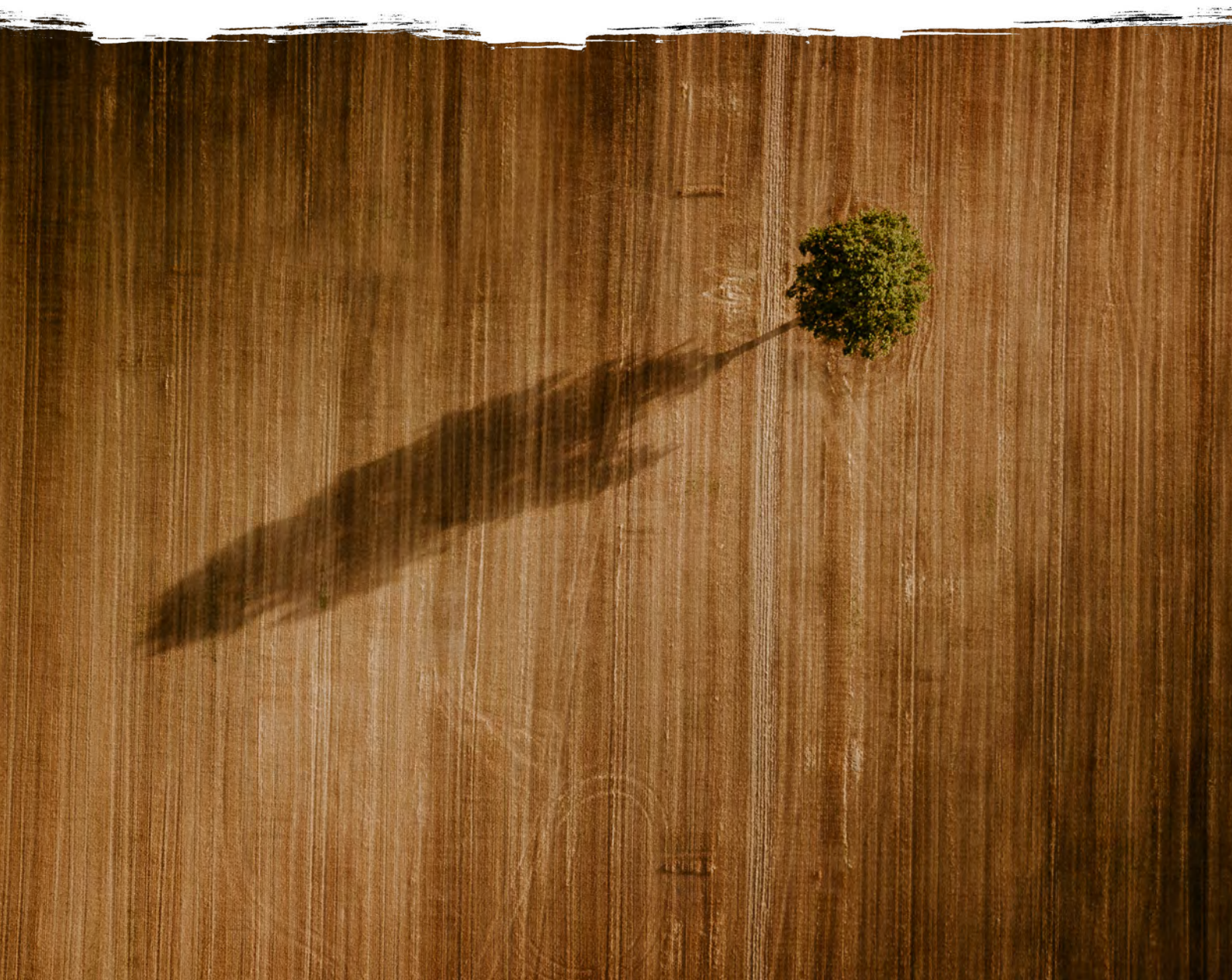




The Net Zero Transition and Offsetting of Carbon Intensity in Retail Investment Portfolios

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Forest Trends works to conserve forests and other ecosystems through the creation and wide adoption of a broad range of environmental finance, markets, and other payment and incentive mechanisms. Forest Trends does so by: 1) providing transparent information on ecosystem values, finance, and markets through knowledge acquisition, analysis, and dissemination; 2) convening diverse coalitions, partners, and communities of practice to promote environmental values and advance development of new markets and payment mechanisms; and 3) demonstrating successful tools, standards, and models of innovative finance for conservation.

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Abstract

The financial sector is witnessing a rapid evolution in climate metrics, driven by both regulatory pressure and consumer-driven trends toward sustainable investment, helping investors prioritize lower carbon investments. Overlooked to date has been the potential for product offerings that mobilize demand for carbon offsets from investors. This paper argues that the development of consumer-facing financial technology platforms and leadership by some investment managers should provide an opportunity for retail investors to go further—not only to prioritize lower carbon or climate transition strategies, but additionally to use offsets to immunize against residual carbon intensity in pension or other savings vehicles. Carbon footprint metrics can provide a hook for retail investor willingness-to-pay to mitigate greenhouse gas emissions and to achieve net zero. Governments and regulators can encourage this trend in order to enhance the financial sector's role in the climate transition: Firstly, to reinforce corporate action in the real economy. Secondly, to secure very large-scale private co-funding for public climate finance in developing countries, including for Nature-based Solutions and REDD+, critical to achieving the goals of the Paris Agreement and to minimizing the global economy's costs of transition to climate stability.

Executive Summary

Financial product innovation will play a critical role in the mobilization of a broad pool of capital, including active participation by retail investors, in funding climate finance.¹

Many investors are prioritizing low carbon and climate-transition strategies. Overlooked to date has been the potential for product offerings that mobilize demand for carbon offsets from investors as a supplementary tool to immunize portfolios against residual carbon intensity.

Corporate demand for carbon offsets in the real (non-financial) economy is already rising rapidly, driven by business focus on transitioning to net zero. Demand is expected to be especially robust in sectors where emissions are hard to abate. The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) under the International Civil Aviation Organization (ICAO) is set to launch a compliance market in 2021 and will be scaled up to full implementation in 2027.² The Institute of International Finance (IIF)'s Taskforce on Scaling Voluntary Carbon Markets final report of January 2021 included a call for enhanced consumer product offerings to bolster industry-wide commitments in order to build a demand signal for scaling voluntary carbon markets.³

The financial sector is witnessing a rapid evolution in climate metrics, driven by both regulatory pressure and consumer-driven trends toward sustainable investment, helping investors prioritize low carbon investments.

¹ Global Financial Market Association. *Climate Finance Market and the Real Economy*. Global Financial Market Association, 2020. <https://www.gfma.org/policies-resources/gfma-and-bcg-report-on-climate-finance-markets-and-the-real-economy/>.

² F. Watson, "ICAO Council adopts 2019 baseline for aviation carbon offsetting system," *S&P Global*, July 1, 2020. <https://www.spglobal.com/platts/en/market-insights/latest-news/coal/070120-icao-council-adopts-2019-baseline-for-aviation-carbon-offsetting-system>.

³ Taskforce on Scaling Voluntary Carbon Markets, *Taskforce on Scaling Voluntary Carbon Markets Final Report*. Institute of International Finance, 2021. https://www.iif.com/Portals/1/Files/TSVCM_Report.pdf.

Investment platforms and managers could offer clients the opportunity to acquire carbon offsets alongside their existing investment portfolios as the next step in low carbon product offerings, to allow them to become “net zero” investors.

Even in the absence of product offerings from investment managers, emerging financial technology consumer-facing platforms (available on android and web interfaces) will provide retail investors directly and easily with carbon footprint data on investment portfolios, highlight lower carbon alternatives and offer opportunities to acquire offsets.⁴

Demand for offsets, as a supplement to low carbon investments, will be driven by retail investor willingness to pay—to go beyond targeting of commercial returns of mainstream socially responsible investing, and to accept a lower overall financial return in exchange for a positive climate impact and a net zero portfolio.

This willingness-to-pay for carbon offsets would reflect that:

- For retail investors a truly low carbon investment portfolio would risk an overly high concentration in specialist clean technology funds or those sectors of the economy that have very low carbon intensity.
- Low carbon strategies that have small tracking errors with standard indices and broader equity market performance are not fully aligned with Paris Agreement goals and are not carbon neutral.
- Low carbon products and strategies could become expensive either because policy is insufficiently ambitious to drive transition in the real economy or because flow of funds into low carbon products drives valuations too high, or both. In this scenario, fiduciaries obliged to maximise returns or savers themselves could rotate out of overvalued equities into standard products and may prefer to have the option to offset their carbon footprint rather than hold equities that could underperform.
- A retail investor may believe they could have greater climate impact via paying for offsets than from accepting lower yields from low carbon assets, or at least would like the flexibility to use carbon offsets to help supplement and switch between strategies and still maintain a low carbon footprint.
- Acquiring offsets would reduce overall carbon footprint while allowing savers to make much needed “transition” investments in those companies in carbon intensive sectors that are dedicating serious resources to adjusting their business models for a more sustainable future.

The extent to which investors need to pay to offset the carbon intensity of portfolios would be reduced if the companies in which they have invested had succeeded in reaching net zero (including through offsetting). This would reinforce competitive pressure for corporate action.

The potential for investors to support international climate finance programs in developing countries has important implications for financial stability (and thus for regulators). It will be impossible to achieve the goals of the Paris Agreement, and thus prevent risks to financial stability, without “Nature-based Solutions” (NbS) to climate change.

Demand from private investors (as well as from corporates) for carbon offsets could help governments secure the massive increases in private co-funding for REDD+⁵ programs to conserve and enhance tropical forests. Such programs are critical to hopes of holding global

⁴ See for example www.sugi.earth.

⁵ REDD+ stands for “Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries.” REDD+ is the framework launched under the United Nations Framework Convention on Climate Change for supporting reduced emissions and increased removals from tropical forests.

warming below 2°C and to minimizing the global economy's costs of transition to climate stability. A quantum increase in REDD+ supply would prevent carbon prices from escalating rapidly or forcing impossibly steep endogenous decarbonization trajectories on key industries, damaging investment valuations or reducing political ambition when emission reduction policies need to be tightened.

If retail investors supplement low carbon and climate transition investment strategies with offset purchases such as REDD+ credits, they would reinforce corporate focus on achieving net zero, reinforce the stability of the financial system and contribute directly to climate change mitigation.

Governments and regulators can encourage this trend:

- To enhance the financial sector's role in the net zero carbon transition; and
- To secure very large-scale co-funding for public climate finance in developing countries, through initiatives such as The Green Gigaton Challenge.⁶

In the sections below we discuss:

1. The evolution of climate metrics in the financial sector
2. Climate metrics and financial performance
3. Socially responsible and impact investing
4. Beyond SRI: Opportunity and rationale for retail investors to offset the carbon intensity of investment portfolios
5. Nature-based Solutions to climate change and financial stability
6. Conclusion and recommendations

⁶ Green Gigaton Challenge, 2021. <https://www.greengigaton.com>.

Section 1

Climate metrics in the financial sector

The financial sector is witnessing the rapid evolution of climate risk metrics as well as emerging regulatory requirements for investment managers and pension fund trustees to climate stress-test portfolios.

This is evidenced by, for example, the Financial Stability Board's Task Force on Climate-Related Financial Disclosures;⁷ climate change reporting requirements in the United Kingdom (UK) Pensions Scheme Bill of November 2020; the European Union (EU) Green Deal proposals to enshrine in law the necessity for all sectors of the economy to transition to net-zero emissions by 2050;⁸ the EU Sustainable Finance Taxonomy framework for investors with reference to this target; and the development of low carbon indexes and climate Value at Risk strategies in the financial markets.

The Network for Greening the Financial System now has eighty-four central banks and regulators as members.⁹ The Montreal Carbon Pledge, an environmental initiative launched by the United Nations Principles for Responsible Investment, encourages investment management firms to monitor and disclose the carbon footprint of their investment portfolios.¹⁰ At the same time, investors are increasingly aware that the value of shares in fossil fuel companies needs to account for the risk of stronger future policy and regulatory responses from governments to climate change.¹¹ In the UK, the Make My Money Matter campaign aims to align the pension sector with society's values to support the transition of the whole economy towards net zero.¹² Some pension providers and asset managers, including Aegon¹³ and Robeco,¹⁴ have set 2050 net zero targets for their investment portfolios.

As Mark Carney, the United Nations (UN) Special Envoy for Climate Change, has stated:

Some of the world's largest insurers, pension funds and asset owners, with over US\$5 trillion in assets under management, have committed to manage down the carbon footprints of their investments by up to 29 per cent, preferably on a scope three basis by 2025 and to be at net zero by 2050. This metrics-based approach will likely become increasingly common...Demands from pension funds and retail investors for more detailed and robust information about the impact of their savings on climate change will force

⁷ Task Force on Climate-related Financial Disclosures, "TCFD Learning Hub." Task Force on Climate-related Financial Disclosures, n.d. Accessed January 2021. <https://www.fsb-tcfd.org>.

⁸ A European Green Deal, "A European Green Deal." European Commission, n.d. Accessed January 2021. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en.

⁹ Network of Central Banks and Supervisors Network for Greening the Financial System, "Membership." NGFS, December 2020. <https://www.ngfs.net/en/about-us/membership>.

¹⁰ Principles for Responsible Investment, "The Montreal Carbon Pledge." PRI Montreal Pledge, n.d. Accessed July 2020. www.montrealpledge.org.

¹¹ See for example UK Sustainable Investment and Finance Association, *Oil Pressure Gauge Survey 2019*. UKSIF, 2019. <https://uksif.org/oil-pressure-gauge-survey-booklet-2019/>; Carbon Tracker Initiative, "Aligning capital market actions with climate reality." Carbon Tracker Initiative, n.d. Accessed January 2021. <https://www.carbontracker.org>.

¹² Make My Money Matter [website]. <https://makemymoneymatter.co.uk>.

¹³ Professional Pensions, "Aegon commits to net-zero default funds by 2050." *Aegon*, 19 January 2021. https://www.aegon.co.uk/content/ukpaw/news/aegon_commits_tonet-zerodefaultfundsby2050.html.

¹⁴ Gilber Van Hassel, "Robeco commits to net zero carbon ambition by 2050." *Robeco*, 4 December 2020. <https://www.robeco.com/uk/insights/2020/12/robeco-commits-to-net-zero-carbon-ambition-by-2050.html>.

companies in all sectors to demonstrate how they're transitioning to net zero.¹⁵

Against this backdrop mainstream financial products with a climate theme have been developing and gaining traction with investment managers at great pace. MSCI (which provides the leading benchmarks for global equity and exchange traded funds) and S&P Dow Jones measure the carbon footprint of their mainstream indexes and have created Low Carbon, Paris Aligned, and Climate Transition indexes that reweight equities based on carbon exposure, calculate Value at Risk for temperature constrained emissions reduction trajectories, or identify leading companies achieving decarbonization in each sector.^{16,17}

Box 1. MSCI Low Carbon Indexes

The MSCI Low Carbon Indexes are intended to help identify potential risks associated with the transition to a low carbon economy while representing the performance of the broad equity market. Launched in 2014, they are the first index series designed to address two dimensions of carbon exposure: carbon emissions and fossil fuel reserves. MSCI Low Carbon Indexes can be split into two index suites:

- The MSCI Global Low Carbon Target Indexes reweight stocks based on their carbon exposure in the form of carbon emissions and fossil fuel reserves. The indexes are designed to achieve maximum carbon exposure reduction and achieve 0.3% (30 basis points) *ex ante* tracking error target while minimizing the carbon exposure relative to their parent indexes.
- The MSCI Global Low Carbon Leader Indexes aim to achieve at least 50% reduction in the carbon footprint of the parent index by excluding companies with the highest carbon emissions intensity and the largest owners of carbon reserves (per dollar of market capitalization). They also aim to minimize the tracking error relative to their parent index.

The MSCI Climate Paris Aligned Indexes are designed to align with a 1.5° scenario using MSCI Climate Value-at-Risk and an ongoing self-decarbonization rate of 10% year on year. The indexes target at least a 50% reduction in Weighted Average Carbon Intensity and 50% reduction in Physical Climate Risk relative to the reference index, while aiming for minimum tracking error and low turnover.

¹⁵ Simon Brooke, "UK green investors can drive net zero." *Raconteur*, 24 November 2020. <https://www.raconteur.net/finance/investing/mark-carney-net-zero/>.

¹⁶ MSCI, "MSCI Low Carbon Indexes." MSCI. Accessed January 2021. <https://www.msci.com/low-carbon-indexes>.

¹⁷ S&P Dow Jones Indices, "Paris-Aligned and Climate Transition (PACT)." S&P Global Inc. Accessed February 2021. <https://www.spglobal.com/spdji/en/index-family/esg/esg-climate/paris-aligned-climate-transition-pact/>.

Box 2. Key concepts for carbon footprints

Carbon footprint methodologies¹⁸ include: Total carbon emissions, carbon to value invested, carbon to revenue intensity, and weighted average carbon intensity.

Total carbon emissions are often used for an investor considering the footprint of their equity share of a company's overall emissions, although weighted average carbon intensity is more widely used as a risk management tool.

An example of total carbon emissions is an Enterprise Value Including Cash metric (EVIC) which shares the emissions burden between equity, bonds, and cash in the company.¹⁹

Company emissions are categorised as:

Scope 1: Direct emissions from owned or controlled sources;

Scope 2: Indirect emissions from the generation of purchased electricity, steam, heating and cooling consumed by the reporting company; and

Scope 3: Other indirect emissions that occur in a company's value chain.²⁰

The GHG Protocol supplies the world's most widely used greenhouse gas accounting standard.²¹ Capturing downstream Scope 3 emissions data (often representing a multiple of Scope 1 and 2 emissions) remains a challenge for companies and investors, as we describe in more detail in the footnote below.²²

¹⁸ Measured in metric tons of carbon dioxide equivalent or tons of CO₂e per annum.

¹⁹ See for example MSCI ESG Research Inc., *Carbon Footprinting 101*. MSCI.
<https://www.msci.com/documents/10199/2043ba37-c8e1-4773-8672-fae43e9e3fd0>.

²⁰ Carbon Trust, "Briefing: What are Scope 3 emissions?" Carbon Trust, 2021. <https://www.carbontrust.com/resources/briefing-what-are-scope-3-emissions>.

²¹ Greenhouse Gas Protocol, [website]. WRI and WBCSD, n.d. Accessed January 2021. <https://ghgprotocol.org>.

²² See Brendan Baker, "Scope 3 Carbon Emissions: Seeing the Full Picture," MSCI, 17 September 2020.
<https://www.msci.com/www/blog-posts/scope-3-carbon-emissions-seeing/02092372761>.

Investors concerned about climate change have traditionally focused on Scope 1 and Scope 2 emissions. However, the net-zero transition is increasing focus on downstream product emissions. Corporate reporting on Scope 3 emissions remains sparse given the complexities involved and thus a challenge for investors to track. To tackle the Scope 3 disclosure challenge, MSCI developed a model to estimate these emissions across fifteen sector categories using a combination of revenue estimates and production data. Scope 3 average intensity was almost three times greater than the combined Scope 1 and 2 intensity of the MSCI ACWI Investable Market Index as of July 2020 and more than six times greater for the oil and gas industry. Some investors have been concerned about the possibility of double counting if they were to incorporate Scope 3 emissions into their portfolio carbon footprinting. If both the oil and gas company and client mining company were in the same portfolio, a comprehensive carbon footprint might count their emissions twice, requiring "de-duplication multipliers," using a large enough dataset encompassing thousands of companies.

See also S&P Dow Jones Indices, "Frequently Asked Questions: Trucost." S&P Global Inc., 2020.
<https://www.spglobal.com/spdji/en/documents/additional-material/faq-trucost.pdf>.

S&P Dow Jones's Trucost proprietary methodology captures the first tier of Scope 3 emissions (the Scope 1 emissions of the company's direct suppliers).

Section 2

Climate metrics and financial performance

Low carbon indexes and climate metrics are helping investors to identify businesses that are managing well the risks associated with what has been described as the “Inevitable Policy Response”²³ for the transition to a net zero carbon economy. And, as the Corporate Leaders Group has stated: “Bold, low carbon action can make good business sense since transition to a low carbon economy is the only way to secure sustainable economic growth and prosperity for all.”²⁴

Financial performance of lower carbon strategies should outperform over the long-term if government policy driving value in the real economy can remain “ahead of the curve” by tightening emissions regulations to achieve Paris Agreement goals. Indeed, the two United States (US) equity funds with the strongest returns in 2020 both focused on clean energy.²⁵ And some evidence of this potential for outperformance can be seen in, for example, the S&P Dow Jones Trucost Paris Alignment Dataset. Using the dataset, investors can track a company’s actual and forecasted carbon intensity and how this intensity needs to be reduced by 2025 to meet the Paris Agreement Goal. Within the S&P 500, equities with the highest quantile alignment outperform those with the lowest by +1.04% on average annually. Constructing a Paris Agreement Goal portfolio from the S&P 500 resulted in an active return over a five-year time period to August 2020 of +11% and an average carbon footprint reduction of 39%.²⁶

However, the S&P Carbon Scorecard 2019 acknowledges that none of the selected indexes is decarbonizing sufficiently for a 2°C or Paris Agreement alignment.²⁷ This includes the S&P 500 Carbon Efficient Index, the S&P 500 Carbon Price Risk 2030 Adjusted Index and the S&P 500 Fossil Fuel Free Index.

The Paris Agreement’s central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5°C.²⁸ Achieving this goal will require major ratcheting up of emission reduction policies.

The Global Financial Markets Association 2020 report (“Climate Finance Markets and the Real Economy”) outlines recommendations necessary to accelerate investment in climate finance.²⁹ The report points out that a key risk to the scaling of the climate finance market is for policymakers and broader society to consider the role of financial market participants and the financial regulatory framework independently from the changes required in the broader

²³ Principles for Responsible Investment, “What is the Inevitable Policy Response?” PRI, n.d. Accessed January 2021. <https://www.unpri.org/inevitable-policy-response/what-is-the-inevitable-policy-response/4787.article>.

²⁴ We Mean Business, *The Climate Has Changed*. We Mean Business Coalition, 2014. <https://www.corporateleadersgroup.com/reports-evidence-and-insights/publications/publications-pdfs/we-mean-business-the-climate-has-changed.pdf>.

²⁵ Michael Mackenzie, “Green energy funds top league table in banner year for ESG.” *Financial Times*, 26 December 2020. <https://www.ft.com/content/cad6fcf9-f755-4988-9c75-d41a9b6ff6d8>.

²⁶ Liam Hynes, *ESG Data Signals: Trucost Paris Alignment Dataset*. S&P Global Inc., 2020. https://www.spglobal.com/marketintelligence/en/documents/esgdatasignals_trucostparisalignment-04.pdf.

²⁷ S&P Dow Jones Indices, *The Carbon Scorecard 2019*. S&P Global Inc., 2019. <https://www.spglobal.com/en/Perspectives/IIF-2019/Trucost-Carbon-Scorecard-2019.pdf>.

²⁸ United Nations Framework Convention on Climate Change, “The Paris Agreement.” United Nations, n.d. Accessed January 2021. <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>.

²⁹ Global Financial Markets Association, “GFMA and BCG Report on Climate Finance Markets and the Real Economy [release].” *Global Financial Markets Association*, 2 December 2020. <https://www.gfma.org/policies-resources/gfma-and-bcg-report-on-climate-finance-markets-and-the-real-economy/>.

economy and economic policy frameworks, including carbon pricing mechanisms. This sentiment has been echoed recently by the president of the Deutsche Bundesbank, Jens Weidman, in discussing how central banks should address climate change.³⁰

In the absence of continued policy tightening, low carbon investment strategies may struggle either to outperform broader market indexes or to become truly aligned with Paris Agreement goals.

Section 3

Socially Responsible and Impact Investing

Retail investor interest and opportunities for investing in low carbon strategies has evolved not only as a result of regulatory pressure in the financial sector, but also as a result of the broader consumer-driven trends in recent years toward sustainable and Socially Responsible Investment (SRI).

According to the Global Sustainable Investment Alliance (GSIA): “Sustainable investing is an investment approach that considers environmental, social and governance (ESG) factors in portfolio selection and management.” Retail investor appetite for SRI has resulted in a surge of SRI product offerings from investment managers and this, alongside regulatory pressure, has focused the minds of business owners in relation to ESG factors.

The GSIA in 2018 reported that sustainable investing assets in the five major markets stood at US\$30.7 trillion, a 34% increase in two years, with climate change the leading environmental, social, and governance (ESG) issue for money managers in asset-weighted terms.³¹ The next report due early 2021 is expected to show a further leap in assets labelled as governed by ESG factors.

“Impact” investing is a subsegment of the SRI universe (with \$705 billion in assets under management), aimed at solving social or environmental problems. The Global Impact Investing Network (GIIN)’s Annual Impact Investor Survey 2020 states that 88% of investor respondents report meeting or exceeding their financial expectations and over two-thirds of respondents (67%) seek risk-adjusted, market-rate returns for their assets. GIIN suggest that “this finding may imply a shift from the increasingly outdated perception of an inherent trade-off between impact and financial performance.”³²

On the other hand, it also suggests that less than one third of impact investment managers intentionally invest for below-market-rate returns, because the majority are encumbered by fiduciary responsibilities to maximise returns. Mission-driven public agencies and philanthropic foundations have been demonstrated to show willingness to pay for public goods (and thus accept lower financial returns) through impact funds.³³ However, for mainstream private investment funds, while regulatory frameworks may be starting to insist on financially material ESG governance practices, maximizing financial returns remains the fiduciary responsibility.

³⁰ Jens Weidmann, “Bundesbank chief: How central banks should address climate change.” *Financial Times [Opinion]*, 18 November 2020. <https://www.ft.com/content/ed270eb2-e5f9-4a2a-8987-41df4eb67418>.

³¹ Global Sustainable Investment Alliance, *2018 Global Sustainable Investment Review*. Global Sustainable Investment Alliance, 2018. http://www.gsi-alliance.org/wp-content/uploads/2019/03/GSIR_Review2018.3.28.pdf.

³² Dean Hand, Hannah Dithrich, Sophia Sunderji, Noshin Nova, “2020 Annual Impact Investor Survey.” *The GIIN*, 11 June 2020. <https://thegiin.org/research/publication/impinv-survey-2020>.

³³ Brad M. Barber, Adair Morse, Ayako Yasuda. Impact investing. *Journal of Financial Economics*, Volume 139, Issue 1, 2021, Pages 162-185, ISSN 0304-405X, <https://doi.org/10.1016/j.jfineco.2020.07.008>.

For example, in October 2020, the US Department of Labor released its final regulation relating to Employee Retirement Income Security Act (ERISA) plan fiduciaries consideration of ESG factors when making investment decisions. A fiduciary can appropriately incorporate pecuniary ESG factors into its decision-making process but may not consider non-pecuniary factors when choosing an investment option or strategy, regardless of whether the factor relates to ESG, if the investment decision can be made based on pecuniary factors alone.³⁴

There is on-going work (e.g., in the European Commission and Parliament) to ensure more rigorous definitions for sustainable investing to prevent accusations of “greenwash.” There is also an academic and media debate about whether, on the one hand, it as a myth that “impact investing” does not deliver commercial returns or whether, on the other hand, “impact investing” should only be defined by a willingness to accept sub-commercial returns and to fund activities that would not otherwise happen.³⁵

What is certainly true is that fiduciary responsibility means that investment managers need explicitly to target commercial returns. There is no built-in willingness-to-pay for public goods from investment vehicles that require commercial returns. They do not lower the cost of capital. Public policy and public funds continue to carry the burden of generating signals in the real economy for low carbon investment.

In short, the huge growth in SRI funds has resulted in a welcome focus on how well businesses are managing ESG issues, and the clear carbon metrics will help investors prioritize low carbon investments. However, the opportunities for retail investors deliberately to deploy capital on concessional terms for climate impact have historically been limited.

Section 4

Beyond SRI: Opportunity and rationale for retail investors to offset the carbon intensity of investment portfolios.

We have previously argued in a January 2019 white paper that there exists an opportunity to harness private savers’ willingness-to-pay directly for climate change mitigation (to accept below-commercial returns in order to have a climate impact that goes beyond business-as-usual), and that investment managers should offer savers the option to make a donation over and above management fees to support government backed climate change mitigation platforms.³⁶ One charity campaign is at present asking private investors to donate a small percentage of the nominal value of their savings for climate change not-for-profit organisations.³⁷

We now argue that the recent rapid evolution of climate risk metrics, allied to consumer-friendly financial technology platforms, will allow retail investors easily to quantify their carbon impacts and the logical next step for many will be to offset those impacts in order to become net zero investors. This will represent a highly scale-able method for retail investors to

³⁴ Joseph A. Lifscics, “The Department of Labor’s ESG-less Final ESG Rule,” Mayer Brown Benefits & Compensation Blog, 11 November 2020. <https://www.usbenefits.law/2020/11/the-dol-final-esg-rule/>.

See also Department of Labor. “Financial Factors in Selecting Plan Investments.” *Federal Register* Vol. 85, No. 220 (13 November 2020): 72846. <https://www.govinfo.gov/content/pkg/FR-2020-11-13/pdf/2020-24515.pdf>.

³⁵ See for example, Jonathan Ford, “Ethical investment is about morals not markets.” *Financial Times [Opinion]*, 3 November 2020. <https://www.ft.com/content/f794162c-3e45-4078-a7be-2e34fea5dd37>.

³⁶ Rupert Edwards, *Harnessing Private Investor ‘Willingness-to-Pay’ for Climate Change Mitigation: A Mechanism to Co-fund Public Commitments to Achieve the Goals of the Paris Agreement*. Forest Trends, 2019. <https://www.forest-trends.org/publications/harnessing-private-investor-willingness-to-pay-for-climate-change-mitigation>.

³⁷ Global Returns Project, “Global Returns Project: Work with us to raise \$10billion every year to tackle the Climate Crisis.” *Global Returns Project*, n.d. Accessed July 2020. <https://globalreturnproject.earth>.

express their willingness to pay for climate change mitigation, complementing the trend of investment managers offering low carbon and climate transition strategies.

To some extent evidence of willingness-to-pay can be seen in analysis suggesting green companies are becoming overvalued. Investors ploughed a record US\$21 billion into SRI funds in the US in 2019, almost quadrupling the rate of inflows in 2018 according to Morningstar. Recent evidence indicates that these inflows are starting to have a distortionary effect, with some analysts suggesting leading green companies are becoming overvalued due to massive flows into SRI funds.³⁸ However, beyond that, platforms are starting to emerge that enable investors to pick funds where a percentage of fees go to funding carbon offsets. BlackRock has developed a low risk liquid product for retail investors that will use at least 5% of net revenue from its management fee to purchase and then retire carbon offsets.³⁹ BNP Paribas in 2020 launched the first investment fund that allows institutional investors the opportunity to offset a significant part of their investment's carbon footprint.⁴⁰ And recently Cushon, a UK based investment platform for employers and retail savers, has started to offer "the world's first net zero pension" committed to achieving net zero from today, rather than by 2050, through the use of offsets.⁴¹

Outside the investment sector itself, there is growing evidence of overall consumer willingness-to-pay to offset the carbon impact of a range of activities from flights to car fuel.⁴² Tools such as the Doconomy carbon calculator help brands and suppliers to better understand the carbon footprint of the products and materials they produce, as well as provide the transparency that will allow consumers to make informed consumption choices.⁴³ Credit card and banking products (e.g., from Bank of the West) are also being developed which enable customers to track and measure the CO₂ impact of their purchases.⁴⁴ SettleUp Earth⁴⁵ and Minimum Eco⁴⁶ are examples of online platforms for calculating and offsetting consumers' carbon footprints for a range of products.

Within the investment sector, financial technology applications using Open banking data platforms will start to disseminate carbon footprint data on personal investments and this analysis will empower retail investors to quantify offset requirements and make offset payments, even if investment managers are slow (or reluctant) to offer this service themselves. For example, a new platform, Sugi.earth, which is collaborating with the UK's Make My Money Matter campaign, uses S&P Dow Jones Trucost carbon metrics and gives retail

³⁸ See for example, Patrick Temple-West, "'Monstrous' run for responsible stocks stokes fears of a bubble." *Financial Times*, 20 February 2020. <https://www.ft.com/content/73765d6c-5402-11ea-90ad-25e377c0ee1f>.

Or Anthony Luzio, "Is a dotcom-style bubble forming in ESG stocks?" *Trustnet*, 3 March 2020. <https://www.trustnet.com/news/7462129/is-a-dotcom-style-bubble-forming-in-esg-stocks>.

³⁹ BlackRock, *Prospectus: BlackRock Liquid Environmentally Aware Fund*. BlackRock, 27 November 2020. <https://www.blackrock.com/cash/en-us/products/307511/>.

⁴⁰ BNP Paribas Asset Management, "BNP Paribas Asset Management launches THEAM Quant Europe Climate Carbon Offset Plan [press release]." *BNP Paribas Asset Management*, 29 March 2019. <https://www.bnpparibas-am.com/en/bnp-paribas-asset-management-launches-theam-quant-europe-climate-carbon-offset-plan/>.

⁴¹ Cushon, "The world's first Net Zero pension." Cushon, n.d. Accessed January 2021. <https://www.cushon.co.uk/info/knowledge/the-worlds-first-net-zero-pension>.

⁴² See for example Shell, "Drive Carbon Neutral." *Shell*, n.d. Accessed January 2021. <https://www.shell.co.uk/business-customers/shell-fuel-card/fuelcardco2.html>.

⁴³ The 2030 Calculator [website], <https://www.2030calculator.com>.

⁴⁴ Bank of the West, "The first checking account to give back to the planet." Bank of the West, n.d. Accessed January 2021. <https://www.bankofthewest.com/campaigns/personal-banking/one-percent-checking-offer.html>.

⁴⁵ SettleUp Earth [website], <https://settleup.earth>.

⁴⁶ Minimum [website], <https://www.minimum.eco>.

investors easy app-based access to the global carbon data of their portfolios across a broad range of UK investment platforms such as leading pension and saving schemes.⁴⁷

Willingness-to-pay for climate impact

Thus, whether offered products by investment managers or empowered by financial technology, retail investors will have the opportunity to pursue low carbon investment strategies and at the same time achieve net zero on their portfolios.

Most retail investors will not be willing to invest exclusively in a narrow and risky set of pure clean technology funds. They need, generally speaking, to maintain reasonably low tracking errors relative to broader equity market performance. And exclusively low carbon portfolios would be skewed to concentration risk in a small number of sectors, avoiding the broader energy, industrials, materials, and even consumer sectors.

Moreover, recognizing that none of the mainstream index-based low carbon strategies are currently decarbonizing sufficiently to be truly aligned with Paris Agreement goals, some will be willing to pay extra to go to net zero. Some may wish to remain in standard strategies and then pay for additional offsets. Or some may wish both to shift to a lower carbon portfolio (for example from the S&P500 to a portfolio weighted according to the S&P500 Paris Agreement Goal described above) and then to go further and offset the residual carbon intensity of this strategy.

Using MSCI data for 5th February 2020,⁴⁸ we can illustrate the relative costs of net zero across different indexes, based on carbon credit prices of \$10 and \$20 per ton of CO₂e (Table 1).⁴⁹

Thus, based on what would currently be a high carbon credit price of \$20 per ton of CO₂e, the very widely used flagship MSCI ACWI Index would cost 0.94% (94 basis points) per annum to offset, the World Low Carbon Target 0.56% (56 basis points) and the World Climate Paris Aligned just 0.17% (17 basis points).

⁴⁷ Sugi [website]. <https://www.sugi.earth/>.

⁴⁸ Personal communication. Dr. Oliver Marchand. Managing Director, Global Head of ESG Research & Development. MSCI Climate Risk Center, 5 February 2021.

⁴⁹ Project-based credits in the voluntary market traded at an average price of just over US\$4 per ton in 2019 (Steve Zwick, "Demand for Voluntary Carbon Offsets Holds Strong as Corporates Stick With Climate Commitments." *Forest Trends' Ecosystem Marketplace*, 23 September 2020. <https://www.ecosystemmarketplace.com/articles/demand-for-voluntary-carbon-offsets-holds-strong-as-corporates-stick-with-climate-commitments/>).

Jurisdictional REDD+ credits have received payments or been offered floor prices by donor governments and the UN GCF of US\$5-US\$10. However, it is anticipated that prices should increase over time (see Rupert Edwards, *A Gigaton REDD+ Bid Strategy: Unlocking the potential for REDD+ in supporting the protection of rainforests and other "natural climate solutions" in tropical forest countries*. Forest Trends, 2020. https://www.forest-trends.org/wp-content/uploads/2020/07/doc_5756_rev.pdf).

Table 1: MSCI major indexes - Total emissions (EVIC) for 5th February 2020⁵⁰ and example carbon costs

Index name	Emissions (ton CO ₂ e /\$ million EVIC)			Carbon cost (ton/CO ₂ e)			
	Scope 1	Scope 2	Scope 3	\$10	Annual offset cost (basis points)	\$20	Annual offset cost (basis points)
MSCI ACWI INDEX	41	13	414	4,679	0.47%	9,357	0.94%
MSCI WORLD	37	11	278	4,264	0.43%	8,529	0.85%
MSCI WORLD LOW CARBON TARGET	9	7	264	2,805	0.28%	5,610	0.56%
MSCI WORLD CLIMATE PARIS ALIGNED	4	5	75	851	0.09%	1,702	0.17%
MSCI EUROPE CLIMATE PARIS ALIGNED	10	6	84	1,001	0.10%	2,002	0.20%
MSCI WORLD ESG LEADERS	23	10	454	4,870	0.49%	9,741	0.97%

Scope 3 emissions are the main driver of the overall emissions footprint in the above table. A more accurate “de-duplication” calculation using large data sets to prevent some double counting across companies would reduce these emissions somewhat and thus also the cost of offsetting.⁵¹ And the extent to which investee companies and their consumers are offsetting their emissions, including Scope 3 emissions, would reduce the carbon footprint of investor portfolios.

Funds benchmarked against MSCI or S&P or other indexes will not replicate exactly the weightings of different equities in the index and will therefore have different carbon footprints. However, investment managers and consumer-facing technology platforms can pay fees to index companies or independent analysts to generate carbon footprint and other climate metrics or will be able to develop them in-house.

When low carbon products become expensive

While continued policy tightening to drive net zero outcomes should create a positive secular trend for low carbon investments, low carbon products and strategies could become expensive (either because policy is insufficiently ambitious and “behind the curve” or because flow of funds into low carbon products drives valuations too high, or both).⁵²

Both investment managers and retail investors need to have the flexibility to switch out of green equities or low carbon indexes if they perceive that these have become overvalued. Indeed, fiduciary responsibilities should force investment managers to do so. For example, lower carbon equities and sectors performed relatively well during the COVID-19 pandemic

⁵⁰ Certain data provided by MSCI Inc. ©2021 in accordance with [msci.com/disclaimer](https://www.msci.com/disclaimer). All rights reserved.

⁵¹ See Brendan Baker, “Scope 3 Carbon Emissions: Seeing the Full Picture,” MSCI, 17 September 2020. <https://www.msci.com/www/blog-posts/scope-3-carbon-emissions-seeing/02092372761>.

⁵² For concerns about ESG investing creating price bubbles see, for example Proinsias O’Mahony, “Are green stocks a mega trend or a bubble in the making?” *The Irish Times*, 3 March 2020. <https://www.irishtimes.com/business/personal-finance/are-green-stocks-a-mega-trend-or-a-bubble-in-the-making-1.4183507>.

bear market in March and April 2020. But as the markets recovered, investment managers to some extent reweighted portfolios out of, for example, technology and healthcare companies and back into carbon-intensive energy and industrial sectors.

For retail investors, holding overvalued low carbon assets may feel a very remote way to provide lower cost capital to the companies whose equity they own and less effective than directly impacting climate outcomes by purchasing carbon credits with high environmental integrity, in particular where carbon accounting methodologies are backed by donor governments and public climate finance programmes.

In such a scenario, investors could examine the alternative of holding standard portfolios while at the same time paying for additional offsets to remain at net zero. For example, an investor could switch out of a passive fund tracking the MSCI World Low Carbon Target index and into one tracking the MSCI ACWI index and pay an additional 38 basis points to remain net zero.

Supporting the transition in carbon-intensive sectors

The sectors where emissions are hard to abate remain critical to economic growth and the transition to a carbon neutral economy. Investing only in lower carbon sectors such as renewable energy, financial services and healthcare, while avoiding oil and gas, mining, agriculture or shipping, does not support the important investment that needs to be made by the most responsible companies within those sectors, that are adjusting their business models to transition to net zero.

As the UK Minister for Pensions and Financial Inclusion, Guy Opperman, has stated: “It would breach fiduciary duty for government to direct pensions to divest from carbon-intensive sectors, who are going to be part of the solution to get us to net zero, when we need a whole economy transition.”⁵³

Some investment managers have developed strategies, such as the Lombard Odier Climate Transition Strategy, which rather than excluding the most carbon-intensive stocks and industries focuses on those businesses leading the way in prioritizing greenhouse gas abatement.⁵⁴ Such strategies can allow investors to maintain exposure to broader equity market financial performance while meeting their desire to support lower carbon investment. Lombard Odier has developed a Paris Temperature Alignment tool that measures in granular detail the carbon emissions of companies in the portfolio, assessing not only the carbon footprint but also the extent to which company emissions are declining fast enough to be aligned with the overall emissions trajectories required to meet the goals of the Paris Agreement. Lombard Odier are also actively examining mechanisms and opportunities to offset their investments through carbon credits in Nature-based Solutions to climate change.

Investors will increasingly need to know whether companies are sufficiently progressing to net zero relative to their respective industry benchmarks. Investments in some carbon-intensive companies represent both an opportunity to finance those businesses leading the way to net zero and at the same time achieve superior returns. For example, Redburn, a leading independent analyst for European public equities, after writing a bearish report on the oil majors in September 2019, in September 2020 made a positive buy recommendation on BP shares. BP’s new strategy, they reported, establishes it as the oil major transitioning most rapidly to a low-carbon business model. By 2030, over

⁵³ Guy Opperman, “Guy Opperman: We want pensions to go green — but I won’t force them to ditch big oil.” *The Times*, 22 November 2020. <https://www.thetimes.co.uk/article/guy-opperman-we-want-pensions-to-go-green-but-i-wont-force-them-to-ditch-big-oil-rk9h68x7q>.

⁵⁴ Lombard Odier Investment Managers, *Investing in the Climate Transition - a Synthesis*. Lombard Odier Investment Managers, 2020.

20% of earnings could come from renewables if the company delivers on its targets. In the meantime, cash returns are set to grow materially with circa US\$10billion of cumulative buybacks between 2022 and 2025. Even assuming returns on renewables investments ultimately disappoint, they made a buy recommendation for 55% upside to a £4.10 fair value.⁵⁵

Investors could, therefore, have the option both to invest in those carbon-intensive companies leading the transition to net zero, *and* at the same time increase their purchases of offsets to reduce the net carbon footprint of the asset which, as a shareholder, they are a co-owner.

Section 5

Nature-based solutions to climate change and financial stability

For policymakers, regulators, investment managers and businesses there is a financial stability rationale for encouraging a trend whereby investors offset the residual carbon intensity of standard, low carbon and climate transition investment strategies. It will be impossible to achieve the goals of the Paris Agreement and thus prevent risks to financial stability without Nature-based Solutions (NbS).

NbS are critically important in the near term for the transition to a carbon neutral economy by the middle of this century, offering around 30% of the mitigation needed to meet the Paris goal of stabilizing global warming below 2°C. Forest protection, restoration, and reforestation could contribute over two-thirds of this NbS mitigation. By far the largest and most cost-effective opportunity is conservation of existing tropical forests.⁵⁶

Harnessing carbon offset demand from investors, in parallel with corporate demand, would help unlock the vast mitigation potential of REDD+ where as-yet unfulfilled supply potential could be mobilized by a quantum increase in funding.⁵⁷ The Green Gigaton Challenge, led by the United Nations Environment Programme, which seeks to bring jurisdictional REDD+ to scale,⁵⁸ is an example of a public-private initiative designed to unlock a supply of high integrity carbon credits and to support forest countries to achieve and go beyond their Paris Agreement goals.

In the non-financial corporate sector, focus on transitioning to a net zero carbon world is moving very rapidly. Reaching net zero will ultimately mean that energy and industrial systems fully mitigate their own greenhouse gas emissions without relying permanently on offsets.⁵⁹ However, a broad range of private companies needs access to large-scale, affordable, and near-term mitigation options from offsets that provide a more flexible pathway for technology investment and de-carbonization. This is especially true

⁵⁵ <https://www.redburn.com>

⁵⁶ Griscom, Bronson W., Jonah Busch, Susan C. Cook-Patton, Peter W. Ellis, Jason Funk, Sara M. Leavitt, Guy Lomax et al. "National mitigation potential from natural climate solutions in the tropics." *Philosophical Transactions of the Royal Society B* 375, no. 1794 (2020): 20190126.

⁵⁷ Rupert Edwards, *A Gigaton REDD+ Bid Strategy: Unlocking the potential for REDD+ in supporting the protection of rainforests and other "natural climate solutions" in tropical forest countries*. Forest Trends, 2020. https://www.forest-trends.org/wp-content/uploads/2020/07/doc_5756_rev.pdf.

⁵⁸ Green Gigaton Challenge [website], <https://www.greengigaton.com>.

⁵⁹ Energy Transitions Commission. *Mission Possible: Reaching Net-Zero Carbon Emissions from Harder to Abate Sectors by Mid-Century*. Energy Transitions Commission, 2018. http://www.energy-transitions.org/sites/default/files/ETC_MissionPossible_FullReport.pdf.

for those sectors where emissions are hard to abate.⁶⁰ The Taskforce on Scaling Voluntary Carbon Markets was recently set up in response to this potential.⁶¹ As Mark Carney, the UN Special Envoy for Climate Change told attendees at the Financial Times Energy Transition Strategies Summit: “This is a necessary market in the transition to net zero...This is an imperative, which is why we are putting so many resources into it...This needs to be a \$50-100bn per annum market.”⁶²

Insights into the value, from a financial stability perspective, of REDD+ programs to protect and restore tropical forests, can be seen from literature modelling carbon prices for a carbon-constrained global economy:

- Variations in carbon price trajectories in Intergovernmental Panel on Climate Change 2°C scenarios have been found to show a wide range of results (depending on socio-economic factors or modeling frameworks), with short-term prices varying from 15 to 360 \$/tCO₂e in 2030, 45 to 1000 \$/tCO₂e in 2050 and 140 to 8300 \$/tCO₂e in 2100.⁶³
- Furthermore, global abatement costs of achieving 1.5°C have been modeled as double those for 2°C, and five to six times as much as those for all actions proposed in current Paris Agreement Nationally Determined Contributions (NDCs), with the aggregate incremental cost of achieving 1.5°C against current NDCs estimated at \$600 billion annually.⁶⁴
- It has been estimated that, under an aggressive approach for conserving and restoring tropical forests in a 2°C scenario, fossil fuel emissions would need to fall to zero by 2045-2050, rather than by 2035 in the case with business-as-usual forest emissions.⁶⁵
- International climate cooperation through carbon markets that include tropical forest protection, could result in almost double the emissions reductions compared to a non-market scenario for implementing NDCs—for the same total cost.⁶⁶
- REDD+ can contribute trillions of dollars in value by “flattening the curve” of the global economy’s costs of transition to climate stability, opening up the opportunity to achieve tighter emissions targets and to maintain total emissions over the period 2010-2100 below 1,200 GtCO₂ (consistent with a 2°C carbon budget) while keeping the global CO₂ price below \$250/t CO₂ by 2050. It also suggests that tightening the carbon budget to 970Gt of CO₂ for the period 2018-2100 (corresponding to a 1.8°C scenario) is politically unfeasible in the absence of significant REDD+ supply.

At a macroeconomic level, the success of NbS and of REDD+ is critical to preventing carbon prices and mitigation costs escalating rapidly. Failure to fulfill the potential for NbS and

⁶⁰ Koch, N., Reuter W.H., Fuss, S., and Grosjean, G. Permits vs. offsets under investment uncertainty. *Resource and Energy Economics* 49 (2017), 33-47. doi: 10.1016/j.reseneeco.2017.03.006.

⁶¹ Taskforce on Scaling Voluntary Carbon Markets, “Private Sector Voluntary Carbon Markets Taskforce Established to Help Meet Climate Goals [release].” Institute of International Finance, 2 September 2020. <https://www.iif.com/tsvcm/Main-Page/Publications/ID/4061/Private-Sector-Voluntary-Carbon-Markets-Taskforce-Established-to-Help-Meet-Climate-Goals>.

⁶² Leslie Hook and Patrick Temple-West, “Carney calls for ‘\$100bn a year’ global carbon offset market.” Financial Times, 2 December 2020. <https://www.ft.com/content/8ed608b2-25c8-48d2-9653-c447adbd538f>.

⁶³ Guivarch, C., and J. Rogelj. “Carbon price variations in 2 C scenarios explored.” (2017).

⁶⁴ Hof, A. F., den Elzen, M. G., Admiraal, A., Roelfsema, M., Gernaat, D. E., & van Vuuren, D. P. Global and regional abatement costs of nationally determined contributions (NDCs) and of enhanced action to levels well below 2 °C and 1.5 °C. *Environmental Science & Policy* 71 (2017), 30–40.

⁶⁵ Houghton, Richard A., and Alexander A. Nassikas. “Negative emissions from stopping deforestation and forest degradation, globally.” *Global change biology* 24, no. 1 (2018): 350-359.

⁶⁶ Piris-Cabezas, P, R. Lubowski, and G. Leslie. *Estimating the Power of International Carbon Markets to Increase Global Climate Ambition*. In: The First International Research Conference on Carbon Pricing. World Bank Working Paper Series. Washington DC: World Bank and Carbon Pricing Leadership Coalition, 2019. <http://hdl.handle.net/10986/32746>

REDD+ would force governments to impose ever-tighter or more urgent endogenous rates of decarbonization on businesses, and an ever-larger burden on yet to be developed negative emissions technologies. Or a surge in mitigation costs could reduce political ambition at a moment when emission reduction policies need to be tightened, thus increasing vulnerability to physical impacts of climate change, with disastrous effects on financial stability.⁶⁷

The growth in demand for offsets (both regulated compliance demand such as CORSIA for the international aviation sector and private voluntary demand) could allow donor governments and multilateral institutions to leverage materially more private co-funding for climate aid, including for NbS in developing countries. This trend would be given a huge boost from investors seeking to achieve net zero using offsets—both in terms of increasing absolute levels of funding, and by reinforcing competitive pressure for corporate action.

Section 6

Conclusion and recommendations

The growth in climate metrics will increase the ability of responsible investors to prioritize low carbon and climate-transition strategies, to target companies committing to lower emissions pathways and to achieve best-in-class portfolios where each investment is below the average impact of that particular industry.

Overlooked to date has been the potential for innovative product offerings that mobilize demand for carbon offsets from investors. Leadership by some investment managers and the development of consumer facing “Fintech” platforms should provide an opportunity for retail investors to go further—not only to prioritize lower carbon portfolios, but additionally to use offsets as a supplementary tool to immunize against residual carbon intensity in pension or other savings vehicles. Carbon footprint metrics can provide a hook for investor willingness-to-pay to mitigate greenhouse gas emissions and to achieve net zero.

At the end of 2020, the MSCI ACWI index had a total market capitalization of \$49 trillion,⁶⁸ (representing 23 gigatons of annual CO₂e emissions based on the data in Table 1 above); the total market capitalization of the S&P500 was circa \$32 trillion.⁶⁹ Investment assets claiming to be following ESG criteria currently approach \$40 trillion.

Even if only a small percentage of investors supplement low carbon and climate transition strategies by using carbon offsets to achieve net zero, they would reinforce corporate action in the real economy, provide a huge boost to government efforts to secure private co-funding for public climate finance in developing countries, including for Nature-based Solutions critical to achieving the goals of the Paris Agreement, and would bolster the stability of the financial system.

Governments and regulators can encourage this trend by harnessing investor demand to public-private initiatives for international climate finance such as the Green Gigaton Challenge.

⁶⁷ Fuss, S., Golub, A., Lubowski, R. The economic value of tropical forests for meeting global climate stabilization goals. [Submitted to *Global Sustainability*] (2020)

⁶⁸ MSCI, MSCI World Index (USD). MSCI, January 2021. <https://www.msci.com/documents/10199/178e6643-6ae6-47b9-82be-e1fc565ededb>.

⁶⁹ Will Kenton and Ed. Michael J. Boyle, “S&P 500 Index – Standard & Poor’s 500 Index.” *Investopedia*, 22 December 2020. <https://www.investopedia.com/terms/s/sp500.asp>.