

Putting carbon markets to work on the path to net zero

How investors can help decarbonise the economy
and manage risk-adjusted returns

October 2021



About the Authors

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For more information on Vivid Economics, please visit vivideconomics.com.

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The carbon market opportunity: How investors can help decarbonise the economy

A new report by GIC, the Singapore Economic Development Board and McKinsey sheds light on how institutional investors can play a role in building robust carbon markets in support of net zero – and why it is in their interest to do so



Opportunities

Carbon allowances could provide **downside protection** and **enhance risk adjusted returns** in scenarios involving **immediate or delayed climate actions**.

Annualised return³
+ 50 to 70
basis points

On average, approximately
0.5% to 1% allocation
of carbon allowances could
mitigate negative impact
of portfolio returns⁴

VCMS are expected to **experience significant growth** with the potential to reach market value of **US\$5B - US\$30B** in 2030

Natural climate
solutions account
for **65-85%**
of total supply
potential by 2030

Number of
corporate net-zero
pledges has increased
by **2x** in 2020

15x
increase in
potential demand
for carbon
credits by 2030

Considerations for investors

- 1 Invest in the VCM value chain and scale up the supply of high-quality credits**, for example by directly financing technology-based carbon removal projects or nature-based solutions that involve forest protection and restoration.
- 2 Be mindful about various risks, including execution, reputation and regulatory changes.**
- 3 Look out for opportunities and regularly evaluate key changes in the markets** which will remain susceptible to regulatory changes, for example, measures to increase price stability.

- 1 Invest in the VCM value chain and scale up the supply of high-quality credits**, for example by directly financing technology-based carbon removal projects or nature-based solutions that involve forest protection and restoration.
- 2 Support the establishment of high-integrity VCM standards and governance: transparent, liquid and high-quality.**
- 3 Guide portfolio companies on the path to net zero**, for example by guiding them on setting and reporting decarbonisation targets or advising them on using carbon credits.

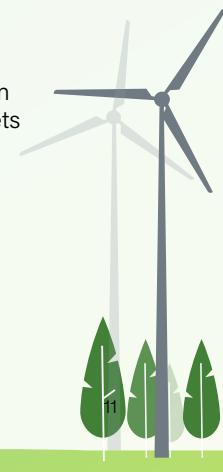
* As of 2020

1. Compensation measures include supporting the avoidance of further emissions (e.g., preserving natural carbon sinks such as forests), and helping others reduce emissions via new technologies that are less carbon intense.

2. Neutralisation measures remove CO₂e from the atmosphere via nature-based (e.g., reforestation) and technology-based (e.g., direct air capture) sequestration.

3. 5% portfolio allocation to carbon allowances vs the expected return for a regular 60/40 equity:bond portfolio of approximately 4 percent.

4. With 5% carbon allowances inclusion vs the expected returns for a regular 60/40 equity:bond portfolio with approximately 4% annualised return.



Executive Summary

As the drive to curb global warming gathers pace, carbon markets are becoming increasingly fundamental to the task of achieving net zero greenhouse gas (GHG) emissions. Compliance carbon markets (CCMs), in which carbon allowances are traded and regulated by mandatory national, regional or international regimes, are a vital part of emission reduction efforts in a growing number of countries. Voluntary carbon markets (VCMs), in which carbon credits are traded by companies and individuals on a voluntary basis, play an important role in driving investment in carbon compensation (avoidance and reduction) and neutralisation (removal) projects.

The total value of global carbon markets grew by more than 20 percent in 2020, a fourth consecutive year of record growth.¹

This joint paper from GIC, the EDB and McKinsey discusses how carbon markets are rapidly emerging as a viable asset class. It suggests that institutional investors could play a critical role in helping corporations and nations use these markets to achieve global climate goals whilst also fulfilling their own mandates. It is not an investment recommendation but it aims to shed light on the evolution of market mechanisms and their relevance to investors.

Today, institutional investors' participation in carbon markets is limited as a result of structural obstacles as well as a lack of visibility on underlying market dynamics and future trends. CCMs are the larger and more mature of the two markets, with a market value of over \$ 100 billion² and an annual trading turnover of over \$ 250 billion,

but they are small in relation to the \$ 19 trillion of total assets under management by the world's top 100 institutional investors in 2020.³ In comparison, VCMs are tiny with a value of \$ 300 million in 2020,⁴ and have not been viable for institutional investment due to limited liquidity, insufficient market size, a non-standardised transaction process and a lack of explainable price mechanisms.

However, the market landscape is changing rapidly. CCMs have stabilised and are becoming easier for institutional investors to understand. Meanwhile, governance and infrastructure are being developed to support the rapid growth in VCMs. We believe that investors should support the development of robust, liquid carbon markets for three reasons.

First, carbon markets are rapidly approaching critical mass from an investment perspective. New emissions trading systems (ETS) are being established and recent market reforms in existing trading systems have created a more predictable framework for institutional investors. VCMs have as much potential to scale as CCMs, with estimates of their expected size in 2030 ranging from between \$ 5 billion and 180 billion.⁵ McKinsey's work with the Taskforce on Scaling Voluntary Carbon Markets (TSVCM) shows how these markets could become a more viable investment option in the future if certain important milestones (such as the standardisation of corporate claims and products) are met.

Second, functioning carbon markets are essential to reach the globally agreed target of keeping global warming to 1.5 C.

¹ Total market value of compliance and voluntary markets based on assessment of traded volume and carbon prices, Refinitiv, Review of Carbon Markets in 2020, January 2021.

² Value of carbon allowances in four largest ETS, multiplied by the average carbon price in 2020.

³ Thinking Ahead Institute, The Thinking Ahead Institute's Asset Owner 100, 2020, <https://www.thinkingaheadinstitute.org/research-papers/the-thinking-ahead-institutes-asset-owner-100/>.

⁴ Value = price multiplied by volume of carbon credit retirements.

⁵ Taskforce on Scaling Voluntary Carbon Markets, January 2021, iif.com.

As stated in the public statement on the High Ambition Path to Net-Zero, companies do not only have the obligation of decarbonising their own operations and value chains. They should also compensate and neutralise their own emissions "on the path to net zero" through high-quality carbon credits.⁶ Institutional investors have an interest in this goal, since if it is missed, their portfolios will be exposed to increasing physical climate risks.

Third, carbon markets offer an important opportunity for institutional investors to manage risk-adjusted returns. Our analysis shows that if investors allocated even a small part of their portfolios to carbon allowances, they could improve the resilience of their portfolios against climate transition risks. This is because, while the precise course of carbon prices remains uncertain, they hinge on policy action, which means that as governments around the world start to take real action, carbon prices could rise.

Working with Vivid Economics, McKinsey's strategic economics consultancy, and its climate analytics suite, Planetrics, we conducted bottom-up modelling of the relative impact of climate risks across individual asset classes. Our goal was to assess the performance of a portfolio that includes carbon allowances, based on three different climate scenarios as outlined by the Network for Greening the Financial System (NGFS).⁷ Based on their widespread adoption, technical criteria, relevance and comparability, we adopted "below 2°C" NGFS REMIND scenarios that reflect the Paris Agreement's goal to keep warming well below 2°C; a more ambitious scenario to keep warming below 1.5°C would have more pronounced impacts on transition risks and

investments. Across these three scenarios, we modelled the performance of a portfolio with an allocation to carbon allowances against a reference portfolio made up of 60 percent equities and 40 percent bonds, over a ten- and 30-year horizon.⁸

We found that carbon allowances could provide downside protection and enhance risk adjusted returns in scenarios involving immediate or delayed climate actions. On average, a carbon allowance allocation of approximately 0.5 to 1 percent could mitigate the negative impact on the returns of a 60/40 reference portfolio. In scenarios involving immediate or delayed climate action, a hypothetical 5% carbon allowance inclusion in the 60/40 reference portfolio could enhance annual return by 50- to 70- basis points (versus the expected return for a regular reference portfolio of approximately 4 percent) over 30 years while volatility would improve by 30- to 50- basis points (versus the expected volatility for a regular reference portfolio of approximately 9.8 percent). In a scenario where no new climate policies are introduced, by contrast, the inclusion of carbon allowances in the portfolio led to diminished returns. This is just one action investors can take to hedge against climate transition risk.

Other actions include selecting securities (picking specific companies within the overall asset class allocations that have more climate-resilient business models); weighting the portfolio away from the sectors most exposed to the transition, such as fossil fuels; increasing exposure to potential transition winners, such as "green" mineral producers (copper, cobalt, lithium, zinc and nickel); selecting asset class allocations that have more climate-resilient business models; and actively engaging portfolio companies to

⁶ Calling for a High Ambition Path to Net-Zero, The Institute of International Finance, 8 July 2021, Authors: LSE, UN-convened Net Zero Asset Owner Alliance, UN Special Envoy for Climate Action and Finance, Standard Chartered, Davis Polk and the Institute of International Finance, https://www.iif.com/Portals/1/Files/High_Ambition_Path_to_Net_Zero.pdf.

⁷ NGFS is a network of 83 central banks and financial supervisors that aims to accelerate the scaling up of green finance and develop recommendations for central banks' role in climate change; website: <https://www.ngfs.net/en>. The three scenarios are: hot house world – where the average carbon price in the global economy remains relatively flat; immediate transition – where climate policies are introduced early and gradually become more stringent, which leads to a gradual increase in global average carbon prices; and delayed transition – where climate policies are not introduced until 2030, resulting in a more disruptive transition, higher physical risks and a much sharper increase in the carbon prices.

⁸ We used the past five years of daily transactional data from ETS, leveraging one of McKinsey's solutions (Vivid Economics' proprietary modelling platform, Planetrics) to derive a bottom-up estimate at individual company level of the potential climate impact on different asset classes. Separately, we applied a Monte Carlo simulation to estimate the cumulative return for 100,000 simulated portfolios based on key metrics for portfolio performance (such as expected return, volatility and correlation with asset classes) over a ten to 30-year timeframe – each with different levels of carbon allowance inclusion (zero percent to 5 percent in a 60/40 reference portfolio) against various climate scenarios.

encourage them to take action to improve their own climate resilience. Investors will likely adopt a mix of all these actions.

While the reasons for institutional investors to consider active participation in carbon markets are compelling, they also need to be mindful of the inherent risks. In CCMs, there are execution risks given the small market size in relation to the scale of institutional assets — for example, there may be potential difficulties in exiting investments in allowances given the relative illiquidity of these markets. Reputational risks are also present given the political sensitivity of ETS. While a healthy amount of trading promotes market growth and liquidity, such activity could also attract criticism if investors appear to be profiting from volatile price movements. Heightened regulatory scrutiny could be invited in the event of sharp price movements or suspicions that carbon allowances are being used for purely speculative purposes. Institutional investors should thus take care to balance their quest for financial returns with due consideration of the markets' fundamental objective, which is to reduce emissions by driving down carbon allowances year on year. Although liquidity in all markets depends on trades made in expectation of a financial return, companies should use CCMs to achieve real decarbonisation, not for profit through pure speculation.

VCMs also harbour many types of risks for institutional investors. There is the risk that the demand for carbon credits will not scale up as projected – for example, if credible standards for the use of credits by companies and investors as part of their climate strategies cannot be established, or if demand from the aviation and shipping industries fails to materialise. Other risks include being seen to invest in low-quality credits as a result of the absence of fixed standards; liquidity risks; execution risks arising from the long time horizon of credits; and more generally, the reputational risk that stems from criticism of compensation and

neutralisation projects as an alibi for genuine emissions reduction or 'greenwashing'.

With all that said, private funding for quality compensation and neutralisation projects is urgently needed to achieve net zero. By one estimate, the world needs to close a \$ 4.1 trillion financing gap by 2050 if it is to meet its climate change, biodiversity and land restoration targets.⁹ VCMs are critical to raising and channeling this flow of funding. **We believe that institutional investors can help accelerate the development of VCMs in three key ways:** by investing directly and helping to scale up the supply of high-quality compensation and neutralisation projects such as Natural Climate Solutions (NCS); by supporting the establishment of high-integrity standards and governance for carbon credits, the absence of which is a critical hurdle in the development of VCMs; and most importantly, by guiding portfolio companies on their journey to net zero. Investors can help companies set decarbonisation targets; report annual progress against those targets; and use credits to help meet their unavoidable commitments, or – better – to set higher climate ambitions.

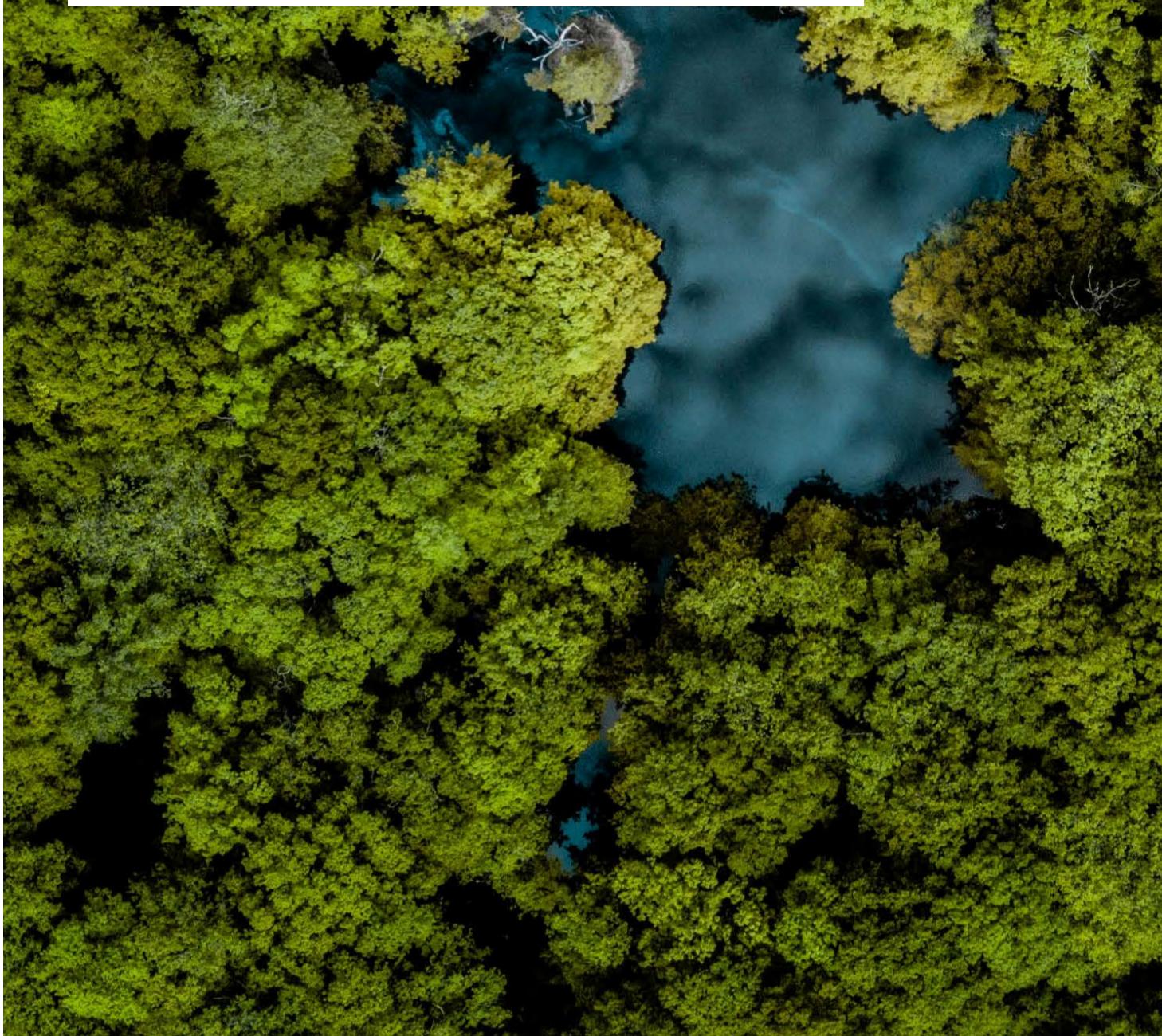
In setting out these actions, this paper highlights the critical role that institutional investors can and should play to help create viable carbon markets in support of decarbonisation. One in five of the world's 2,000 largest publicly listed companies have now committed to a net zero emissions target, along with countries responsible for 61 percent of global GHG emissions.¹⁰ These targets will not be achieved without robust and investable carbon markets, and such markets will not come into being unless institutional investors become actively involved.

⁹ State of Finance for Nature, United Nations Environment Programme, 27 May 2021, Authors: UNEP, WEF, ELD, Vivid Economics, <https://www.unep.org/resources/state-finance-nature>.

¹⁰ Taking Stock: A global assessment of net zero targets, Energy & Climate Intelligence Unit, 23 March 2021, Authors: Energy and Climate Intelligence Unit (ECIU) and Oxford Net Zero, <https://eciu.net/analysis/reports/2021/taking-stock-assessment-net-zero-targets>.

Introduction

The challenge and opportunity of carbon markets





As the world focuses on moving towards net zero carbon emissions, it is increasingly clear that active and liquid markets for carbon will be needed to help it get there.¹¹ Net zero by mid-century is the goal set by the 2015 Paris Agreement, with the aim of limiting the rise in global temperatures caused by the accumulation of greenhouse gases in the atmosphere to 1.5°C.¹² One in five of the world's 2,000 largest publicly listed companies have now committed to a net zero emissions target – along with countries responsible for 61 percent of global GHG emissions.¹³

Compliance and voluntary carbon markets are both needed to achieve net zero

These commitments are translating into corporate and national action plans to reduce emissions while also increasingly driving carbon market activity in two forms. First, governments' efforts to regulate emissions through cap-and-trade schemes have created growing CCMs, in which participants can trade carbon allowances. Second, there is a nascent but rapidly expanding VCM in which participants can buy carbon credits that channel funds into projects that reduce or remove carbon, thus compensating for, or neutralising, their own emissions. While the reduction of companies' own emissions is the priority, companies will likely need carbon credits to complement and accelerate such action.

In 2020, the total value of global carbon markets grew over 20 percent, marking a fourth consecutive year of record growth.¹⁴ The potential benefits of these markets in the context of the Paris Agreement's goals are clear. CCMs enable policymakers to control emission levels in a given territory and incentivise companies to reduce emissions, in effect by putting a price on carbon.

VCMs can potentially channel billions of dollars from companies committing to net zero to projects and technologies that can reduce or remove carbon, thus helping the world draw nearer to its goal.

Financial markets play a vital role in facilitating the global economy by allocating resources, creating liquidity for businesses and enabling risk management, for example through price hedging. They are able to do this because they are liquid and transparent in nature and perceived to be broadly representative of supply and demand in relevant asset classes. This is how financial trading has spread to new asset classes in recent decades – like commodity futures and options – enabling the allocation of investments and management of risk in activities like producing, trading and buying agricultural commodities.

Carbon markets could work in the same way, but with a focus on allocating resources away from emissions-intensive activities and towards emissions removal and reduction. But, in order to fulfil this function, they also need to be liquid, transparent and representative of a distinctive, investable asset class.

Investors play a critical role and can benefit from participating in carbon markets

In both compliance and voluntary carbon markets, investors and financial institutions play a vital role, in the sheer volume of capital that they can collect, allocate and deploy. They can connect supply and demand and help build liquidity and market depth: for example, in CCMs investors can trade carbon allowances within ETS to increase liquidity and bridge gaps in supply and demand.

¹¹ Net zero means the production of GHG emissions and the amount removed from the atmosphere are in balance. This can be achieved by reducing existing emissions and actively removing greenhouse gases from the atmosphere. These two different routes work in tandem.

¹² The Paris Agreement within the United Nations Framework Convention on Climate Change (UNFCCC) addresses climate-change mitigation, adaptation and finance, and was signed in 2016. The Agreement's long-term aim is to restrict the rise in the global average temperature to well below 2°C, preferably to 1.5°C, compared to pre-industrial levels.

¹³ Taking Stock: A global assessment of net zero targets, Energy & Climate Intelligence Unit, 23 March 2021, Authors: Energy and Climate Intelligence Unit (ECIU) and Oxford Net Zero, <https://eciu.net/analysis/reports/2021/taking-stock-assessment-net-zero-targets>.

¹⁴ Total market value of CCMs (four largest ETS) and VCMs is based on an assessment of the traded volume and carbon prices, Refinitiv, Review of Carbon Markets in 2020, January 2021.



In VCMs they can promote global decarbonisation efforts by investing in reduction or removal of carbon credits, either directly or through third-party funds. They can also exert significant influence on portfolio companies to prioritise decarbonisation and share best practices (see Exhibit 1).

Like other financial markets, carbon markets could reallocate resources – in this case away from emissions-intensive activities and towards emissions reduction

Fund will be used to purchase carbon credits.¹⁵

In practice, however, institutional investors' participation in carbon markets remains limited today, due to a number of structural reasons and a lack of visibility on underlying market dynamics. This report aims to provide insight on current and future carbon-market trends that will help investors determine how they can participate in and derive benefits from carbon markets, bearing in mind the diverse mandates under which they operate.

In recent years leading institutional investors and fund managers have begun to explore carbon markets. A prominent example is BlackRock's 2019 announcement that a portion of net revenues that are earned by its Liquid Environmentally Aware

¹⁵ The new environment for cash investing, BlackRock, March 2020, <https://www.blackrock.com/cash/literature/brochure/the-new-environment-for-cash-investing-leaf.pdf>.

In practice, participation by institutional investors in carbon markets remains limited today

We look separately at compliance and voluntary carbon markets, considering how investable they are today and developments that may make them more investable in future. We then consider

how carbon instruments could enhance investment portfolios and suggest ways in which investors could prepare to get involved. In discussing VCMs, we have built on the blueprint published by the TSVCM in January 2021 (see sidebar).¹⁶

¹⁶ The TSVCM is a private-sector-led initiative working to scale an effective and efficient VCM to help meet the goals of the Paris Agreement. It is sponsored by the Institute of International Finance (IIF) with knowledge support from McKinsey.

Sidebar

Overview of the Taskforce on Scaling Voluntary Carbon Markets

The TSVCM is a private-sector-led initiative working to establish effective and efficient VCMs to help meet the goals of the Paris Agreement.

An advisory board of 20 environmental NGOs, investor alliances, academics and international organisations provides guidance on TSVCM recommendations.

The TSVCM has over 250-member institutions which represent buyers and sellers of carbon credits, standard setters, the financial sector, market infrastructure providers, civil society, international organisations, and academics.

The TSVCM's unique contribution has been to bring all parts of the value chain to work intensively together and to provide recommended actions for the most pressing challenges facing VCMs.

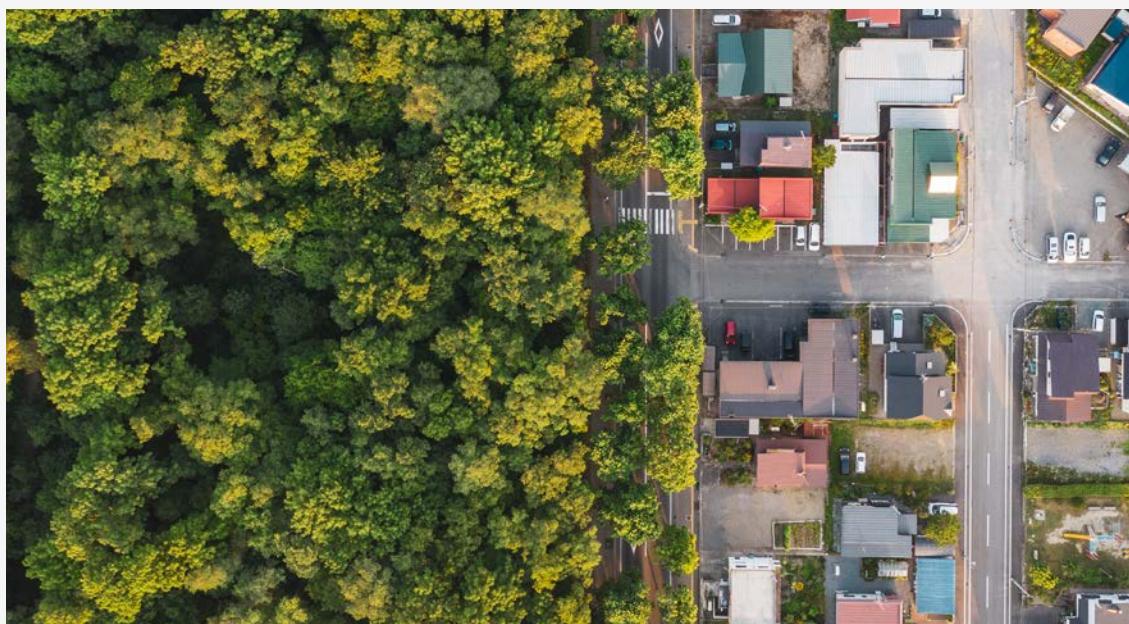
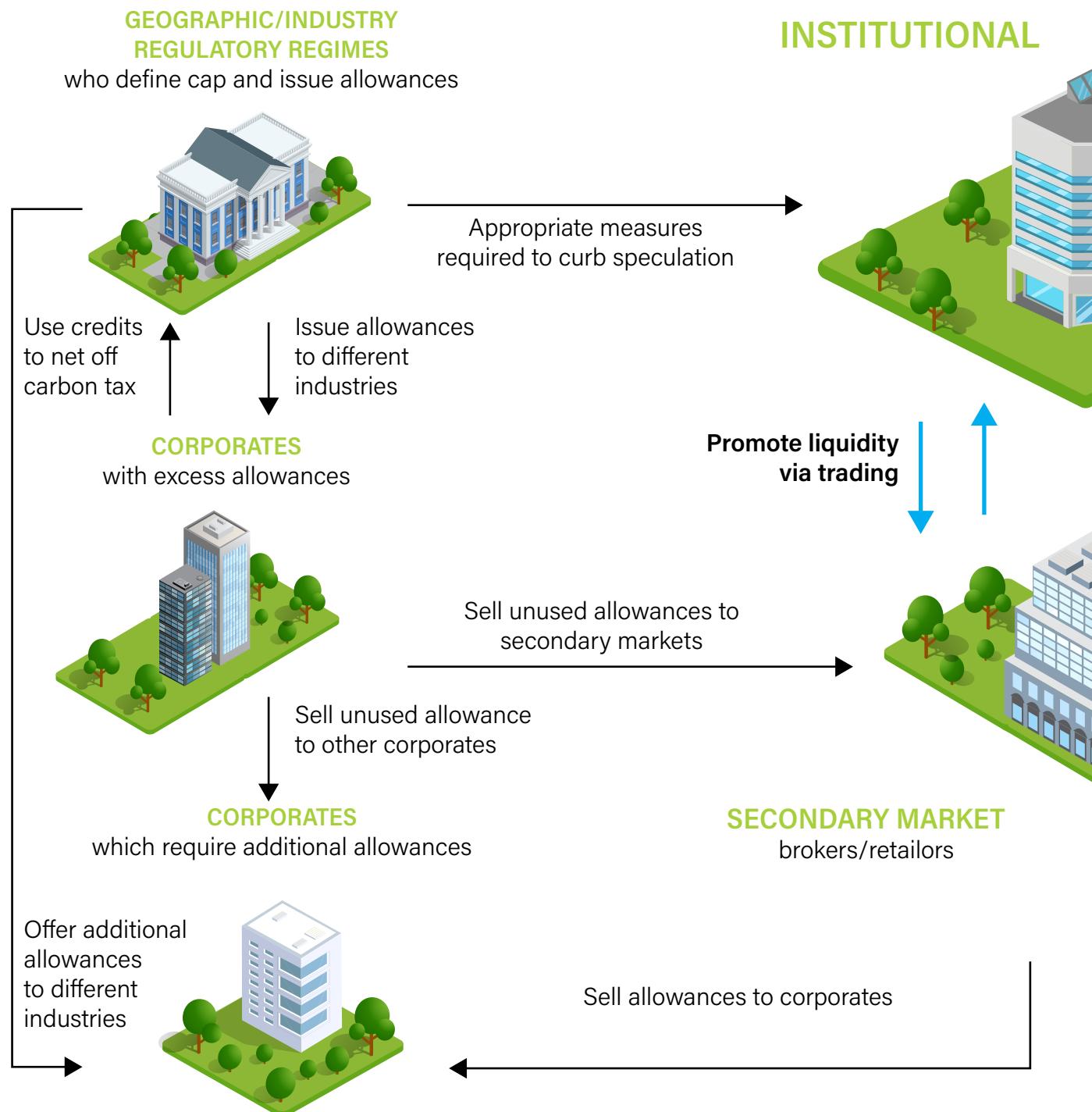


Exhibit 1: Institutional investors have a crucial and central role in carbon markets ...

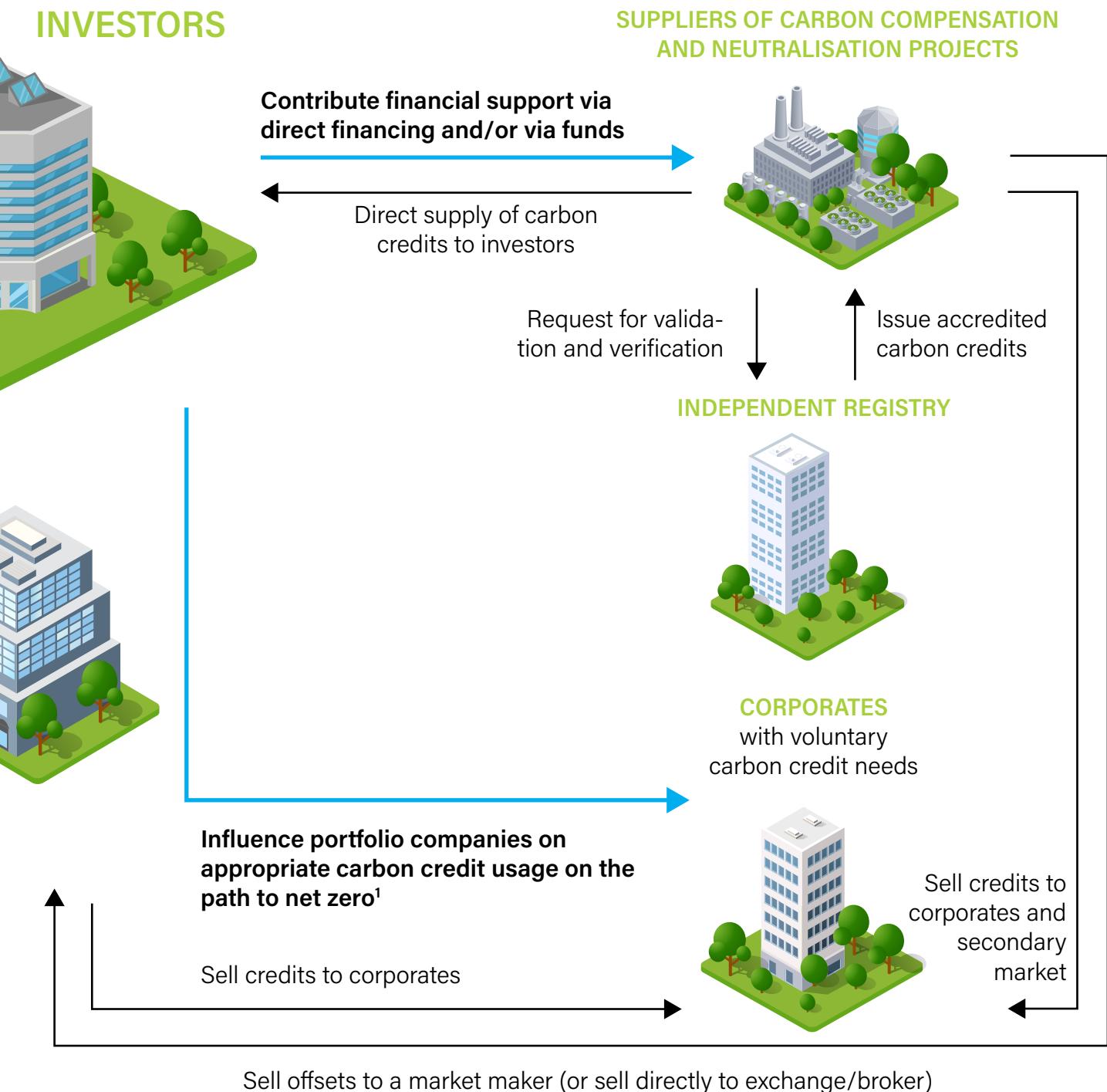
→ Flow of carbon allowances/offsets → Role of institutional investors in carbon markets

COMPLIANCE MARKETS KEY STAKEHOLDER



... primarily by creating market liquidity and providing project financing

VOLUNTARY MARKETS KEY STAKEHOLDERS

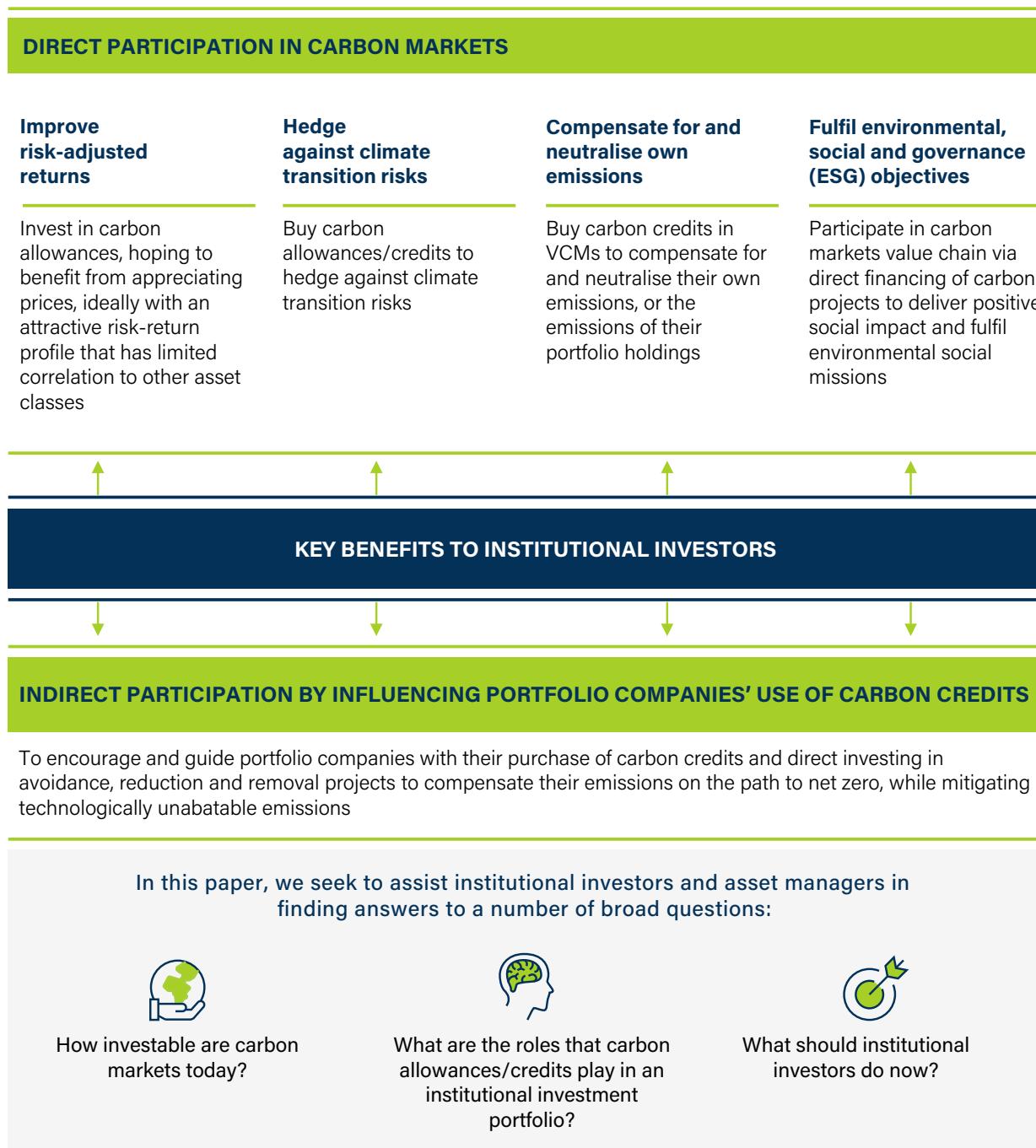


Carbon-market investments can serve diverse investor objectives

Investors, of course, have to follow various investment mandates, ranging from pure financial returns to those that consider other factors, like environmental, social and governance criteria. This report argues that carbon markets are potentially relevant to investors in an equally wide variety of ways depending on their specific mandate.

Exhibit 2 illustrates the range of objectives investors could hypothetically pursue by investing in carbon markets.

Exhibit 2: Institutional investors are now well positioned to pursue a range of financial and environmental objectives through carbon market mechanisms



First, they could act on their own behalf, for example, by buying carbon credits in VCMs to compensate for and neutralise their own emissions, or by funding carbon avoidance and removal projects in order to fulfil environmental, social and governance objectives. Second, investors could buy carbon allowances or credits as an investment, seeking a return from price appreciation. Third, investors could buy carbon allowances to hedge against climate-transition risk impacting the performance of other asset classes in their investment portfolio. Investors can also act indirectly by encouraging their investee companies to buy carbon credits in VCMs in order to compensate for their own emissions or to fund schemes to mitigate residual emissions.

Carbon markets are potentially relevant to investors in a wide variety of ways depending on their specific mandate

By increasing their involvement in carbon markets, investors can pursue their investment mandates as well as develop market mechanisms that help reduce emissions. Accordingly, investors should start thinking now about how carbon-market allowances and credits could fit into their overall investment strategy, and how to prepare to participate.

Sidebar

Moving from a niche market to a mainstream asset class

The recent history of international financial markets contains many examples of asset classes that have moved from being an esoteric market niche to a mainstay of institutional portfolios. In commodity markets, for example, futures and options contracts rapidly gained prominence from the 1970s onwards as a means of hedging volatile commodity prices, and ultimately became a mainstream asset class. The emergence of spot and futures markets in liquefied natural gas (LNG) is perhaps the latest example of a commodity market developing in this way.

In broader capital markets, the history of the credit default swaps (CDS) could hold valuable lessons for the potential evolution of carbon allowances and credits as an asset class. CDS grew rapidly in the decade from 2000, becoming popular as a means of hedging against bond or credit defaults,

before becoming notorious as one of the key areas of risk concentration in the 2008–2009 global financial crisis. This led to a tightening of regulations, standardisation of contracts and clearing houses for trading, all of which has helped to stabilise the market. Now CDS are widely recognised as useful portfolio management tools and an important part of financial markets.

Like CDS in the 1990s, carbon markets are at an early stage of development, but they could move rapidly from niche to mainstream if the right standards are established and policed.

Key questions for institutional investors

- Q1. How do carbon markets currently fit within your investment mandates?**

- Q2. How will you develop a strategy to integrate them into your operations?**



Chapter 1

Assessing the feasibility and attractiveness of carbon markets





For any investor examining an emerging asset class, investability (whether an investment is executable, feasible and/or attractive) is a principal consideration. Without feasible execution options, investors will find it impossible to develop a concrete investment strategy even if the potential asset meets the criteria of their investment mandate. In this chapter, we lay out five key criteria for assessing the investability of different carbon markets and consider how their investability may evolve in the future.

We find that while some CCMs are investable today, they remain a difficult proposition for institutional investors as they lack depth and their pricing has historically been erratic and highly susceptible to regulation changes, such as in quota allocations. VCMs, while relatively small and immature and not yet investable today at a scale required for institutional investors, have a significantly more fluid market mechanism. This can be attributed to carbon credit prices that are determined by voluntary supply and demand, and therefore considerably less susceptible to regulatory mandates and policy.

In both cases, the situation is changing rapidly. CCMs have stabilised and are becoming easier to understand, while governance and infrastructure are being developed to support rapid growth in VCMs. We therefore suggest investors prepare to get involved and keep a close watch for key market milestones that could increase the credibility and robustness of different carbon instruments as an asset class.

"Some compliance carbon markets are investable today, but they remain a difficult proposition for institutional investors"

Differences between compliance and voluntary carbon markets

As mentioned briefly in the introduction,

there are two main types of carbon markets: compliance and voluntary carbon markets.

CCMs such as the European Union Emissions Trading System (EU ETS) usually imposes a regulatory cap on emissions, typically by granting a limited allowance of emissions that a certain industry sector or company is permitted to emit. Beyond this, allowances for excess emissions need to be purchased on the market, while unused allowances can be sold.

VCMs work differently. Corporate emitters can voluntarily buy carbon offsets, certified by private standards, to compensate for or to neutralise their unabated emissions. Compensation works through the purchase of avoidance credits (for instance, protecting against deforestation) and removal credits (like helping emitters capture and permanently store emissions). Neutralisation is achieved when the amount of emissions emitted is equal to the amount of emissions removed, through purchase of removal credits. These removal credits, also known as negative emissions, can come from NCS (an example of this is reforestation) or via technology-based approaches (such as direct air capture and storage¹⁷).

The impetus within CCMs comes from regulation: historically, prices have been driven by governmental interventions and responses to economic crises. By contrast, VCMs are driven by corporates' net zero commitments, consumer demand for carbon-neutral products and investors' pressure on their investee companies to decarbonise operations and compensate for unabated emissions.

Although some compliance markets allow independent credits to offset compliance obligations (e.g., China and California allow the use of credits to meet up to 5 percent and 4 percent of the compliance market annual obligations respectively), it is important to recognise that compliance and voluntary carbon markets operate largely independently of one another.

¹⁷ Direct air capture is a technology designed to capture carbon dioxide from the atmosphere. The CO₂ can be permanently stored in deep geological formations or used in the production of fuels, chemicals, building materials, and other products containing CO₂.

(Exhibit 3). As such, we have assessed the two markets separately.

In this report, we have not included the international carbon market operating under the Clean Development Mechanism. This in principle allows the transfer of emission reductions between countries, but has suffered from insufficient demand and low prices in recent years. Depending on the outcome of negotiations on finalising Article 6 of the Paris Agreement, this mechanism could gain new impetus.

Criteria for assessing the investability of carbon markets as an institutional asset class

In order to understand the characteristics of individual carbon-market instruments, we have assessed the compliance and voluntary markets from the perspective of what matters most to institutional investors – whether carbon credits and allowances qualify as an asset-class in the context of their long-term investment strategy. Our analysis covers five criteria that are commonly critical for investors, across a variety of mandates, in appraising common and mature classes of investments. In order of importance to investors, these

Exhibit 3: Market mechanisms are fundamentally different for both markets, requiring a different lens to explore each market

Key characteristics



Compliance markets (CCMs)

Credits obtained by regulated entities in order to meet predetermined regulatory targets	Relatively high liquidity with direct relationship with volatile power, gas and coal prices	Large market value (e.g. ~\$260bn in 2020 with ~\$30bn from Europe and ~\$25bn from North America)	Highly regulated, with robust monitoring, reporting and clear quality verification standards
Credits are mainly available under cap-and-trade schemes from both primary and secondary markets			

Voluntary carbon markets (VCMs)

Credits voluntarily purchased by companies and individuals (purchased funds are used for project development)	Low liquidity with limited trading potential in secondary markets where most buyers surrender and use the credit	Limited market value in current status with strong growth potential (i.e. ~\$300m in 2020, est. ~15x growth potential to reach \$5bn-\$180bn by 2030 depending on scenarios materialising) ¹	Fragmented and complex market with low to no regulation, different accounting methodologies with varying degrees of rigor and a variety of industry-created standards
Credits are mainly available from private project developers and OTC brokers			

Compliance and voluntary carbon markets operate largely independently with limited overlaps existing within and across markets (eg certain compliance markets allow the use of a small % of voluntary credits to meet compliance targets)

1. Voluntary carbon market sizing forecast based on scenarios. Base case illustrated based on prioritisation of low-cost supply (\$5bn-\$40bn). Higher scenarios on investment in technology-based solutions and preference for local supply estimated market value ranging from \$25bn-\$180bn. Market size in 2030 will ultimately depend on demand signals and buyer preferences.

Source: CFA report; expert interviews; Refinitiv, Carbon Markets Year in Review 2020.

are: accessibility; market size; liquidity; standardisation of transactions; and the existence of a rational or explainable basis for price movements, which we call price explainability (Exhibit 4).¹⁸

In making this appraisal, we recognise that some established and popular investment classes may not tick all these boxes. But with carbon markets, we are principally

interested in the combined effect of these criteria in enabling establishment of a transparent, common and convergent price across markets. In assessing investability, we also take into account other risk factors such as legal definitions of carbon allowances and regulations in relation to financial instruments, which may raise red flags for institutional investors.

¹⁸ Note: we assess the attractiveness of carbon markets (such as their risk-return profile) in the following section and focus on its executional feasibility, which is investability, in this section.

Exhibit 4: Assessing investment feasibility and attractiveness of investing in carbon markets for institutional investors

5 criteria to assess the feasibility and attractiveness of carbon markets instruments as a new asset class	1 High accessibility Can institutional investors have access to markets? (e.g. matured secondary markets such as public exchange)	2 Sufficient market size Is the market large enough (or will it become so) for institutional investors to allocate sufficient share of capital?	3 Sufficient liquidity Does the market have enough liquidity which allows for portfolio rebalancing with sufficient frequency?	4 Sufficient standardisation Is there sufficient standardisation of asset valuation that is replicable and scalable for institutional investors?	5 High price explainability Can institutional investors understand the source of price fluctuation or is it random (e.g. driven by speculation)?
5 criteria for investment (in order of priority) for institutional investors	5 investability criteria: quantitative and qualitative thresholds are defined against individual criteria in reference to other edge asset classes	Secondary market is: <ul style="list-style-type: none">▪ Sufficient: publicly tradable with replicable transaction processes▪ Investable: available with non-standardised transaction processes▪ Not investable: not available for institutional investors	Market cap ¹ is: <ul style="list-style-type: none">▪ More investable: \$50bn▪ Less investable: <\$50bn²	Annual trading volume as % of total market cap is: <ul style="list-style-type: none">▪ Sufficient: >100%▪ Investable: 10–100%▪ Not investable: <10%³	Asset valuation is: <ul style="list-style-type: none">▪ Sufficient: uniform valuation methodologies for all assets▪ Investable: assets can be categorised by several valuation methodologies▪ Not investable: each asset requires individual evaluation Drivers to explain historical returns are: <ul style="list-style-type: none">▪ Sufficient: available and can be used for future perspectives▪ Investable: available yet cannot easily be used for future perspectives▪ Not investable: not identifiable nor relevant for future trends

This framework is developed for large institutional investors to consider the readiness of large investment portfolio inclusion of carbon assets from CCM and VCM markets. These criteria does not necessary determine the feasibility of investment for corporates who would like to purchase carbon credits to fulfill their net zero ambition.

1. Defined based on market cap of ETS (2020) x carbon price (2021).
2. Assuming global top 20 institutional investors deploying 0.5% of portfolio to carbon markets every year to reach 2.5% of total portfolio allocation in 5 years.
3. 10% set based on global private market in-year fundraising as share of assets under management in 2020.

Please refer to Appendix for detailed quantitative and qualitative thresholds of individual criteria.

Source: Thinking Ahead Institute; Willis Towers Watson; McKinsey's analysis; McKinsey's Private Markets Annual Review 2021.

Compliance carbon markets: investable in some markets for institutional investors

CCMs are the more mature of the two categories, with a market value of approximately \$ 100 billion and an annual trading turnover of over \$ 250 billion.¹⁹ By way of comparison, this last figure is equivalent to 20 percent of the value of global oil consumption, and twice the value of the global market for LNG.²⁰ As such these markets are investable today, but insufficient market depth limits their potential for broad-based institutional investor participation. There are currently 24 ETS in force around the world, with eight more scheduled to come into operation and another 14 being considered.²¹ Notably, China launched its first ETS in 2021.²²

In terms of accessibility (the most important criterion), most regional ETS allowances are already available under cap-and-trade schemes on publicly tradable exchanges.²³ Investors can participate in an auction or by buying physical certificates or futures contracts in secondary markets. For the other criteria, the EU ETS offers investable size (over \$ 230 billion in trading value in 2020), liquidity (annual trading volume at three to four times the market value) and sufficient product standardisation with uniform valuation methodologies for all assets.

From the perspective of institutional investors, CCMs lack sufficient depth. In 2020, discretionary assets under management of the world's 100 largest institutional investors totalled \$ 19 trillion.²⁴ If every top investor were to invest just 1 percent of their portfolio in carbon allowances, that would amount to some

\$ 190 billion – nearly double the current total of CCM market value.

It remains unclear whether institutional investors will be allowed unrestricted access to these markets as they develop. Discussions are underway in relation to several ETS, for example, on whether to impose constraints on the banking of allowances in order to minimise speculative trading and stabilise markets. This would limit institutional investors' room to manoeuvre. Investors therefore need to pursue a balanced approach, participating in carbon markets to boost liquidity and ensure that they can fulfil their function of driving emissions reduction, rather than a strategy based purely on financial returns. For now, the important point is that CCMs are growing, both in number and maturity. China, having pledged to reach carbon neutrality by 2060, has launched an ETS that covers about four billion tonnes of CO₂ per year, or 40 percent of its national carbon emissions. Germany is phasing in a new national system covering upstream transport and heating emissions. Vietnam, Indonesia and Mexico are among other countries working on ETS pilot projects.

Moreover, existing markets (the European Union, the United States, South Korea and New Zealand) are likely to grow further as prices increase in expectation of a tightening of emission caps, and as secondary market liquidity develops on the back of improved market infrastructure, price transparency and quality standards. They already display significantly higher trading velocity than VCMs.²⁵

¹⁹ Value of carbon allowances in four largest ETS, multiplied by the average carbon price in 2020.

²⁰ The U.S. Energy Information Administration (EIA) estimates that the world consumed 92.2 million barrels per day (b/d) of petroleum and other liquid fuels in 2020 (<https://www.eia.gov/todayinenergy/detail.php?id=46596>) Average closing price of oil per barrel is \$ 39.68 (WTI Crude Oil Prices - 10 Year Daily Chart | MacroTrends, <https://www.macrotrends.net>) Estimated total value of annual oil consumption worldwide is \$ 1.3 trillion. LNG market value: The global planned LNG market was valued at \$ 102.2 billion in 2019, and is projected to grow at a CAGR of 9.9 percent from 2020 to 2030; <https://www.alliedmarketresearch.com/planned-lng-market>.

²¹ <https://icapcarbonaction.com/en/icap-status-report-2021>.

²² <https://icapcarbonaction.com/en/ets-map>.

²³ Cap and trade: cap denotes an overall GHG emissions limit within a country, region or scheme; the regulatory authorities generally reduce the overall number of emissions allowances each year to steadily reduce the cap, making the allowances more expensive. Trade refers to the facility to buy and sell emissions allowances to meet that capped level.

²⁴ Thinking Ahead Institute, The Thinking Ahead Institute's Asset Owner 100, <https://www.thinkingaheadinstitute.org/research-papers/the-thinking-ahead-institutes-asset-owner-100/>.

²⁵ Actual tradable market value (such as the float) can be significantly lower given that the primary use of carbon allowances is for compliance entities to meet their own emission cap.

Compliance markets are growing, both in number and maturity, with China introducing an emissions trading system expected to cover about 40 percent of national emissions

One key difficulty is that it remains a challenge to explain future price trends in CCMs given that prices are highly responsive to regulations. Historically, prices have been driven by governmental interventions and responses to economic crises; hence, they provide limited grounds for future price forecasts. This has made it tricky for institutional investors to invest in the EU ETS.

The history of the EU ETS over the past ten years illustrates the point. At the beginning of the previous decade, the market saw low prices caused by the lasting impact of the 2009 recession: emissions fell, international credits enabled a high level of compliance and there was a surplus of supply over demand for allowances. The resulting weakness of the price signal transmitted by the market then prompted EU authorities to consider structural reforms.

From 2014 to 2016, 900 metric tonnes of CO₂ equivalent of allowances were removed from the market; in addition, a Market Stability Reserve was announced to provide long-term price stability. In 2018, the EU Allowance (EUA) experienced a four-fold price spike above its average level between 2013 and 2017.²⁶ Introduction of the Market Stability Reserve in 2019 resulted in the withdrawal of 397 million allowances equivalent to 24 percent of EUAs in circulation at that time. Further

withdrawals are expected until at least 2023, and this has contributed to further price increases and attracted speculators and non-compliance investors to the market. As a result, annualised volatility for the EU ETS since 2016 has stood at approximately 50 percent, which has made it challenging for investors to develop future perspectives on prices.

In contrast, the California ETS has enjoyed a more stable risk-return profile (approximately 7 percent annualised returns and 10 percent annualised volatility²⁷ since 2016) thanks to the introduction of auction price-floor mechanisms (which increase the auction price at a steady rate) – and this looks set to continue.²⁸ However, the California market alone is not large enough (\$ 6 billion in 2021) for investors to deploy meaningful amounts of capital.

Future evolution will depend on establishing a clear and stable framework for price signals.

The evolution of CCMs is driven by three factors: government policy aimed at increasing carbon prices, market structure featuring a steady reduction of carbon supply each year and increasing public awareness. How rapidly CCMs progress towards full investability will largely depend on governmental interventions to create a stable framework for the transmission of price signals. Both the EU ETS and the California ETS offer some important pointers in that regard.

After extensive reforms (including the previously mentioned Market Stability Reserve), the EU ETS has shown consistent price increases in recent years (Exhibit 5). Since 2020, and for the next ten years, the scheme mandates faster emission reductions with larger volumes

²⁶ The EUA is the tradable unit under the EU ETS that gives the right to emit one tonne of CO₂, or the equivalent amount of two other greenhouse gases, nitrous oxide (N₂O) and perfluorocarbons (PFCs).

²⁷ This is based on monthly ICAP price volatility; at daily level, annualised volatility is higher at 20 percent due to negative daily auto correlation.

²⁸ The California Air Resources Board (CARB) established the California ETS, which entered into force in 2013. The California Carbon Allowance (CCA) accounts for approximately 85 percent of the state's GHG emissions, covering power generation, energy-intensive industries and fuel distribution businesses. The CCA is based on a cap-and-trade concept where the total limit on covered GHG emissions are set on the regulated industries. The cap is reduced over time and rising CCA prices help to equalise the marginal cost of emissions reduction for all covered entities.

of allowances auctioned and no voluntary credits allowed. Additionally, the EU Green Deal will likely promote future price visibility to encourage compliance entities to invest in the transition. Given this context, the ETS price is expected to grow at a fairly steady rate over the next three to five years, with further growth acceleration to reach € 48 to 80 per metric tonne by 2030, based on the latest price forecasts from some analysts.^{29,30} Although this price outlook will improve investability in the EU ETS, investors will need to closely follow region-specific regulatory drivers and form views on future-price changes (for example, with regard to revision of the EU ETS for Phase IV (2021 to 2030) and the EU Green Deal). ETS markets

are essentially synthetic with different counteracting regulatory trends that could make EUA prices volatile and hard to predict (despite a general consensus that prices will increase).

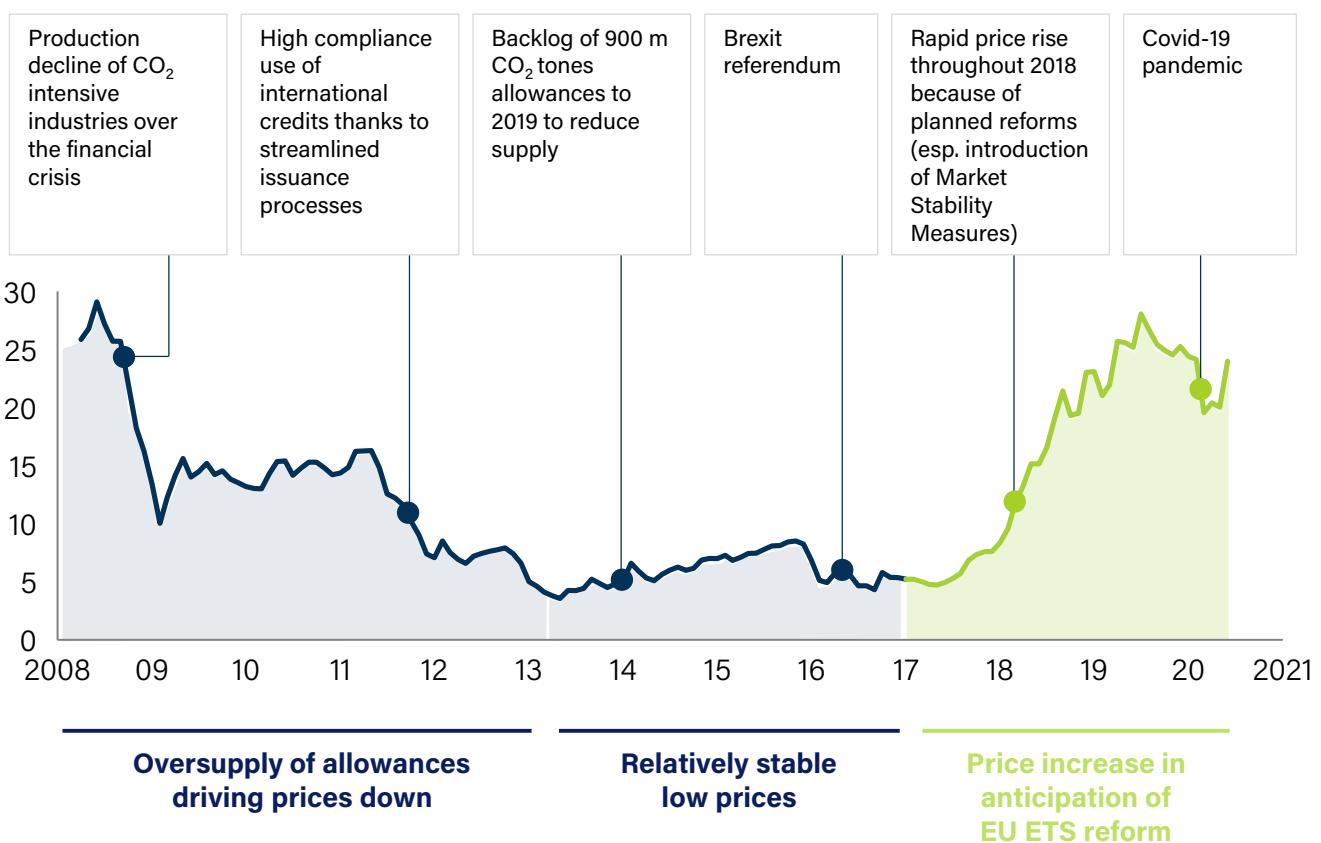
Market stabilisation has also been an important objective for the California ETS. This market is unique in that it uses an auction reserve price that increases annually by 5 percent plus inflation to ensure that the market does not become oversupplied. This has contributed to stable price growth of the California ETS in the past. In recent years, the system has been reinforced with the introduction of a price ceiling which prevents the

²⁹ S&P Platts Analytics forecasts prices are expected to rise over the long-term to € 48 per mt by 2030 due to tighter post-2020 EUA supply as well as the ongoing operation of the Market Stability Reserve, <https://www.spglobal.com/platts/en/market-insights/latest-news/coal/020421-eu-carbon-price-surge-justified-by-fundamentals-seb-bank>.

³⁰ ICIS forecast EUA prices are expected to hit the € 80 per tonne CO₂ equivalent level towards 2030, <https://www.icis.com/explore/resources/news/2021/02/16/10606727/early-eu-carbon-price-cap-change-to-have-biggest-price-impact-icis-analysts>.

Exhibit 5: After extensive reforms, the EU ETS has shown stable price increases in past years

Price development of EU ETS allowances, € per tonne monthly average



Source: Intercontinental Exchange; press search

price per tonne of CO₂ emissions from rising without limit, the inclusion of two allowance-price-containment reserve tiers below the price ceiling, and reductions in the use of voluntary credits (especially for credits generated from projects that do not provide direct environmental benefits in the state). These measures are key to market stability and should lead to reasonably steady price growth to 2030, climbing to over \$ 30 per tonne of CO₂ from around \$ 15-20 per tonne of CO₂ in 2021 (assuming 5 percent regulated auction floor price increase plus 2 percent inflation).

An important area of uncertainty is that regulators could introduce complementary climate policies that could negatively impact the price of carbon allowances. Governments have a range of policy tools to accelerate the transition to a low carbon economy, such as introducing a carbon tax, or tightening emissions standards such as in transport or power generation sectors. Such measures would potentially decrease the demand for carbon allowances and limit carbon price appreciation.

Exhibit 6 compares the investability of the EU and California ETS.

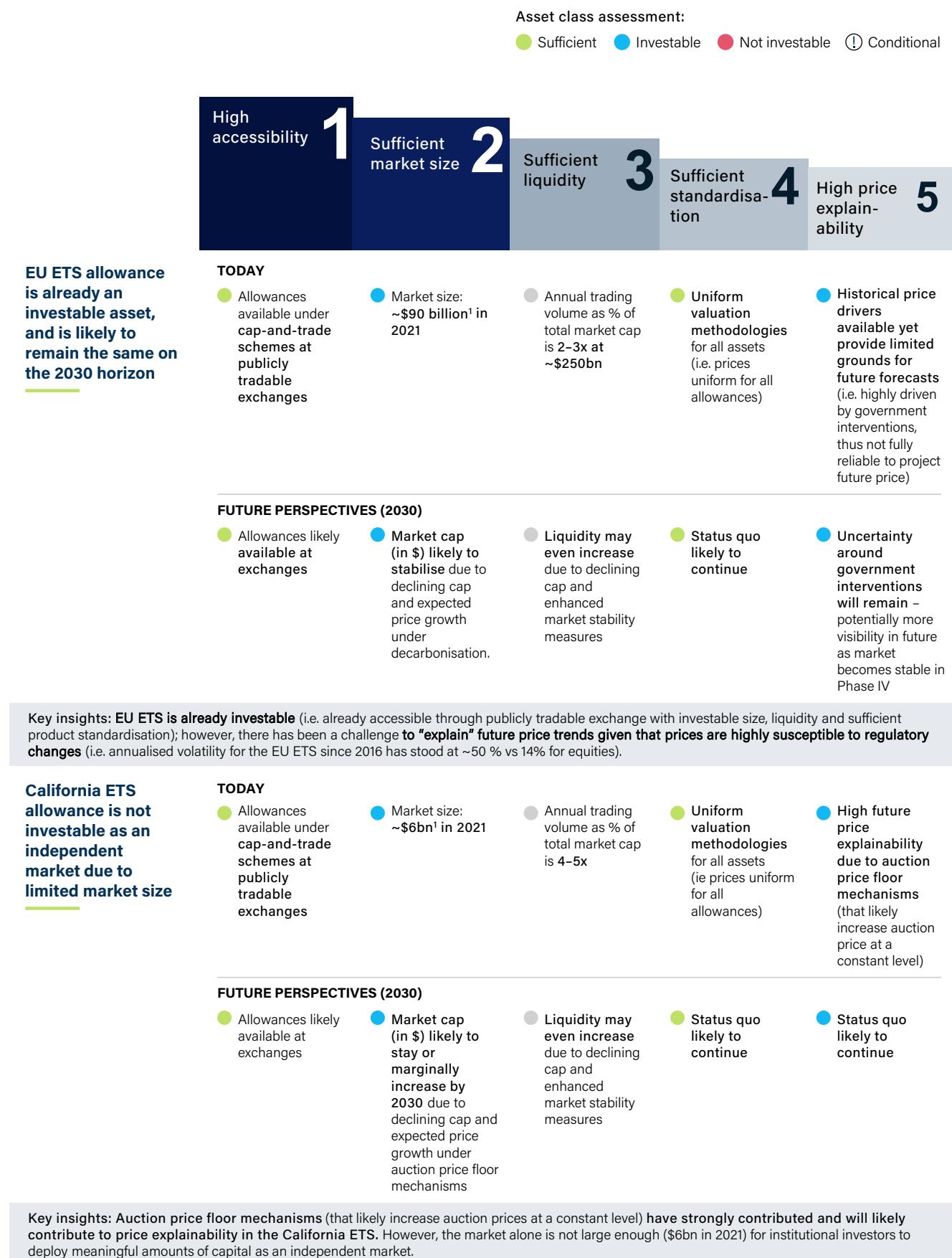
Conclusion: Compliance markets have stabilised but remain susceptible to regulatory change

The analysis above shows that CCMs have been stabilised through governmental interventions. Based on historical trends, we also conclude that they remain highly susceptible to regulatory changes and that, as a result, investors are likely to remain cautious about them despite signs of price growth. Nevertheless, we suggest investors should be on the lookout for opportunities and regularly evaluate key changes in the markets – for example, measures to increase price stability. In this regard, we have observed a gradual convergence of regional markets over time. California ETS had auction reserve prices and cost-containment reserves from 2013. The US Regional Greenhouse

Gas Initiative (RGGI) initially had a floor price (from 2008) but also adopted a cost-containment reserve in 2014. New Zealand initially had a price ceiling, but has replaced this with an auction reserve price (starting in 2020) and a cost-containment reserve (starting in 2021).

We should note that the varying characteristics among regional carbon markets mean that best practices in some regions may not always be applicable to others due to different economic contexts or regulations. Depending on how these events play out, carbon allowances may become a more investable asset class for investors.

Exhibit 6: CCM deep-dive – investability assessment of EU ETS vs California ETS under 5 criteria



1. Defined based on market cap of ETS (2020) x carbon price (2021).

Voluntary carbon markets: not viable today but could become investable in future

It is our assessment that investors would find it difficult to execute their investment strategy in VCMs, rendering them not investable at this point. VCMs are barely accessible through secondary markets with varying qualities and standards and heavy reliance on over-the-counter transactions. In terms of size, they are currently tiny: some \$ 300 million in 2020, roughly split between the \$ 250 million avoidance market and the \$ 50 million removal market. At the same time, there is low liquidity and price explainability. Prices have historically largely been determined via non-standardised processes between project developers and brokers.

This means that carbon credits are neither commoditised nor fungible today. Obstacles to commoditisation include the fact that many corporates have bespoke requirements for credits, such as their vintage, origin, type and co-benefits. Consequently, most institutional investors have adopted a wait-and-see attitude to VCMs. However, this position could change rapidly if large-scale changes being advocated by groups like the TSVCM come to pass.

If such changes lead to greater liquidity and commoditisation, they could quickly make VCMs investable, and their growth could outpace that of CCMs to bring them to a similar total market value as soon as 2030. VCMs are also primarily dictated by voluntary supply and demand. As a result, they have lower exposure to regulatory risks, compared with CCMs. Accordingly, investors need to develop their understanding of the underlying growth drivers and market milestones for VCMs, in order to be ready to participate at the appropriate time. As with CCMs, we suggest that investors focus on five principal criteria: **accessibility, sufficient market size, sufficient liquidity, standardised transactions and high price explainability.**

Most institutional investors have adopted a wait-and-see attitude to voluntary carbon markets. However, this position could change quite rapidly

Accessibility

VCMs are currently difficult for institutional investors to access owing to a lack of consistent or agreed upon standards as well as the absence of standardised contracts and market infrastructure. Investors will need to follow the evolution of these components in detail, placing particular emphasis on the activities of the TSVCM in establishing the attributes and governance of a functioning global market.

Sufficient market size

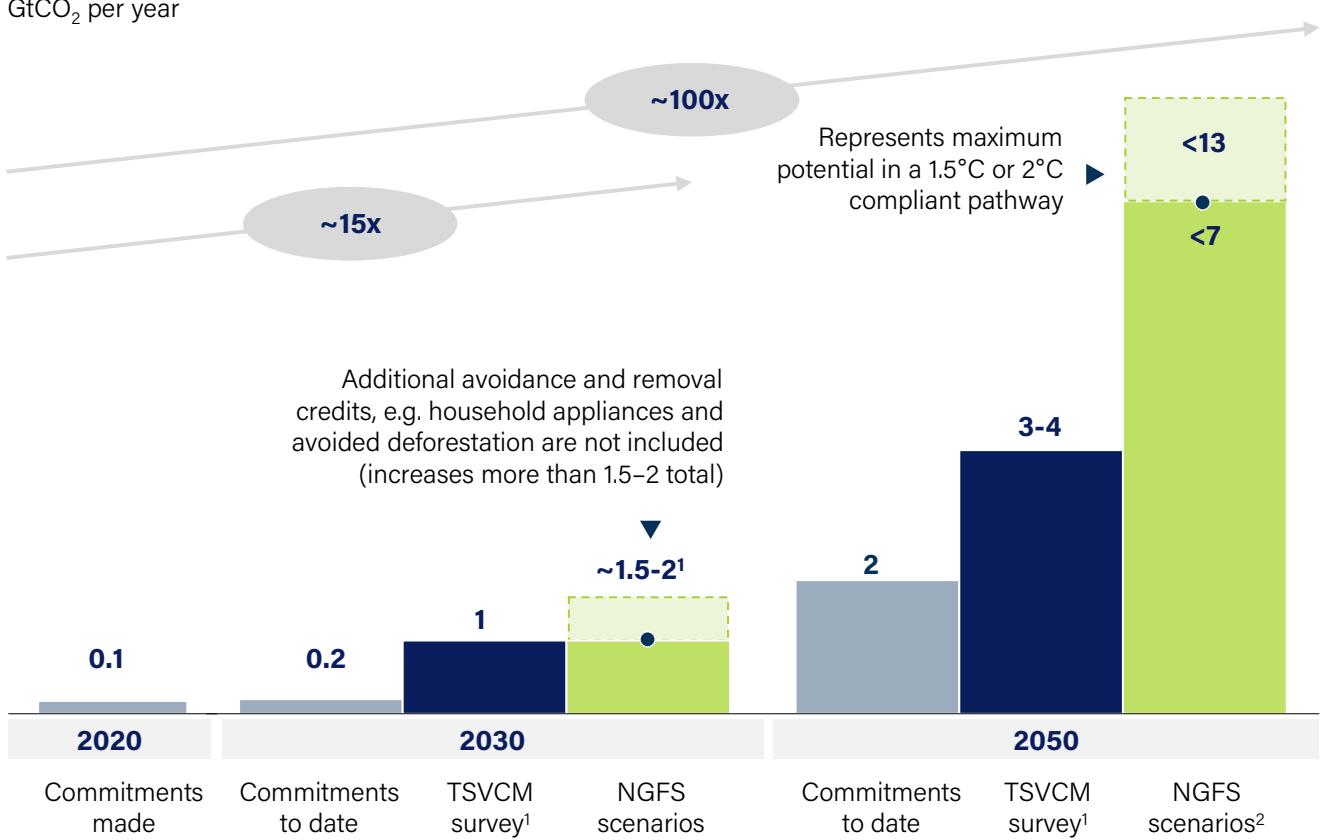
VCM demand could grow approximately 15-fold to 1.5 to 2 gigatonnes of CO₂ per year by 2030, and approximately 100-fold to 7 to 13 gigatonnes of CO₂ per year by 2050 (Exhibit 7). Key volume growth drivers include the supply of both technology-based solutions and NCS, together with the overall level of commitment of companies to net zero – corporate net zero pledges have doubled in less than a year since late 2019.

The key driver of price growth is buyer preferences for different types of projects. If demand for high-cost supply increases (that is, preference for technology-based solutions or local supply), the average price and total market size will also increase. We have tested five different scenarios that range from \$ 5 to 15 per tonne of CO₂ (prioritisation of low costs) to \$ 50 to 90 per tonne of CO₂ (preference for local supply) in 2030. Respectively, this translates to a market size of \$ 5 billion to 30 billion and \$ 50 billion to 180 billion in 2030 when assuming 1 to 2 gigatonnes of CO₂ demand.

Exhibit 7: VCM market sizing – demand for voluntary credits could grow to ~15x by 2030 and 100x by 2050

The TSVCM survey projects 1 Gt in 2030 and 3–4 Gt in 2050

Voluntary demand scenarios in 2030 and 2050, GtCO₂ per year



Key insights for institutional investors

- Demand volume is not the only key driver of VCM prices
- The nature of demand is also critical to assess market dynamics (e.g. demand for high-quality credit is expected to increase, hence driving up prices of certain high-quality credits, while others will probably remain unused)
- As such, it is important to assess high-quality credit issuance to derive a more holistic view on market trends

1. Projected credits demand envisioned by subject matter experts within the TSVCM.

2. This is an upper bound in 2050 as it assumes that all removal/sequestration is supported by voluntary credits.

Source: McKinsey analysis; NGFS.

Sufficient liquidity

Liquidity could be created through greater clarity on corporate claims. However, buyers need more clarity on the definition of what the path to net zero means for corporates, and on the legitimate use of compensation or neutralisation credits for corporates. Corporates can refer to the TSVCM's statement on the high ambition path to net zero for such guidance (see sidebar).³¹ This would provide higher conviction on market growth (for example, on liquidity and size). Most recent market developments (like the Carbon Pricing Leadership Coalition report on the task force on net zero goals and carbon pricing³², the SBTi net zero³³ consultation, Voluntary Carbon Markets Integrity Initiative³⁴, and regional initiatives such as the Sustainable Market Initiative's Financial Services Taskforce³⁵) point toward the need for compensation and neutralisation measures on the path to net zero. TSVCM's statement on the high ambition path to net zero is increasingly becoming a reality and hence will further accelerate VCM market development. It is thus important for institutional investors to monitor VCM closely in the near term as markets scale rapidly, such as ongoing negotiations around the Paris Agreement's Article 6 and other efforts to create standards for corporate claims (like SBTi and ISO).^{36,37}

Standardised transactions

As the TSVCM argued, a liquid market requires standardised transactions with strengthened quality assurance and data transparency. While several standards-setters have implemented safeguards to address these issues, stakeholders

remain sceptical, and buyers are demanding greater transparency and a further strengthening of impact and quality assurance for carbon projects. To unlock market participation at scale by institutional investors, there is a need for a globally acknowledged high integrity and quality standard across key methodology types. This standard will have a significant impact on price explainability and valuation, and help create a more commoditised VCM.

One key ongoing initiative is the Global Emissions Offset futures (GEO) contract, a physically settled contract that allows for delivery of CORSIA-eligible voluntary carbon credits from three registries: Verra's Verified Carbon Standard (VCS), the American Carbon Registry (ACR) and the Climate Action Reserve (CAR). Deliveries will be facilitated through CBL Markets, a global leader in spot energy and environmental markets. This initiative aims to standardise credit quality across multiple standards.

Greater price explainability

For VCMs to become viable for institutional investors, they need to develop transparent and readily understandable pricing mechanisms and supporting market infrastructure. Today, credits are mainly traded over the counter, resulting in limited transparency on market data (transaction volumes and price levels) and a paucity of reference data, which has been a key barrier to market growth in the past. Standardised, tradable products and contracts through transparent market

³¹ Calling for a High Ambition Path to Net-Zero, The Institute of International Finance, 8 July 2021, Authors: LSE, UN-convened Net Zero Asset Owner Alliance, UN Special Envoy for Climate Action and Finance, Standard Chartered, Davis Polk and the Institute of International Finance, https://www.iif.com/Portals/1/Files/High_Ambition_Path_to_Net_Zero.pdf.

³² Carbon Pricing Leadership Coalition, Report on The Task Force on Net Zero Goals and Carbon Pricing, 22 September 2021, <https://www.carbonpricingleadership.org/news1/2021/9/22/netzero-report>.

³³ SBTi Foundations for Net-Zero Target-Setting in the Corporate Sector, September 2021, <https://sciencebasedtargets.org/net-zero>.

³⁴ Voluntary Carbon Markets Integrity Initiative, launched virtually on July 29, 2021, which focuses on developing high integrity guidance for buyers of carbon credits and claims that they can make, <https://vcminegrity.org/>.

³⁵ Sustainable Market Initiative – Financial Services Taskforce, executives from a number of the world's largest banks have come together as members of the Sustainable Markets Initiative's (SMI) Financial Services Taskforce (FSTF) to work on meaningful and actionable plans to help accelerate the world's transition to a sustainable future, <https://www.sustainable-markets.org/taskforces/financial-services-taskforce/>.

³⁶ The SBTi is a partnership between CDP Worldwide (a non-profit that runs the global disclosure system for investors, companies, cities, states and regions to manage their environmental impacts), the United Nations Global Compact (a voluntary initiative encouraging organisations to implement universal sustainability policies), global research non-profit the World Resources Institute (WRI), and environmental NGO the World Wide Fund for Nature (WWF).

³⁷ The International Organization for Standardization (ISO) is an independent, non-governmental international organisation with a membership of 165 national standards bodies that develops voluntary, consensus-based, market-relevant international standards, including carbon standards.

infrastructure (such as exchanges) could help increase liquidity, scale up transactions and ease market entry for institutional investors – provided that the quality of credits traded and integrity of

market participants are ensured. Exhibit 8 compares the investability of avoidance/reduction credits and the removal/sequestration credits.

Sidebar

Calling for a High Ambition Path to Net Zero

This public statement, signed by members of the TSVCM, calls for high ambition companies to go above and beyond plans that regard net zero only as an end point. The statement encourages companies to compensate (avoid and reduce) and neutralise (remove) their emissions “on the path to net zero”, on top of decarbonising their own operations and value chains in line with scientific consensus.

To enable this higher level of corporate commitment, and to prevent “greenwashing”, a high integrity market for carbon credits is needed, with clear

differentiation between neutralisation (removal credits) and compensation (avoidance/reduction credits). The taskforce also underscores that the only carbon credits that have a role to play in mitigating climate change – be that through the removal, avoidance or reduction of emissions – are those of high quality. For instance, they need to be “additional” (i.e., have measurable emissions reduction impact that would not have occurred in the absence of carbon credits), and there should be recognition of benefits for local economies and communities.

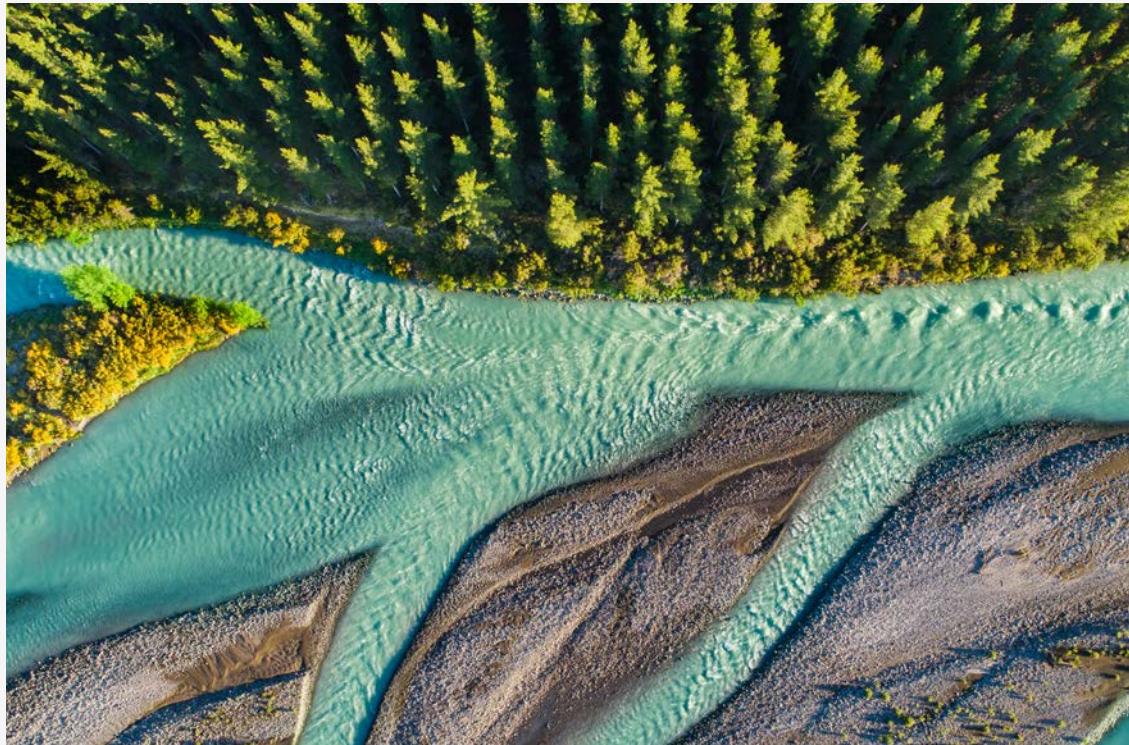


Exhibit 8: VCM deep-dive – investability assessment of compensation (avoidance and reduction) credits vs neutralisation (removal/sequestration) credits under the 5 criteria

Asset class assessment:
● Sufficient ● Investable ● Not investable ● Conditional

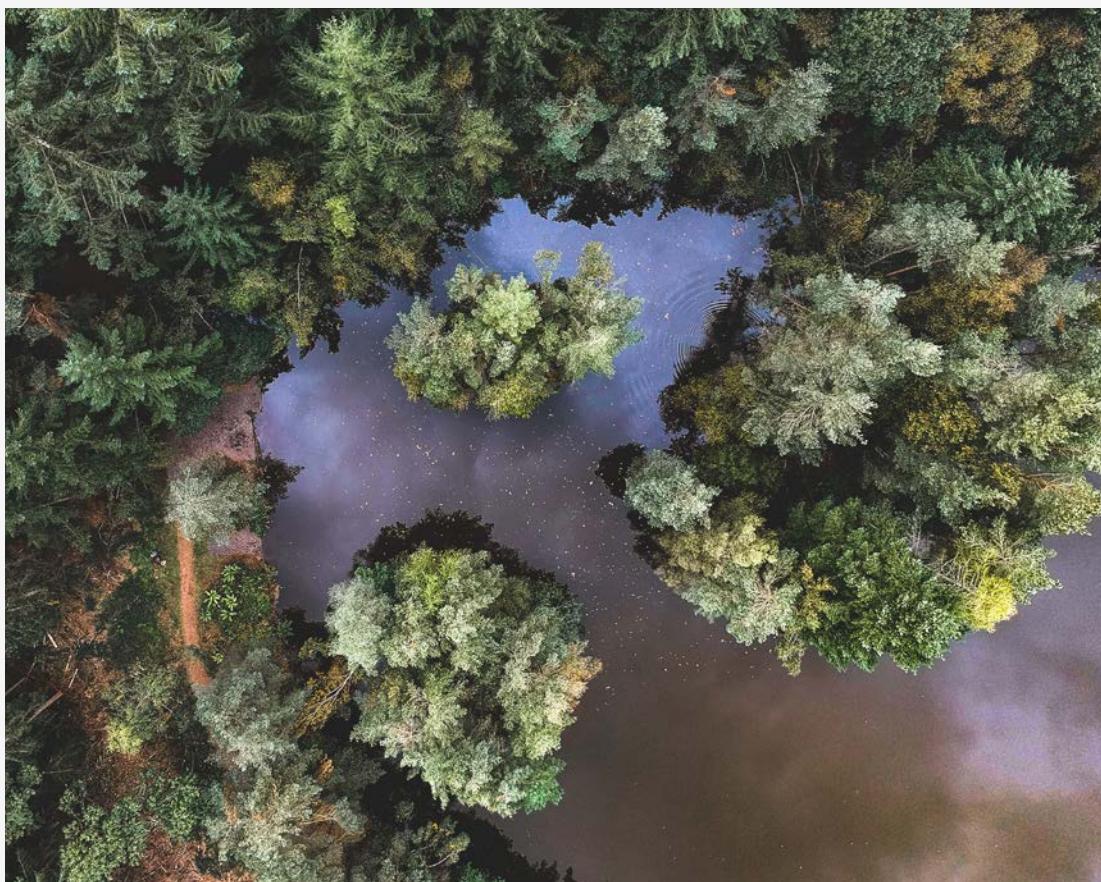
High accessibility 1					Sufficient market size 2	Sufficient liquidity 3	Sufficient standardisa- 4	High price explain-ability 5
Compensation (avoidance and reduction) credits are not investable at a scale required for institutional investors as of today, yet may become investable on the 2030 horizon	TODAY							
	<ul style="list-style-type: none"> ● Credits available from secondary markets; varying degrees of quality, and variety of industry-created standards 	<ul style="list-style-type: none"> ● Limited market size in current status (ie ~\$250m in 2020) 	<ul style="list-style-type: none"> ● Extremely low liquidity in current status due to illiquidity of credit trading across different standards 	<ul style="list-style-type: none"> ● Transaction / valuation process highly dependent on intermediaries (eg OTC brokers) with diverse qualities and standards 	<ul style="list-style-type: none"> ● Not available – historical prices not available in sufficient detail and largely driven by non-standardised price setting by project developers and brokers 			
FUTURE PERSPECTIVES (2030)								
	<ul style="list-style-type: none"> ● Accessibility could become sufficient provided that transparent market infrastructure (eg exchange) is developed with standardised, tradable products 	<ul style="list-style-type: none"> ● Strong growth potential in volume to reach \$5B-180B by 2030 in total depending on scenarios materializing Demand for credits from corporate net zero commitments and carbon neutral commodity buyers may prefer carbon removal projects over carbon avoidance/reduction projects 	<ul style="list-style-type: none"> ● Liquidity could increase provided that transparent market infrastructure (eg, exchange) is developed with standardised, tradable products 	<ul style="list-style-type: none"> ● Reputable standards to safeguard quality and impact (if successfully implemented) may standardise valuation in several methodologies 	<ul style="list-style-type: none"> ● Transparent market infrastructure (if successfully implemented) to provide better visibility into demand and supply drivers 			
Neutralisation (removal/sequestration) credits are not investable at a scale required for institutional investors as of today, yet may become investable on the 2030 horizon	TODAY							
	<ul style="list-style-type: none"> ● Credits available from secondary markets; varying degrees of quality and variety of industry-created standards 	<ul style="list-style-type: none"> ● Limited market size in current status (ie ~\$50m in 2020) 	<ul style="list-style-type: none"> ● Extremely low liquidity in current status due to illiquidity of credit trading trading across different standards 	<ul style="list-style-type: none"> ● Transaction/ valuation process highly dependent on intermediaries (eg OTC brokers) with diverse qualities and standards 	<ul style="list-style-type: none"> ● Not available – historical prices not available in sufficient detail and largely driven by non-standardised price setting by project developers and brokers 			
FUTURE PERSPECTIVES (2030)								
	<ul style="list-style-type: none"> ● Accessibility could become sufficient provided that transparent market infrastructure (eg exchange) is developed with standardised, tradable products 	<ul style="list-style-type: none"> ● Strong growth potential in volume to reach \$5bn-\$180bn by 2030 in total depending on scenarios materialising Demand for credits from corporate net zero commitments and carbon neutral commodity buyers may prefer carbon removal projects over carbon avoidance/reduction projects 	<ul style="list-style-type: none"> ● Liquidity could rise further as net zero corporate claims increase provided that transparent market infrastructure (eg, exchange) is developed with standardised, tradable products 	<ul style="list-style-type: none"> ● Reputable standards to safeguard quality and impact (if successfully implemented) may standardise valuation in several methodologies 	<ul style="list-style-type: none"> ● Transparent market infrastructure (if successfully implemented) to provide better visibility into demand and supply drivers 			

Sidebar

Performance of VCM credits

One of the obstacles to investability in VCMs has been the paucity of historical price data with which to analyse returns, volatility and correlations with other asset classes. Even looking at the available data, historical returns have not been attractive for institutional investors. Prices were consistently above \$ 5 per tonne between 2007 and 2013 but decreased to around \$ 3 per tonne in recent years as supply outstripped demand. Even when breaking down the price by project type, based on past data, most project types have not demonstrated an attractive price increase. As of today, household services, forestry and land use, and energy efficiency or fuel switching are the categories that have enjoyed above-average price levels. However, there has

been strong variance among prices in individual categories: for example, there was an increase from approximately \$ 1.80 per tonne to around \$ 2.50 per tonne for waste disposal while renewable energy maintained a relatively flat price of \$ 1.40 per tonne over the 2016 to 2019 period. As a consequence, it would be a challenge for institutional investors to invest in certain project types until the quality of carbon credits is standardised and more transparent pricing becomes available.



In summary,

VCM growth may outpace CCM growth to achieve a similar total market value by 2030. In light of this, it is important for investors to evaluate VCMs closely and reassess their position if major shifts in the above-mentioned signposts are observed.

Key questions for institutional investors

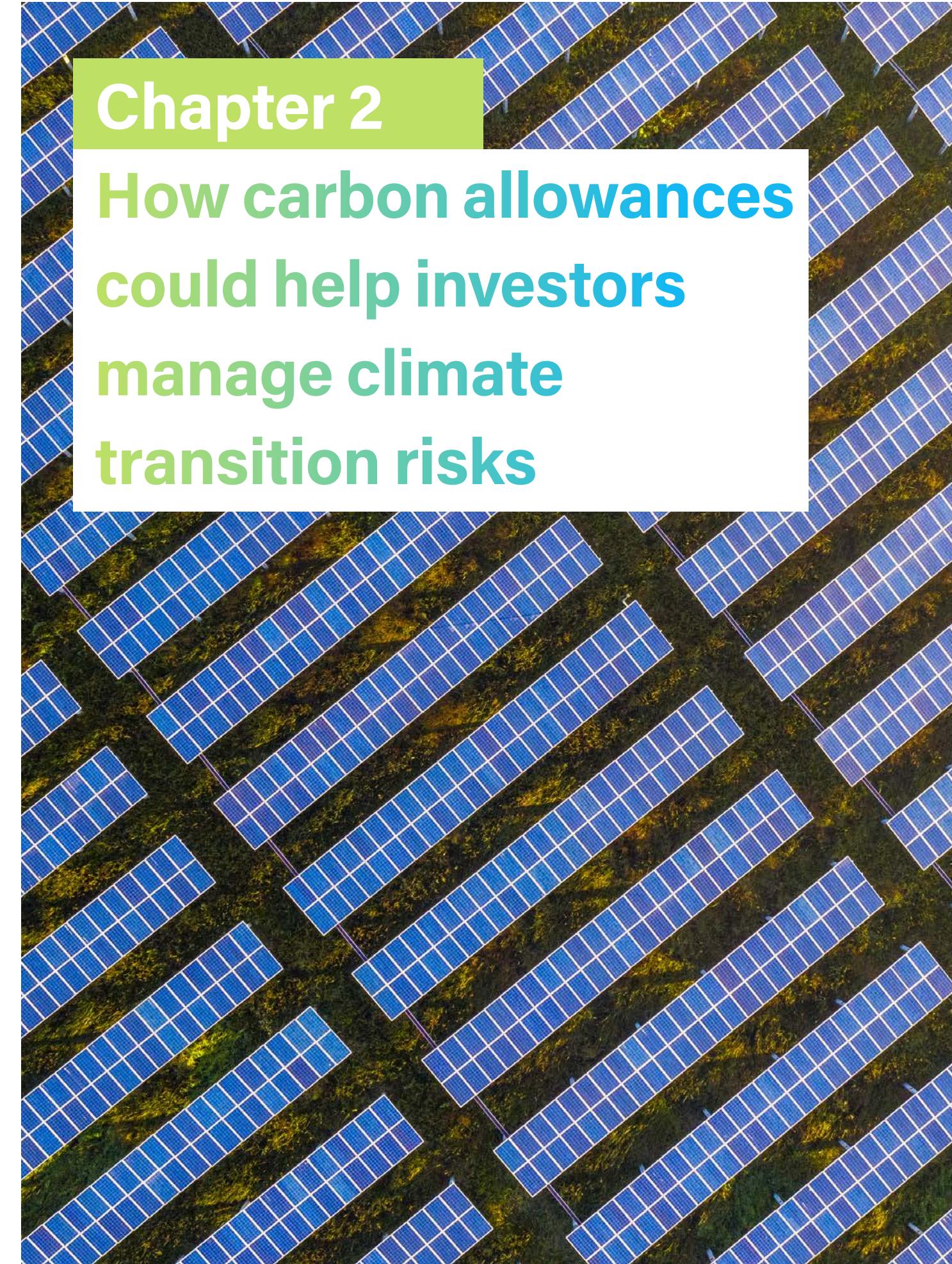
- Q1. What is your current view of compliance carbon markets as an asset class?**

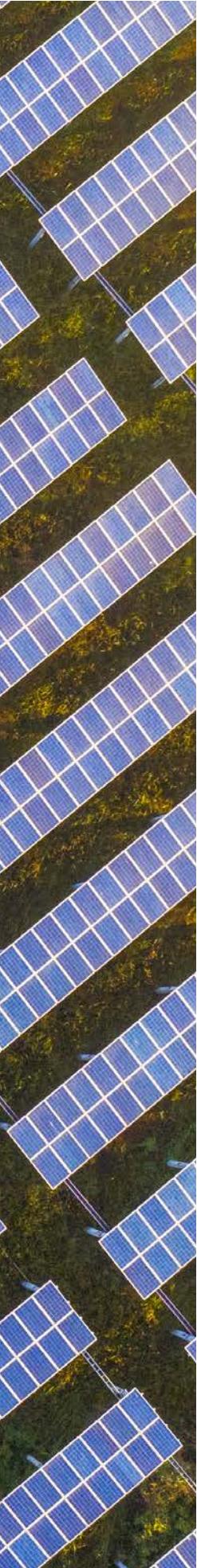
- Q2. How would voluntary carbon markets need to develop in order to become an investable asset class for you?**



Chapter 2

How carbon allowances could help investors manage climate transition risks





While investing in carbon markets remains a difficult proposition for institutions, this position could change rapidly. On this basis, we explored what investors could achieve by including carbon allowances in their portfolios today. Using CCM transaction data, we examined the potential effect on portfolios of including allowances under three representative climate scenarios within a ten- and 30-year timeframe.

We conclude that carbon markets offer an important opportunity for investors to improve risk-adjusted returns and manage risk. Our analysis shows that if institutional investors allocated even a small part of their portfolios to carbon allowances, they could improve the resilience of their portfolio against climate transition risks. This is because, while the precise course of carbon prices remains uncertain, they hinge on policy action, and as governments around the world start to take real action, carbon prices could rise.

If institutional investors made even a small allocation to carbon allowances, they could improve the resilience of their portfolio against climate transition risk

Recent historical data from CCMs shows positive returns

We analysed five years of historical ETS transactional data from four major trading schemes (EU ETS, US California Carbon Allowance (CCA) ETS, US RGGI ETS and NZ ETS) to construct a global ETS index. This gave us a proxy to estimate the future volatility of ETS and its correlation with other asset classes. As indicated in Chapter 1, this was a period of steady ETS price increases, attributable to enhanced regulations designed to cap the number of allowances in the market over the next decade. Unsurprisingly, the data shows

positive returns from all four current major ETS since 2016.³⁸

An equal-weighted index (25 percent each) shows an annualised return of 22.5 percent since 2016, while a market-cap-weighted index shows an annualised return of 34.7 percent. By comparison, global equities returned 14 percent and bonds returned 3 percent over the same period. Assuming a 60/40 portfolio that had invested 10 percent into carbon ETS since 2016, the portfolio would have enjoyed a 1.3 percent increase in annualised returns (using the equal-weighted index), or a 2.8 percent increase in returns (using the market-cap-weighted index).³⁹

This data is only of limited use, since ETS performance is closely linked to regulatory decisions, and past patterns offer little guidance for the future. Past ETS data, however, can inform forward-looking perspectives in order to assess the potential impact on financial assets and carbon allowances of various climate transition scenarios, which are the focus of this chapter.

Using carbon allowances to hedge against climate transition risk

A key determinant of the scale and nature of transition risks facing the global economy will be the precise pathway adopted by governments and corporations in reducing emissions. To assess what role carbon allowances could play in investment portfolios, we have conducted a climate-scenario-based modelling exercise. Our modelling is hypothetical, but it could serve as a foundation for investors to develop more customised portfolio simulations based on their own detailed assumptions. We use a ten-year timeline as the core framework in this paper, with forecasts to 2050 providing supplementary analyses to support and emphasise key messages. Our methodology is explained in detail in the sidebar below.

³⁸ In 2014, oversupply of allowances was reduced by back loading and in 2019, the European Union introduced the Market Stability Reserve to stabilise the market (see Chapter 1, Exhibit 6).

³⁹ Historical portfolio analysis performed with equity, bonds and carbon ETS transaction data from January 2016 to March 2021.

As the basis for this exercise we selected three of the authoritative scenarios established by the NGFS. We selected the NGFS REMIND scenarios which were developed to provide a common starting point for analysing climate risks to the economy and financial system. We chose these scenarios on the basis of their widespread adoption, the alignment of their technical criteria with the Paris Agreement, their relevance to the financial sector and their consistent underlying modelling methodology.

Of the publicly available NGFS scenarios, we adopted the below 2°C scenarios to reflect the Paris Agreement's goal to keep warming well below 2°C; a more ambitious scenario to keep warming below 1.5°C would have more pronounced impacts on transition risks and investments. These offer a range of potential outcomes depending on the climate-transition policies that are implemented globally:

- **Hot house world** – the status quo where the average carbon price in the global economy remains relatively flat at \$ 3 to 4 per tonne.⁴⁰
- **Immediate transition** – the assumption of optimal carbon prices in line with the long-term targets; climate policies are introduced early and become gradually more stringent, which leads to strong annual growth of approximately 35 percent from \$ 3 per tonne in 2020 to \$ 70 per tonne in 2030 and stabilises at about 6 percent annual growth to \$ 230 per tonne in 2050.
- **Delayed transition** – the assumption that climate policies are not introduced until 2030, resulting in a more disruptive transition, higher physical risks and a much sharper increase in carbon prices from approximately \$ 3 per tonne in 2030 (i.e., same as hot house world scenario) to approximately \$ 740 per tonne in 2050.

⁴⁰ Definition of carbon price in this paper is referring to global economy implicit average carbon price in real term (\$, 2020), unless otherwise stated.

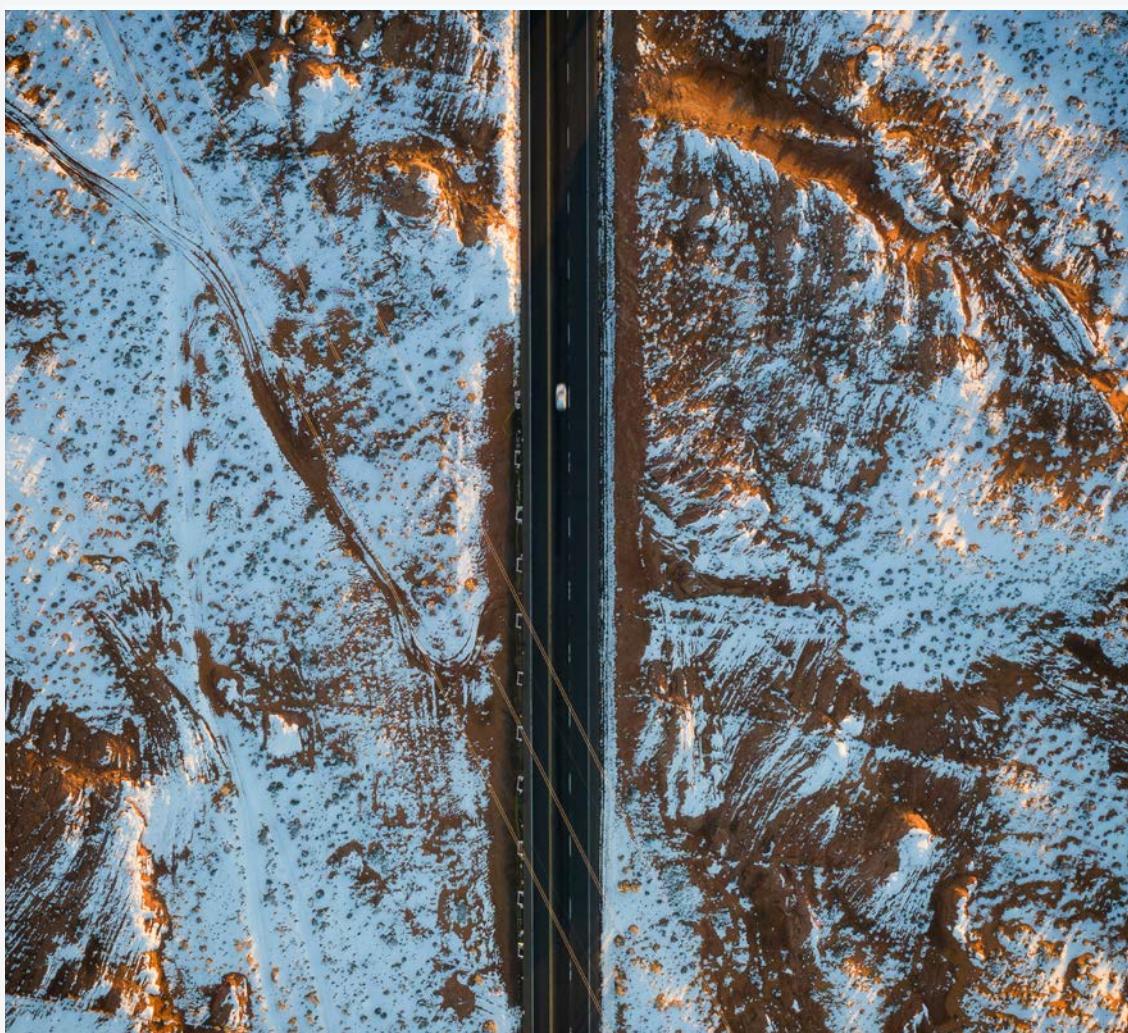
Sidebar

NGFS Climate Scenarios

The NGFS Scenarios are designed to illustrate the different practical outcomes from different policy scenarios, and highlight a few important themes including the rapid decarbonisation of electricity, increasing electrification, more efficient uses of resources and a spectrum of new technologies to tackle remaining hard-to-abate emissions.

NGFS explores six scenarios in three categories: 'orderly' scenarios in which climate policies are introduced early and become gradually more stringent; 'disorderly' scenarios in which transition risk is higher owing to policies being

delayed or divergent across countries and sectors; and 'hot house world' scenarios where policy efforts are insufficient to halt significant global warming, resulting in severe physical risks.



Sidebar

Our modelling approach

We have adopted a five-step approach (Exhibit 9).

Exhibit 9: Leveraging Vivid Economics' bottom-up climate impact analyses, we adopted a rigorous 5-step approach with Monte Carlo simulation to estimate the cumulative return for 100,000 simulated portfolios against 3 potential climate scenarios



STEP 1: Climate-scenario building

3 NGFS REMIND scenarios to model climate risks on assets

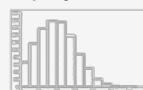
- 'Hot house world' scenario: only current policies maintained and physical risks intensify
- 'Delayed transition' scenario: a more disruptive transition after 2030 to limit warming to below 2°C
- 'Immediate transition' scenario: transition policies are introduced immediately to limit warming to below 2°C



STEP 2: Asset-level derived inputs

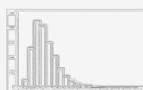
Expected returns and volatility, correlation matrix for each asset class

Equity



Global ETS index

Bonds



Global REIT index

Vivid Economics' Planetrics team assessed climate risk impact on the valuation of individual asset classes under each scenario



STEP 3: Portfolio-level inputs

Portfolio composition assumptions

Base reference portfolio:

- Portfolio 1: 60% equities, 40% bonds
- Portfolio 2: 57% equities, 38% bonds, 5% ETS

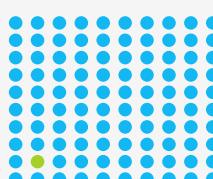
Alternative portfolio with real estate:

- Portfolio 1: 40% equities, 40% bonds, 20% REITs
- Portfolio 2: 38% equities, 38% bonds, 19% REITs, 5% ETS



STEP 4: Monte Carlo simulation

Cumulative return for 100,000 simulated portfolios



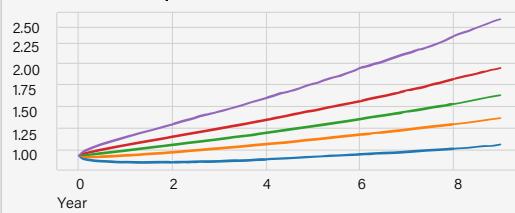
Cumulative return of portfolio no 8,243



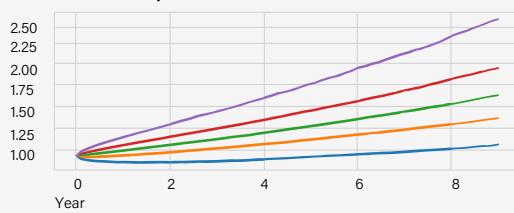
STEP 5: Aggregated results

Performance estimates for the portfolio

Portfolio 1: 60 equities/40 bonds



Portfolio 2: 57 equities/38 bonds/5 ETS



1. The hot house world scenario is a theoretical global scenario not specific to any country/region and assumes no new climate policies beyond those already implemented before NGFS published the forecast in June 2020. The scenario's impact on a global carbon price is a simplification intended to capture an amalgamation of a range of different transition policies implemented by nations around the world.

Step 1.

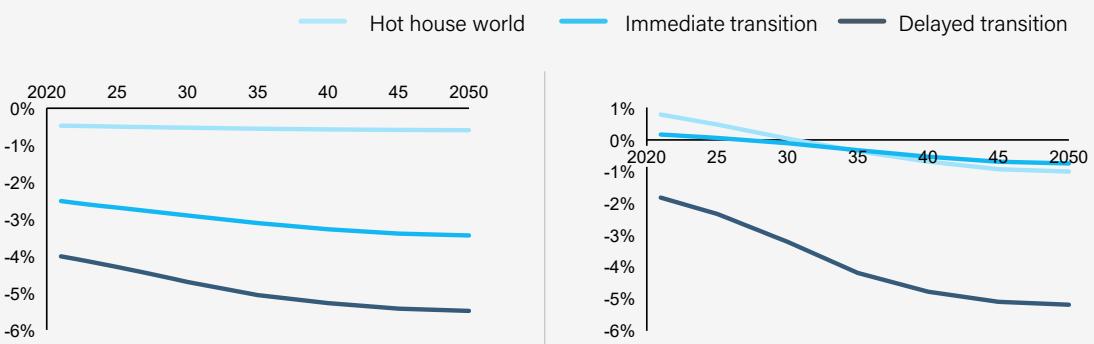
Select the climate scenarios that form the basis for subsequent modelling (see above).

Step 2.

Use Vivid Economics' Planetrics analytics platform to derive asset-level inputs for equities, bonds and a global ETS index. The overall financial impact of the various assets under each

scenario is derived by discounting the cash-flow estimates from the asset-modelling component to net present value terms, assuming investors have foresight on climate impacts. For example, stocks and bonds are common investment instruments in portfolio holdings. The values of both asset classes are expected to be impacted by various physical and transition risks such as physical damage, demand destruction and carbon costs (Exhibit 10).

Exhibit 10: Asset-level-derived inputs on expected returns – relative value impact for individual asset classes on the 2050 horizon



Equity relative market value impact

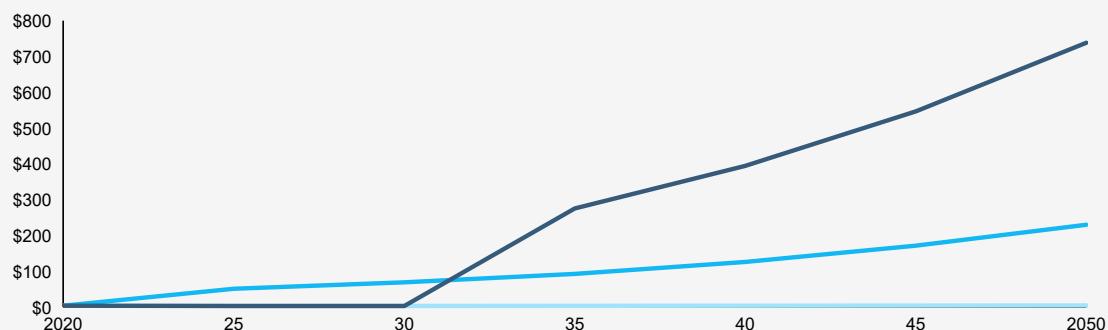
iShares MSCI ACWI ETF consists of ~2,300 companies across developed and emerging markets.

Value impact at individual company level is derived by assessing climate impact on company's annual earnings and discounting impacts over the period to 2050 to arrive at the relative impact on current valuation.

Bond relative market value impact

J.P. Morgan Hedged Global Government Bond Index, which consists of sovereign bonds of multiple tenors.

Impact reflects the macroeconomic shocks arising from changes in energy consumption, energy costs, the physical risks of climate change and the response of governments and central banks to those shocks.



NGFS carbon price pathway

NGFS REMIND scenarios, which are widely used by central banks and the financial sector for climate stress testing.

Expected return of carbon allowances is calculated based on forecasted price pathways.

1. The hot house world scenario is a theoretical global scenario not specific to any country/region and assumes no new climate policies beyond those already implemented before NGFS published the forecast in June 2020. The scenario's impact on a global carbon price is a simplification intended to capture an amalgamation of a range of different transition policies implemented by nations around the world.

Vivid Economics, McKinsey's strategic economics consultancy with broad sustainability and macroeconomic capabilities, and **Planetrics**, their climate analytics suite that helps quantify, report and manage climate risks, help companies navigate the urgent implications of climate change and transform towards net zero carbon emissions (Exhibit 11).

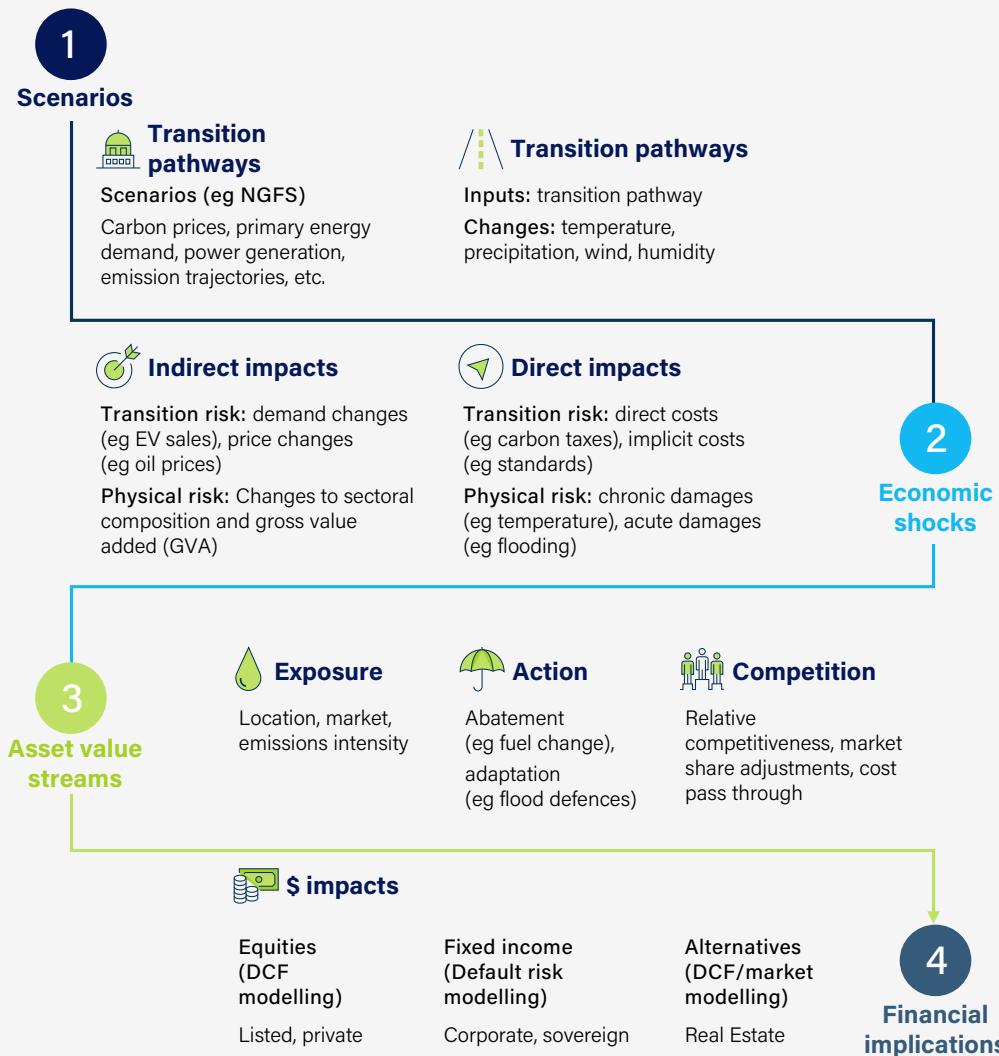
Step 4.

Apply Monte Carlo simulation to generate a set of 100,000 potential portfolio return outcomes over the ten-year (2030) and 30-year (2050) period for the hypothetical investment portfolios under each of the three climate scenarios – we assume the returns are distributed normally.

Step 5.

Aggregate the information to create a projected portfolio performance. We construct two hypothetical investment portfolios to help assess how portfolio performance is likely to be impacted by including 5 percent of carbon allowances,

Exhibit 11: Asset-level-derived inputs on expected returns – Planetrics model features a 4-step framework to conduct bottom-up quantification of investor implications for different climate scenarios by sector and security



and run the Monte Carlo simulation for each to estimate its return trajectory and calculate the expected annualised return in two different portfolios:

- **Reference portfolio.** 60 percent equities and 40 percent bonds, where iShares MSCI ACWI ETF is used as the proxy for the equity part of the portfolio and J.P. Morgan Global Government Bonds Index for the bond part of the portfolio.
- **5 percent carbon inclusion.** 57 percent equities, 38 percent bonds and 5 percent carbon allowances.

Currently we have seen some market price acceleration in leading ETS markets (for example, the carbon price has increased by over 80 percent in the first nine months of 2021 from €33.5 to over €61.7 per tonne); this outpaced the NGFS 2021 carbon-price projection that forms the basis in our modelling, and as such, our derived future return on carbon instruments can be discounted if the current growth trend discontinues. For more details, please refer to the Technical Appendix.

Exhibit 12: Asset-level-derived inputs overview – we leveraged Vivid Economics' PlanetView model, market analyst reports and available historical market data

ETS	ASSET-LEVEL INPUTS	Other assets (equities, bonds and real estate)
NGFS 2021 forecast world average carbon prices from 2020-50, assuming the return will be constant over the 10- and 30-year forecast periods	EXPECTED ANNUALISED RETURN	Vivid Economics' Planetrics modelling on relative value impact per asset class per climate scenario based on NGFS 2021 forecast Analyst forecasts ¹ as baseline <i>For a more detailed explanation on the methodology, please refer to Appendix</i>
Standard deviation of historical monthly returns of equally weighted major ETS markets ² since 2016	EXPECTED ANNUALISED VOLATILITY	Analyst forecasts ¹ for individual asset class' volatility
Correlation between ETS and other asset classes of historical monthly returns of equally weighted major ETS markets ² since 2016	CORRELATION BETWEEN ASSET CLASSES	Analyst forecasts ¹ to calculate correlation matrix across asset classes



1. Industry consensus on long-term capital market assumptions from J.P. Morgan and BlackRock, Invesco

2. 4 major ETS markets are included : EU, US CCA, RGGI and NZ.

The result of investing in carbon allowances depends on the climate scenario

The effect on performance, of including carbon allowances in our hypothetical investment portfolio, varies between the climate transition scenarios. We present the results of this scenario modelling exercise in Exhibit 13. In each case, the built-in assumptions produce radically different portfolio performance results.

For example, under the hot house world scenario, the inclusion of carbon allowances in an investor's portfolio would reduce returns due to the lower annualized return of carbon allowances.

Different climate scenarios produce radically different portfolio performance results

In contrast, under the immediate transition scenario, carbon prices would rise steadily while equity and bond

markets experience negative impacts from rising transition costs. An allocation of 5 percent to carbon allowances would thus improve annualised portfolio returns by approximately 1.4 percent by 2030 and 0.5 percent by 2050; in addition, this comes with a slightly lower volatility of 10 to 20 basis points due to more diversified portfolio with carbon allowances across four different markets.⁴¹

Under the delayed transition scenario, allocating 5 percent to carbon allowances with a lack of material-policy action in the short term, would lead to lower returns towards 2030 and a 0.7 percent annual return enhancement by 2050, due to a sharp increases in carbon prices coupled with higher transition risk impact on other asset classes. This comes with a slightly lower volatility of 10 basis points.

⁴¹ Portfolio returns mentioned in this report refer to annualised returns, unless otherwise stated.

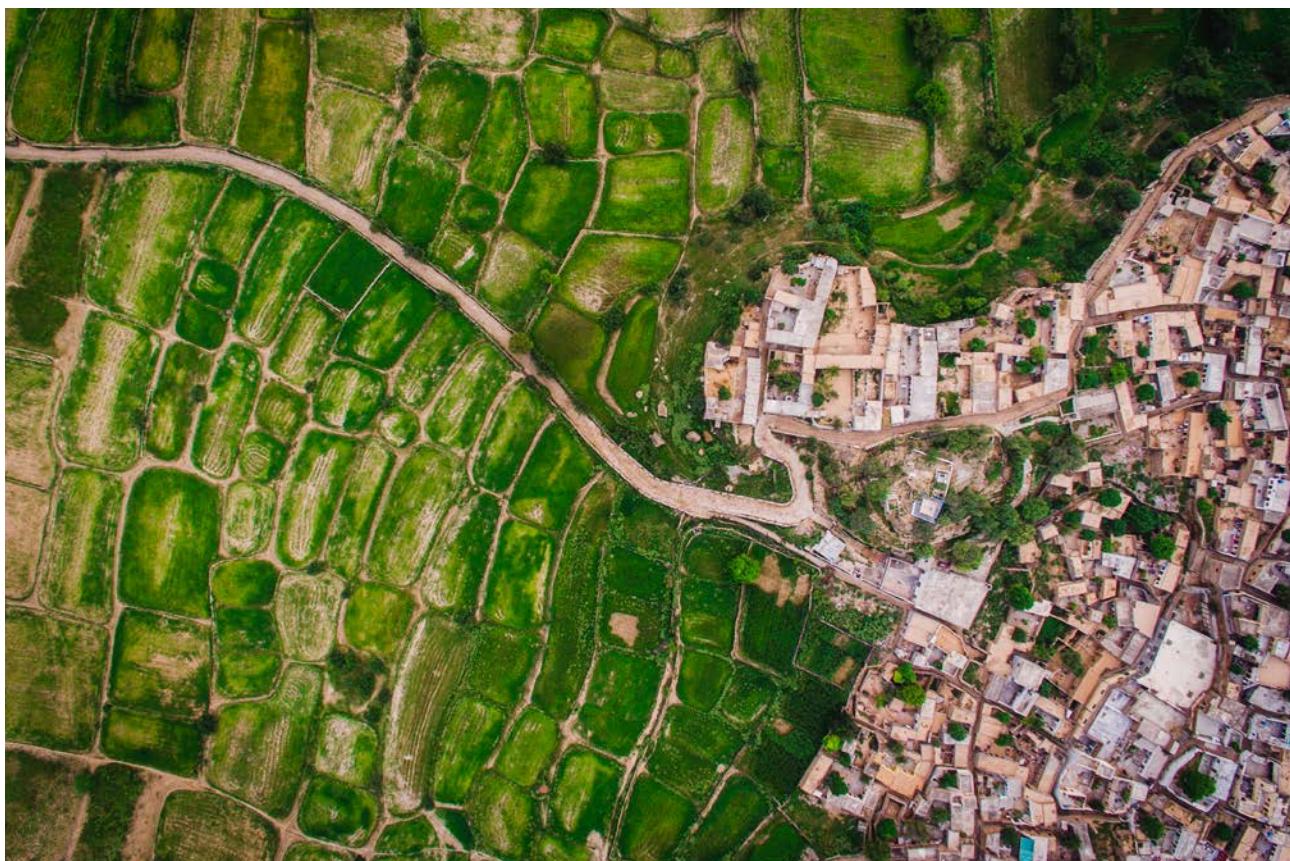
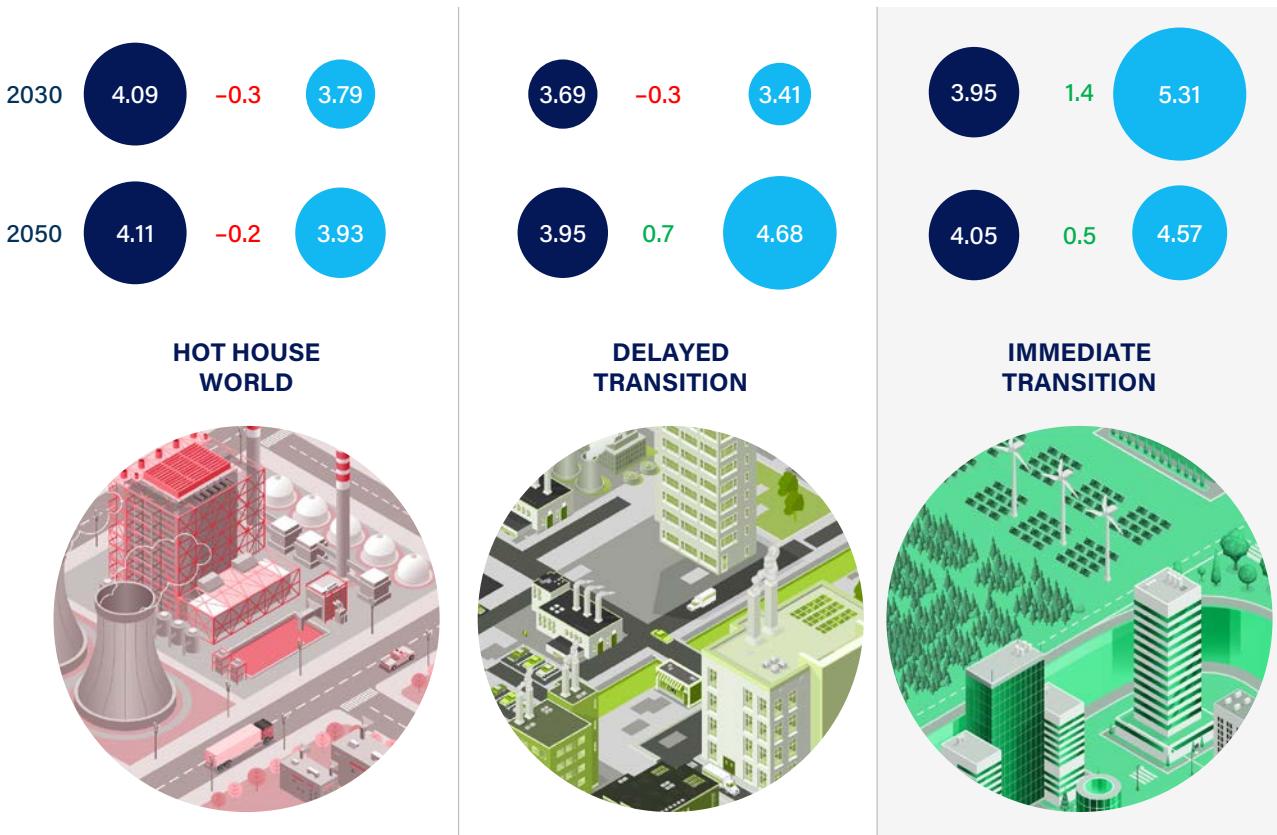


Exhibit 13: Results on a 60/40 reference portfolio – 5% carbon allowances inclusion could drive overall portfolio returns up 0.5% to 1.4% in climate transition scenarios

Portfolio performance projection¹

Percent

● A. Reference portfolio² ● B. Reference portfolio with 5% ETS XX / XX Difference in return % (B-A)



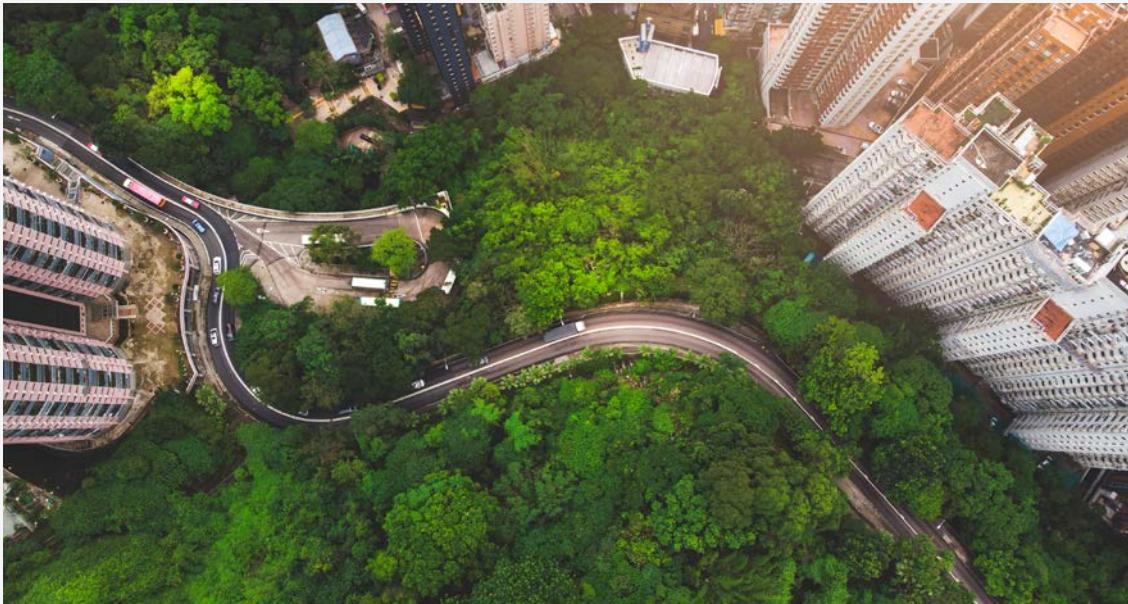
1. Portfolio performance is projected using Monte Carlo simulation; carbon allowances return and relative impact on other asset classes (eg, equity, bonds) are calculated based on NGFS 2021 forecast
2. Reference portfolio consists of 60% equities and 40% bonds.

To put this another way, under the immediate transition and delayed transition scenarios, a 60/40 reference portfolio without carbon allowances could underperform by some 20 to 40 basis points annually in the next 30 years.

As such, carbon allowances could be a potential investment to help investors manage different climate scenarios. Based on our modelling insights, a small allocation (approximately 0.5 to 1 percent) of carbon allowances in a 60/40 reference portfolio could be sufficient to provide diversification from potential

climate risks (Exhibit 14). Conversely, if there is no climate transition in the future, a 5% inclusion of carbon allowances in the investor's portfolio will lead to lower returns of 20- to 30-basis-points annually.

Carbon allowances could be a potential investment to help investors manage across different climate scenarios



Sidebar

Alternative portfolio with 20 percent real estate

Across asset classes, real estate is particularly exposed to physical climate risks: the Planetrics model projects a negative impact on real estate markets of between 4 and 8 percent by 2030 – one to three percentage points more than the expected impact on global equity markets.¹

To explore the implications, we constructed an alternative hypothetical portfolio with a 20 percent allocation to real estate: in this case a 5 percent allocation to carbon allowances could enhance returns by approximately 50 to 70 basis points by 2050 in both immediate and delayed transition scenarios.^{2,3}

To ensure sufficient diversification of climate transition risks, this alternative portfolio requires allocating approximately 10 basis points more to carbon allowance inclusion (compared to the 60/40 reference portfolio) to facilitate the increasing impact on the values of physical risks after 2030 in the delayed transition scenario.

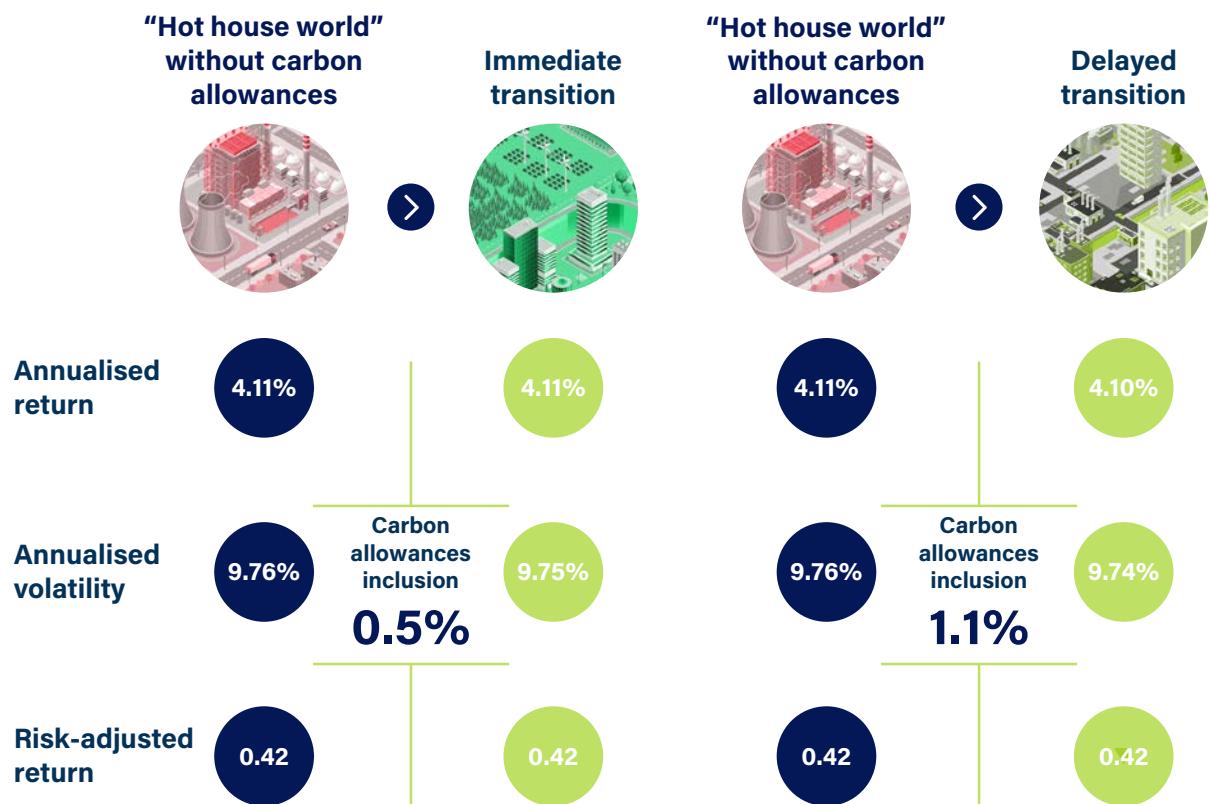
The Asia-Pacific is the most vulnerable region in all three climate scenarios – it is expected to suffer twice as much physical damage versus the global average owing to its densely populated coastal areas and weak infrastructure. Institutional investors with higher allocations to Asian real estate may want to consider including additional carbon allowances to ensure proper risk diversification.

¹ Represented by iShares Global REIT ETF, which consists of approximately 300 REITs primarily in the United States (67 percent), Japan (9 percent), the United Kingdom (5 percent), Australia (4 percent), Canada (3 percent) and Singapore (3 percent).

² Alternative portfolio consists of 40 percent equities, 40 percent bonds and 20 percent REITs which used iShares Global REIT ETF as proxy, which consists of approximately 300 REITs primarily in the United States (67 percent), Japan (9 percent), the United Kingdom (5 percent), Australia (4 percent), Canada (3 percent) and Singapore (3 percent).

³ Alternative portfolio with 5 percent carbon allowances consists of 38 percent equities, 38 percent bonds, 19 percent REITs and 5 percent carbon allowances.

Exhibit 14: Results on a 60/40 reference portfolio – ~1% of carbon allowances inclusion would neutralise performance drop caused by climate risks



Investors should be mindful of the risks associated with investments in carbon allowances

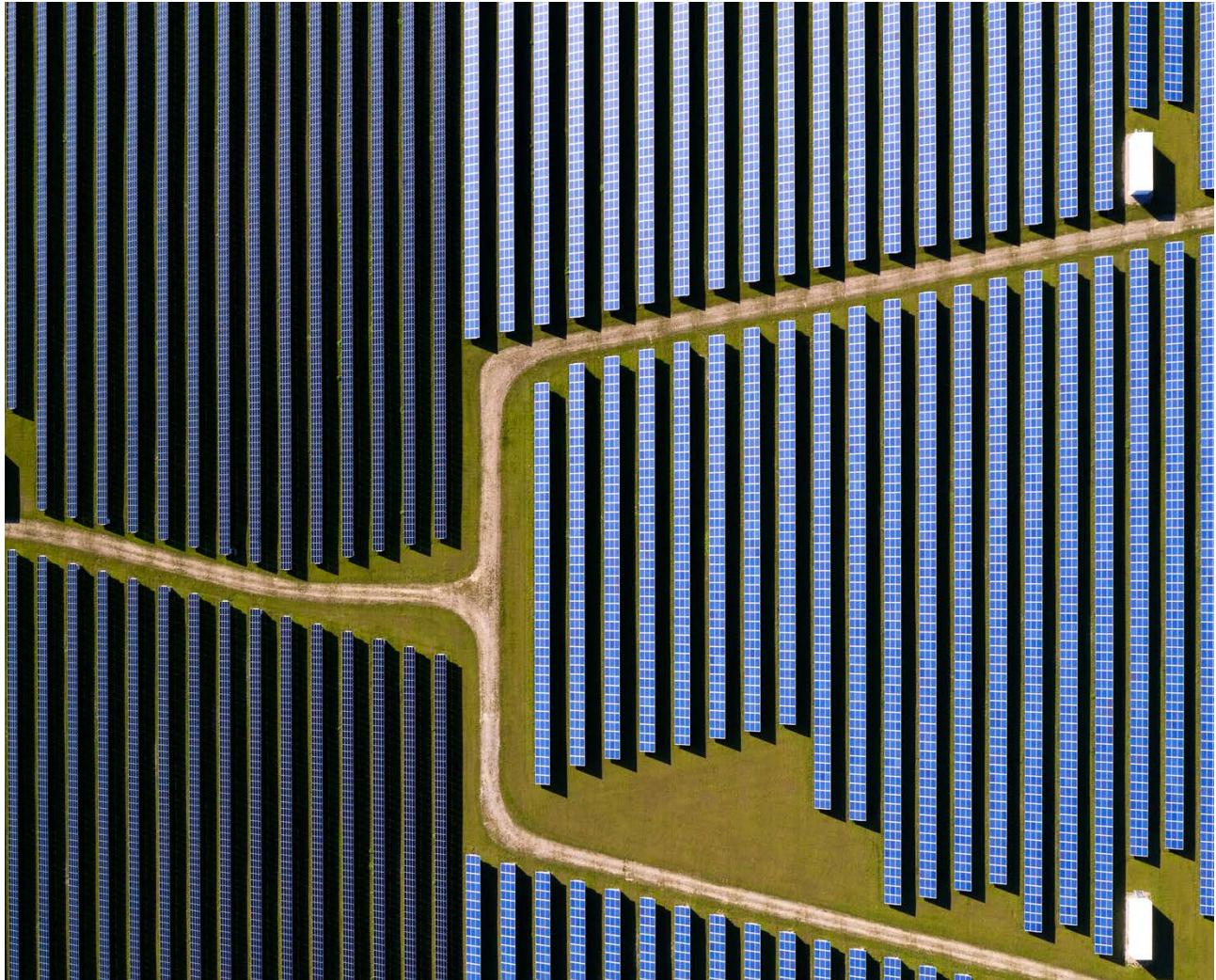
We have demonstrated above some of the potential benefits of including carbon allowances in an investment portfolio under varying climate scenarios. The discussion would be incomplete, however, without considering the risks inherent in investment in CCMs. Principal among them are a number of reputational risks.

As instruments of government policy, CCMs are inherently subject to greater scrutiny than other financial markets, not only from financial regulators but also from NGOs, politicians and a wider public wary of policy-driven markets being used to generate speculative profits. It is therefore more important than ever that institutional investors approach these markets with a well-judged and clearly-articulated strategy

that ensures their actions are linked to the ultimate policy goal of reducing carbon emissions to net zero. Generating long-term returns in pursuit of this goal is likely to be palatable, but seeking speculative profit from short-term price movements could be problematic. In Exhibit 1, we showed the various ways in which institutional investors could usefully participate in carbon markets, for example to facilitate liquidity and long-term development of CCMs.

A related set of risks arise from policy uncertainty. For example, the Greens (the most climate-ambitious political group in the European Parliament) stated in a position paper dated May 2021, that additional rules should be introduced to avoid speculation on ETS allowances: for example, by limiting the amount of ETS allowances that can be held by financial market participants.⁴²

⁴² Ewa Krukowska, 'EU Carbon Rally Triggers Greens' Call for Curbs on Speculation', Bloomberg Green, 20 May 2021, bloomberg.com.



The issue of speculation has also triggered a complaint from Poland, with the government asking the European Commission to investigate the role of financial players in recent price spikes.

As instruments of government policy, compliance carbon markets are inherently subject to greater scrutiny than other financial markets

At a more technical level, there are market liquidity risks due to differences in the legal definitions of carbon allowances. For example, differences in jurisdiction may raise an additional barrier to allowance trading between different regions. In California, an emission allowance is a limited tradable authorisation to emit up to 1 tonne of CO₂ equivalent but does not constitute property or a property right. The California Air

Resources Board (CARB) retains authority to terminate or limit the 'authorisation to emit' so that in cases of fraud or market manipulation it has a mechanism to protect the market. By contrast, the US district court in Louisiana ruled that the right to report, transfer or sell carbon allowances was enough to designate them as part of a property's rights. This potentially affects the sales of carbon allowances or credits generated outside California: if a carbon credit from Louisiana were accepted into California's market, the credit would have two distinct legal statuses, as property in Louisiana, but non-property in California. This situation would be fraught with difficulty for investors, since under the Californian rule, they could in certain circumstances be expropriated by CARB without legal recourse.

Similar uncertainties over rights exist in relation to the EU ETS, and illustrate the legal and accounting risks involved. The ETS Directive does not specify the legal

nature of the allowances traded and leaves the definition of this to the discretion of EU member states through national legislation – the definitions used by member states vary widely. While some states consider allowances as property rights and thus eligible for use as securities or financial instruments, others see them as administrative authorisations or *sui generis* administrative rights; still others operate a mixed regime.⁴³ The precise definition of allowances affects how they are treated on the balance sheet and in the nature of trading. For example, the ability to use allowances as collateral is critical to developing the allowance financing market; such development would also improve liquidity. But this requires emission allowances to be classified as financial instruments.

These complexities need to be understood in detail and managing them must be incorporated into all investment strategies involving CCMs. Indeed, getting comfortable with the legal and regulatory detail is crucial to an investor's decision on whether these markets are in practice investable. Investors need to consider the strength of their legal claim on the assets they buy: if it is weak, because property rights are not clearly defined or because they cannot be enforced, that should be a red flag. They must also be cognisant of whether they are permitted to invest in specific assets from a regulatory point of view. In the EU, MiFid rules state that emission allowances are to be considered financial instruments, but do not mention VCM credits. Solvency 2 does not mention carbon markets at all, and UCITS rules for mutual funds would appear to prohibit a pure carbon allowance investment.

⁴³ Legal nature of EU ETS allowances report, European Union, 2019, op.europa.eu; Ashley Seager, 'European taxpayers lose €5bn in carbon trading fraud', The Guardian, 14 December 2009, guardian.com; Jack Horgan-Jones, 'Carbon credit fraud in the EU: how does it work?' Irish Times, 7 May 2019, irishtimes.com.

Key questions for institutional investors

- Q1. How will you define your strategy to participate in carbon compliance markets and manage associated risks?**

- Q2. How would you structure a trial investment into emission allowances?**

- Q3. What percentage allocation to carbon allowances would best suit your portfolio?**



Chapter 3

Shaping an investor agenda for growth in voluntary carbon markets





As climate transition goals evolve, so do carbon markets. Public expectations of businesses and investors with respect to tackling climate change are changing rapidly. Regulation is evolving fast, driving change in CCMs, and corporate net zero commitments are proliferating, potentially increasing demand for carbon credits in VCMs. Although CCMs can be considered investable today, their size is still a limitation for institutional investors, but the position is evolving. Meanwhile, VCMs are still at a nascent stage, far from reaching the levels of liquidity and transparency that would enable them to both be investable and perform the resource allocation and risk management functions that financial markets serve elsewhere in the economy.

All this makes for a bewildering environment for institutional investors considering how to approach carbon markets as part of their investment strategy in the short, medium and longer term. How can they assist in decarbonisation before carbon instruments are ready as an asset class? What role should they play in developing VCMs and facilitating the global transition to net zero emissions?

In this chapter we discuss actions that investors can consider to assist the development of VCMs, identify potential investment opportunities and assess the inherent risks. We argue that regardless of their specific investment mandate, it is in investors' own interest to support the development of robust, liquid carbon markets in which they can actively participate, for three reasons.

First, as we have seen, carbon markets are rapidly approaching critical mass from an investment perspective. Second, as discussed in the previous chapter, carbon markets offer an important opportunity for investors to improve risk-adjusted returns and manage risk. And third, investors have a vested interest in the development of robust, investable carbon markets as without them the world is likely not unable to achieve the globally agreed upon target of keeping warming to 1.5°C. If that target is missed, institutional investment portfolios

themselves will be exposed to increasing physical climate risks.

It is in investors' own interest to support the development of robust, liquid carbon markets in which they can actively participate

Three moves investors can explore today

Investors could explore three moves to assist in the development of VCMs and prepare themselves for participation:

- Investing in the VCM value chain and scaling up the supply of high-quality credits.
- Supporting the establishment of high-integrity VCM standards and governance.
- Guiding portfolio companies on the path to net zero.

1. Investing in opportunities in the VCM value chain and scaling up the supply of high-quality credits

An increasing number of companies are establishing science-based climate targets in line with a 1.5°C pathway: the number of such commitments doubled in late 2019. This is translating into unprecedented action across the VCM value chain. Companies are announcing significant investments in new carbon avoidance and removal projects such as NCS and carbon capture and storage, and there is increased momentum in the creation of appropriate market infrastructure.

Institutional investors are already at the centre of this action. For example, investor pledges to transition investment portfolios to net zero are growing. The Net Zero Asset Owner Alliance brings together 49 institutional investors with a total of \$ 7 trillion assets under management, that

have pledged to transition their portfolios to net zero by 2050.^{44⁴⁵}

All this activity is leading to significant growth in demand for carbon credits. Existing commitments from more than 700 large companies already show a steep increase in the number of investments in credits from today's level. However, this fails to account for the acceleration in new commitments. A survey by the TSVCM suggests that they could grow ten-fold to 1 gigatonne of CO₂ in 2030 and then triple or quadruple again to 3 to 4 gigatonnes by 2050 (Exhibit 7 in Section 1).

Such growth is bound to create attractive investment opportunities, both in technology-based carbon removal projects and in nature-based solutions involving forest protection and restoration. An example of the former is the long-term

partnership between the Drax Group and Mitsubishi Heavy Industries to create the largest carbon capture project, permanently removing millions of tonnes of carbon dioxide from the atmosphere each year. Drax has already transformed its power station near Selby in North Yorkshire to become the largest decarbonisation project in Europe and has ambitions to go further by using Bioenergy Carbon Capture and Storage (BECCS) to permanently remove millions of tonnes of CO₂ each year from the atmosphere to create a negative carbon footprint for the company.⁴⁶

⁴⁴ Katherine Dunn, 'BlackRock's Larry Fink to CEOs: Get serious on net-zero targets, or else', Fortune, 27 January 2021, fortune.com; Michael Mackenzie and Billy Nauman, 'BlackRock pushes companies to adopt 2050 net zero emissions goal', Financial Times, 26 January 2021, ft.com.

⁴⁵ <https://www.unepfi.org/net-zero-alliance/>.

⁴⁶ <https://www.drax.com/about-us/our-projects/bioenergy-carbon-capture-use-and-storage-beccs/>.



In nature-based solutions, the number of investment announcements is accelerating even faster. Leading institutional investors are already active in directly financing carbon avoidance, reduction and removal projects to increase supply and drive scale. For example, a number of investors are working with London-based specialist advisory firm, Permian Global Advisors LLP, to fund large-scale reforestation projects capable of generating returns from carbon-credit sales to corporations facing growing calls to fight climate change.⁴⁷ In Singapore, various financial institutions have started to finance carbon projects within Southeast Asia in order to facilitate regional decarbonisation and develop knowledge in carbon markets.⁴⁸

Leading institutional investors are already active in directly financing carbon avoidance, reduction and removal projects to increase supply and drive scale

An alternative to directly financing projects is by investing through funds. HSBC Global Asset Management is working with climate-change advisory firm, Pollination, to create a fund that aims to be the world's largest manager of natural capital, including assets such as farmland, forests and water.⁴⁹ Temasek Holdings and BlackRock have collaborated to form The Decarbonization Partners to invest in early-stage growth companies that use technology to reduce carbon emissions.⁵⁰ The first fund has a target of \$1 billion, and will include capital from both companies. At the same time, Standard Life Aberdeen, a leading UK-based investor, is now partnering with ClimateCare, an environmental consulting company, to support an accredited carbon

project based in the Gola Rainforest of Sierra Leone – the credits are available to both consumers and business clients.⁵¹ Finally, Macquarie has teamed up with non-profit Flora and Fauna International to invest \$25 million and identify endangered rainforests that can generate carbon credits if saved.⁵²

Key to success in investing in NCS will be the knowledge and expertise that enables investors to identify and source high-quality projects. Different carbon projects have diverse characteristics in terms of project size, volume and economics; they offer different benefits for buyers depending on project type, location and quality – investors should start investigating these characteristics today in order to be in a position to participate as markets develop.

⁴⁷ Stephen Rumsey, 'Protecting Tropical Forest in an Age of COVID-19', Permian Global, 1 December 2020, permianglobal.com.

⁴⁸ DBS Bank raises sustainable finance target to SGD50 billion by 2024, DBS Bank, 4 February 2021, dbs.com; OCBC sustainability report 2020, OCBC Bank, ocbc.com

⁴⁹ <https://pollinationgroup.com/climateassetmanagement-1/>.

⁵⁰ Temasek and BlackRock Launch Decarbonization Investment Partnership, Temasek Holdings, 13 April 2021, temasek.com.sg.

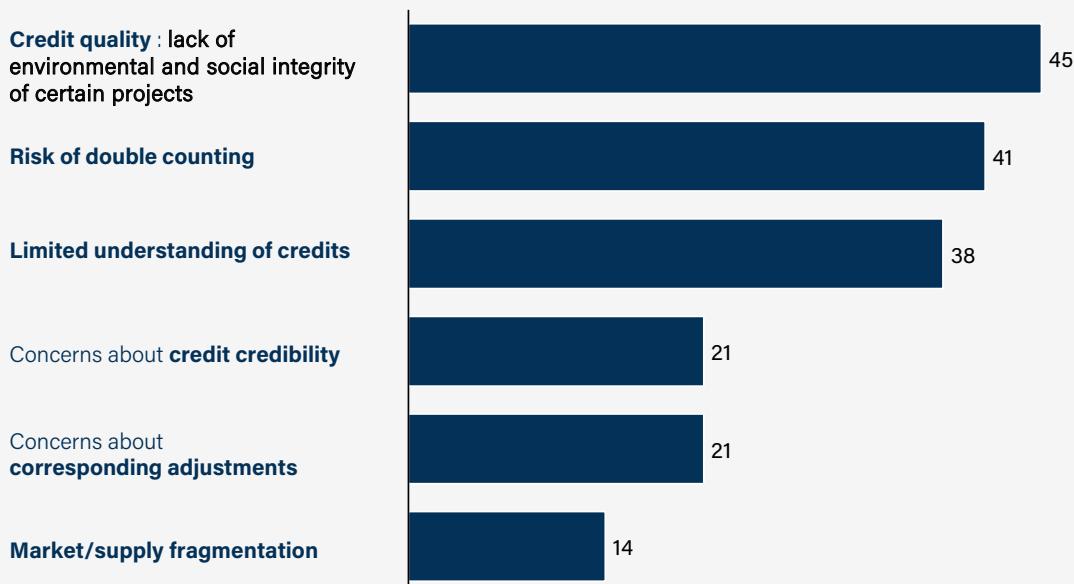
⁵¹ Going carbon neutral for World Environment Day, Standard Life Aberdeen, 5 June 2020, abrdn.com.

⁵² Ally Catterick, 'BioCarbon attracts new investment', Fauna & Flora International, 14 July 2011, fauna-flora.org.

Exhibit 15: TSVCM survey of its members identified credit quality as a key pain point of carbon credits

TSVCM survey on pain points expressed by current or future buyers¹

% of buyers who commented on the survey



Recent development to further carbon credits quality standards establishment:

On 21 September 2021, Taskforce on Scaling Voluntary Carbon Markets (TSVCM), **announces the formation of a new, independent governance body for the voluntary carbon markets (VCMs)**. The announcement marks a major milestone in the Taskforce's mission to bring greater quality and integrity to trading on VCMs. This will reduce CO₂ emissions, preserve natural habitats, mobilize much-needed capital to develop sustainable technology and ultimately accelerate the transition to net zero.

This new governance body will be led by 22 representatives on the Board, acting in an individual capacity and representing distinct perspectives. The Board has been specially selected to reflect the diversity, skills mix and clout required to rapidly progress the creation of high-integrity, scaled VCMs. It **will substantially advance the integrity and quality of carbon credits through the establishment of threshold standards**.

1. Based on buyers' comments expressed in TSVCM Phase I survey, with results as of October 2020. More buyers answered the survey but did not comment of the topic

Source: TSVCM Phase II report, TSVCM website: <https://www.iif.com/tsvcm/Main -Page/Publications/ID/4586/New-Governance-Body-Formed-to-Ensure-Integrity-of-Voluntary-Carbon-Markets>

Sidebar

Assessing opportunities to invest in VCMs

For investors considering participation in VCMs, project quality is the most crucial issue.

A TSVCM survey (Exhibit 15) has identified credit quality as a critical pain point for its members in the purchasing

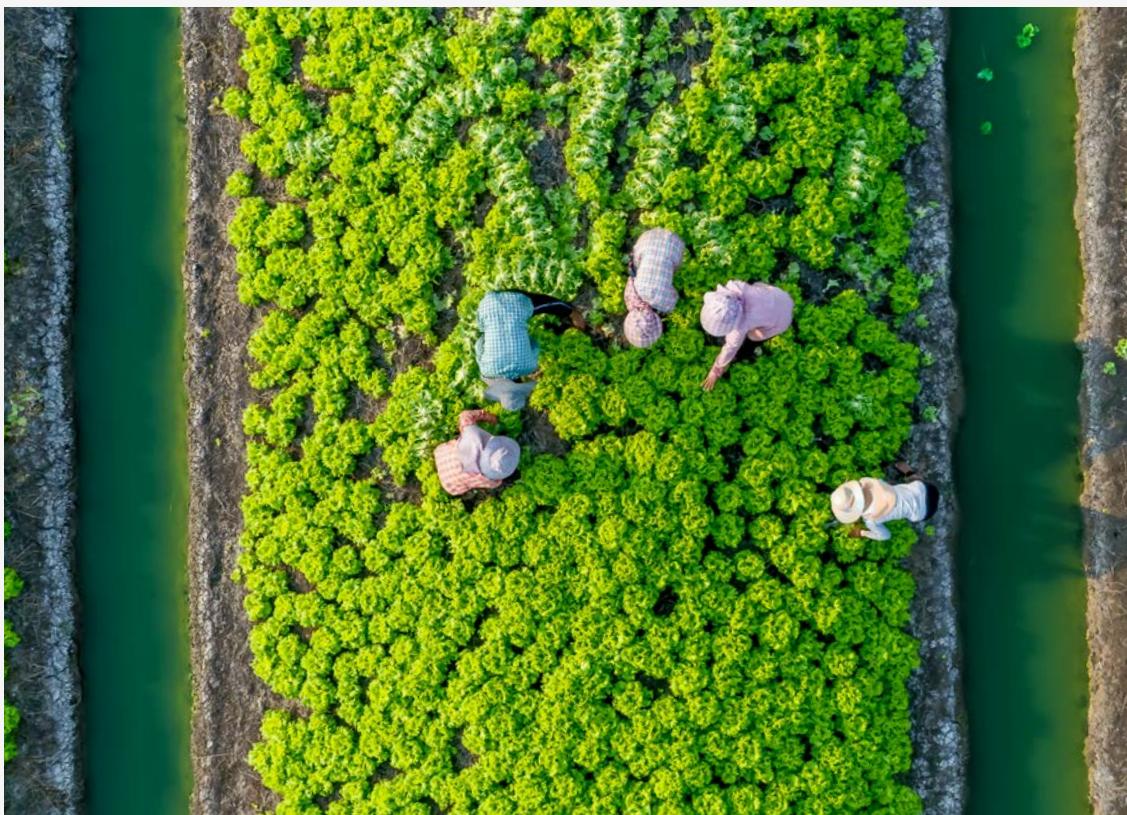
of carbon credits. In the taskforce's January 2021 report, it called for the establishment of core carbon principles (CCPs), which sets out threshold quality criteria to which carbon credits and their underlying standard and

methodology can be assessed against. These CCPs serve as a first step in creating and scaling a transparent and high-integrity carbon credit trading market. The report lays out detailed definitions of potential CCPs which can help investors identify and source for projects of the right quality. In the path towards scaling VCMs, the taskforce is pushing to design and establish robust CCPs and market integrity principles amongst other key focal areas (e.g., stakeholder engagement, governance and standardised documentation, legal principles and contracts).

Beyond the overall quality standards, investors need to consider a range of additional attributes specific to individual projects. These include vintage (the actual year of emissions reduction) as well as project types with different characteristics. The forestry and land use category alone comprises multiple project types, including afforestation,

reforestation, conservation (REDD+) and agroforestry. Technology-based carbon removal projects such as carbon capture also vary widely. In addition, investors should consider co-benefits such as biodiversity, how a project might contribute to the UN's Sustainable Development Goals and its geographic location. The project type is also a key factor to consider, as this attribute tends to determine project costs, the available co-benefits and the types of climate pledges corporates can cover.

The predominant project type on the market today is NCS (Exhibit 16). NCS projects are expected to account for 65 to 85 percent of the total potential credits supply in the coming years. It is likely that the mobilisation of NCS will be needed to meet corporate demand on the 2030 horizon given the low supply potential of 'additional' emissions reduction and removal opportunities and the currently high cost of technology-based removal.



From the perspective of investors wanting to deploy capital at a relatively large scale (as discussed in Chapter 1) identifying potential projects and validating associated data can be a challenge: it requires in-depth expertise in sourcing NCS projects and dedicated investment teams to execute relatively small projects.

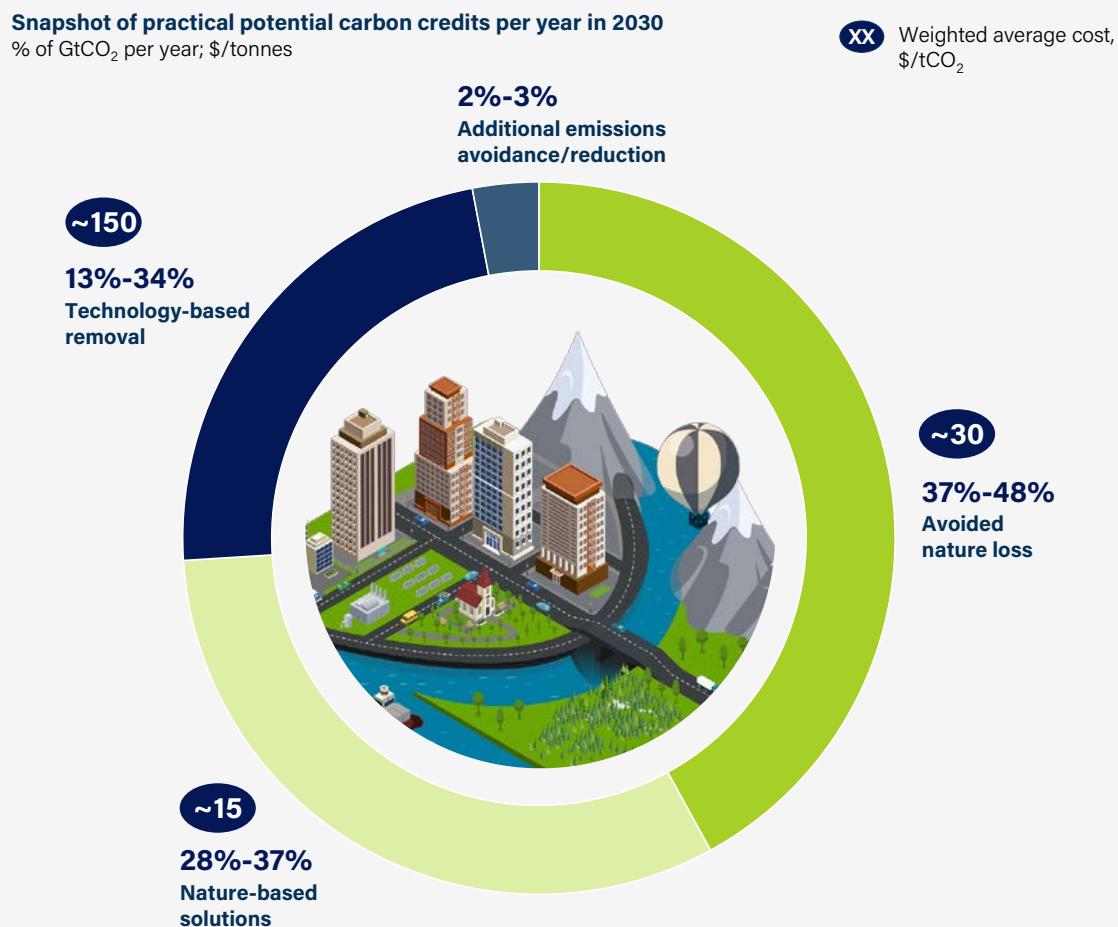
One example is Shell, which has a global ambition to be a net zero emissions

energy business by 2050 or sooner. In Singapore, Shell has set up carbon-trading and carbon-project origination teams.¹ They work with carbon advisors such as Permian Global on forestry projects in Southeast Asia (e.g. Borneo) to offset carbon emissions. This initiative has also assembled an in-house verification team for quality assurance and is investing in R&D for measurement solutions and methodologies. Shell invested around \$ 90 million in nature-based projects in 2020,

¹ Shell Singapore outlines path to transform its business in the country, Shell, 10 November 2020, shell.com.sg

Exhibit 16: On the 2030 horizon, we find that NCS accounts for 65-85% of the total supply potential with much lower mobilisation costs than technology-based removal

Supply that could enter the market is more likely between 1–5 Gt per year



1. 0.2 GtCO₂/yr represents a highly conservative lower bound given it represents existing inventory and excludes pipeline projects and/or forecasts for new projects.

Source: McKinsey's analysis; McKinsey Nature Analytics.

participating in VCM and ramping up financing to help meet its pre-pandemic pledge to allocate \$ 300 million to reducing emissions over a three-year period (Exhibit 17).²

Given the required expertise and scale of participation in the value chain, investors may require intermediaries with higher risk appetite to actively explore these types of carbon reduction and removal projects, in order to deploy large amounts of capital in NCS. The expectation is that such intermediaries would de-risk NCS projects (for example, by verifying

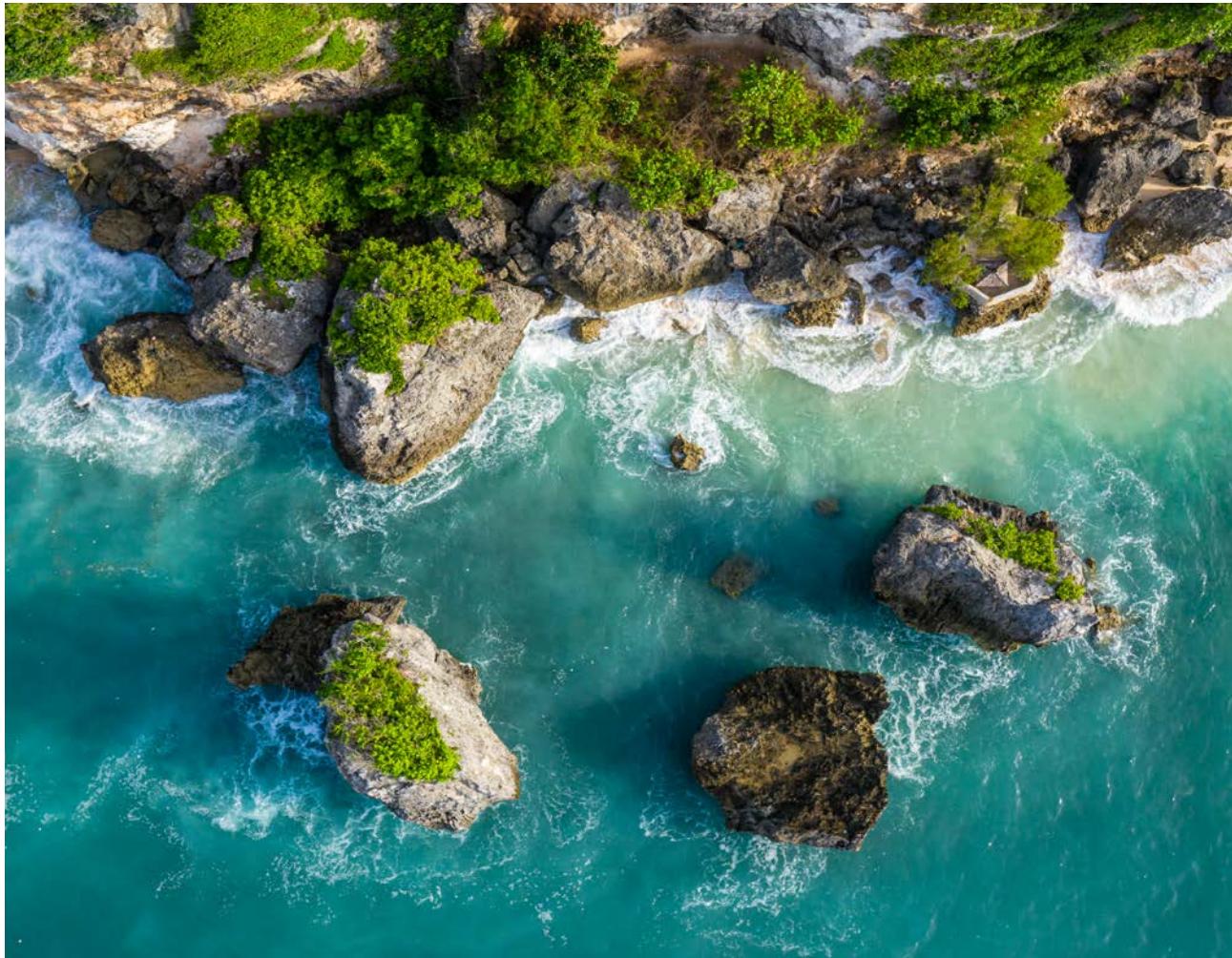
project quality, proving business models and managing projects across forested regions) so that institutional investors can deploy capital and help the market grow. One leading example is commodity trader New York headquartered Hartree Partners, who partnered with sustainability firm SYSTEMIQ in May 2021 to launch a joint venture designed to help clients buy carbon credits from high-quality nature-based projects.³

² Shell Sustainability Report 2020, Shell, reports.shell.com

³ 'New joint venture Vertree helps partners invest in nature & net zero', Systemiq, 26 May 2021, systemiq.earth.

Exhibit 17: Shell developed dedicated team expertise across its value chain to enable its global ambition to be a net zero emissions energy business by 2050 or sooner





2. Supporting the establishment of high-integrity VCM standards and governance

A critical hurdle in the development of VCMs, and a risk for potential investors, is the lack of agreed on and implemented quality standards for carbon credits. The TSVCM identified this as an important issue for buyers of current and future credits.

Surveys carried out by the TSVCM revealed widespread doubts concerning a potential lack of environmental or social integrity in certain projects; a majority backed the idea of introducing additional safeguards regarding assessment methodologies and restrictions on project vintage. To define what a high-integrity credit looks like across categories, the TSVCM proposed a set of core carbon principles to set threshold standards, and the establishment of a governance body to oversee their operation.

There is a crucial role for institutional investors in supporting high-integrity standards and governance, working through the various investor alliances and with interested parties such as the TSVCM and the Singapore Government. Unless higher quality standards are agreed upon and enforced, VCMs will fail to realise their potential to assist in emission reduction and removal, and investors will lose a significant opportunity to invest in and support decarbonisation.

Specifically, because high-quality projects have provided and will continue to provide better benefits for buyers in the future, efforts made now to gain expertise in standards will provide significant early-mover advantages when carbon credits become ready as an asset class.

There is a crucial role for institutional investors in supporting high-integrity standards and governance

3. Guiding portfolio companies on the path to net zero

Investors are already in an intensive dialogue with investee companies about decarbonisation and the extent to which their strategies are aligned with the goals set out in the Paris Agreement. This can only intensify as government authorities and financial regulators carry out their promise to require increased corporate disclosure of climate transition risks and mitigation strategies.

Institutional investors can guide portfolio companies on setting decarbonisation targets (such as net zero) as well as interim targets for emission abatement; support them in reporting annual progress against those targets; and advise them on the use of voluntary carbon credits to help meet their commitments, or to set higher climate ambitions. All of this requires detailed expertise on the part of investors and investee companies, not least on the potential role of voluntary credits in meeting net zero commitments.

The SBTi states that net zero commitment by a company should aim 'to achieve a scale of value-chain emission reductions consistent with the depth of abatement achieved in pathways that limit warming to 1.5°C, and 'to neutralise the impact of any... residual emissions... by permanently removing an equivalent amount of atmospheric carbon dioxide'.⁵³ But as the

same paper points out, today 'corporate net zero targets are being approached inconsistently, making it difficult to assess these targets' contribution to the global net zero goal'.

There are different standards with regards to the appropriate role of carbon credits in meeting corporate net zero commitments during the climate transition. For example, the ISO requires that to qualify as suitable for offsetting, a project 'should result in emission reductions or removal enhancements in addition to what would have happened in the absence of the project'.⁵⁴ On the other hand, the SBTi says, 'credits are only considered to be an option for companies wanting to finance additional emission reduction beyond their SBT or net zero target (the concept of above and beyond)... and avoided emissions are also not counted towards SBTs'.⁵⁵ The appropriate claims for the path to net zero, including the use of compensation credits, are evolving. Accordingly, detailed criteria that will be used to validate net zero targets and guide credible corporate claims are still being reviewed.⁵⁶

But the overall intent of net zero is clear: it requires companies to decarbonise their entire value chain, and only allows them to mitigate emissions considered to be unabatable – in contrast to a less stringent target such as 'carbon neutral', which allows corporates to offset all their emissions, without requiring decarbonisation. TSVCM's publication 'Calling for a High Ambition Path to Net Zero' recommends that companies aim for net zero as an end point in decarbonising their operations and value chains, while also compensating and neutralising their emissions 'on the path to net zero'.⁵⁷ As such, institutional investors that have a net

⁵³ Foundations for Science-Based Target Setting in the Corporate Sector, SBTi, September 2020.

⁵⁴ ISO website, ISO 14064-2:2019(en) Greenhouse gases – Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements, <https://www.iso.org/obp/ui#iso:std:iso:14064:-2:ed-2:v1:en>.

⁵⁵ SBTi website, <https://sciencebasedtargets.org/faqs#does-the-sbt-i-accept-all-approaches-to-reducing-emissions>.

⁵⁶ Abate emissions following interim Science Based Targets: abatement means measures that a company takes to prevent, reduce or eliminate sources of GHG emissions within its value chain, including internal decarbonisation and attribute certificates; Neutralising unabated emissions signifies measures that a company takes to remove carbon from the atmosphere in order to counterbalance the impact of a source of emissions that remains unabated, such as removal or solutions credits; compensation means measures that companies take to prevent, reduce or eliminate sources of GHG emissions outside of their value chain, such as avoidance or reduction credits.

⁵⁷ https://www.iif.com/Portals/1/Files/High_Ambition_Path_to_Net_Zero.pdf.

zero target should ensure their portfolio companies also set net zero as their ultimate goal, as this would allow them to use removal credits, with an option to also compensate using avoidance credits on the path to achieving net zero.

The key role for investors committed to creating a path to net zero is thus to ensure that their own actions and those of their portfolio companies are consistent and aligned with the goals of the Paris Agreement. Investors that have set a net zero target need to ensure that their portfolio companies also use removal credits to neutralise residual or hard-to-abate emissions, and similarly consider using avoidance credits to compensate for unabated emissions over the course of the transition as a contribution to global decarbonisation goals.

Effective use of carbon credits could create additional benefits to help portfolio companies achieve their climate pledges (for instance, reduced costs for critical technology to avoid or remove carbon). However, garnering these benefits and achieving their climate ambitions requires investors to ramp up their expertise in the technicalities of offsetting (Exhibit 18). Some leading investors and asset managers have already begun asking their portfolio companies to disclose a decarbonisation plan aligned with the Paris Agreement. Cazenove Capital, a UK-based asset manager, has begun neutralising the carbon footprint of the portfolio's equity investments via projects focused on biodiversity and reforestation.⁵⁸

Effective use of carbon credits could bring additional benefits to help portfolio companies achieve their climate pledges

⁵⁸ Cazenove Capital unveils innovative carbon offsetting scheme, Cazenove Capital, 29 October 2020, cazenovecapital.com

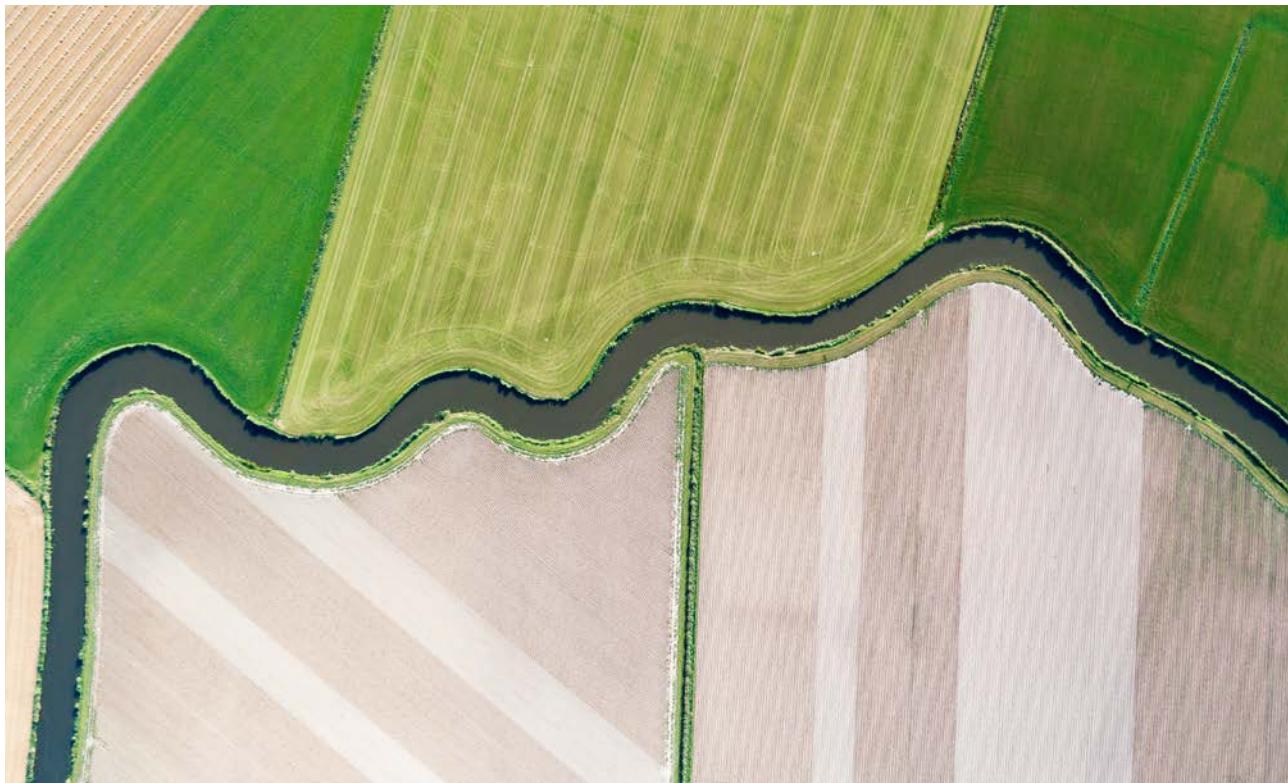
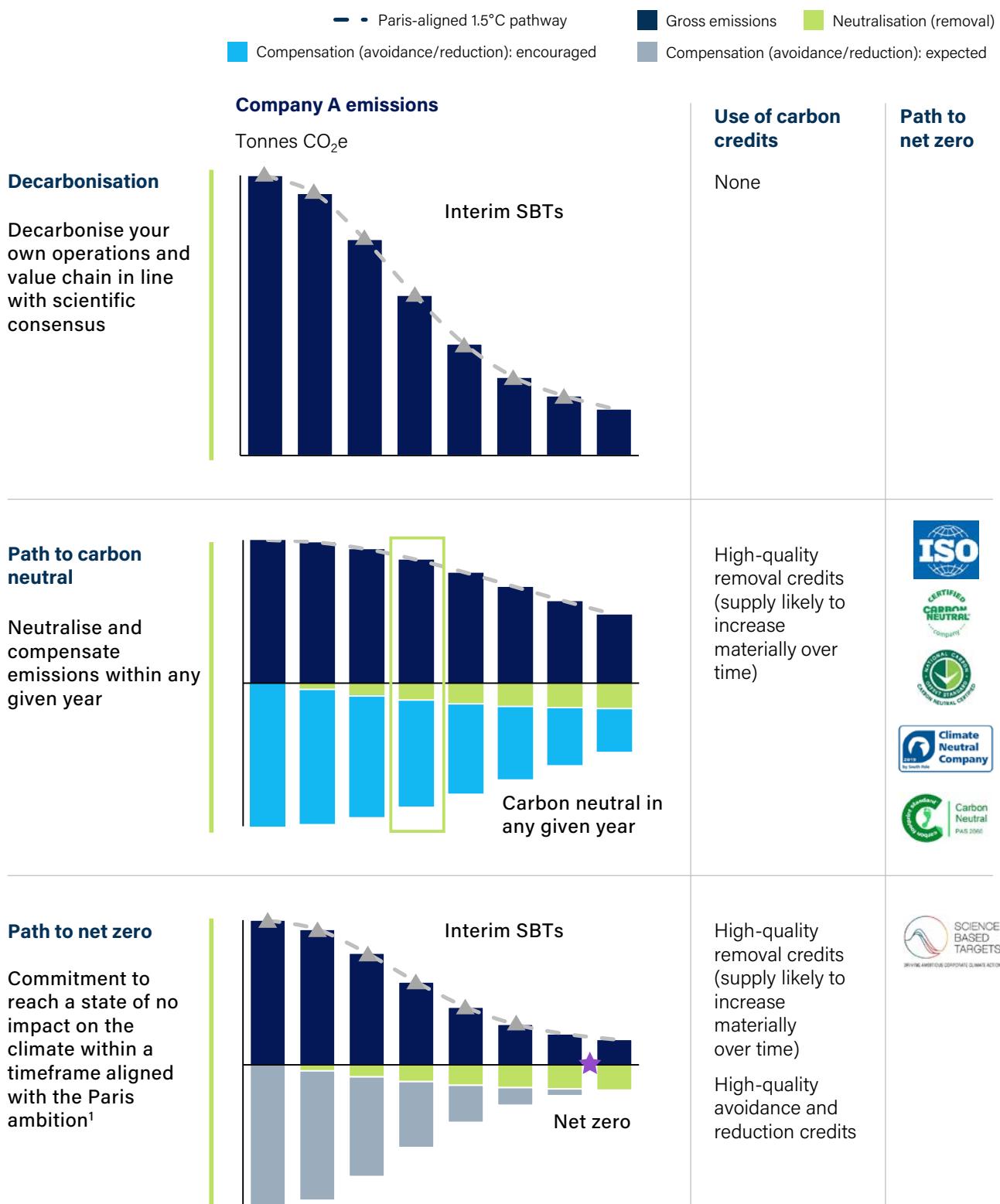
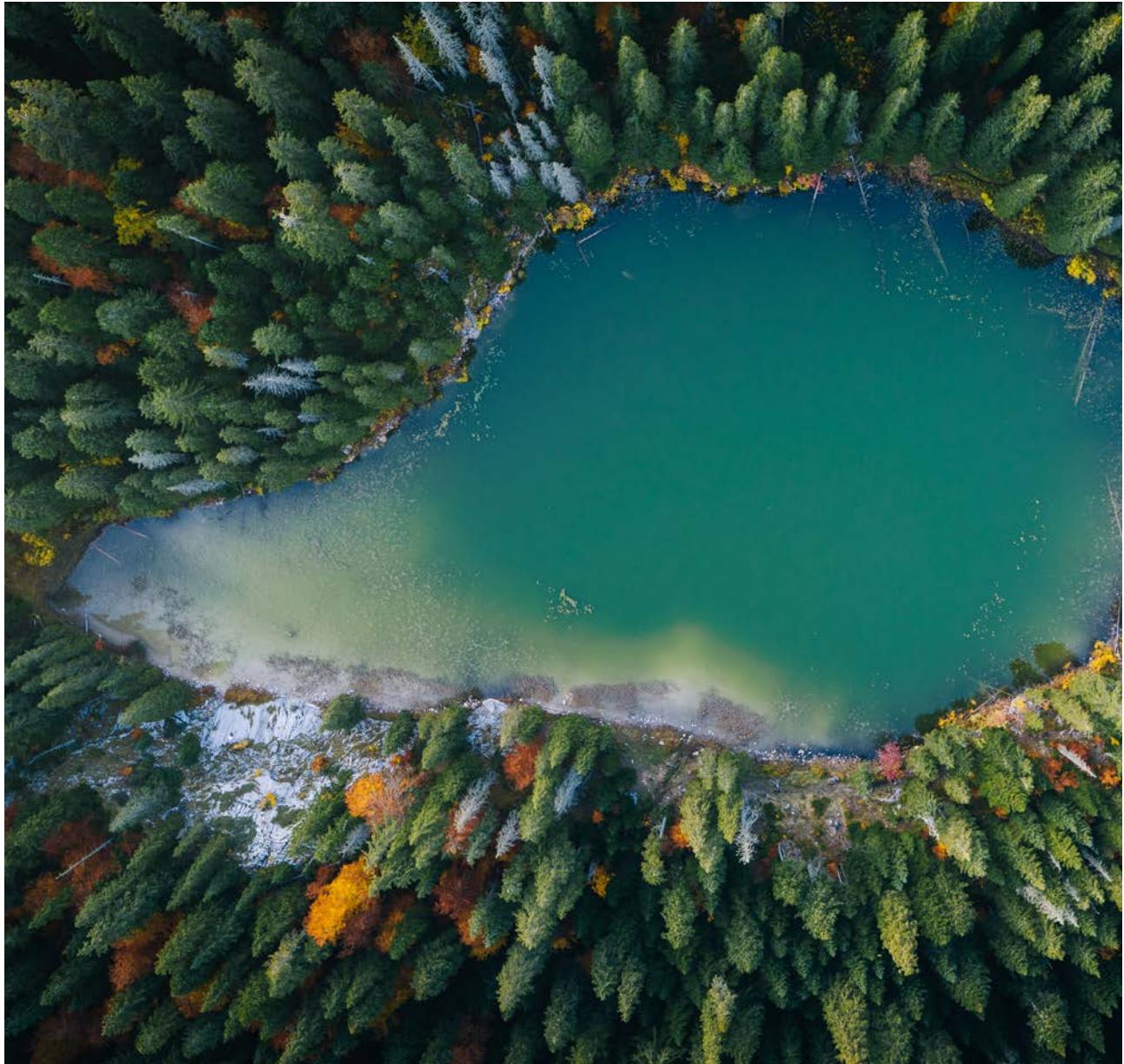


Exhibit 18: Institutional investors can guide portfolio companies on their path to net zero



1. Abate emissions following interim Science Based Targets: abatement includes measures that companies take to prevent, reduce or eliminate sources of GHG emissions within its value chain, including internal decarbonisation and attribute certificates; neutralize unabated emissions includes measures that companies take to remove carbon from the atmosphere in order to counterbalance the impact of a source of emissions that remains unabated, ie removal/sequestration credits; compensating emissions includes measures that companies take to prevent, reduce or eliminate sources of GHG emissions outside of their value-chain, ie avoidance/reduction credits.



Investors need to guard against key risk factors in VCMs

As we have argued throughout this report, VCMs are still nascent and do not yet represent an investable asset class, though this situation could quickly change. As such, they present investors with a number of risks which they need to keep in mind. The efforts to establish high-integrity standards and a solid market infrastructure outlined above will go some way to mitigate these risks, but investors should not lose sight of the potential pitfalls as they consider participating.

The first is the risk that demand for credits will not scale up as projected – for example, if credible standards for the use of credits by companies and investors as part of their climate strategies cannot be established. The demand for credits also partially depends on business, technology and policy developments in specific emission-intensive sectors such as airlines, shipping and heavy industry.

Another key risk arises from the investment time horizon. VCMs almost always involve projects with long lead times: it can take two to three years

to activate a NCS project⁵⁹ and five to seven years until the first credit is issued by a forestry and land use project.⁶⁰ Given the urgent need for carbon reduction and removal, it is therefore inevitable that investments in VCMs will increase sharply before standards, governance and infrastructure have been satisfactorily established. While this is the case, markets will lack liquidity, reliable data and transparent price discovery and will thus feature significant execution risk and higher risk premia than CCMs.

There is a risk that demand for credits will not scale as projected - for example if credible standards for the use of credits by companies and investors cannot be established

Perhaps the most important risk for investors today is reputational risk arising from the perceived lack of environmental integrity. To guard against this and ensure that their motives are not impugned, investors need to ensure that their objectives are always aligned with the foundational objectives of carbon markets and to execute their strategy in ways that contribute to global decarbonisation. There are a number of steps they can take in this regard:

- **Prioritise emission reductions over offset investments.** In their dealings with portfolio companies on climate strategy, investors should always emphasise that the reduction of emissions from their own operations

and supply chains must be the principal means of meeting their climate commitments; investing in removal and reduction credits are a useful complement that ensure alignment with the Paris Agreement and can be used to set higher climate ambitions.

- **Carefully assess projects against five integrity criteria.** While establishing standards and governance for VCMs is a collective endeavour, it is up to individual investors to verify that their projects are compliant with those standards and to subject potential offset investments to their own sense test. There are five critical criteria that are particularly important in this respect:

a. Additionality. A project is 'additional' when the emission reductions resulting from the project are higher than the reductions that would have occurred without the project.

b. Carbon leakage. Leakage occurs when a project creates emissions elsewhere (for instance, when protecting a forest area leads to increased deforestation in other unprotected areas).

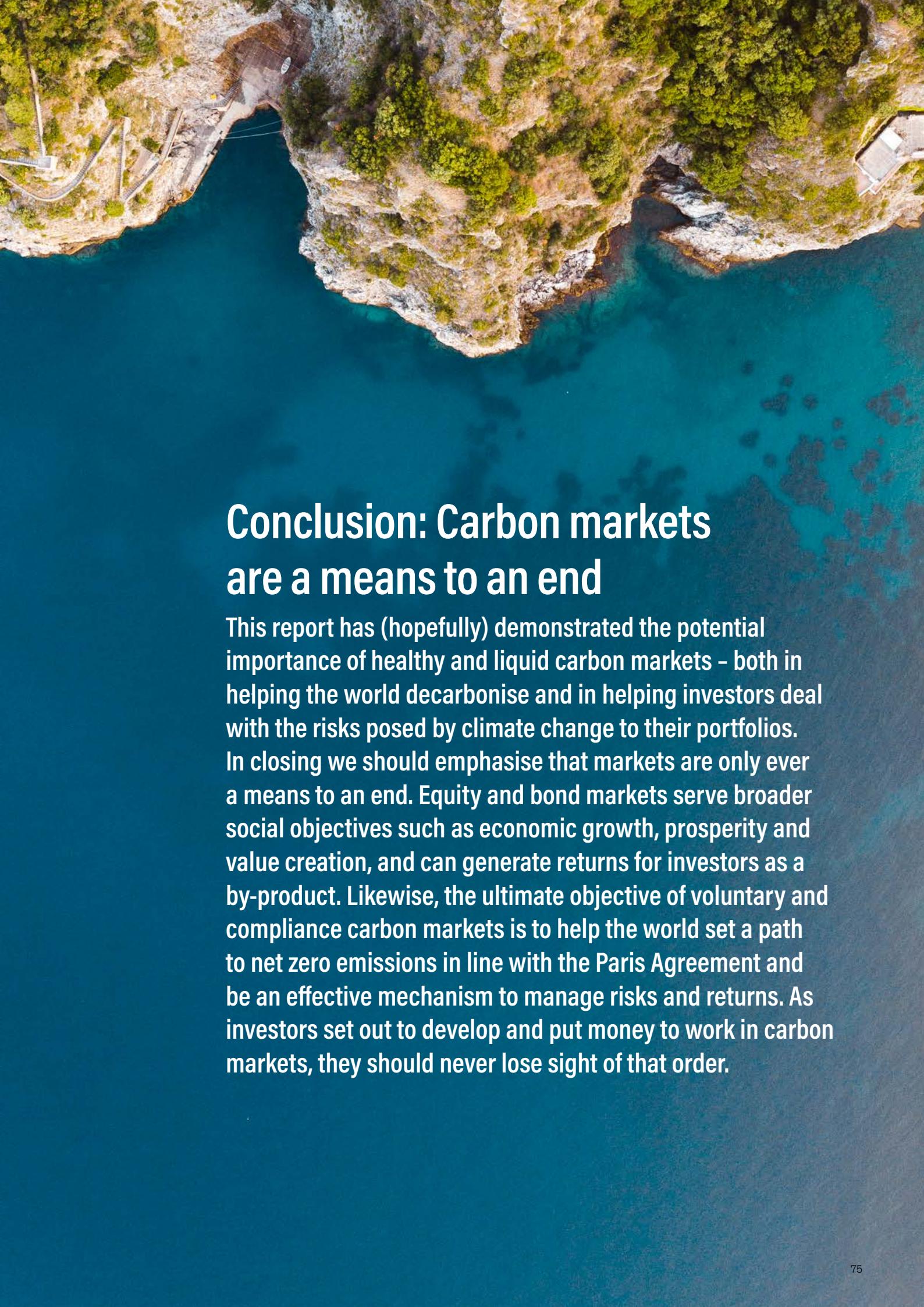
c. Double counting. Double counting happens when a host counts a carbon credit sold abroad towards its own climate targets. Currently, despite corresponding adjustments being unfinalized, ongoing negotiations on Article 6 of the Paris Agreement may result in more stringent safeguards being implemented around double counting in VCMs.⁶¹

⁵⁹ The Business Case for Natural Climate Solutions, joint report by Conservation International, DBS Bank, National University of Singapore (NUS) and Temasek.

⁶⁰ McKinsey analysis of registries on average years between start of the first vintage period (that is verified GHG emission reductions or CO₂ equivalent removals) and first issuance; excluding approximately 62 projects from Plan Vivo (no issuance dates) and CAR (projects changing their compliance or voluntary eligibility over time).

⁶¹ The TSVCM report highlighted that '*corresponding adjustment is an accounting tool currently being discussed within negotiations on Article 6 of the Paris Agreement as the way of ensuring that double counting of greenhouse gas emissions mitigations transferred internationally between countries' nationally determined contributions is avoided. Even though the specific rules around corresponding adjustments have yet to be finalised, they represent a new concept and there are still differing opinions as to whether and how these adjustments should apply to the voluntary carbon market...*'

- d. Permanence.** A project is ‘non-permanent’ when emissions removal is reversed due to events such as deforestation or destruction from natural disasters.
 - e. Verification.** A high-quality carbon credit should be registered and verified with an internationally recognised standard.
- Avoid side effects that impact the overall carbon markets.** As a rapidly-growing phenomenon, VCMs are likely to attract speculative capital that could have disruptive effects on price signals and investment patterns. Investors should build their strategy on a long-term basis and avoid speculative bubbles that drive carbon credits prices to unsustainable levels.

The background of the slide is a high-angle aerial photograph of a rugged coastline. A large, light-colored cliff face with patches of green vegetation rises from the water. A small, dark pier or dock extends from the cliff into a deep blue sea. In the upper left corner, a set of wooden stairs leads down to the water. A small white boat is moored at the end of the pier. The overall scene is one of natural beauty and tranquility.

Conclusion: Carbon markets are a means to an end

This report has (hopefully) demonstrated the potential importance of healthy and liquid carbon markets – both in helping the world decarbonise and in helping investors deal with the risks posed by climate change to their portfolios. In closing we should emphasise that markets are only ever a means to an end. Equity and bond markets serve broader social objectives such as economic growth, prosperity and value creation, and can generate returns for investors as a by-product. Likewise, the ultimate objective of voluntary and compliance carbon markets is to help the world set a path to net zero emissions in line with the Paris Agreement and be an effective mechanism to manage risks and returns. As investors set out to develop and put money to work in carbon markets, they should never lose sight of that order.

Key questions for institutional investors

- Q1. In which part of the value chain
can you invest to make the
biggest difference in voluntary
carbon markets?**

- Q2. How can you encourage
portfolio companies to make
optimal use of credits in
addition to (not instead of)
reducing their own emissions?**

- Q3. How can you collaborate with other stakeholders to best establish high standards of quality, governance and infrastructure in voluntary carbon markets?**
- Q4. How will you devise a strategy that ensures your actions and investments are aligned with the ultimate objective of helping the world to decarbonise?**



Technical Appendix

A detailed overview on CCMs and VCMs

Compliance carbon markets

CCMs comprise two main mechanisms: ETS, with cap and trade being the most actively tradable product due to the high liquidity of emission credits and allowances investment in selected countries and regions, and carbon tax (where there is no direct investment or trading, although there is potential for voluntary carbon credits to be allowed to offset tax obligations). Both carbon taxes and ETS are equally effective and popular market-based instruments for reducing emissions, although each has certain advantages and disadvantages.

To date, many global emitters (China, the European Union and the United States) have opted to adopt ETS, making CCMs increasingly important in supporting global transitions to net zero. Within ETS, there are two instruments available to institutional investors:

- 1. Physical certificates.** These are the most common type of instrument accessible in the market; participants buy physical certificates in an auction or on the secondary market, with the holding being recorded in a designated carbon registry.
- 2. Futures contracts.** The EUA and the US CCA and RGGI are actively traded and physically established products in the futures market. All three markets are in contango despite no physical cost of carry. The size of this market is equivalent to that of physical certificates: globally, approximately 14 gigatonnes of futures and options were traded on the Intercontinental Exchange (ICE) in 2020 compared to some 10 gigatonnes of physical certificates.

Voluntary carbon markets

Investors are still largely at an early exploratory stage in the process: many leading asset managers and owners have started to define targets and aspirations for climate solutions within their portfolio, but very few have carried out investment trading of carbon credits. In today's secondary market, voluntary carbon credits can be traded in two ways:

1. Retailers or project developers

(for example, ClimateCare and TerraPass) in over-the-counter markets serve as the main channel. Credits are issued and retired by private standards (such as the Gold Standard and Verra's VCS).⁶² Retailers contract with project developers and take ownership of credits; thus, pricing for end users is usually opaque (especially in the case of for-profit retailers). Some project developers directly sell carbon credits to users (for example, South Pole, who has over 700 carbon reduction or removal projects globally and sells carbon credits).

2. Wholesale broker or exchange players

(such as AirCarbon Exchange) facilitate transactions between project developers and end buyers for a fee without taking ownership of the credit; however, to date, they have very little share of the trade. Overall, the type of project and the quality of the credits, as proxied by private standards, drive pricing.

⁶² Standards offered by independent third-party certification are essential to verify that the impact of carbon-avoidance and removal projects that generate carbon credits are real, verifiable, additional, and permanent. Key standard bodies are: Gold Standard, Verra's Verified Carbon Standard, Clean Development Mechanism –part of the Kyoto Protocol and Plan Vivo Foundation.

Institutional investors can access the instruments via carbon credits that focus on four aspects:

1. **Avoided nature loss** (for example, projects that limit the loss and degradation of forests and peatland, which currently sequester large amounts of carbon).
2. **'Additional' emission avoidance or reduction** that reduces emissions from current sources, which do not have the financial incentive or regulatory requirement to decarbonise.
3. **Nature-based solutions** that use nature to sequester more CO₂ in the biosphere, including reforestation and restoring soil, mangroves, seagrass and peatlands.
4. **Technology-based removal** that removes CO₂ from the atmosphere with the help of modern technology and stores it in the geosphere or through other secure methods.

Five criteria for carbon instrument investability assessment

Our analysis assesses each of the five criterion in terms of whether its magnitude is sufficient for investment. The framework is built for large institutional investors to consider the readiness of large investment portfolio inclusion of carbon assets from CCM and VCM markets. These criteria do not necessarily determine the feasibility of investments for corporates that purchase carbon credits to fulfill their net zero ambitions.

1. **High accessibility by institutional investors.** Assets must be accessible for institutional investors. We explored whether the secondary market is: sufficient (publicly tradable through exchange or established via a replicable transaction process), investable (available but would require a non-standardised transaction process) or not investable.

2. **Significant market size.** Institutional investors require a large market size for an asset to be an asset class. In this context, market capitalisation (or issuance) which allows (or will allow) institutional investors to deploy a sufficient share of their portfolio is important. Here, we looked at whether market capitalisation or issuance is more investable (more than \$ 50 billion) or less investable (less than \$ 50 billion).⁶³

3. **High liquidity.** This refers to the trading volume which allows for portfolio rebalancing with sufficient frequency. In this context, we looked at the trading volume as a percentage of the total market size (or credit issuance) – that is, the average number of transactions made for one allowance. We assessed whether this annual trading volume is: sufficient (more than 100 percent), investable (10 to 100 percent), or not investable (less than 10 percent).⁶⁴

4. **Standardisation of transactions.** Given the size of institutional investments, transactions need to be transparent and standardised, so that investors can deploy large capital at scale. We reviewed whether asset valuation is: sufficient (valuation is standardised across assets, meaning that there are uniform valuation methodologies for all assets), investable (assets can be categorised by several valuation methodologies) or not investable (each asset requires individual evaluation).

5. **High price discoverability.** Strong historical returns and persistence over time enable future price projection, so drivers that explain historical performance need to be available. Here we looked at whether availability is: sufficient (available and can be used for future perspectives), investable (available yet cannot easily be used for future perspectives) or not investable (unavailable).

⁶³ Assuming global top 20 institutional investors deploying 0.5 percent of portfolio to carbon markets every year to reach 2.5 percent of total portfolio allocation in five years.

⁶⁴ Based on global private market in-year fundraising as share of assets under management in 2020.

Detailed modelling approach overview

Step 1.

Our analysis is based on three NGFS REMIND-MAgPIE climate scenarios: hot house world, immediate transition and delayed transition.⁶⁵ These scenarios are the basis on which we model investment portfolio performance and climate risk impact.

1. **Hot house world scenario.** Only current climate policies are maintained. Nationally determined contributions under the Paris Agreement are not met and emissions grow until 2080 leading to more than 3°C of warming. This causes severe physical risk.
2. **Immediate transition scenario.** Climate policies are introduced early and gradually become more stringent. Net zero emissions by 2070 offer a 67 percent chance of limiting warming to below 2°C.
3. **Delayed transition scenario.** Paris-aligned climate policies are not introduced until 2030. As a result, emissions reductions are sharper than the ‘immediate transition’ scenario to limit warming to the same target. This leads to stringent and disruptive policy responses, which increases transition risk.

Emissions prices are defined as the marginal abatement cost of an incremental ton of greenhouse gas emissions. In the models used to produce the NGFS Climate Scenarios, shadow emissions prices are a proxy for government policy intensity. The prices are calculated to be consistent with a pre-defined temperature target (e.g., 67% chance of limiting global warming to 2°C). This is a simplification. In reality, governments are likely to pursue a range of different policies. This means carbon prices will

diverge from model optimal levels. Emissions price trajectories will also vary across models due to other underlying assumptions such as the costs of new technologies and the extent to which they are deployed.

Step 2.

To generate a portfolio return forecast, we use industry consensus on long-term capital market assumptions from J.P. Morgan, BlackRock and Invesco as our baseline return profile for individual asset classes, and then apply asset-level valuation impact from climate risks based on our proprietary climate risk models from Planetrics (part of McKinsey).

For each asset class, we choose a global index as a proxy to help us estimate both its baseline performance and climate impact. There are:

- **Global equities market.** iShares MSCI ACWI ETF, which consists of approximately 2,300 companies across developed and emerging markets. In terms of geography, roughly 57 percent of the companies are based in the United States, 6 percent in Japan, 5 percent in China, 4 percent in the United Kingdom, 3 percent in France and Canada, and 22 percent in other countries. In terms of sectors, the top three are information technology (21 percent), financials (15 percent) and consumer discretionary (12 percent).
- **Global bond market.** J.P. Morgan Hедged Global Government Bond Index, which consists of sovereign bonds of multiple tenors primarily in Japan, Italy and the United States.
- **Global real estate market.** iShares Global REIT ETF, which consists of approximately 300 REITs primarily in

⁶⁵ REMIND-MAgPIE is a comprehensive IAM framework that simulates, in a forward-looking fashion, the dynamics within and between the energy, land-use, water, air pollution and health, economy and climate systems. The models were created over a decade ago (Leimbach, Bauer, Baumstark, & Edenhofer, 2010; LotzeCampen et al., 2008) and are continually being improved to provide up-to-date scientific evidence to decision and policy makers and other relevant stakeholders on climate change mitigation and SDGs strategies.

the United States (69 percent), Japan (9 percent), the United Kingdom (5 percent), Australia (4 percent), Canada (3 percent) and Singapore (3 percent).

Based on this approach, we calculate the following asset-level input:

- **Expected annual growth rate:**

- For carbon credits, the expected annual growth rate is derived from NGFS 2021 carbon price forecasts – world average price, as proxies for future ETS prices. We use the NGFS carbon price forecast for 2030 and 2050 to calculate the expected annualised return assuming it will be constant over the forecast period.
- For equities, bonds and real estate, we take an average of the market assumptions from the external sources (J.P. Morgan, BlackRock and Invesco) as the baseline growth rate, and apply climate risk value impact to arrive at the final expected annual growth rate for each asset class under each climate scenario.

- **Expected annualised volatility:**

- For carbon credits, we use historical monthly returns of equally weighted major ETS markets since 2016.
- For equities, bonds and real estate, we use analyst forecasts (from J.P. Morgan, BlackRock and Invesco) for individual asset class' volatility.

- **Correlation between asset classes:**

- For carbon credits, we use historical correlations of the daily returns since 2016 of equally weighted major ETS markets, against other asset classes.
- For equities, bonds and real estate, we use analyst forecasts (from J.P. Morgan, BlackRock and Invesco) to calculate the correlation matrix across asset classes.

Step 3.

We construct three hypothetical investment portfolios, with an increasing percentage of carbon-credit allocations (0 and 5 percent) to help us evaluate the effect of carbon-credit inclusion on the overall portfolio performance.

For the baseline, we use a generic 60 percent equities and 40 percent bonds reference portfolio for simplicity considerations. Other alternative asset classes, such as real estate, have also been considered and assessed in our analysis, as we recognise the diversity of modern investment portfolios and the wide range of portfolio holdings for different types of institutional investors. These analyses of more complex reference portfolios are not included in this report as the overall conclusions on carbon credit inclusion remain the same.

To evaluate the effect of carbon credit on portfolio performance, we construct a hypothetical portfolio based on the reference portfolio with 5 percent carbon allowance allocation. The carbon allowance portion of the portfolio consists of equal weighting of major ETS markets (EU ETS, US CCA, RGGI and NZ ETS).

The resulting two portfolios are:

- **Portfolio 1 (reference portfolio):**
60 percent equities and 40 percent bonds.
- **Portfolio 2 (5 percent carbon credit):**
57 percent equities, 38 percent bonds and 5 percent carbon allowances.

Step 4.

We now use the Monte Carlo simulation to generate a total of 100,000 portfolio return outcomes over the ten- and 30-year period for each of the investment portfolios under each of the climate scenarios. We assume the returns of the asset classes are normally distributed.

Step 5.

By aggregating the 100,000 portfolio outcomes, we can determine the key metrics that are interesting to portfolio managers when making investment decisions – these include annualised returns, annualised volatility and risk-adjusted returns.

Rationale on climate scenarios selection

We use NGFS REMIND scenarios to model the transitions and physical impacts for the 2030 and 2050 horizon because: NGFS scenarios are widely used by central banks and the financial sector for climate stress testing; they provide key physical and transition scenario parameters required as the inputs for estimating economic shocks, including temperature rise, carbon prices and energy system characteristics; and the scenarios are widely adopted, and have excellent technical criteria, relevance and comparability. Among the eight climate scenarios from NGFS REMIND-MAgPIE, the three sub-scenarios below are selected to cover a comprehensive range of scenarios:

- **High physical risks - hot house world.** To further test the impact of intensifying physical risks, this scenario assumes heightened physical risks based on a high climate sensitivity (90th percentile warming effects from scenario emissions), high ice-sheet-level melt and increasing tropical cyclone risk.
- **A range of transition risks.** Immediate versus delayed transition represents the range of risks based on how quickly decarbonisation actions are implemented.
- **2°C scenarios are widely acknowledged and adopted** by multiple peers, governments and central banks for climate stress testing and target setting, and this meets the Paris Agreement's temperature ambition of well below 2°C.

Underlying drivers on value impact of climate scenarios

We estimate relative value impacts from climate-risk scenarios with assumed foresight to potential climate change and hence adjust discounted net present valuation across the covered periods. One highlight here is that our modelling assumption is on the 2050 horizon and most of physical risk impacts are expected post 2050 (especially in the hot house world scenario); as such current the modelling has limited assessment of physical impact and focuses more on the transition risks.

- **Physical impact.** Change in net present value for listed or private equity or corporate debt based on the chronic and acute impacts of rising temperatures on a firm's costs and revenue. This includes increased average annual damages from extreme weather on property, plants and equipment, and changes in labour and agricultural productivity arising from higher temperatures.
- **Adaptation.** Change in net present value based on the ability of firms to adapt to intensifying physical risks by taking actions to mitigate the impacts of more extreme weather and higher temperatures.
- **Demand destruction.** Change in net present value based on declines in demand arising from changes in consumption patterns that are driven by consumers facing carbon costs when consuming a firm's products or associated products (both competing and complementary).
- **Demand creation.** Change in net present value based on increases in demand arising from changes in consumption patterns that are driven by consumers avoiding carbon costs when consuming a firm's products or associated products (both competing and complementary).

- **Direct carbon costs.** Change in net present value based on the direct carbon costs on a firm's scope 1 and 2 emissions relating to its activities. Emission-intensive activities experience the largest increase in production costs from carbon pricing.
- **Abatement.** Change in net present value based on the ability of a firm to mitigate carbon costs by adopting technologies capable of reducing or eliminating emissions from its activities.
- **Market impacts.** Change in net present value based on the ability of a firm to pass through rising production costs from physical or transition risks to consumers. The amount of costs that can be passed through to consumers depends on the structure of the market a firm is active in and how exposed a firm is to climate impacts compared to competitors. This also includes modelled changes in output resulting from price changes induced by cost pass throughs, changes in firm market share and cost savings resulting from incomplete cost pass throughs by power producers to business consumers (affects scope 2 emissions costs).

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