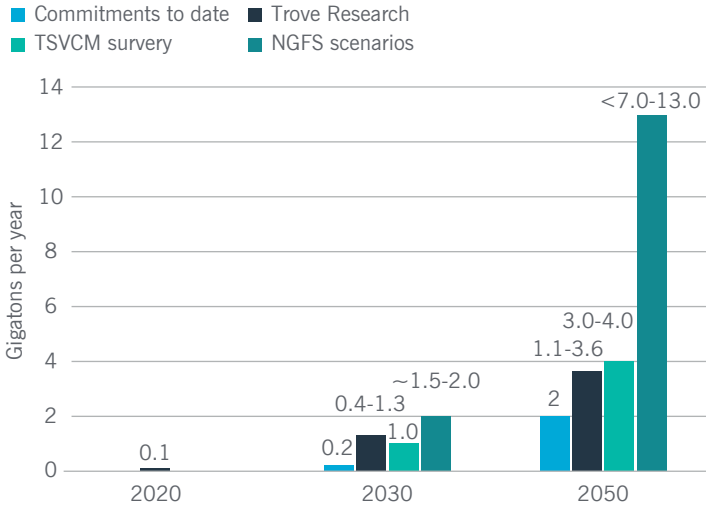
Demand

Demand for carbon credits is expanding rapidly as corporates, financial institutions, and governments commit to net zero climate targets. Typically, demand is driven by a desire to compensate for unavoidable emissions in the short term or balance residual emissions in the longer term to ultimately achieve net zero. To do this in practice, one carbon credit can be purchased and retired to offset one tCO2e of emissions.

In 2021, voluntary carbon market purchases and retirements grew by 70% to 161 million tCO2e from 95 million tCO2e in 2020 (Trove Research). The financial services sector is the largest source of demand, accounting for about half of all NCS credit purchases, followed by the chemicals and oil and gas sectors.

Future demand for voluntary carbon credits will be driven by decarbonization across all sectors of the economy. The basic approach for estimating credit demand growth is based on current and expected future corporate net zero commitments and residual emissions that would need to be offset by credit purchases. After accounting for emissions reductions required under Paris aligned mitigation targets, it's possible to estimate the residual emissions in the decades leading up to 2050. These residual emissions could be offset with carbon credits. Taking this approach has led to a range of estimates for voluntary carbon credit demand (Figure 3). The most conservative estimate assumes no increase in net zero commitments to date, leading to future demand of 2.0 gigatons/year by 2050. Other estimates suggest voluntary market demand growth could increase to as much as 13 gigatons/year by 2050 or 100 times compared with 2020 demand.

Figure 3: Estimates of voluntary demand for carbon credits



Sources: NGFS; TSVCM; Trove Research; McKinsey.

Notes: **Commitments to date** reflect demand established by climate commitments of more than 700 large companies. They are lower bounds for likely growth in commitment and do not represent all companies worldwide. **TSVCM** = Taskforce on Scaling Voluntary Carbon Markets; these amounts reflect demand based on a survey of subject matter experts in the TSVCM. **NGFS** = Network for Greening the Financial System; these amounts reflect demand based on carbon dioxide removal and sequestration results from carbon credits purchased on the voluntary market (whereas some removal and sequestration will result from carbon credits purchased in compliance markets and some will result from efforts other than carbon offsetting projects). **1 gigaton** = 1,000 million tons = 1,000,000,000 tons.

Supply

The primary source of supply for growing carbon credit demand in the voluntary markets is from independent crediting mechanisms, with the top two standards — VCS and Gold Standard — accounting for over half of all credits issued between 2019 and 2021. Across standards and project types, credit issuances in 2021 were 368 million tCO2e (Trove Research); and between 2019 and 2021, they totaled 494 million tCO2e. Forestry and land use credits are a major source of supply, accounting for 115 million tCO2e in 2021 (31% of total) and 200 million tCO2e over the past three years (40% of 2019–2021 total). (Ecosystem Marketplace, 2021).

The dominance of forestry and land use credits in the market is in large part because these sources of emissions reductions and removals are proven technologies and among the lowest cost available. Peer-reviewed research (Bastin et al., 2019; Busch et al., 2019; Fargione et al., 2018; Griscom et al., 2017) suggests that over 1/3 of the near-term, lowest cost climate mitigation can come from forests, agriculture, and land. Several estimated decarbonization cash cost curves show that both in terms of carbon abatement cost and carbon sequestration costs, agriculture and forestry are in the 40–100 USD/tCO2e cost range with annual potential to generate more than 10 GtCO2e per year of avoided emissions and removals. This is compared to alternative methods of capturing and removing CO2 from the atmosphere, such as direct air carbon capture and storage, where scalable technologies are still under development and can cost more than USD 400/tCO2e.

As demand for credits grows with net zero commitments and compliance schemes increasingly incorporate, independent standards, we expect that these independent crediting systems will be the primary source of supply for markets going forward. This will be supported by efforts that are underway to standardize crediting mechanisms and improve transparency. For example, the Taskforce on Scaling Voluntary Carbon Markets has as a primary goal to develop a set of core carbon principles for what constitutes a high-integrity credit and ensure robust governance for overseeing it. Other independent groups like the Voluntary Carbon Markets Integrity Initiative and Science Based Targets initiative (SBTi) are working to provide guidance for corporates and institutions on how credits can be used and claimed as part of net zero decarbonization strategies.

Figure 4: Voluntary market credits by type and crediting mechanism 2019–2021

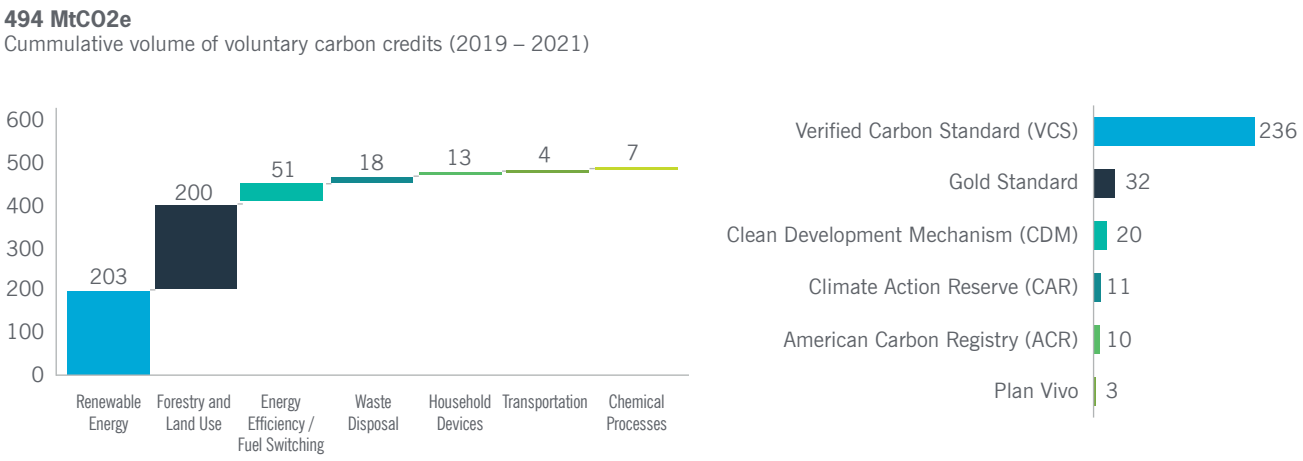
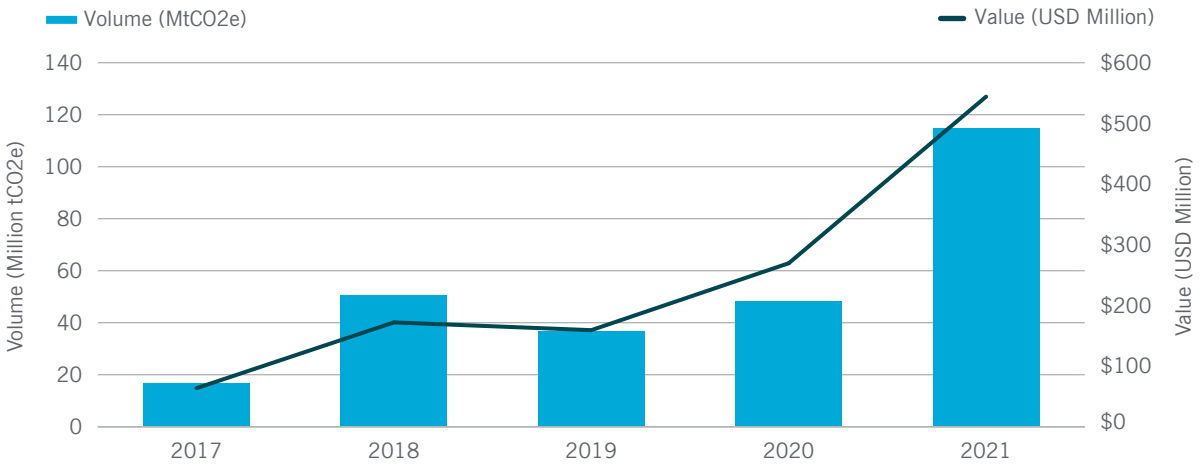


Figure 5: Voluntary market forest and land use carbon credits



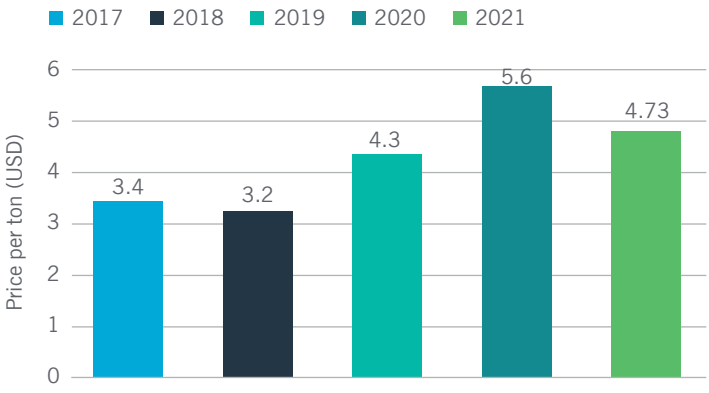
Source: Ecosystem Marketplace, 2021.

Price

The market price for carbon credits varies widely by project type and perceived quality in terms of additionality, permanence, leakage, and co-benefits. The co-benefits of a project describe the value projects deliver beyond carbon. For example, some projects restore ecosystem function, enhance habitat to benefit biodiversity, improve water quality, or create employment opportunities. Price is also a function of implementation costs, which depend on scale, location, and technology. And finally, supply and demand balance influences credit price. Historically, prices for NCS have been the highest of any project type in large part because of the material co-benefits and higher willingness to pay for removals.

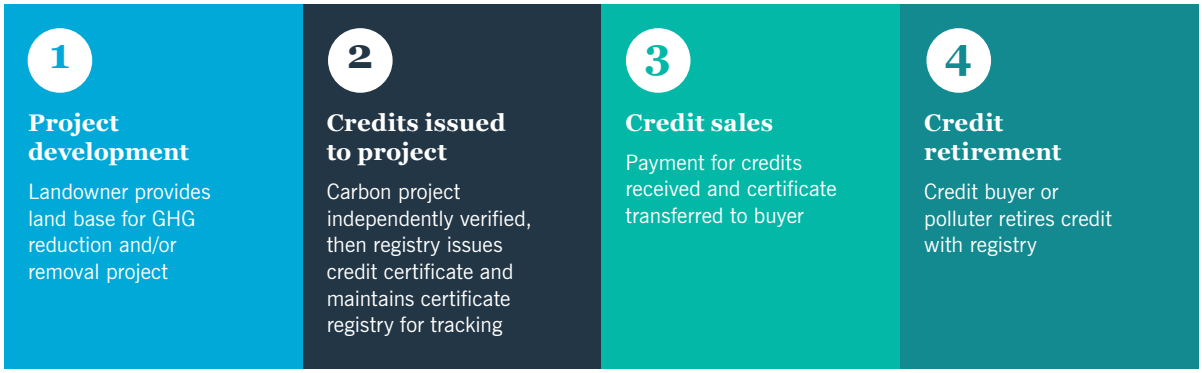
In 2021, the average price for voluntary forestry and land use carbon credits was 4.73 USD/tCO2e for a total transacted volume of 120 million tons. Historical price data shown in Figure 6 are based on aggregated quarterly volumes and weighted average prices for forestry and land use projects. Voluntary market prices are averages across project types with REDD+ (avoided emissions credits) representing a large share of total credits and pulling down average prices. In 2021, improved forest management (IFM) and reforestation credits were trading in the in the 10–12+ USD/tCO2e range. Observations from 2022 show VCS improved forest management credits trading at around 15 USD/tCO2e and reforestation credits at 30 USD/tCO2e, reflecting the premium for removals.

Figure 6: Voluntary market forest and land use carbon credits



Source: Ecosystem Marketplace, 2021.
Note: For 2021, prices are through August 31.

Figure 7: Voluntary market carbon crediting and sales process



CARBON CREDITING AND SALES PROCESS

How does the carbon credit market work in practice? The basic process from project development and credit origination to credit sales and retirement is described in Figure 7. To date, timberland owners have been more active than farmland owners in carbon project development largely because of the high cost of soil carbon measurement, a larger minimum economic scale, and the prevalence of lease structures. However, as soil carbon metrics advance and the price for carbon credits increases, more agriculture (and forest carbon) projects are expected to come online. Credit sales in voluntary credit markets may be to brokers, commodities traders, corporates or financial institutions. Finally, credits are retired with the issuing registry. Retiring credits in compliance markets, where voluntary market credits are allowed, requires tracking in both the independent registry and in the registry that is part of the compliance system.

For a carbon credit to be issued and traded, requires a clear definition of project types, quantification of emission reductions or GHG removals, and standardization across crediting mechanisms. Across the major crediting mechanisms, climate benefits carbon projects must be:

- **Real and measurable**
  Realized and not projected or planned, and quantified through a recognized methodology
- **Permanent**
  GHG emissions or removals must endure for a period at least as long as the emitted gas is contributing to climate change, with safeguards to reduce the risk of leakage or reversal
- **Additional**
  Emissions reductions or removals achieved by the project must be "above business as usual," and would not have happened unless the project was implemented
- **Independently verified**
  Carbon projects must be verified by an accredited, independent third party
- **Unique and traceable**
  Credits are transparently tracked in a public registry to ensure that 1 carbon certificate is used to offset exactly 1 tCO2e

These common principles are applied to ensure the credibility of a carbon credit in the market regardless of project type or location.

Recent critique of both voluntary and compliance market carbon credits (e.g., Bloomberg, 2021 and ProPublica, 2021) has centered around individual project's failure to uphold one or more of these principles and the crediting mechanisms treatment of additionality and leakage (i.e., when reducing emissions in one location, has the unintended consequence of increasing emissions elsewhere). Concerns about carbon crediting mechanisms, and a desire to improve standards, led Microsoft to develop their own carbon strategy, focused on procuring "high-quality" removals to achieve their corporate net negative target by 2030 (Microsoft, 2021).

WHAT DOES THIS MEAN FOR INVESTORS?

Investors in land-based assets are well positioned to benefit from carbon pricing systems and growing demand for carbon credits. As climate action ramps up across the private and public sectors, we expect timberland and farmland's capacity to generate verified carbon credits will be increasingly valued. In 2021, the voluntary carbon market grew by 190% to about USD 1 billion and is expected to continue growing as both carbon credit demand and price increase. Investments in timberland and farmland that reduce or remove GHG emissions and generate high-quality carbon credits can offer tremendous climate mitigation benefits and returns for asset owners.

The capacity to generate verified carbon credits from timberland and farmland, in addition to timber and agricultural crops, has the potential to enhance investor returns and provide diversification benefits when credits are monetized. For U.S. timberland, we estimate that the incremental return from carbon credit sales above traditional timberland varies by region and ranges up to about 250 basis points on average (assuming 2Q 2022 carbon prices). In some cases, managing for carbon does not diminish commercial timber or agricultural values. And in other cases, revenue from the sale of carbon more than offsets any reduction in timber or agricultural crop values. In addition, we find that returns from investment strategies, including the joint production of carbon and timber or carbon and agricultural crops, appear to be weakly correlated with returns from traditional timberland and farmland. As a result, management for carbon has a potentially beneficial diversification role in land-based portfolios.

Depending on the investment strategy and investor objectives, credits can also be retained or retired by the asset owner. For single-owner direct investments or separate managed accounts, the investor may elect to retain and retire credits, contributing toward their own net zero targets. However, in co-mingled funds, allocating investors their pro-rata share of carbon credits can be complicated by competing objectives across investors, preferences for particular crediting mechanisms or project methodologies, agreement on price, and credit fungibility. Looking ahead, as carbon credit markets continue to evolve, the tokenization of credits could facilitate credit allocations to fund investors and improve liquidity via trading on global exchanges.

Opportunities for carbon project development in timberland and farmland exist both in the U.S. and internationally. There is evidence that the opportunities for NBS exist at the greatest scale and lowest cost outside the U.S., largely in Latin America (Griscom et al., 2017; Busch et al., 2019). Investment in these regions will be critical to achieving maximum climate benefit and where we expect investment opportunities will be greatest.

Looking ahead, the key to continued growth of carbon credit markets will be transparency, standardization across crediting mechanism, and credibility among stakeholders. Recent public scrutiny of carbon credits and crediting mechanisms has encouraged the urgency of the Task Force on Scaling Voluntary Carbon Markets, Science Based Targets initiative (SBTi), Voluntary Carbon Markets Integrity Initiative and many other independent groups' work to both improve and strengthen standards going forward and provide guidance on how credits can be used and claimed as part of corporate and institutional net zero decarbonization strategies. The work of these groups will improve accountability across market participants and ultimately require carbon crediting mechanisms meet or exceed a set of core principles to ensure integrity and meaningful climate mitigation.

> *"Carbon credit markets are a mechanism for investors in land-based assets to unlock the carbon value from investments in timberland and farmland to help efficiently achieve net zero commitments."*

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1 Carbon dioxide equivalent is the amount of carbon dioxide (CO2) emission that would cause the same integrated radiative forcing, over a given time horizon, as an emitted amount of a GHG or a mixture of GHGs (IPCC, 2014).

A word on risk

As an asset class, agricultural investments are less developed, more illiquid, and less transparent compared to traditional asset classes. Agricultural investments will be subject to risks generally associated with the ownership of real estate-related assets, including changes in economic conditions, environmental risks, the cost of and ability to obtain insurance, and risks related to leasing of properties.

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