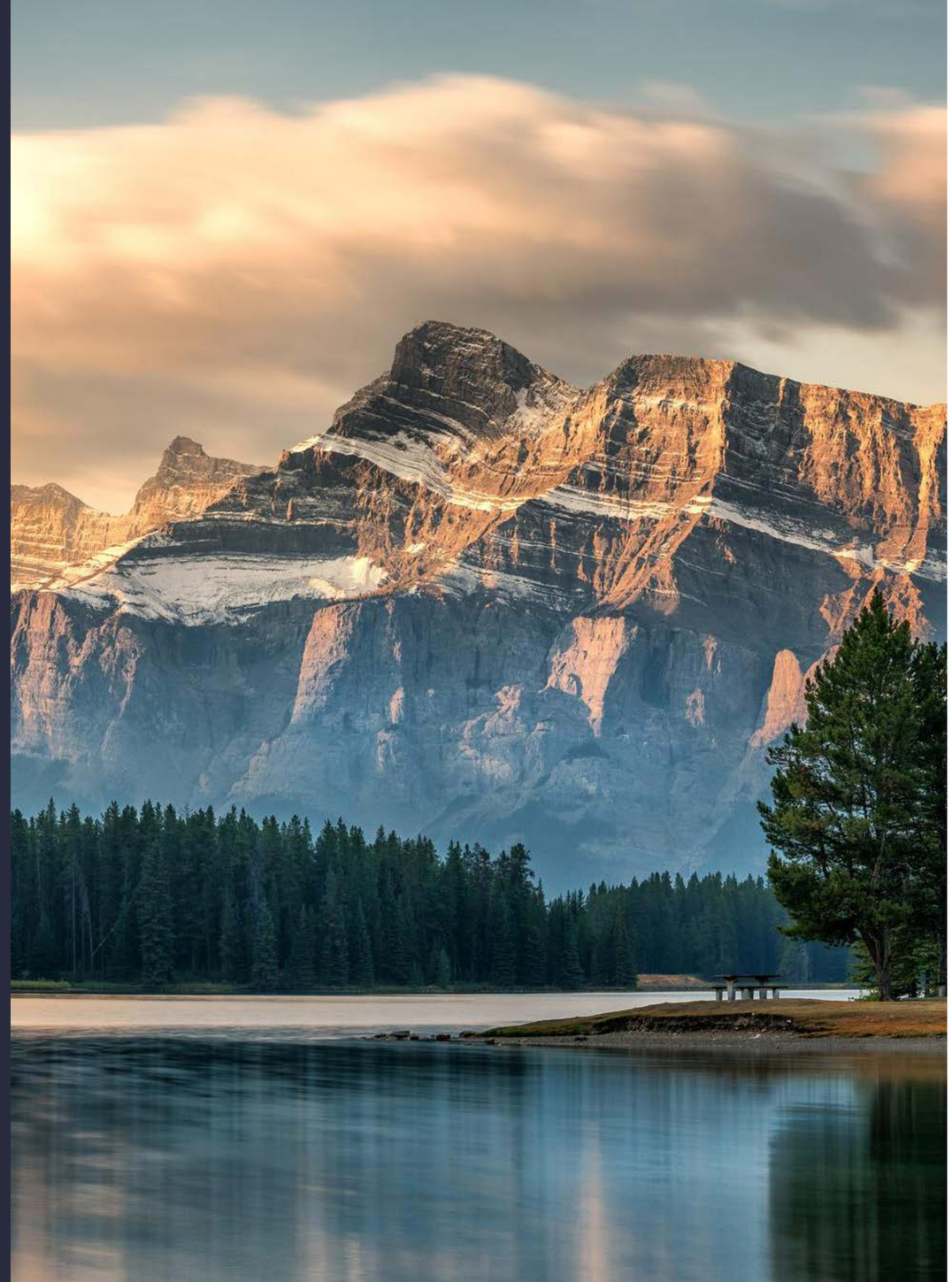
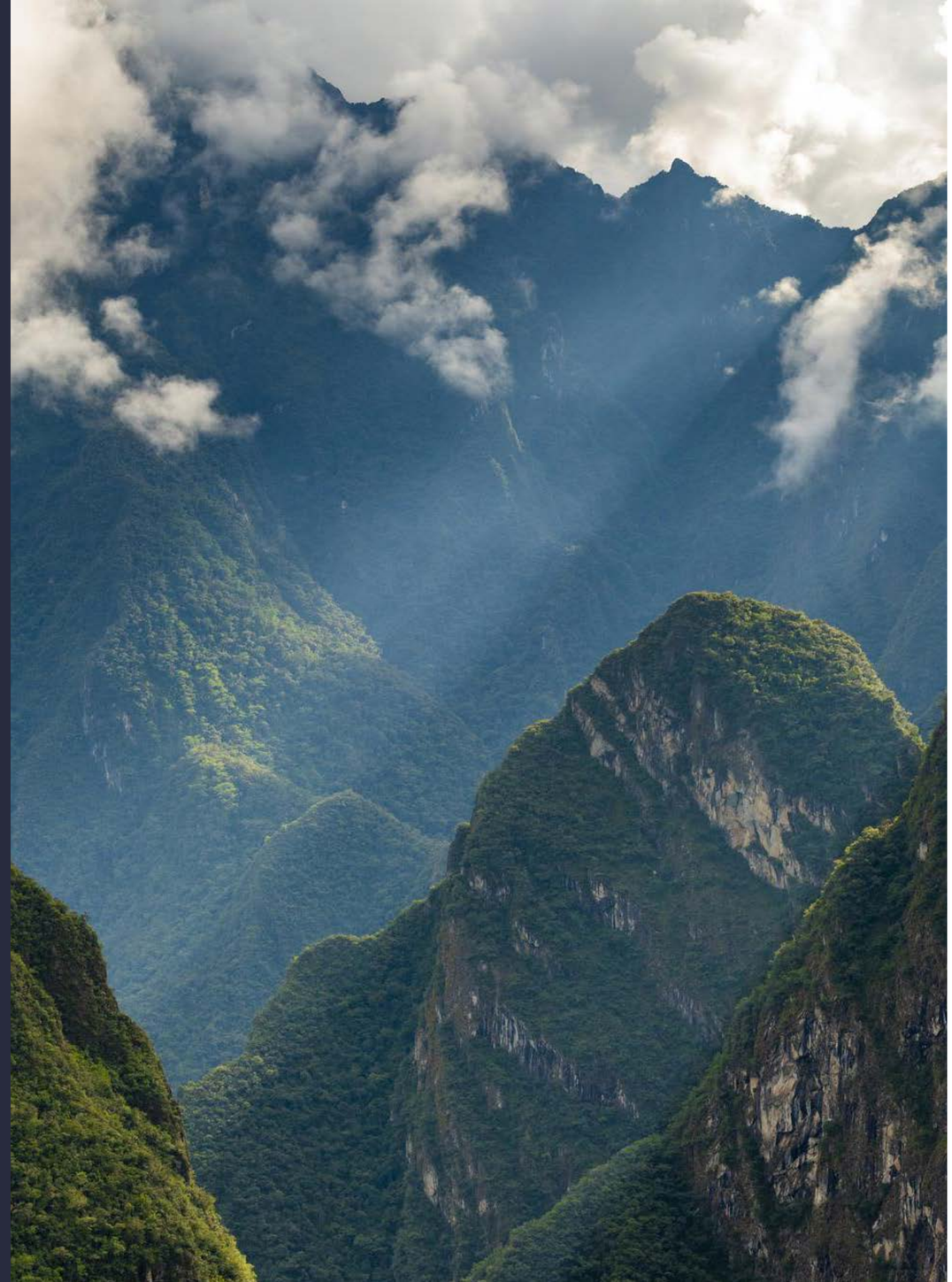


Manulife Investment Management

Climate-related financial disclosures

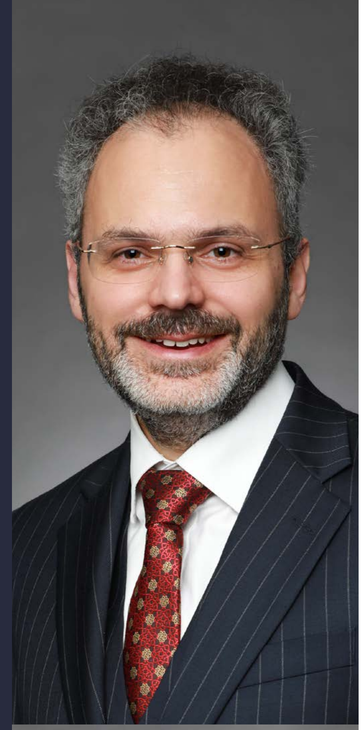
2021

Assembled in response to the Task Force on Climate-related Financial Disclosures



What you'll *find*

The disclosures in this report cover the activities of the investment management teams of Manulife Investment Management's public and private markets businesses. The report does not cover the activities of non-affiliated investment managers who manage some client assets on our behalf.



A *letter* to stakeholders

We're pleased to present our 2021 climate-related financial disclosure, which we've developed in alignment with the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD). We consider the TCFD framework to be a vital tool for helping regulators, investors, and companies understand the scope of the physical and transition risks that climate change poses, as well as the presence of technological and other opportunities that may arise as companies seek to meet the challenges of climate change and the transition to a net zero economy.

In this year's report, we've updated our governance, risk management, and strategy-related disclosure, and we've enhanced our metrics and targets disclosure in several dimensions. First, with respect to our listed equity and fixed-income assets, we've aggregated a representative sample of accounts to provide an estimation of our public markets investments emissions as we strive to improve on our year-on-year level of disclosure within the TCFD's recommended disclosure guidelines. Second, we describe our participation in a new initiative to collect data directly from companies in infrastructure and private equity and credit (PE&C) portfolios. This activity is part of a larger industry-led initiative to standardize the reporting and collection of environmental, social, and governance (ESG) data in private markets, which we believe will help enable greater transparency and comparability of ESG data across the industry.

We're also pleased to say we've successfully met a goal we set for ourselves in 2020 of launching a carbon sequestration-focused impact investment product that's designed to respond to investors' growing needs to meet their own net zero targets.

Collective action remains a focus for us as well. We've remained deeply involved in a variety of global initiatives focused on climate change. For example, we signed on to statements to spur action from governments and issuers, including the Global Investor Statement to Governments on the Climate Crisis. We believe with combined efforts of governments, regulators, industry, nongovernmental organizations (NGOs), academic institutions, and other investors, we stand a better chance of fostering the behaviors and disclosures that can help make a meaningful impact. In addition, we recognize the close links between climate and biodiversity issues, and so use this report to describe some of our activities in support of biological diversity in natural ecosystems. For example, we became a signatory to the new Finance for Biodiversity Pledge, which commits to protecting and restoring biodiversity through finance activities and investments.

We believe the framework provided by the TCFD helps facilitate much of our collaborative work, and we eagerly continue in our efforts to work together with industry peers, regulators, and other entities toward nature-positive and climate-related goals over the long term.

Sincerely,

Peter Mennie
Chief Sustainable Investment Officer, Public Markets

Brian Kernohan
Chief Sustainability Officer, Private Markets

The *scope* of this report

Manulife Investment Management is the unified global organization that represents the global wealth and asset management arm of Manulife Financial Corporation (Manulife). This disclosure is Manulife Investment Management's third TCFD-aligned report. Accordingly, it sets out how we incorporate climate-related risks and opportunities into investment oversight through appropriate governance, strategy, risk management, and metrics and targets.

Manulife Investment Management functions as part of the broader Manulife group, not a stand-alone entity and, as such, parts of this report must necessarily refer to processes at a wider corporate level while other sections relate only to Manulife Investment Management. That said, this document doesn't purport to reflect Manulife's overall climate initiatives or to comprehensively disclose its approach to climate risks and opportunities. It seeks to holistically cover Manulife Investment Management's capabilities across asset classes and should be read in conjunction with Manulife's Climate-related Risks and Opportunities (or TCFD) disclosure, which is published as part of Manulife's annual ESG report, for a broader perspective.

Manulife has been a supporter of the TCFD since 2017, and published its first disclosure aligned with the TCFD in 2019.

The disclosures in this report cover the activities of the investment management teams of Manulife Investment Management's public and private markets businesses. The report does not cover the activities of non-affiliated investment managers who manage some client assets on our behalf.

Highlights of our climate-related activities

Climate action

80%

targeted greenhouse gas (GHG) reduction by 2050 across our real estate portfolio[1]

35%

is Manulife's commitment to reducing scope 1 and scope 2 emissions by 2035[2] and making its general account investment portfolio net zero by 2050

3M $MtCO_2$

estimated amount of CO_2 removed from the atmosphere by our managed forests and farms annually over the past five years—4x more CO_2 than is involved in managing these properties[3]

Lead engagement investor

for a large chemical company as part of Climate Action 100+

Published our first Real Estate TCFD-aligned climate report, which outlines:

- Climate-related physical and transition risks our real estate may face in the short, medium, and long-term
- The opportunities and plans to address both, supporting the transition to a low carbon economy

We signed on to statements to spur action from governments and issuers, including the Global Investor Statement to Governments on the Climate Crisis. We joined the Climate Engagement Canada initiative with goals to encourage Canadian corporate issuers to manage, and report on, their transition to a net zero economy.

1 As of December 31, 2021. Target is an intensity-based reduction of scope 1 and scope 2 emissions (from a 2018 baseline) for the properties that are within our operational control. **2** Our commitment to emissions reductions apply to any properties where we have operational control. **3** As of December 31, 2021.

Global collaboration

Participating member of the UNEP FI pilot project Phase II

Participated in the Informal Working Group of the TNFD and became a member of the TNFD Forum

Support research into the resilience of agriculture and forestry to climate change at MIT's Joint Program on the Science and Policy of Global Change with the University of California, Davis

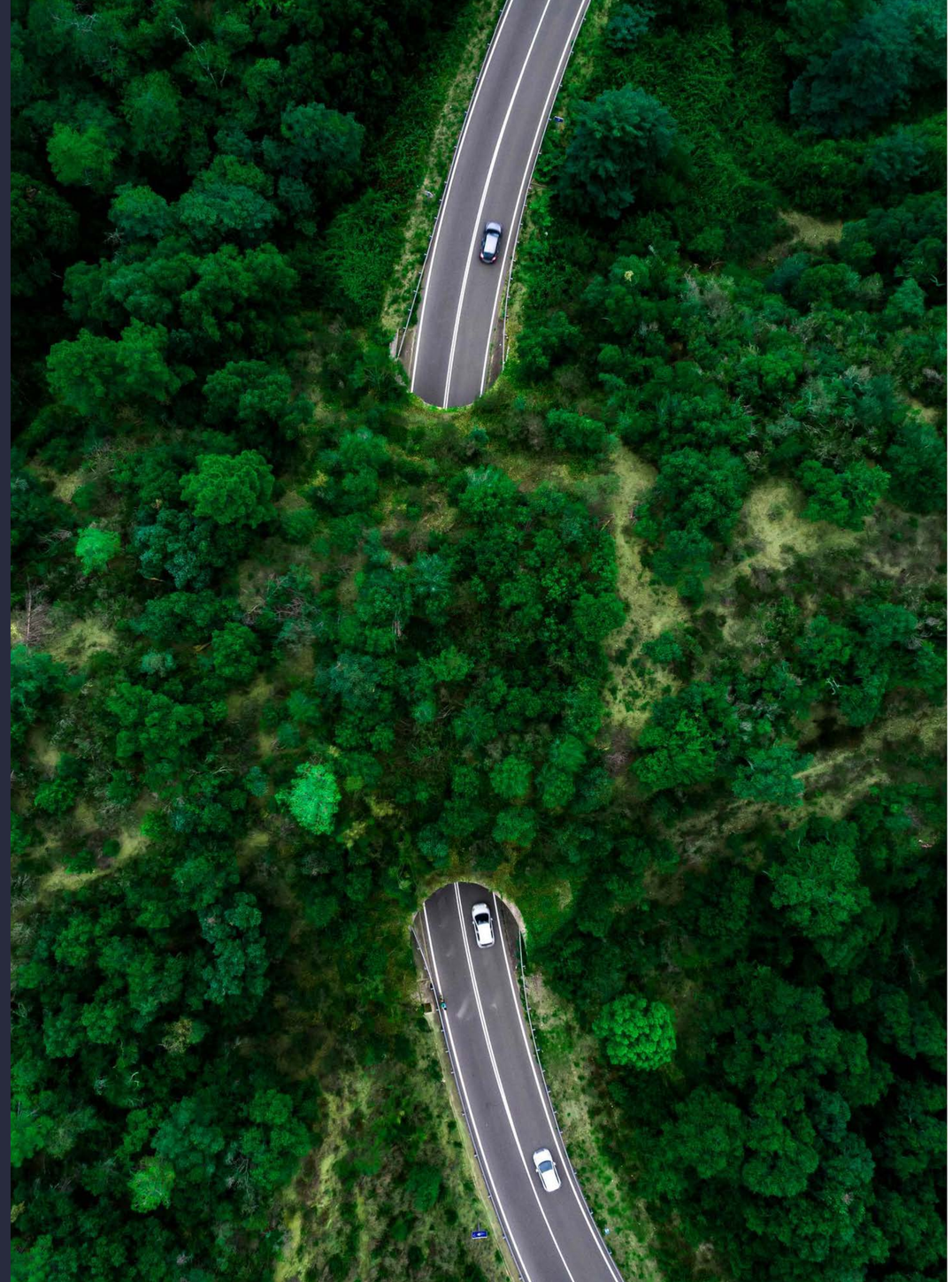
Participate in the World Business Council for Sustainable Development's (WBCSD's) Forest Solutions Group, Scaling Positive Agriculture, and Nature Action projects

We became a member of the Finance for Biodiversity Pledge to deepen our commitment to biodiversity

We're a participating member of the Cambridge Institute for Sustainability Leadership

We were appointed to the PRI Infrastructure Advisory Committee and the PRI Real Estate Advisory Committee

As of December 31, 2021.



Collaborative initiatives—additional insights

In 2021, Manulife Investment Management demonstrated support of the following responsible investment activities as investor co-signor with other asset managers and asset owners.

Global Investor Statement to Governments on Climate Change—The statement calls for governments to raise their climate ambition and take meaningful action by implementing policies that will attract capital to create significant investment opportunities in clean technologies, green infrastructure, and other assets, products, and services needed to accomplish the low-carbon transition. As an investor in corporate and sovereign credit, this statement aligns with our interest of reducing emissions.

CDP Science-Based Targets Campaign—The campaign encourages the world's largest and highest impact companies from a carbon emissions standpoint to set science-based emissions reduction targets in line with the 1.5°C warming scenario. We're a proponent of this campaign, as companies who set science-based targets see an average emissions reduction of 6.4% annually.

Finance for Biodiversity Pledge—By signing on to the pledge, we're committing to collaborate and engage with companies on biodiversity and assess our own biodiversity impact in order to set targets and disclose appropriate reporting on biodiversity factors by 2024. As an entity with deep heritage in agriculture and forestry, biodiversity is particularly relevant to our business.

Summary of our climate approach aligned with the TCFD recommendations

Governance

- **Board oversight—**Manulife Investment Management's climate strategy is overseen by Manulife's executive sustainability council (ESC). The CEO and president of Manulife Investment Management, Paul Lorentz, is a member of the ESC. This council brings together representatives from multiple businesses and functional areas across Manulife to drive the development of the firm's overall climate strategy, risk management activities on climate-related matters, performance tracking, and disclosures.
- **Management's role—**Manulife Investment Management's climate strategy for third-party clients is set by our two sustainable investing committees (SICs), one for public markets and the other for private markets. The two SICs are chaired by the applicable group CEO with membership drawn from Manulife Investment Management's leadership team. The SICs oversee our teams' sustainable investing activities and support the implementation of our sustainable investing and sustainability risk statement.
- **Accountability—**Sustainability-related key performance indicators are factored into our annual employee performance review and remuneration metrics. Accordingly, each team is expected to contribute to the firm's advancement in sustainable investing overall and adhere to research processes that integrate sustainability considerations.

Strategy

- **Accurately measuring climate risks and opportunities—**We aim to identify climate risks and opportunities over various timeframes and reflect their financial or other impact in our investment analysis while mitigating the impact through our stewardship approach.
- **Sustainability integration—**We take a variety of actions to appropriately account for climate-related factors in each asset class according to its internal, technical, and market dynamics along with its regional expression. This work occurs throughout our sustainability integration process, engagement strategies, and the development of climate-focused investment frameworks.
- **Building resilience—**We conduct scenario analysis across uncertain future pathways and seek to understand the potential impact of different climate scenarios on our investment strategies and owned and operated assets. We engage with regulators and policymakers, civil society, investee companies, and our peers in financial markets to address climate change systemically. We believe this builds resilience into our portfolios and for all our stakeholders, from our employees to our clients and the communities in which we operate.

We take an active approach to sustainable investment management

We take a variety of actions to appropriately account for climate-related factors throughout our environmental, social, and governance (ESG) integration process, engagement strategies, and the development of climate-focused investment frameworks.

Risk management

- **Identifying climate risk—**Our processes for identifying climate risks are supported by our policies and engagement practices. Manulife's environmental risk policy, updated in 2020, sets out an enterprise-wide framework for the management of environmental risks within our operating business activities. In parallel with this framework, Manulife Investment Management identifies and assesses climate risks in our clients' investment portfolios through public disclosure and third-party sources, as well as through our own research, company engagement, and collaborative initiatives. As a component of risk management, we conduct climate scenario analysis.
- **Managing climate risks—**As stated in Manulife Investment Management's climate change statement, we may take a variety of actions toward managing climate-related risks and opportunities across our investments. Broadly summarized, our available actions relate to asset allocation and selection, investment analysis and research, proxy voting, mitigating direct GHG emissions, deploying sustainability management best practices for operated assets, and participating in collaborative engagements focused on climate initiatives.
- **Integrating climate risks—**Climate risks are integrated into our overall approach to risk management, with overlapping lines of defense. We believe this approach helps ensure that we understand the extent of these risks in our clients' portfolios and for the assets we own or operate.

We're committed to identifying and managing the climate-related risks and opportunities

We engage with investee companies to encourage best practices in climate-related disclosure.

Material climate-related risks are managed taking into account the asset class, geography, and underlying investment strategy.

Metrics and targets

- **A range of useful metrics—**We use a variety of metrics to manage climate alignment, including green investments, corporate carbon footprinting and emissions reduction targets, climate value at risk (climate VaR) and portfolio warming potential, sovereign climate risks, and monitoring strategy-level emissions.
- **Emissions and risks—**For our third-party managed portfolios, we use various tools to manage physical and transition risk, such as scenario analysis and carbon footprinting and metrics such as fossil fuel reserves, forward-looking company carbon reduction targets, green revenues, and sectoral reduction pathways.

  As an asset owner, operator, and investor, we assess climate risk and seek to reduce our emissions or use our influence to encourage the companies we invest in to reduce their GHG emissions and align their business models with the realities of a changing climate. We also partner with other investors and industry experts to tackle climate change on a broader scale. By working collaboratively with peer investors, we're strengthening our potential ability to reduce systemic climate change risks and realize the economic benefits of the low-carbon transition.
- **Targets—**Manulife Investment Management will continue building on our sustainable investing capabilities, increasing the number and variety of sustainable investing options available to our clients, including climate-focused strategies.

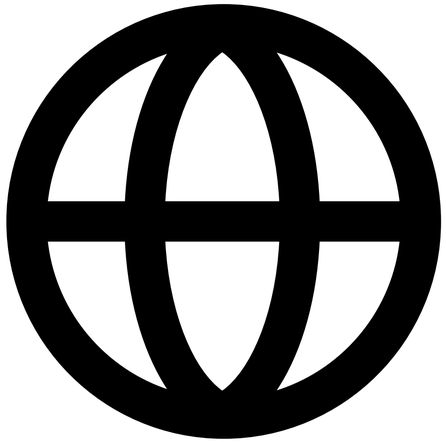
We seek to improve sustainability metrics

We're participating partners in some of the world's most innovative initiatives to help evolve the standard metrics for sustainable asset management.

We seek to standardize an approach using more forward-looking metrics, location-specific data, and scope 3 emissions.

We continue to build out carbon footprinting, such as weighted average carbon intensity, as well as a variety of other climate-related metrics.

Our climate-related financial disclosure



Governance

Board oversight

The sustainability governance structure of Manulife Investment Management is connected to larger sustainability governance at Manulife.

The president and CEO of Manulife Investment Management is joined by other senior Manulife leaders on the Manulife executive sustainability council (ESC), and the leaders of our sustainable investing teams in Manulife Investment Management work closely with Manulife's chief sustainability officer. In this way, Manulife Investment Management's governance structure is well connected to the broader sustainability community and leadership across Manulife.

The ESC is responsible for the climate strategy, risk management, and disclosures for Manulife, and Manulife Investment Management's policies and governance practices are aligned with the ESC's guidance. This extends to Manulife Investment Management's climate change statement, which applies to our third-party investment management activity and was developed within the context of appropriate risk management.

Our sustainability governance

Manulife **Manulife Investment Management**

Corporate governance and nominating committee	Audit committee	Management resources and compensation committee	Risk committee

Executive sustainability council

General counsel	Chief analytics officer	Chief marketing officer—chair	Chief human resources officer	Chief executive officer	President and CEO, Manulife Investment Management	Chief sustainability officer	Chief financial officer	Chief operations officer	Chief investment officer	Chief risk officer

Sustainability center of expertise

- Composed of sustainability leaders across public markets, private markets, the general account, and the Manulife organization
- Provides a forum for information sharing and consultation on sustainability initiatives, performance, and reporting

Legal and compliance center of expertise

- Composed of legal and compliance members from each business unit and region
- Legal, compliance, and regulatory affairs consultation
- Provides a forum for information sharing and consultation on legal and compliance related to Manulife sustainability matters

Our committees and working groups are convened to enable regular decision-making oversight

Sustainable investment regulatory working group

- Composed of functional department heads from public markets sustainable investment, private markets sustainable investment, product, operational risk, legal, compliance, and manager research
- Monitors regulatory implementation
- Provides advice and guidance to ESG regulatory change initiatives across the global organization

Public markets sustainable investing committee

- Integral to public markets strategic oversight
- Focuses on key sustainability initiatives and strategy
- Comprises senior cross-functional leads and ESG team members; meets monthly

Proxy voting working group

- Members include cross-functional business heads in public markets
- Reviews escalated voting decisions

Private markets sustainable investing committee

- Supports ESG integration across private markets
- Led by the global head of private markets
- Includes global heads of private asset classes, sustainability specialists, and representatives from strategy, risk, distribution, legal, and marketing

As of December 2022. For illustrative purposes only.

Our governance structure includes sustainable investing committees (SICs) and working groups that provide oversight, conduct ongoing risk assessments, and help steer our sustainability initiatives across global capital markets.

We view the involvement of leaders in all asset classes, as well as representatives from functional areas such as operations, legal, compliance, risk, and technology, to be crucial to supporting our sustainable investing activities across the organization and ensuring the buy-in and commitment required for success.

Our committees and working groups are convened to enable regular decision-making oversight. The heads of the public and private markets businesses chair their respective SICs, which enables regular decision-making oversight of the sustainable investing agenda that's appropriate to specific asset classes. In turn, chairs of these SICs communicate directly to other leaders of the global wealth and asset management arm of Manulife.

Related to proxy voting specifically, Manulife Investment Management has a proxy voting working group to act as a control against conflicts of interest in the proxy voting process. This working group comprises functional experts from across the organization, including the legal, compliance, investment, and sustainable investing teams. Climate change-related topics are typically discussed on a weekly basis during the proxy season.

Our sustainable investing policies and statements

Our policies, statements, and governance practices guide our sustainable investment activities. We use our policy and statement framework below to guide our activities from environmental, social, and governance (ESG) integration to investment stewardship. While our climate change statement outlines our approach to climate change in our investment practices, our full catalogue of policies and statements may also touch on aspects of our approach to the issue.

Global policies and statements

- Sustainable investing and sustainability risk statement
- Climate change statement
- Nature statement
- Cluster munitions policy
- ESG engagement policy
- Global proxy voting policy and procedures
- Executive compensation statement
- Responsible contracting statement

Asset class-specific frameworks

- Real estate sustainability framework
- Timberland and agriculture sustainable investing framework
- Infrastructure sustainable investing framework
- PE&C sustainable investing framework

Management's role

Management directs the firm's climate strategy

The governance structure we've established enables oversight of our teams' sustainable investing activities and supports the implementation of our sustainable investing policies. This governance structure also applies to the oversight of climate-related issues. The SICs for our public and private markets is responsible for supervision and decision-making of the sustainable investing agenda at the appropriate levels of the firm. These committees, which meet at least quarterly, include representatives from across different business functions who are stakeholders in implementing the sustainable investing agenda.

Management stays informed with the support of dedicated sustainability teams

The SICs are supported by teams of sustainable investing professionals who facilitate the implementation of Manulife Investment Management's sustainable investing agenda. This occurs through a variety of activities and projects, including:

- Preparing annual business plans
- Identifying and developing sustainable investing leading practices
- Supporting investment teams to develop tools and methodologies to adopt these leading practices across the investment lifecycle
- Leading the participation in external initiatives or collaborative industry engagement
- Dissemination of new resources such as tools and data
- Research support for investment teams
- Engagement and stewardship research and support

We conduct regular sustainability training for our investment teams

Our sustainability professionals conduct periodic training sessions for investment personnel on thematic sustainability issues. For example, earlier in 2022, we held a training conducted by the Union of Concerned Scientists with a focus on understanding climate change. Other climate-related training included climate disclosures and the Science Based Targets initiative (SBTi). Training is led either by our teams or by external experts, including leading academics. We also conduct or sponsor training sessions for specific investment teams as needed; investment analysts are expected to participate in these training sessions as part of their ongoing professional development.

Our investment teams have access to internal and external ESG data to assess the potential impact of material ESG factors on the valuation and risk/return profile of investee companies. Given that we operate as a community of specialist investment teams, each team incorporates these ESG factors into the investment process in a manner that aligns best with the team's investment decision-making approach.

Our sustainability-focused professionals support our asset management teams globally

25

dedicated sustainable investing professionals

400+

investment professionals are advised on sustainability and stewardship activities

Reflects key investment professionals including portfolio managers, analysts and traders.

Global expertise across regions and asset classes

- **ESG research and analysis**
- **Implementation of sustainability practices**
- **Training and education sessions**
- **ESG monitoring (investment monitoring)**
- **Proxy voting research**
- **Stewardship practices for operation of real assets**

Investment teams

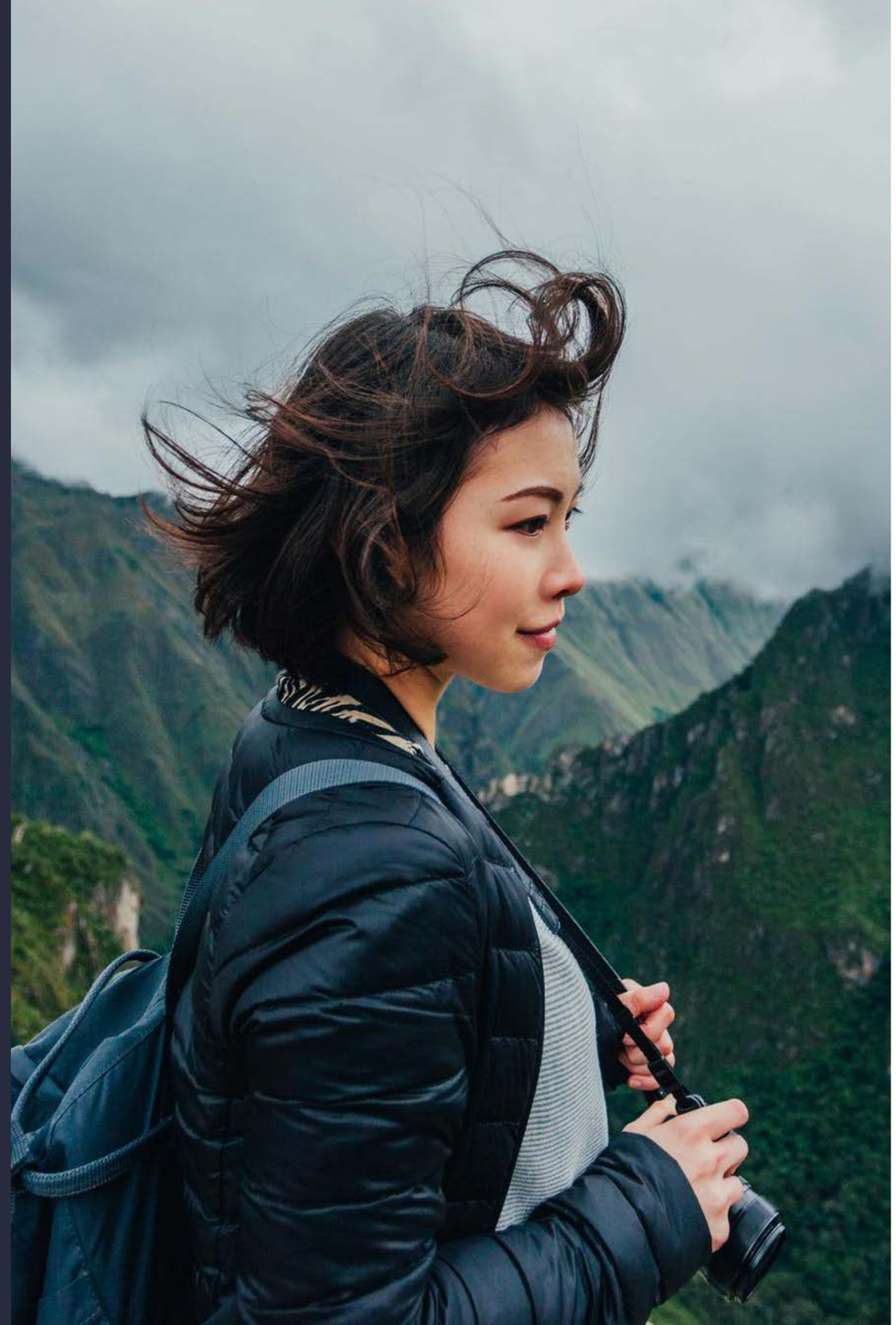
Integrating environmental, social, and governance (ESG) factors and stewardship in their investment activities

- Listed equity
- Fixed income
- Multi-asset solutions
- Real estate
- Infrastructure
- Private equity and credit (PE&C)
- Timberland
- Agriculture

Real asset operation teams

Integration of sustainable investing within assets we own and operate in real estate, timberland, and agriculture

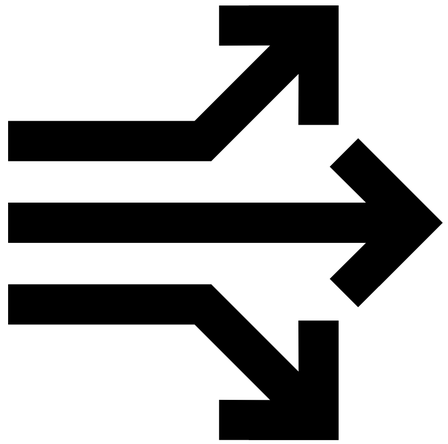
Source: Manulife Investment Management, as of December 2021.
Listed equity, fixed income, and multi-asset integration reflects Manulife Investment Management Public Markets activities only.



Sustainability-related key performance indicators are factored into our annual employee performance review and remuneration metrics

At Manulife Investment Management, we recognize that sustainable investing is rapidly becoming a critical driver of success within the asset management industry. We've set a clear target to be at the forefront of this industry evolution, further defining our value proposition and strengthening our competitive advantage.

Since 2022, across all public and private markets asset classes, the contribution of investment and property management professionals to sustainable investing and stewardship forms part of the discretionary bonus decision-making process each year. Accordingly, each team is expected to contribute to the firm's advancement in sustainable investing overall and adhere to research processes that integrate ESG considerations.



Strategy

We believe that unmitigated climate-related risks present a systemic threat to societal and financial stability—and, therefore, to our business and our clients' financial objectives—over the coming decades. It's too early to know what the decarbonization rate will be globally, which makes it imperative to assess the actual and potential material impacts of climate-related risks and opportunities in our portfolios and ensure that they're climate resilient.

We also believe that the understanding of climate change across capital markets remains varied, leading to potential mispricing of assets, and that many companies may be inadequately prepared to respond to the risks and opportunities of the low-carbon transition. A key element of our overall strategy is to identify and incorporate these risks and opportunities in our portfolios.

Our climate change statement explains that to understand the impact of climate change on investment decisions, asset managers should assess the transition risk, physical risk, and opportunities posed by climate change to the companies in which they're invested. We recognize that climate change could have an economic impact, which will vary from company to company or asset to asset. The varying degree will depend on the exposure level of each sector, industry, and geography.

Climate risks and opportunities over time

Accurately measuring climate risks and opportunities: We aim to identify climate risks and opportunities over various timeframes and to reflect their financial impact in our investment analysis.

Climate change is already occurring, and it's likely to intensify over the coming decades. In this context, we prioritize sustainability criteria when it comes to the assets we own and operate. And we believe the companies we invest in must respond to the challenges of climate change by developing new technology, adapting to changing policy, being flexible in the face of changing consumer preferences, and preparing for physical risks. These conditions and imperatives create risks and opportunities that have financial impacts that we need to act on today.

Although there's no set rule for short-, medium-, and long-term time horizons for climate-related issues, short term usually refers to through 2024, medium term refers to 2025 to 2035, and long term refers to 2035 to 2050 or 2100.

The TCFD classifies climate-related risks relevant to investors over these timeframes as physical (associated with changes in chronic or acute weather patterns) and transition related (effects resulting from the transition to a low-carbon economy, including policy, legal, technological, and market changes to address mitigation and adaptation requirements). The TCFD framework also emphasizes that efforts to mitigate and adapt to climate change produce opportunities for companies, industries, and investors. We recognize that these risks and opportunities vary by sector and geography.

These risks and opportunities will have financial impacts over these short-, medium-, and long-term time horizons. Policy and legal risks can be short term, as they aim to help mitigate climate change before it happens; the promise of new technology can also sometimes be quickly recognized in the market. Reputational damage can have more lasting medium-term impacts, similar to the effects of changing customer behavior. The severity of physical risks tends to be more certain over the longer term, but acute weather events can be unpredictable and may happen in the near term. The prospect of stranded assets is also more predictable over the long term but is increasingly priced into financial markets today; examples of stranded assets could be due to GHG regulations, rapid technology switching, or physical risks (chronic and acute) leading to uneconomical operation of an asset.

We aim to identify these risks in our research, which is reflected in our investment selection, valuation, and portfolio construction; we also believe that scenario analysis is a meaningful tool to understand the impact of climate change. In those asset classes in which we've developed scenario analysis, most portfolios show that climate transition risk—or the general cost associated with moving from a current business-as-usual scenario in the direction of a more carbon-neutral future—represents a significant portfolio risk. Physical hazard risk, or the cost impact associated with extreme weather events, which we identified in our initial analysis as extreme heat, coastal flooding, and tropical cyclones, is also critical to assess at a portfolio level. Both types of risk can often be partially or fully offset by climate-related opportunities.

Impact of climate risks and opportunities

Sustainability integration: We aim to incorporate identified climate risks and opportunities throughout our investment processes.

The climate-related risks and opportunities that we identify are integrated into our investment process and managed in our business strategy and planning. In our integration process, we focus on attractive risk-adjusted returns and portfolio

resiliency over the long term. We factor in differences across asset classes, industries, geographies, and operating models, and as climate science evolves, so too does our approach.

There's no single dataset that perfectly captures the risks of climate change effects. For this reason, we apply an active approach to internal and third-party data and use tools that we complement with our own industry knowledge and firsthand experience. This expertise is built through engagement to understand companies' vulnerabilities and strengths and through our own stewardship efforts, in which we seek to understand the full spectrum of risks and opportunities related to our owned and operated assets.

We develop differentiated analytical techniques, including scenario analysis, to inform our security selection and valuation; scenario analysis can also inform portfolio positioning. Our investment teams that currently use scenario analysis are most often using 1.5˚C, 2˚C, 3˚C, and 4˚C scenarios, although these are complemented by many teams' inclusion of carbon pricing and assessment in their analysis. However, we also go beyond buy and sell decisions to include engagement focused on climate action and active stewardship in our investment process.

We share sustainability goals with our clients. We've been building our sustainable investing capabilities to help clients guard against climate risks, while seeking to invest in companies that we believe contribute to sustainable climate solutions. In addition, we continue to develop thematic products and investment strategies as potential options for our clients. Because we view climate-related risks as systemic, we also contribute to external initiatives and collaborative industry engagements as appropriate.

We seek to communicate transparently with our clients about our climate-related investing strategy and process, and we believe this may help support our clients in responding to their own stakeholders. In 2020, we made our climate change statement publicly available, and since 2021 we have outlined our climate-related efforts and activities in our annual stewardship report. In addition, we began piloting the provision of enhanced client reports on a variety of sustainability metrics, including portfolio carbon footprints, for some equity and fixed-income investors.

Supplemental guidance for asset managers

We take a variety of actions to appropriately account for climate-related factors in each asset class according to its internal, technical, and market dynamics along with its regional expression. This work occurs throughout our sustainability integration process, engagement strategies, and the development of climate-focused investment frameworks.

Timberland and agriculture

Climate change presents both risks and opportunities for our timberland and agriculture businesses, and both risks and opportunities inform our business strategy.

Climate-related risks to the biological assets we manage include wildfire, drought, high winds, flooding, pest outbreaks, and increased costs (transition risk associated with carbon pricing), among others. These risks may vary in prevalence and magnitude depending on location and asset type but may be directly influenced by climate-related weather changes such as temperature or precipitation extremes or volatility. We have a variety of levers at our disposal to mitigate these risks, such as crop or tree genetics, species diversification, nursery practices, planting density, forest thinning, automation, fuel switching, and insurance. We account for such risks, as well as our ability to mitigate them, from investment due diligence all the way through asset management. Importantly, this also includes the imperative to reduce our contributions to climate change, which is why we're hard at work developing decarbonization strategies for both asset classes throughout 2022.

Climate-related opportunities also influence our timberland and agriculture business strategy. Forests and farms are both natural capital assets. They represent natural stocks of value that produce flows of benefits, or ecosystem services, to both their owners and society at large. In addition to the basic ecosystem services they provide in the form of food and fiber, they also provide a host of other services, such as climate change regulation, water filtration, and recreational opportunities. In particular, carbon sequestration is a key capability

for trees (forests) and soils (farms). We see considerable opportunity to leverage the natural capital assets we manage to help our investors reduce their carbon footprints, and increasingly so as markets for carbon sequestration and other payments for ecosystem services develop and mature.

Infrastructure

As long-term infrastructure investors, we recognize that companies adhering to strong environmental standards can improve their financial performance as well as minimize risks to their businesses.

We see renewable energy as one of many opportunities in infrastructure. As an investor, we see the potential for attractive risk-adjusted returns, as portfolio revenues are generally generated from long-term contracts that offer customers an energy cost savings value proposition. But we also see this as an opportunity to support society's transition to cleaner energy.

Our infrastructure investment team is an active participant in the energy transition in the United States, with investments in industries such as solar, wind, and battery storage. We believe these and other renewable energy assets are the key components of a lower-carbon electricity system.

Real estate

As a manager of real estate investments, our business is exposed to risks and opportunities from the environment in which we operate, and we recognize that physical climate risk has progressively become a core real estate issue. As the impacts of climate change are increasingly felt worldwide, it's vital for our investors, employees, and tenants to understand the importance of addressing this issue.

While we continue our efforts to mitigate climate change by transitioning our operations and supply chain to low carbon, we also recognize that we must build climate resilience within our real estate portfolios and across our management practices.

The nature and level of risk are dependent on structural forces that will shape the short and long term, and our business will be affected in both positive and negative ways by the climate transition. The opportunities depend on our action and response.

Reducing our carbon footprint is critical to our transition to a low-carbon economy and a sustainable future. In 2020, our real estate team set a long-term GHG-reduction target of 80% by 2050.[1]

Private equity and credit (PE&C)

Assessing the risks and opportunities related to climate change is an integral part of our sustainable investment approach for our PE&C businesses. Within PE&C, we assess climate-related risks primarily during our pre-investment due diligence process. On an annual basis, we update and monitor the ESG performance of our investments using our proprietary framework, which incorporates climate-related issues that may be deemed material for a particular investment. Across all assets, profiling potential material risks and opportunities related to climate change is critical to preserving and enhancing the value of our investments.

Publicly listed asset classes—equity and fixed income

Climate change assessment is a critical part of our investment process and our corporate engagement program, which is particularly relevant in hard-to-abate sectors. Our global presence enables us to track climate regulations, consumer sentiment related to regulations, and the decarbonization efforts of individual companies.

Within publicly listed asset classes we assess transition risk by using a blend of qualitative analysis and quantitative ESG metrics such as climate VaR, which assigns a mathematical value to the estimated financial impact of climate change. The severity of physical risks tends to be more certain over the longer term (apart from acute weather events, which can be unpredictable) and typically depends on where an asset is physically located. Scenario analysis, in which the impact of climate change can be modeled through a range of possibilities, is one of the key tools we use to put a financial value on climate risk.

We're also developing investment frameworks and investment processes for climate-change themed investment strategies, with a focus on portfolio resilience.

While climate risks exist, so do opportunities, including the promise of new technologies. We see green hydrogen, biofuels, and batteries as examples of these opportunities. We attempt to identify the issuers who are leveraged to these themes and track their competency to capture the opportunities. One way we measure this is by assessing the value of low-carbon technology patents filed by issuers, as we believe this can provide useful insight in regard to innovation and progress.

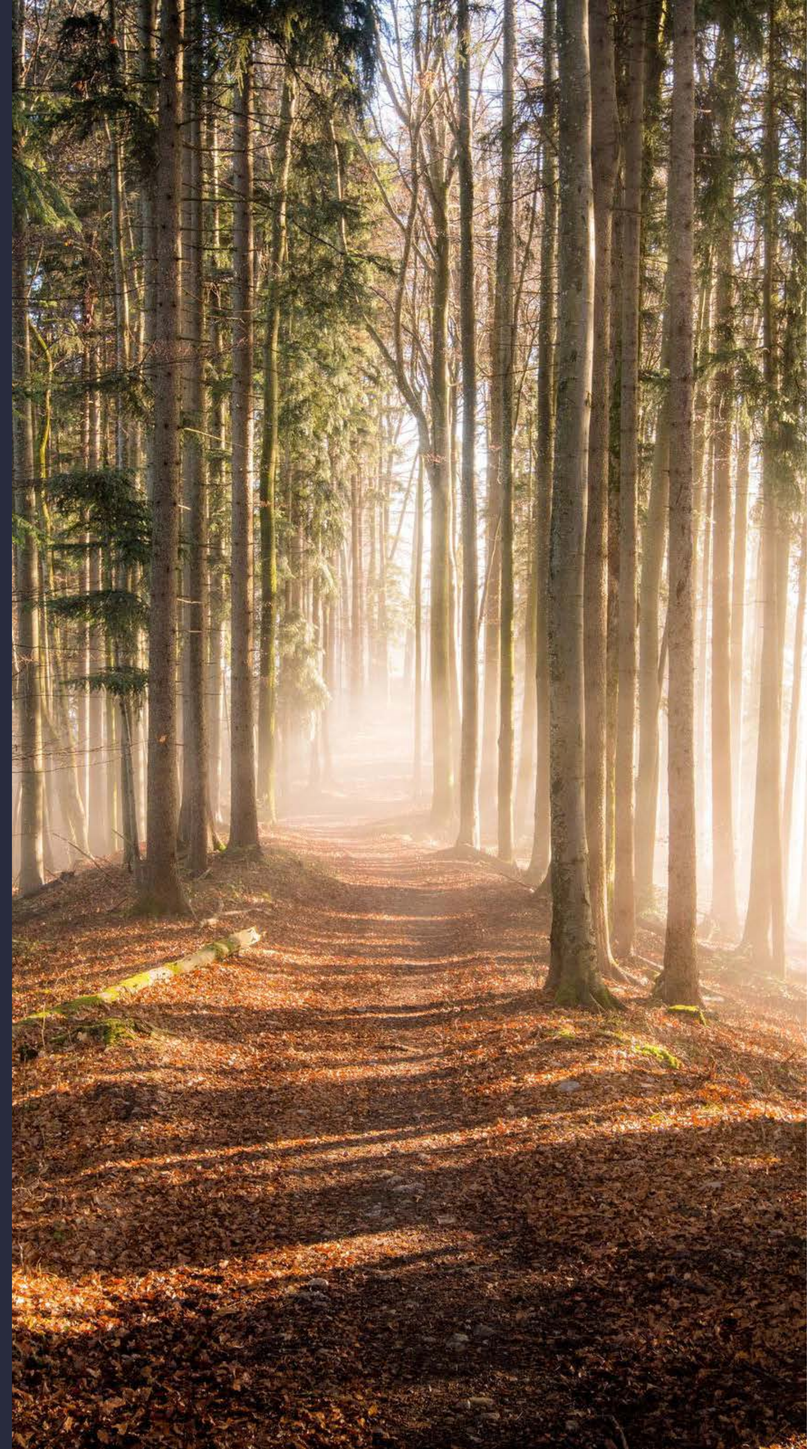
Understandably, tackling climate change is an integral part of our corporate engagement program, particularly when it's a material factor for a firm or industry. We aim to share our knowledge and findings with investee companies in the hope that it can help them strengthen their sustainability footprint and reduce climate risk. Our collaborative approach with issuers enables mutual learning and the sharing of evolving best practices around climate-related disclosure and management.

Building resilience

We conduct scenario analysis across uncertain future pathways and seek to understand the potential impact of different climate scenarios on our investment strategies and owned and operated assets. We believe this builds resilience into our portfolios and for all our stakeholders, from our employees to our clients and the communities in which we operate.

In 2020, we identified a number of areas in which we could be more effective in our efforts to address climate change. In particular, we made progress in assessing climate risk and resilience in our real estate portfolio as well as through third-party portfolio review. Since then, we've developed models and tools to assess the potential impact on our business of the four Intergovernmental Panel on Climate Change (IPCC) scenarios.

The third party climate assessment tool that we utilize applies a multi-year time horizon to assess risks and opportunities based on direct emissions, covering both physical and transition risks and opportunities. The policy risk is calculated based on nationally determined contributions, with the technology opportunities based on the International Energy Agency's (IEA's) Energy Technology Perspectives model (which in 2022 was superseded by the IEA's Global Energy and Climate (GEC) Model). Several teams at Manulife Investment Management also apply other scenarios and carbon pricing estimates into their models or develop worst-case cost scenario assumptions. In 2022, we developed a proprietary model that allows investment teams to assess their climate exposure across their portfolios.



In 2021, we began working with peers on Phase II of the UN Environment Programme Finance Initiative (UNEP FI) climate scenario working group. This work builds on Phase I of the pilot program, which involved development of an assessment tool for investors to review climate risk across portfolios. In that phase, we contributed to the "Changing Course" and "Changing Course: Real Estate" reports that were shared with the wider industry. Phase II of UNEP FI aims to introduce new methodologies and identify sector-specific risks and opportunities related to climate change.

Timberland and agriculture

We conducted a scenario analysis in 2020 involving our agriculture assets in California and timberland assets in New Zealand. Both analyses focused on downscaled high-carbon physical impacts and low-carbon transition elements. We selected our California agriculture assets and New Zealand timber assets because we believe our asset classes in these regions provide a reasonable approximation for the breadth of potential climate scenario impacts on our business until we complete a full portfolio-wide scenario analysis.

- These regions represent the highest concentrations of assets under management per square kilometer for each of our asset classes.
- California and New Zealand allowed us to examine scenario analysis in two different countries (and include both the Northern and Southern Hemisphere in our assessment). This provided insights into national, regional, and global differences particularly relevant for transition scenarios.
- California agricultural assets allowed us to explore water risk under different scenarios, which is among the most significant climate-related impacts facing our agricultural assets.

The results of the scenario analysis case studies are found in the tables below, highlighting physical impacts in the high-carbon scenario and transition impacts in the low-carbon scenario.

Case Study Scenario Analysis Insights: California Agriculture

High-carbon scenario

Physical impacts	Business impacts
Increased average temperatures (global mean increase of 3.7°C by 2100)	• The impact of warmer winters on bee colonies to be monitored. • The greatest potential impact of increased average temperatures is on chill hours. Increased warming and fewer chill hours may require moving northward.
Increased wildfire risk	• Risk of smoke-tainted vineyards. • Risk of smoke blocking out sunlight and impacting almond drying rates.
Changes to natural areas and biome shift	Risk of biome shift is more likely to be felt by the ecosystem surrounding farmland, rather than directly on the assets. These impacts would need to be monitored.
Changes in precipitation, water availability and quality • Increased variability in availability • Earlier snowpack melt • Aquifer depletion • Increased precipitation • Increase in the intensity of rainfall	• Crops will require increased amounts of water. Snowpack is an important natural water reservoir that may become depleted. • More intense storms may result in precipitation being washed out to sea rather than seeping into the ground, thus preventing aquifer replenishment. • Water stress is likely to increase. In severe cases, insufficient water may require transitioning some assets to areas with more water.
Mean global sea level rise of 0.63 m by 2100	Little to no impact on current assets; may increase salination of some aquifers. To be monitored.
Transition impacts	**Business impacts**
Increased likelihood of regulatory developments affecting water use.	Water regulation will likely become prevalent in California over the coming decades. This may increase operational costs but may also present water banking opportunities.

Low-carbon scenario

Transition impacts	Business impacts
Carbon pricing ($100/$tCO_2$ by 2030 and $140/$tCO_2$ by 2040 in advanced economies)	• Risk of higher operational costs from carbon pricing, which may be passed onto consumers, depending on price pressures (e.g. substitution-related price ceilings). • Opportunity for monetizing soil carbon sequestration as carbon prices rise.
Renewable energy (increased deployment, including of bioenergy)	• Increased biofuels demand presents opportunity to expand into new crops and serve a new market. • Projected reduction in renewable energy prices could present opportunity to install on-site microgrids to reduce energy costs.

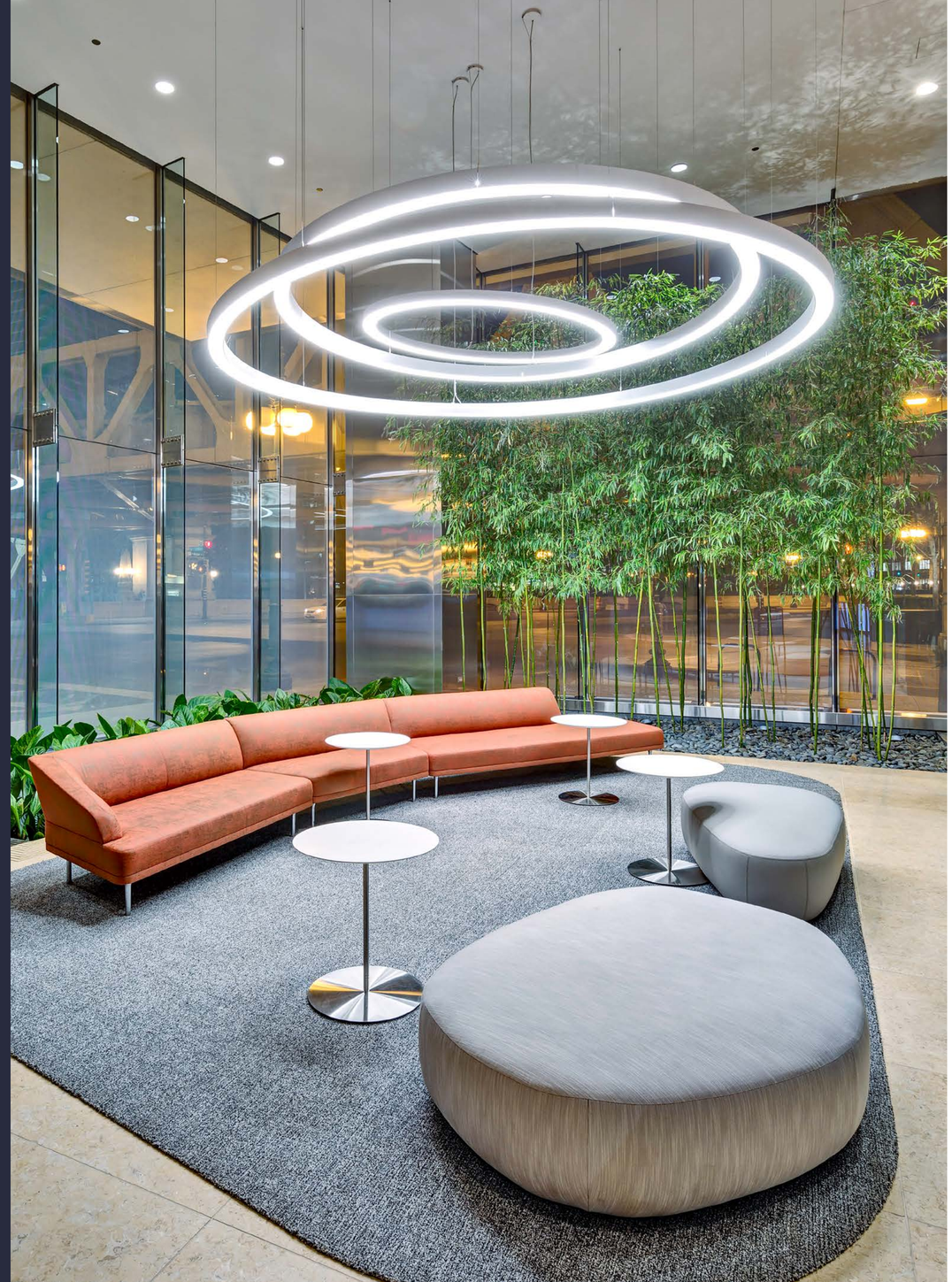
Case Study Scenario Analysis Insights: New Zealand Timberland

High-carbon scenario

Physical impacts	Business impacts
Increased average temperatures • Global mean temperature increase of 3.7°C by 2100 • Higher elevation warming relatively more than lower elevation	• Opportunity for gaining increased share of China's timber market as European timber regions may be subject to more extreme climate changes with attendant impacts on their productivity. • Increased average temperatures may extend range for pine to higher altitudes, should land ownership opportunities become available.
Changes to natural areas • Rise in snowline • Biome shift	Most of Manulife Investment Management Timberland and Agriculture Inc's (MIMTA) New Zealand plantation forests are Radiata pine, which is fairly resilient to biome shift.
Changes in precipitation and storms • Increased flood damage • Increased risk from hurricanes/cyclones	Risk of heavy rainfall, wind, and cyclones, leading to forest loss and possible debris wash out.
Mean global sea level rise of 0.63 m by 2100	Rising temperatures and sea levels are unlikely to impact New Zealand Radiata pine.

Low-carbon scenario

Transition impacts	Business impacts
Carbon pricing and growth of the carbon market (increasing carbon pricing to $100/tCO$_2$ by 2030 and $140/tCO$_2$ by 2040 in advanced economies)	• Higher carbon prices would increase shipping costs, which may be offset by a projected increase in global demand for lumber. • MIMTA has monetized most carbon offsets available for its New Zealand properties and afforestation opportunities are currently scarce, making generation of new carbon offsets unlikely.
Increased bioenergy (grows to 7% of power generation by 2050)	• Industrial shift toward biofuels may provide an opportunity if demand for wood pellets increases, although growing fiber demand for newer uses and in building materials may offer a higher price point. • Carbon pricing may increase the costs for fossil fuels, making biofuels more attractive and potentially an opportunity for MIMTA.
Renewable energy (increased deployment of wind and solar)	There is likely little opportunity to provide new renewable energy capacity due to the New Zealand energy grid's low emissions profile.



Real estate

Identifying and understanding the climate risk to a company or portfolio enables the development of resources and tools to manage that risk and improve resilience effectively. Our real estate business takes a global portfolio approach to understand climate threats, inventory existing resilience practices and features, and identify improvement opportunities for climate change management.

We consider the risks detailed on the following pages as having potential impacts on our business across either short-term (1–5 years), medium-term (5–10 years), or long-term (10+ years) time horizons.

Identified transition risks and opportunities[4]

Risk	Timeline	Mitigation and opportunity
Regulation: Increasing climate-related regulations, including carbon pricing, regional efficiency, or emissions standards, and increasing disclosure requirements. Regulation changes could lead to increasing operating and compliance costs.	Short to long term	We continue to monitor emerging regulations and incorporate assessment of building performance and efficiency in our due diligence to stay ahead of carbon pricing and minimum efficiency requirements.
Market: Shift in capital away from high-emitting products and services, potentially affecting tenant demand, asset value, and fundraising.	Short to long term	Improving portfolio efficiency could create new avenues for financing and increase investor and tenant demand. We continue to certify and build assets to green building standards such as LEED, Energy Star, Comprehensive Assessment System for Built Environment Efficiency, and BOMA BEST, implement energy and emission reduction programs, and collaborate with tenants and clients on shared climate goals.
Technology: There is a cost to move to a low-carbon economy, including capital upgrades to retrofit assets, advanced technologies for buildings, demand for high-quality transactable ESG data, real-time metering, and shifting to renewable energy sources.	Short to long term	Short-term capital costs are expected to be offset from paybacks on lower operating costs and meeting tenant demand. Our ongoing energy, water, greenhouse gas (GHG), and waste programs support our team in allocating capital toward low-carbon technology and improving property performance.
Reputation: Failure to act or the perception of not acting on climate change could affect our reputation as a global real estate leader and risk our relationship with tenants, employees, communities, and investors.	Short to medium term	To communicate our climate change action and impact, we disclose our objectives and performance annually through several independent and industry frameworks, including Principles for Responsible Investment (PRI), Global Real Estate Sustainability Benchmark (GRESB), our annual real estate sustainability report, and this climate disclosure report. We also support Manulife's disclosure to CDP.

4 Represent a non-exhaustive list of the main risks and opportunities currently identified across our real estate portfolio. Risks and opportunities are subject to change over time and are ultimately addressed on a case-by-case basis depending on the individual characteristics of each property.

Identified physical risks and opportunities[4]

Risk	Timeline	Mitigation and opportunity
Acute risks		
Flooding: Flooding can cause asset damage, downtime, and incurred costs through insurance premiums and deductibles. Flooding may affect our ability to obtain insurance in vulnerable markets.	Short to long term	Our insurance team reviews portfolio flood exposure annually to understand insurance implications. Properties have regular site assessments completed by our insurer, which include recommendations for protection measures.
Extreme storms: Climate change is expected to increase the frequency and severity of extreme storms, high winds from hurricanes, typhoons, snowfall, or ice storms from extreme temperature fluctuations. This can cause asset damage and downtime from power loss.	Short to long term	We prepare properties for storms through our emergency management planning and seek to minimize downtime by using on-site backup power generators.
Wildfires: Wildfires can not only cause asset damage, but may also affect occupant health through reduced air quality.	Short to long term	Our teams consider various resilience measures, including fire-resistant building materials, on-site emergency water supply, and high-efficiency air filters to protect indoor air quality.
Chronic risks		
Heat stress: Rising global temperatures can affect employee and tenant productivity and increase operational costs to maintain safe and comfortable building conditions.	Short to long term	We seek to identify opportunities to improve cooling efficiency and costs through capital upgrades, building commissioning, and operating procedures.
Water stress: Water scarcity can affect water availability and increase operational costs.	Short to long term	We seek to maximize operational efficiencies while minimizing consumption through practices such as water audits and installing low-flow appliances and faucets, and minimizing landscaping water requirements, where applicable throughout our portfolio.
Sea-level rise: Rising sea levels can present similar challenges to flooding while also risking failed development approvals and “stranded” assets in vulnerable areas.	Long term	We review and consider exposure to sea-level rise in acquisition and new development decisions, as well as across our existing portfolio. We invest in preventative infrastructure and consider underwriting, where applicable.

Risk management

Manulife Investment Management has been committed to developing a risk management approach and framework that articulate how we identify and manage the climate-related risks and opportunities to which we're exposed. We integrate the consideration of ESG factors, including climate-related issues, into the investment process of the majority of our investment teams, as we seek to deliver long-term resiliency and sustainable investment outcomes for clients. As an asset manager, we operate and invest within the constraints of our client mandates.

Meanwhile, we bear responsibility toward shareholders, clients, and stakeholders to assess, report on, and manage climate-related risks, and we continue to assess climate-related risks and manage our own business impact on climate change. We're developing strategies that support sustainability goals, including strategies oriented toward investors who wish to have structurally lower carbon emissions and intensity and want to identify with companies that are making strong progress on climate change goals.

How we identify climate risks

Our process for identifying climate risks is supported by our policies and engagement practices. In addition, we identify climate risks through public disclosure and third-party sources, as well as through our own research, company engagement, and collaborative initiatives.

Manulife's environmental risk policy, updated in 2020, sets out an enterprise-wide framework for the management of environmental risks within our business activities. In parallel with this framework, Manulife Investment Management identifies and assesses climate risks through public disclosure and third-party sources, as well as through our own research, company engagement, and collaborative initiatives.

To better identify and assess climate-related risks for our investee companies, as well as for assets we own and operate, we consider and incorporate external assessments and information from different sources. We apply tools designed to analyze carbon emissions, conduct scenario analysis, examine fossil fuel reserves, and formulate conclusions about physical and transition risks, along with other topics across the climate-related risk spectrum.

We also obtain climate risk data from companies' publicly disclosed documents. Meanwhile, we can engage with companies when they don't sufficiently disclose and in cases in which data providers have information gaps.

Manulife Investment Management has participated in a wide range of climate change-focused associations and organizations that contribute to more robust efforts at climate disclosure, including:

- Asia Investor Group on Climate Change (AIGCC)
- CDP
- Climate Action 100+
- ESG Data Convergence Initiative
- Institutional Investors Group on Climate Change
- GRESB
- Sustainable Accounting Standards Board Investor Advisory Group (SASB IAG)
- Sustainable Forestry Initiative (SFI)
- UN PRI
- UNEP FI TCFD pilot project

Supplemental guidance

We host sustainability education and training across the firm on several sustainability issues, including climate-related topics.

For all investment staff, the sustainable investing teams host periodic training on thematic sustainability issues for which the content and medium can vary. Training is either led by the internal sustainable investing teams or leveraged from external service providers and experts. Investment staff attendance at such trainings is tracked. These meetings also include outside speakers or training from the sustainable investing teams on topics relevant to that market or sector. In 2021, different climate-related topics were covered through these sessions, such as the green bond market, carbon pricing, net zero commitments, and greenwashing.

Another key example is where training occurs in our global engagement research initiative (GERI) discussions. This program consists of bimonthly meetings with public markets equity, fixed-income and sustainable investment professionals. Each GERI meeting has a sector theme and internal professionals as well as outside speakers who are invited to present pertinent research for a given sector; for example, in 2021, one focus topic was climate-related proposals in the oil and gas industry.

The sustainable investing teams also conduct training for specific investment teams on an as-needed basis. For example, training has been provided to the liability-driven investment team on broader topics such as climate change, in addition to specific topics such as GHG emissions breakdown by sector, climate VaR, and climate scenarios.

In portfolios of publicly listed asset classes, we engage with investee companies to encourage best practices associated with climate-related disclosure.

In fulfilling our duty as a fiduciary to protect our clients' assets and to act in their best interests, we believe that our responsibilities of stewardship align with a long-term investment view. Our fundamental investment process goes beyond financial statement analysis and involves ongoing monitoring of a company's (or other entity's) strategies, capital structure, and management of ESG risks and opportunities. Within the daily risk report encompassing each strategy, climate metrics are provided to describe those issuers with a higher climate exposure; additional specifics are found in climate tools that are available to our public markets investments teams.

Climate tools (public markets asset classes):

1. **Portfolio carbon footprint—**We actively measure the portfolio carbon footprint, which enables portfolio managers to comprehend portfolio carbon intensity and provides a baseline for benchmarking and setting strategies to decarbonize.

2. **Robust transition company assessment—**The investment organization within Manulife Investment Management uses various tools and data points when assessing whether a company has a credible climate strategy and transitional plan. Those tools include the Transition Pathway Initiative, the CDP, the Science Based Targets initiative, Trucost GHG emissions data, and IEA scenario analysis data.

3. **Climate scenario analysis—**During 2021, we began providing climate risk data aligned to multiple climate scenarios within our daily risks reports, which encompass those investee companies with the highest climate risk exposure at an individual portfolio level.

Linking climate exposure to active ownership, we seek to engage with companies/entities both before and after we invest in order to enhance the long-term value of our clients' investments. One topic we engage on is helping companies with disclosure, including climate-related information. We apply a materiality-based approach to our investment decision-making process, but we recognize that some factors could have material effects across industries and geographies. For example, we believe that climate change and diversity are virtually universal topics that could affect investments in all asset classes, geographies, and sectors.

We believe that investors can play a strategic role, not only in the identification and analysis of the systemic risks from climate change, but also through using our voice to improve the outcomes for our clients, as well as the economy, environment, and society. Through our sustainability analysis, we identify key barriers to effective stewardship and the improvements we believe are needed now to promote the smoother functioning of financial markets. This helps our own climate risk assessment, but it also advances the market overall and can help reduce systemic risk.

A key example of this activity is our involvement in the SASB IAG. The IAG includes global asset owners, asset managers, and investment intermediaries who recognize investors' need for consistent, comparable, and reliable disclosure of financially material, decision-useful ESG information.

2021 engagements with investee companies and other entities

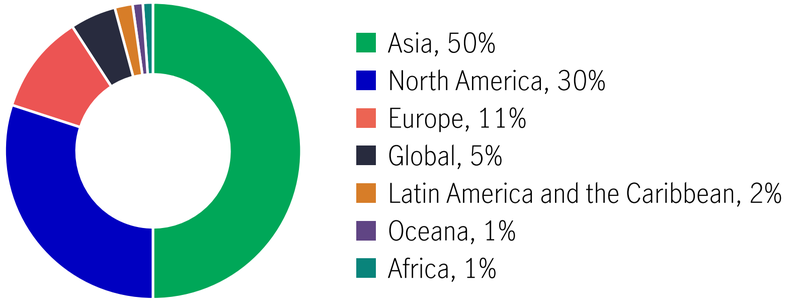
1,313 total engagements in 2021

805 issuers engaged

126 influencers, regulators, NGOs, governments, and vendors engaged

Total engagements include instances where we engaged with the same issuer/party on multiple occasions over the 12 months ending December 31, 2021.

Engagements by region



As of December 2021. The global category includes vendors, NGOs, and influencers with a worldwide focus and coverage. Mexico is included in the Latin America and Caribbean category.

Top engagement discussion topics in 2021[5]

Discussion topics	Engagement
GHG emissions	20%
General tag for ESG disclosure	19%
Energy management	16%
Sustainable finance	12%
Labor practices	8%
Board structure	7%
Executive compensation	6%
Physical impacts of climate change	6%
Product design, lifecycle management, and/or packaging	6%
Employee engagement, diversity and inclusion	5%
Water and wastewater management	5%
Employee health and safety	5%
Management of the legal and regulatory environment	4%
Board diversity (gender/ethnicity)	4%
Data security	3%
Product quality and safety	3%
Human rights and community relations	3%
Environmental business opportunities	3%
Waste and hazardous materials management	3%
Board independence	3%
Materials sourcing and efficiency	3%

5 This list relates to engagements with public markets issuers and was compiled using data from our proprietary engagement tracker, as of December 31, 2021. A single engagement may be represented across multiple topics as a single engagement often covers a range of issues. The list above reflects topics that we track that were discussed in at least 3% of our total engagements.

In our role as chair of the Exchanges Working Group for the IAG, we work with exchanges to recognize the SASB standards as globally applicable within a core set of corporate ESG disclosures. Furthermore, in our bilateral company engagements, we ask issuers to use SASB standards in disclosures to investors. As a result of this collective effort, we're beginning to see greater adoption of SASB standards as a reporting framework.

Manulife Investment Management has also been involved in ongoing regulatory consultations to drive sustainability across sectors. In 2021, we provided comments to the U.S. Securities and Exchange Commission (SEC) regarding their general call for feedback on potential climate change disclosures. We intend to continue to participate in future SEC public consultations as we generally support the SEC's action in the development of a framework for consistent, reliable, and comparable nonfinancial data across issuers.

Managing climate risks

We manage climate risks throughout the different stages of our investment process

As put forth in our climate change statement, we may take a variety of actions toward managing climate-related risks and opportunities across our businesses and investments to appropriately price climate risk. Broadly summarized, our available actions relate to asset allocation and selection, investment analysis and research, proxy voting, mitigating direct GHG emissions, deploying sustainability management best practices for operated assets, and participating in collaborative industry climate initiatives.

In general, with publicly listed asset classes, our preferred position is to engage directly with companies to encourage effective implementation of climate risk mitigation and adaptation strategies, reserving the right to divest any investment.

Sustainability risks and factors throughout the investment lifecycle

Our investment teams are empowered to make decisions in line with their respective investment philosophies and clients' objectives. Each investment team has responsibility for its own investment process, from research through implementation. The integration of ESG factors into investment processes aligns with this approach, ensuring that our analysis is relevant and meaningful to each team's investment process. The heads or chief investment officers of each asset class have oversight of the investment processes of the individual investment teams, which includes the evolution of our sustainable investing approach.

We look to incorporate material sustainability risks and opportunities throughout the stages of our investment lifecycle, taking into account the characteristics of the asset class and investment capability in question as well as industry and geography, among other factors.

Climate change and risk management

We acknowledge that climate change is one of the most material long-term risks to our business model, and its effects are already being felt. We seek to remain abreast of the best available science on climate change and to understand its impact on our investments. The IPCC urges action to limit global warming to 1.5°C in order to prevent the destabilization of the climate system and reduce the risk of impending extreme weather events, changes to global food systems, biodiversity loss, and poverty.

According to an IPCC report issued some years ago, "limiting global warming to 1.5°C would require rapid and far-reaching transitions in land, energy, industry, buildings, transport, and cities." Additionally, as noted by the World Resources Institute, "$5 trillion will be needed annually by 2030 to finance the systemwide transformations needed to limit global warming to 1.5°C. But to meet this target, annual increases in total funding from public and private sources must accelerate by a factor of 13." Such profound changes present significant risks and opportunities for all institutions, including those in the private sector.

The combination of our sustainability-focused activities in assets we own and operate, rigorous fundamental research, proprietary ESG assessments, third-party providers and direct collection of climate-related data enables us to manage climate-related risks within the parameters of a specific product or investment strategy.

Partnering with clients on their climate-related goals

We aim to deliver long-term resiliency and sustainable investment outcomes for clients, including by partnering with them on their climate-related goals. We also aim to engage with our investee companies to accomplish this goal using a variety of internal initiatives.

- Training for investment staff on topics such as climate science, analysis, and available tools
- Engagement with companies in relation to their climate disclosure, business strategies, governance, and emissions reduction plans and progress
- Development of strategies that support sustainability goals
- Education and reporting for our clients on climate risks and opportunities
- Operations and emissions reduction within our own real estate, timberland, and farmland assets

Supplemental guidance

Material climate-related risks are managed by considering asset class, geography, and underlying investment strategy.

As we have investment teams operating in different markets, there are different nuances in the approach to investing. Accordingly, a team integrates ESG factors into its investment process in a manner that best aligns with its investment approach. Each team bears responsibility for the evaluation of ESG factors throughout the due diligence, decision-making processes and ongoing stewardship. The ESG integration within each asset class or investment strategy always focuses on material ESG risks, as we believe that identifying and assessing material sustainability issues help us protect and enhance the value of the assets we own or operate.

The importance of E, S, and G depends on the industry, guided by an ESG materiality map for each sector to ensure consistency. Ultimately, determining the materiality also requires a certain level of judgment from the investment team based on their understanding of the asset or company and the industry it operates in. We generally feel that it's unlikely that any asset or company will be unaffected by climate change; however, some industries may have a higher exposure than others, and the materiality map can identify those industries.

Integrating climate risks

Climate risks are integrated into our overall risk management framework.

Because we operate across numerous asset classes and markets, we've implemented overlapping processes to identify and respond to different types of risk. In turn, our investment teams are empowered to account for the market and systemic risks in their investment process, which are then monitored at an organizational level.

Manulife Investment Management practices a three lines of defense model in terms of risk management, with the investment staff responsible for first line risk management, compliance and risk functions the second, and audit the third. All three lines have entirely separate management structures and reporting authorities to ensure independence.

Across our investment capabilities, portfolio managers are ultimately responsible for managing risks in their portfolios. Our public markets teams are aided by an investment risk group, combined with a dedicated sustainable investing team and models that monitor market risk, which reports up to a multidisciplinary risk committee and chief risk officer. We participate in collaborative engagements in connection with a variety of systemic risks commonly defined in terms of ESG factors, which helps us amplify our impact across the global capital markets.

We rely on both quantitative and qualitative risk management inputs

We believe our risk management framework and processes help to ensure that we understand the extent of these risks in our clients' portfolios and for the assets we own or operate.

Portfolio managers

Our first line of defense

Investment risk/Sustainability teams and models

Multilevel risk management functions

Collaborative engagements

Systemic risk identification and mitigation

Different forms of risk are simultaneously addressed and managed

- Liquidity
- Climate-related physical hazards
- Low-carbon transition
- Operational
- Market

For illustrative purposes only.

Risk forums in public asset classes

Forum	Risk discussions	Responsibility
Portfolio risk monitoring	• Stock-specific risk • Tracking error as well as sources of common factor risks • Portfolio construction • Sector/regional allocation • Position size and liquidity	Investment risk team
North America and Asia fixed-income ESG task force	• Tracking implementation of ESG framework within research and portfolio management • Raising portfolio-specific ESG concerns and review of ESG fixed-income assessment • Sharing ESG engagement activities • Education sessions on key sustainability issues led by external experts	Chaired and overseen by portfolio managers and analysts
Sustainable investing committees	• Raising risks to senior management, including the CEO • Overseeing progress of the sustainable investing agenda	Public and private markets CEOs, senior cross-functional leads, and sustainable investing team members
ESG portfolio quarterly review	• Identifying portfolio- and stock-level ESG risks and opportunities • Performing and monitoring climate scenario analysis for each portfolio and discussing high-risk companies • Updating individual company ESG-related engagements	Portfolio manager

Does not represent all risk forums where climate-risk management is discussed.

Real estate

In 2021, we built a rigorous risk management approach and framework for our real estate platform that laid out how we identify and manage the climate-related risks and opportunities to which we're exposed. This work had its genesis in a portfolio-wide risk study that we conducted in 2020, which drew on third-party data combining both historical results and forward-looking climate model outputs focused on seven distinct risks: floods, extreme windstorms, wildfire, sea-level rise, drought, heat stress, and earthquakes. As a result, our framework developed in 2021 takes a three-step approach involving raising awareness, evaluating risks and opportunities, and integrating best practices.

1 Raise awareness

Raising awareness is vital to educating our property and asset management teams and stakeholders about the science of climate change, how it can put a business and its operations at risk, what we can do to mitigate it, and how we can prepare and become resilient to its shocks and stressors. We've implemented two approaches to improving climate risk and resilience awareness through training and access to climate data.

2 Evaluate risks and opportunities

Identifying and understanding the climate risks to a portfolio enable the development of resources and tools to effectively manage those risks and improve resilience. To understand our real estate portfolio's climate threats, we inventory our existing resilience practices and features and identify improvement opportunities for climate change management. Our approach includes an evaluation on both the organizational and portfolio levels.

3 Integrate best practices

Once opportunities for climate change management have been identified, it's necessary to develop operational standards to enhance the resilience of current practices. We seek to integrate best practices into each stage of the real estate investment lifecycle. We use a stepwise process to ensure that teams are putting into place essential measures to make our portfolios more resilient, which we supplement with training, guidance, and tools to support action while incorporating new initiatives to help teams progress and improve.

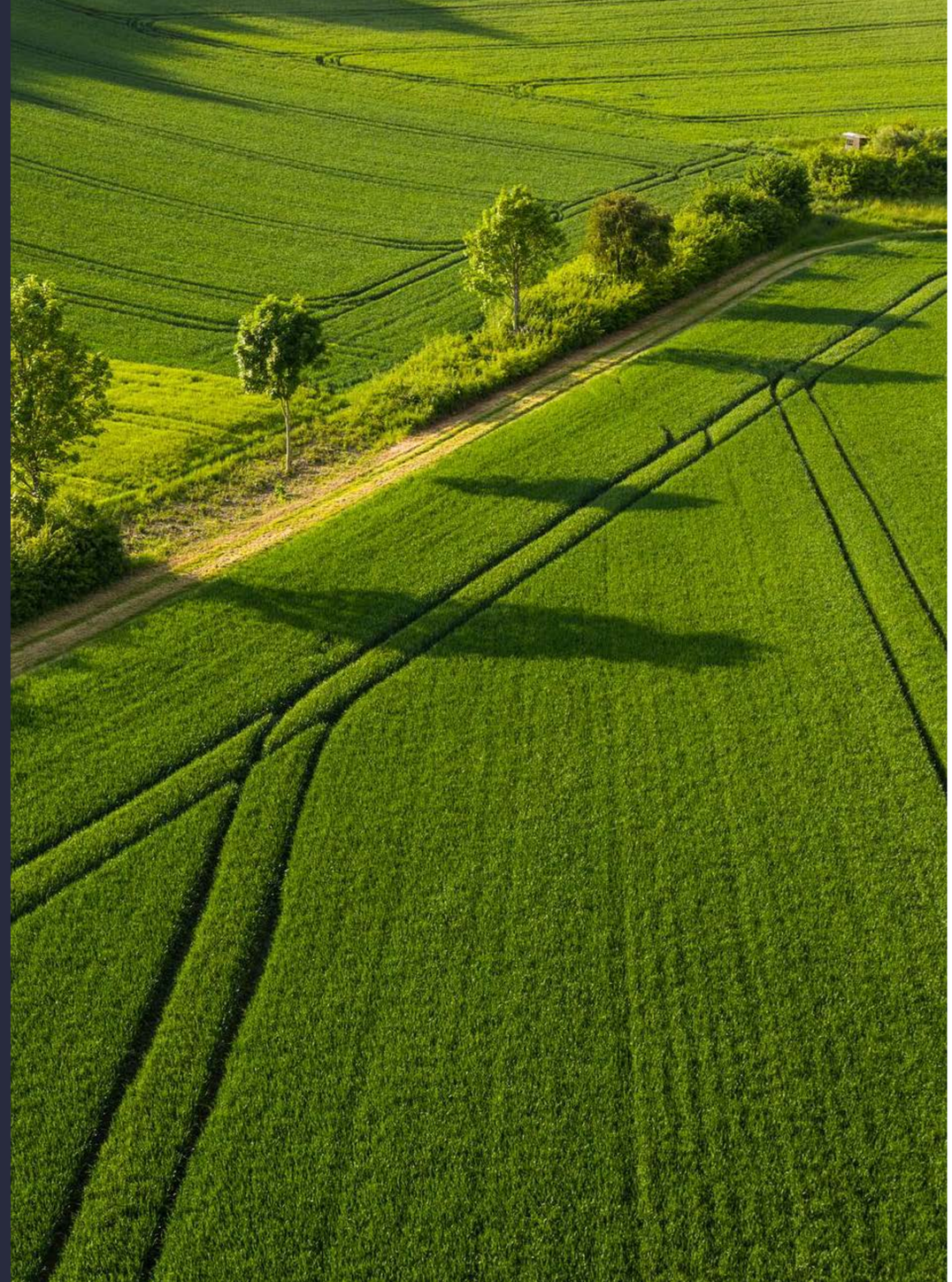
Assessing both our physical climate risks and resilience aligns us with the recommendations of the TCFD. More important, it helps us manage long-term risk—the right thing for a responsible building owner and manager to do.

Timberland and agriculture

Comprehensive, portfolio-wide scenario analysis for our farmland and timberland assets requires accurate, long-term, site-specific data and sector-specific transition models. Currently, globally recognized and peer-reviewed data for timberland and agriculture assets is limited, but we're exploring ways to obtain or develop information tailored to sector-relevant scenarios to achieve fuller results in future years.

Timberland scenario analysis

Ensuring the resilience of a climate strategy given the multiple possible climate outcomes requires various scenario analyses. These are challenging exercises because of significant uncertainties around the ability of biological assets to adapt to changing climate conditions. While standard scenarios and business responses exist in the energy industry, for example, to date, there's no equivalent for forestry.



As mentioned earlier in this report, in 2020 we conducted a pilot scenario analysis of our New Zealand timberland that we reported in our 2020 climate-related financial disclosure. In 2021, we built on the pilot and extended the analysis across our entire platform, engaging our forest operations professionals from the United States, Chile, Brazil, Australia, and New Zealand in workshops to better gauge our ability to prepare for the realities of climate change.

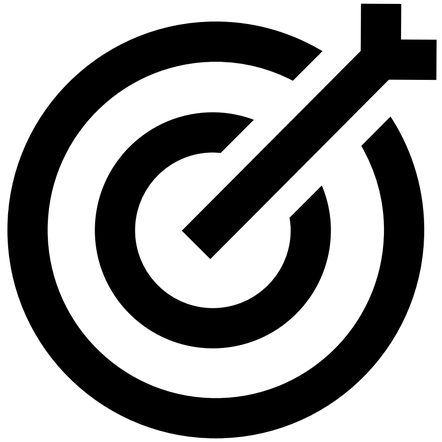
While these workshops unveiled a treasure trove of information, our most important takeaway was how similar the types of risks were across forest types and geographies. While different in degree, the number of key risks is small, although they interact and influence each other in ways that simple linear cause-effect relationships don't accurately convey. Climate change is a systems problem, and we've adapted our thinking about it to reflect that reality.

Learn more about our approach to climate-related risk management in our sustainable investing timberland 2022 report.

Agriculture: improving our capabilities

Integrating climate-related risk management into our farmland management requires high-quality data that enables an accurate quantification of our existing emissions and removals, since decarbonization plans and progress monitoring require measurement against a reliable baseline. Straightforward and scalable methods for calculating emissions—and especially soil carbon sequestration—have historically been lacking, so we've spent the past three years progressively improving our capabilities in this area, and it's an essential supporting element of our decarbonization plan.

Learn more about our approach to climate-related risk management in our sustainable investing agriculture 2022 report.



Metrics and targets

Metrics used

Where appropriate, we use a variety of metrics* to manage climate alignment, including green investments, corporate carbon footprinting, portfolio warming potential, sovereign climate risks, and strategy-level emissions.

Where appropriate, we use a variety of metrics to manage and monitor our alignment and that of our investee companies and assets with the Paris Agreement's goal of limiting the global average temperature rise to well below 2°C, compared to pre-industrial levels. We also use these metrics to manage and monitor the potential financial effects associated with climate change on our business. By understanding the benefits and limitations of the tools we use, we're better able to analyze the risks and opportunities available. Some of the metrics we use include:

- **Green investments—**We track our investments in certified green real estate, certified timberland and agriculture assets, and renewable energy infrastructure; our sustainable Asia bond strategy also has a dedicated allocation to green bonds.
- **Direct data collection—**In 2021, we launched a new initiative to collect data directly from companies in our infrastructure and PE&C portfolios to gain a better understanding of their ESG performance.
- **Carbon footprinting—**We calculate annual GHG and carbon inventories for invested timberland, farmland, and real estate properties. In addition, for some public markets portfolios, we may use exposure to fossil fuel reserves, emissions disclosure to assess exposure to a potential increase in carbon pricing or transition risk, or weighted average carbon intensity (WACI) data in metric tons of carbon dioxide equivalent (tCO_2e/$M sales) to assess the relative efficiency of emissions.
- **Implied portfolio warming potential—**We use the MSCI implied portfolio warming potential metric to assess our public equity and fixed-income portfolio alignment with the Paris Agreement. This warming potential methodology captures all emissions of issuers (scope 1, scope 2, and scope 3) as well as revenues from low-carbon technology to provide an aggregate forward-looking perspective versus the carbon budget at 2°C warming to compute an implied temperature in the year 2100.

* Use of these metrics may vary by investment team and strategy and may differ between clients.

- **Sovereign ESG model—**Our proprietary sovereign ESG model allows us to track climate-related risks—including the momentum of these risks—for 200 countries and territories.
- **Strategy-level emissions monitoring—**We measure emissions at a strategy level to better understand and incorporate risks related to business disruptions, stranded or impaired assets, and regulatory risk, among other physical and transition risks that stem from climate change.

We're working closely with peers, academics, professional bodies, regulators, governments, and international agencies to further develop our tools and approaches. For example, we're a member of the UNEP FI investor Phase II pilot project and the Investment Leaders Group convened by the Cambridge Institute for Sustainability Leadership. We also have a close partnership with the MIT Joint Program on the Science and Policy of Global Change, which provides sponsors with access to historical information, analysis, projections, and modeling capabilities focused on climate change and its impacts using economic and earth system models.

Supplemental guidance

As these metrics change over time, we expect to incorporate more forward-looking metrics, location-specific data, and scope 3 emissions data.

Another metric added to our thematic equity portfolio focusing on climate change is the tracking of portfolio companies that have set targets using the SBTi. Our global climate equity strategy specifically uses this data to assess forward-looking climate metrics in addition to current and past emissions.

This incorporation of forward-looking metrics is an area we expect to build on going forward; specifically, we expect to continue reviewing the high-emitting sector pathways needed to meet the goals of the Paris Agreement and net zero ambitions.

Sector-level emissions intensity metrics at a unit level, rather than at a revenue level, will likely be one area of further development.

Physical climate risk is another area that we expect to continue evolving, and this is often dependent on location-specific data. We've therefore engaged with data providers by offering input and feedback as they develop these databases. Additionally, as more companies measure and report on their scope 3 emissions, we expect the quality of that data to improve.

Emissions and risks

We use a variety of tools and participate in an array of engagements to assess the spectrum of climate-related risk across our public and private markets asset classes.

For our third-party managed portfolios, we use various tools to manage physical and transition risk across our portfolios. These tools include scenario analysis and carbon footprinting, as well as metrics such as fossil fuel reserves, forward-looking company carbon reduction targets, green revenues, and sectoral reduction pathways.

As an asset owner, operator, and investor, we assess climate risk and use our influence to encourage our assets and the companies we invest in to reduce their GHG emissions and align their business models with the realities of a changing climate. We also partner with other investors and industry experts to tackle climate change on a broader scale. By working collaboratively with peer investors, we're strengthening our potential ability to reduce systemic climate change risks and realize the economic benefits of the low-carbon transition.

Emissions and removals

We define our organizational boundary using the operational control approach for scope 1 and scope 2 emissions, per the GHG Protocol. Under the operational control approach, a company accounts for 100% of the GHG emissions from operations over which it has operational control, regardless of financial ownership of the entity. It doesn't account for GHG emissions from operations in which the company owns an interest but has no operational control; therefore, Manulife Investment Management discloses emissions from real assets (timberland, agriculture, and real estate), as these are under our operational control.

Manulife's GHG-related disclosure

Manulife reports its GHG emissions in its annual sustainability report and to the CDP, a global database of corporate carbon emissions. This disclosure includes:

- Manulife scope 1 and scope 2 emissions from businesses in which Manulife has operational control
- Scope 3 emissions from business travel (air travel, rental car mileage, and personal car mileage), paper use, and waste generated in operations (municipal solid waste)

Manulife's emissions are calculated according to the GHG Protocol and are reviewed by a third party using a limited assurance procedure.

Private markets investments

Timberland emissions and carbon removal data

Our timberland assets removal data includes annual increases in carbon stock within our standing forest inventory (biogenic growth), plus carbon stored in wood products harvested during a given year. Due to year-over-year variation introduced to forest inventory estimation methodologies, as well as harvesting schedules, we report a five-year average of carbon removals. Timberland removal data is verified by an independent, third-party reviewer[6] in accordance with the GHG Protocol Corporate Standard and ISO 14064-3:2006.

Metric	2021	2020
Properties managed	101	97
Total standing forest carbon stock (tCO_2e)	615,204,003	607,912,905
Scope 1 GHG emissions (tCO_2e)	80,035	76,753
of which: managed fire emissions (tCO_2e)	52,318	51,200
of which: fertilizer (N_2O) emissions (tCO_2e)	24,838	22,411
of which: fuel combustion emissions	2,879	3,142
Scope 2 GHG emissions* (tCO_2e)	0	0
Scope 3 GHG emissions (tCO_2e)	195,330	159,617
Biogenic stock change (tCO_2; + sequestration, - emission)	3,179,520	3,703,626
Carbon stored in harvested wood products (tCO_2e)	2,979,656	2,917,609
Net sequestration (tCO_2; + sequestration, - emission)	5,883,811	6,384,865
5-year average sequestration (tCO_2; + sequestration, - emission)	2,747,187	2,522,044

All GHG figures shown in thousand tCO_2e; carbon sequestered includes net forest carbon stock growth and long-term storage in harvested wood products. GHG profile for Chile will be available in 2023 after a full year of data is available. Scope 1 emissions are direct emissions from sources that we control. These include timberland emissions from fertilization and prescribed burns. Scope 3 emissions are indirect emissions in the value chain. Timber emissions associated with harvesting activity are classified as scope 3 as harvesting is conducted by contractors. Positive net carbon sequestration means removals exceed emissions; negative net carbon sequestration means emissions exceed removals. Scope 3 emissions currently accounted for include GHG Protocol categories 1 (purchased goods and services such as contractor harvesting) and 2 (end of life treatment of used products such as emissions from short-lived harvested wood products, although these are conservatively treated as scope 1 emissions). They do not currently include upstream or downstream transportation of products, or processing and milling.

* We do not report Scope 2 emissions as it is de minimus given the asset class.

6 Verified by FuturePast. Please see Manulife Investment Management's policies and disclosures for further details.

Agriculture emissions and carbon removal data

Removals from agriculture (i.e., soil carbon sequestration) aren't verified, as there's a high degree of uncertainty due to limited standards for quantification. Effective monitoring of decarbonization progress relies on improved GHG quantification methods to establish a baseline.

Metric	2021	2020
Properties managed	269	270
Scope 1 GHG emissions (tCO_2e)	47,072	36,634
of which: fertilizer (N_2O) emissions (tCO_2e)	18,474	11,233
of which: fuel combustion emissions	26,999	22,221
Scope 2 GHG emissions (tCO_2e)	17,922	10,177
Scope 3 GHG emissions (tCO_2e)	195,684	199,569
Biogenic removals (tCO_2)	293,046	330,288
Net sequestration (tCO_2; + sequestration, - emission)	32,368	83,908

All figures shown in thousand tCO_2e; scope 1 and 2 emissions are calculated based on activity data provided by managers directly operating our farms. Scope 3 emissions are those from leased farms outside our operational control and are estimated using crop-specific emissions intensity data from publicly available research. Carbon sequestration is also estimated using crop-specific sequestration data. Whereas scope 1 and 2 emissions are calculated based on activity data provided by operations managers, scope 3 emissions are estimated.

Real estate emissions

Real estate greenhouse gas emissions[7]	2021	2020	2019	2018	2017
Scope 1 emissions (tCO_2e)[8]	**36,571**	37,772	39,606	37,086	32,468
Scope 2 emissions (tCO_2e)[9]	**103,180**	115,153	129,585	160,642	156,642
GHG intensity ($kgCO_2e/sf$)	**3.8**	3.9	4.6	4.9	5.0

Source: Manulife Investment Management, 2021. This data includes assets under Manulife Investment Management's operational control managed on behalf of Manulife as well as those managed on behalf of third-party clients. It excludes real estate leased by Manulife Investment Management and/or Manulife from third parties. Where they are material, the following greenhouse gases (GHG) are accounted for as per the GHG Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFCs), and sulfur hexafluorides (SF_6s).

To help mitigate the effects of climate change, Manulife Investment Management's real estate arm is committed to reducing our GHG emissions and transitioning to low-carbon energy sources.

In 2021, the real estate investment portfolio's total GHG emissions were 139,752 tCO_2e, down 13,173 tCO_2e compared with 2020; in addition, we purchased 45,500 more megawatt hours of renewable energy across our portfolio.

Real estate investment portfolio emissions were reduced in 2021 due partly to less energy use as employees worked remotely during the COVID-19 pandemic, as well as because of energy efficiency project improvements. In 2021, we launched a GHG management working group to support our 2050 target of an 80% reduction in carbon intensity of scope 1 and scope 2 emissions (using 2018 as a baseline) where we have operational control.[7]

We use a variety of metrics and targets to manage and monitor progress in our real estate portfolio. These are also used to identify and monitor the potential financial effects associated with climate change on our business. Some of the metrics we use include GHG reduction; energy, water, and waste reduction; asset-specific targets; and physical risk data.

Our ambition to manage our carbon impact has never been more imperative. This carbon reduction goal will keep us accountable and help measure our GHG emissions reduction in line with our global targets.

7 Location based emissions. 2020-2017 values restated due to data revisions and operational control updates. **8** Scope 1 includes emissions from natural gas, diesel and refrigerant emissions. Refrigerant and diesel emissions are only included in 2021-2019. **9** Scope 2 includes emissions from purchased electricity and steam.

Energy, water, and waste reduction—We monitor property and portfolio energy, water, and waste performance through our proprietary Sustainable Building Standards twice each year. Properties we operationally control aim to conduct an energy audit to identify improvements every three years.

Asset-specific targets—We set asset-specific targets in our Sustainable Building Standards program, and performance against targets is monitored semiannually. We also encourage teams to include both utility and Sustainable Building Standards targets in their annual performance objectives to drive improvement and encourage action to meet our goals.

Physical risk data—We track property resilience scores, which combine third-party physical risk data with property resilience survey results. We also track the number of properties located in 100-year flood zones and report in alignment with SASB through our insurance program.

PE&C and infrastructure

In 2021, we launched a new initiative to collect data directly from companies in our infrastructure and PE&C portfolios to gain a better understanding of their ESG performance.

We asked portfolio companies to provide data across key categories, including GHG emissions, renewable energy, and climate policy, in line with the framework established by the ESG Data Convergence Project. This project is an industry-led initiative launched in September 2021 to standardize the reporting and collection of ESG data in private markets, thereby enabling greater transparency and comparability of ESG data across the industry.

To complement these efforts, we also engaged an external consultant to support the estimation of financed emissions (i.e., scope 3 emissions) for our infrastructure and PE&C asset portfolios to obtain an initial view of the carbon footprint of these asset classes. We plan to provide initial results from our analysis across infrastructure and PE&C in our 2022 report.

Listed equity and fixed-income investments

Investment strategies are exposed to different ESG risks and opportunities based on geography, geopolitics, industry, issuer size, and thematic focus. For this reason, we believe ESG issues should be analyzed, managed, and prioritized in connection with the unique profile of each investment.

That said, climate change is an existential challenge. The overwhelming consensus among scientists is that there's a limited amount of carbon dioxide that the world can afford to emit into the atmosphere if we're to limit the global average temperature rise to 1.5˚C.

Consequently, we live in a carbon-constrained world, and so we believe it's important to analyze the emissions of the portfolios we manage on behalf of our clients. This will help us understand our current contribution to global climate change mitigation and where we have opportunities to do more.

Defining the scope of our analysis

For the fiscal year 2021, this analysis focuses on the 4 largest strategies by assets under management (AUM) in our listed equity portfolios and the 6 largest fixed-income strategies by AUM. These strategies represent approximately 34% of our total equity AUM and 40% of our total fixed-income AUM.[10] To calculate emissions, we used a representative account from each of the 10 strategies. We've used a sample group to provide an estimation of our public markets investments emissions

10 Data as of December 31, 2021. Analysis excludes multi-asset portfolios and assets subadvised by unaffiliated third parties.

as we strive to improve on our year-over-year level of disclosure within the TCFD's recommended disclosure guidelines. We'll continue to explore opportunities to increase the scope of coverage in future reports, as we aim to improve both our level of disclosure and our understanding of our public market's investment emissions.

Our approach to selecting key performance metrics

For the purposes of this report, we've chosen to use array of emissions calculations. We believe this allows us to get at different facets of climate issues, including disclosure, and provide a more granular analysis when it comes to managing portfolio-level climate risks and opportunities.

For the purposes of our TCFD reporting, we've calculated the GHG emissions profile based on multiple calculation methods as well as different combinations of the emissions categories. We regard this as particularly important for two reasons: First, direct emissions are known to be more easily measured and are easier for companies to control; second, indirect emissions are larger and involve a higher degree of estimation. As a result of their indirect nature, companies might argue that their ability to control these categories of emissions is more attenuated. For these reasons, we believe it's critical to employ several methods of measuring emissions and to use these in dialogue with investee companies.

How to measure responsibility for emissions within the capital structure

A few years ago, the use of market capitalization as a denominator for calculating and normalizing GHG emissions dominated industry practice. Effectively, this holds shareholders to account for all the emissions of a company. This might seem very reasonable—shareholders are the ultimate owners and can ultimately dictate a change of approach.

However, as carbon performance metrics have evolved and as methods of analyzing fixed-income investments' carbon performance were developed and standardized, it was a natural progression to move from market capitalization to enterprise value including cash (EVIC). This enables an accounting for issuer debt as part of the emissions allocation/apportioning practice. In effect, this means that those providing finance to companies through equity ownership or through lending are assigned emissions responsibility, but in subtly different ways. Equity is measured by current market value, whereas debt is measured based on book value.

Carbon footprint calculation methods

1 Equity ownership-only

Total carbon emissions for a portofio normalized by the market value of the portfolio, expressed in tons CO_2e/$M invested.

$$\frac{\sum_{n}^{i}\left(\frac{\textit{current value of investment}_i}{\textit{issuer's market capitalization}_i} \times \textit{issuer's scope 1 and scope 2 GHG emissions}_i\right)}{\textit{current portfolio value (\$M)}}$$

2 Equity ownership and debtholders

Equity carbon footprint	Debtholder carbon footprint
$\frac{\text{current value of investment}}{\text{issuer's enterprise value + cash}}$	$\frac{\text{book value of investment}}{\text{issuer's enterprise value + cash}}$

Source: tcfdhub.org, October 2022.

GHG emissions performance

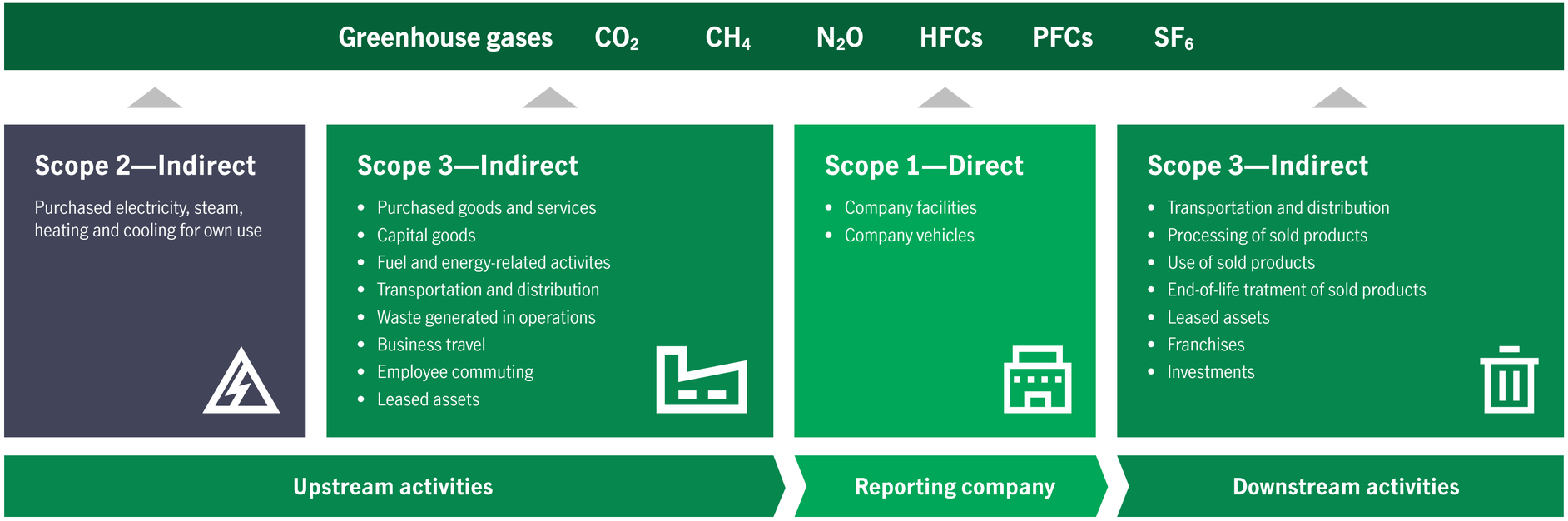
As we increase the scope of GHG included in calculations—moving from scope 1 to scope 2 and scope 3 (both upstream and downstream indirect emissions), emissions quantities increase as do carbon footprints. Companies have widely adopted the GHG Protocol to report GHG emitted from their activities. The various scopes of emissions are defined by the protocol to explain the levels of control and ownership, whether the emissions are direct or indirect relative to the company.

Scope 1 is considered direct GHG emissions from sources that are owned by the entity. Fuel used in owned/controlled assets such as combustion, furnaces, and company vehicles are included in scope 1.

Emissions associated with scope 2 are considered indirect and are made up of the emissions that come from purchased electricity, steam, heat, and cooling.

Scope 3 emissions are indirect emissions that aren't included in scope 2 and are categorized into upstream and downstream activities. Upstream activities include purchased goods and services, capital goods, and waste generated from operations, while downstream emissions include the use of sold products, end-of-life treatment of sold products, and other defined classes of indirect emissions.

An overview of scope 1, scope 2, and scope 3 emissions



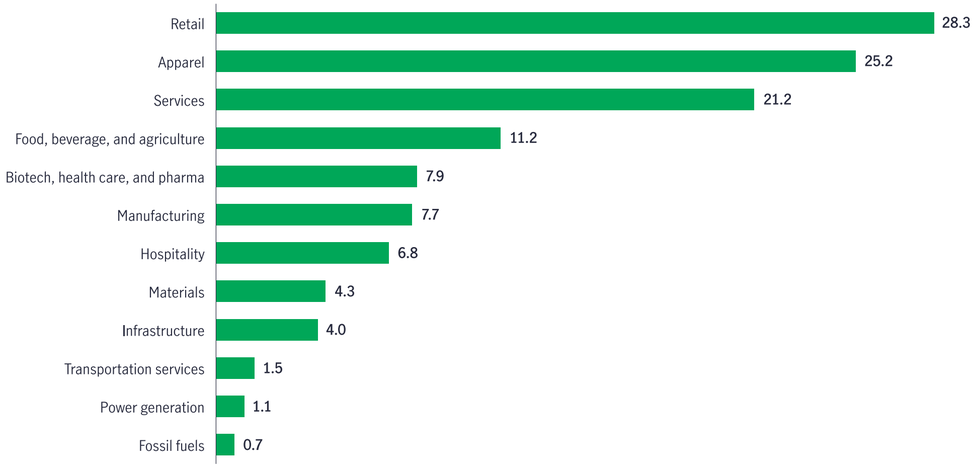
Source: GHG Protocol, 2016.

Generally speaking, firms have the most control—and therefore the greatest hope to make a short-term reduction impact—on scope 1 emissions, but typically these are the smallest part of a company's total emissions. The CDP has found, for example, that upstream scope 3 emissions that suppliers reported for 2020 were, on average, 11.4 times greater than those produced through their direct operations.

Downstream scope 3 emissions are also particularly material across a variety of industries. Consider, for example, the combustion of gasoline by consumers within internal combustion engines as use of sold products for an oil and gas major. Or, to take an example from banking, consider the financed emissions implicit in a bank's total loan portfolio—also part of the investments category of downstream scope 3 emissions per the GHG Protocol. Under a holistic approach to emissions disclosure, scope 3 additions can indicate enormous carbon footprints—which is the primary reason scope 3 is such an important facet of emissions reduction.

Indirect emissions such as scope 2, but particularly scope 3, are commonly the hardest elements for companies to influence in the short term; however, there's a variety of strategies companies can employ to manage these emissions. For example, they can redesign their products to have a lower emissions profile, or they can collaborate with downstream companies to reduce their emissions profile, including advocating for more efficient use of products. Of course, these efforts take time—and further investment—to support such innovation and emissions-reduction efforts. This is one reason we believe it's important to adopt a balanced approach to engagement with companies, trading off easier but smaller shorter-term opportunities against larger but potentially more significant longer-term gains.

Upstream emissions: scope 3 emissions are on average 11.4 times higher than operational emissions



Source: CDP, 2020. The average of the final ratio of scope 3 supply chain emissions to scope 1 and scope 2 operational emissions and direct emissions.

Our carbon footprint and carbon exposures

We believe that engaging with companies on their most material sustainability issues can enhance their long-term competitiveness and profitability, generating collective prosperity for investors, companies, and society as a whole. Consequently, we engage with companies over a wide variety of ESG issues, including climate-related concerns. In this regard, we engage with issuers to understand their transition plans and help them set targets for emissions reductions across their operations as well as in their upstream and downstream indirect emissions. In looking closely at their carbon footprint, we're also looking at facets of our own scope 3 downstream emissions, which makes our engagement efforts work as a two-way street of potential improvement.

Total carbon emissions—In terms of absolute emissions by ownership, our clients' representative fixed-income and equity portfolios were collectively responsible for 10.7 million metric tons of CO_2e in 2021.[11] As a percentage of the world's total absolute emissions of 36.3 gigatons in 2021, this equals a fraction of a single basis point. While this is obviously a small share of global emissions, it's important to recognize that whenever one of our investee companies reduces emissions, the impact applies across the total emissions of that firm, not just our portion of those emissions. Through engagement with investee companies, we can potentially have a stronger influence on emissions reduction than what's suggested by the size of our individual positions or by our public markets AUM.

Carbon intensity—We believe it's important to consider data on emissions intensity as well as total emissions. Clearly, it's unrealistic to expect two companies that are broadly identical but one being twice the size of the other to have the same total emissions. But it's reasonable to measure their emissions per unit of sales or other standardized metric, as this provides insight into the emissions efficiency involved in each company's operations, product development, and/or service execution.

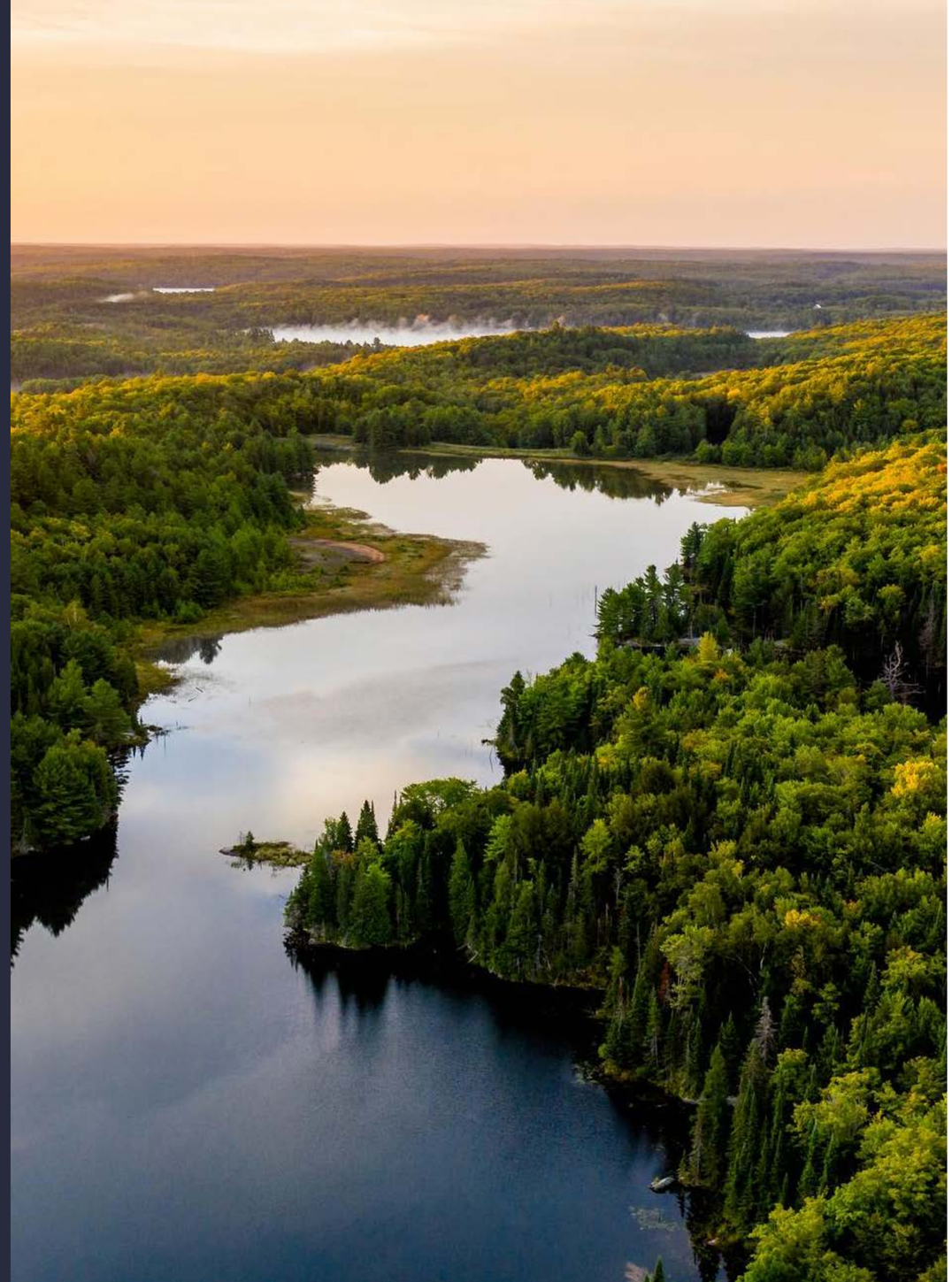
That said, we must remind ourselves that limiting total emissions is the real-world outcome we're trying to achieve; therefore, too much emphasis on intensity figures carries the risk of missing a critical sustainability objective. So, while a company may indeed get more efficient in reducing carbon emissions per unit of production or per $1 million of sales it generates, its absolute emissions could be increasing at a faster rate than the rate of its intensity reduction. For this reason, we believe the rate of absolute emissions reduction should be considered alongside changes in carbon intensity.

Carbon footprint—In terms of our carbon footprint, where the total emissions of our portfolio are normalized by the total AUM, our disclosures include both unadjusted data and data adjusted to remove cash, derivatives, sovereigns, and issuers for which GHG emissions data isn't available. In our view, this enables a fuller understanding of our portfolio. As expected, we observe an outsize proportion of scope 3 downstream emissions.

We calculate our carbon footprint using the Partnership for Carbon Accounting Financials methodology, which has gained traction in the market and among standard-settings bodies. This motivates our decision to publish both the adjusted and unadjusted figures as mentioned above. In our view, using unadjusted figures can easily understate the carbon footprint: When the denominator is the unadjusted total AUM of a portfolio (including cash, derivatives, and other noncorporate issues), the footprint figure could show significant efficiency if the proportion of noncorporate security exposure is bigger within the portfolio—for the simple fact that these securities lack carbon emissions data.

To achieve a more representative footprint, we removed securities that lack this data and focused the calculation on securities that have underlying carbon and EVIC figures. For each scope combination, we observed a doubling of the emissions metric when comparing adjusted to unadjusted figures. While there's no international consensus on how the denominator adjustments are made at this point in time, and

11 Absolute emissions were calculated based on one representative portfolio per strategy. Calculated based on data available at time of analysis.



regulations aren't prescriptive, we believe this requires careful interpretation by asset managers. For transparency, we communicate both footprint figures.

WACI—WACI is the standard metric used by investors to assess the emissions management efficiency of investee companies. Our blended equity and fixed-income carbon intensity for our 10 strategies for scope 1 and scope 2 is 301 metric tons of CO_2e/$1M in sales. In our emissions disclosure, we show WACI for different indexes as disclosed by the index provider. We note, in particular, the variability between regions and asset classes.

In our view, it's important to acknowledge that comparing a metric such as WACI isn't as simple as we might think because underlying emissions estimation methodologies may differ. For example, some of the major index providers have proprietary ESG research and data capabilities; therefore, they source emissions and compute carbon estimates based on their own expertise. By contrast, other index providers may rely on third-party providers that are dedicated to providing raw data and carbon estimates that use different methodologies.

The variation in output can be illustrated using actual data as described on the following page for an auto manufacturer whose emissions disclosure for 2021 highlights its differences relative to three separate index providers' estimated emissions data for the same company. Data omissions for indirect emissions are one problem encountered here, as are the underlying assumptions used to determine estimates—including for direct emissions.

Emissions estimates can vary substantially between corporate disclosures and index providers

As a result of these variances, comparing portfolios with each other and portfolios with an index using a seemingly simple figure such as WACI may not be a very meaningful exercise. Over time, we believe these comparison challenges will be reduced as more companies disclose the full scope of carbon emissions. In the meantime, financial markets will continue to use available figures—preferably with caveats regarding missing, incomplete, or variable data, but realistically not always with a full appreciation of the underlying characteristics related to different industries and geographies.

Global automobile manufacturer

Metric	Company reported figures (reported for the first time in FY 2021)	Provider A's estimated data (FY 2020)	Provider B's estimated data (FY 2020)	Provider C's estimated data (FY 2020)
Scope 1	185,000	420,156	108,395	208,662
Scope 2	403,000	341,906	236,126	557,082
Scope 3—upstream	N/A	840,237	24,408,344	N/A
Scope 3—downstream	1,954,000	6,498,345	6,197,633	N/A
Scope 3—upstream and downstream	N/A	14,636,365	30,605,978	N/A

For illustrative purposes only. Estimated emission in absolute metric tons.

Our listed equity and fixed-income portfolios' carbon exposures

Absolute Carbon Emissions and equivalents

Absolute quantity of emissions our representative equity and fixed-income portfolio is responsible for, based on the amount invested (vs. EVIC) in the portfolio companies

Metric	Six largest fixed income strategies ($MtCO_2e$)	Four largest equity strategies ($MtCO_2e$)	Combined total of fixed income and equity ($MtCO_2e$)
Scope 1+2	2,221,598	106,054	2,327,652
Direct (scope 1) and tier 1 indirect (scope 2+3 from tier 1 supply chain)	2,856,449	151,010	3,007,459
Scope 1+2+3 upstream	3,813,802	263,827	4,077,629
Scope 1+2+3 upstream and downstream	10,167,376	551,499	10,718,875

Carbon footprint

Carbon footprint normalized to value invested (apportioned by EVIC) enables us to compare carbon intensity across different portfolio sizes

Metric	Six largest fixed income strategies ($MtCO_2e$)	Four largest equity strategies ($MtCO_2e$)	Combined total of fixed income and equity ($MtCO_2e$)
Unadjusted data			
Scope 1+2	48	27	45
Direct (scope 1) and tier 1 indirect (scope 2+3 from tier 1 supply chain)	62	36	58
Scope 1+2+3 upstream	83	59	79
Scope 1+2+3 upstream and downstream	222	130	208
Re-weighted based on data availability			
Scope 1+2	109	27	97
Direct (scope 1) and tier 1 indirect (scope 2+3 from tier 1 supply chain)	140	36	124
Scope 1+2+3 upstream	186	59	167
Scope 1+2+3 upstream and downstream	495	130	439

Continued ...

Our listed equity and fixed-income portfolios' carbon exposures (continued)

Weighted-Average Carbon Intensity (WACI)

Weighted average GHG intensity per $1M of sales that underlying securities generate, enables us to conduct GHG attribution analysis

Metric	Six largest fixed income strategies ($MtCO_2e$/$1M sales)	Four largest equity strategies ($MtCO_2e$/$1M sales)	Combined total of fixed income and equity ($MtCO_2e$/$1M sales)
Scope 1+2	328	155	301
Direct (scope 1) and tier 1 indirect (scope 2+3 from tier 1 supply chain)	377	197	350
Scope 1+2+3 upstream	460	272	431
Scope 1+2+3 upstream and downstream	1,473	689	1,354

Source: Manulife Investment Management. Analysis used cross-sectional data, as of December 31, 2021. Total data coverage is 66% for fixed income and 97% for equities for the data in the analysis.

Supplemental guidance

Using data to address climate change risks and opportunities across asset classes, we continue to build out carbon footprinting, including WACI and a variety of other climate-related metrics.

The following case studies illustrate how we implement this across asset classes and geographies in our real asset, fixed-income, and equity strategies as well as in thematic and ESG-integrated strategies.

The case studies shown here are for illustrative purposes only; do not represent all of the investments made, sold, or recommended for client accounts; and should not be considered an indication of the ESG integration, performance, or characteristics of any current or future Manulife Investment Management product or investment strategy.

Manulife Investment Management conducts hundreds of ESG engagements each year but does not engage on all issues or with all issuers in our portfolios. We also frequently conduct collaborative engagements in which we do not set the terms of engagement but lend our support in order to achieve a desired outcome. Where we own and operate physical assets, we seek to weave sustainability into our operational strategies and execution. The case studies shown are a sampling across issues and geographies. Our approach to ESG investing and incorporation of ESG principles into the investment process differs by investment strategy and investment team. It should not be assumed that an investment in the company discussed was or will be profitable. Actual investments will vary, and there is no guarantee that a particular fund or client account will hold the investments or reflect the characteristics identified. Please see our ESG policies for details

Case study

Real estate carbon management

In 2021, we formed the carbon management working group to develop a strategy to meet our GHG reduction target of 80% by 2050.[1] The working group, which has representation from our real estate, engineering and technical services, asset management, and sustainability teams, is responsible for:

- Overseeing property-specific carbon reduction plans and the rollout of our portfolio GHG management plan.
- Providing GHG tools, resources, and support to property and asset management teams to inform strategies to reduce emissions.

The working group's immediate goals focus on education and development of property-level GHG management tools. Going forward, the working group will oversee the GHG reduction strategy, support property teams to develop long-term GHG management plans, and track progress against our target.

Case study

Timberland acquisition

Our most significant acquisition of 2021 was an 89,000-acre forest in the U.S. state of Maine. The property, named Blueback for the highly sought-after subspecies of Arctic char native to this region, is a contiguous block of timberlands with a diverse mix of naturally regenerated spruce fir and northern hardwood tree species. Blueback will be managed for Manulife's general account as a carbon-focused investment underpinning its net zero journey.

The core of the investment thesis is centered on the timberlands being used primarily to store carbon and to generate high-quality, high-integrity carbon credits. Manulife reserves the option to sell the carbon credits as offsets or use the carbon removals as insets (applying the carbon credits generated by forests owned by the company in order to neutralize its own emissions) for the purpose of meeting Manulife's net zero commitments. Additionally, the lands are subject to a working forest conservation easement and offer unique recreational opportunities given the scenic lakes, rivers, and ecological features of the region. A portion of the lands will also be used for sustainable stewardship practices as a working forest.

Case study

Regenerative and organic almonds in California

Regenerative agriculture shows great promise for climate change mitigation and adaptation. Many of our farms use regenerative practices, but few of them have undertaken systematic studies to help determine and quantify the benefits of such practices in contrast to other farming regimes. That's what we're doing at Madera 7.

We've managed the almond orchard at our Madera 7 ranch in California for nearly 30 years. When we were replanting the orchard in 2019, we took advantage of the opportunity to conduct a large-scale experiment into the benefits of different types of farming systems. The practices we're currently testing include:

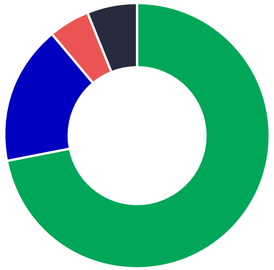
- **Orchard reincorporation—**Grinding the old trees and reincorporating the wood chips/organic material back into the ground
- **Organic production—**No application of synthetic fertilizers or pesticides
- **Regenerative practices—**Cover crops, reduced tillage, reduced usage of herbicides and pesticides, blending fertilizer with compost and green waste
- **Irrigation practices—**Different irrigation systems and wetting patterns

Over the next five years, we'll be closely tracking crop quality, yields, costs, water consumption, and pests, as well as all the materials used while cultivating each of the trial sites. We won't have definitive results for some time, but similar previous exercises have already enabled us to reduce our pesticide and herbicide application by 20% to 30%, while also reducing the number of passes required by mowers (therefore reducing GHG emissions).

Case study

Reducing scope 3 emissions at a European multinational retail and wholesale grocery operator

In our engagement with a major European multinational retail and wholesale grocery operator, the company estimated that 2% of its emissions currently comes from activities directly and indirectly linked to the operations of its stores (i.e., scope 1 and scope 2 activities), meaning 98% of its emissions came from scope 3 activities. The company shared that the latter activities could be broken down into four categories, with procurement of goods and services representing the lion's share of emissions.



Profile of the company's scope 3 emissions

- Procurement of goods and services, 72%
- Use of products sold, 17%
- Transport, 5%
- Other, 6%

The company has committed to achieving a net zero profile in scope 1 and scope 2 emissions across its stores by 2040 and in its e-commerce business by 2030. To achieve these reductions, the company is focused on sourcing 100% of its electricity from renewable sources across its sites by 2030 by reducing energy consumption and lowering emissions from refrigerants.

With respect to scope 3 emissions, the company has committed to reducing emissions by 29% relative to 2019 levels by 2030. Because the issuer's value chain is complex, it needs to focus reductions across several areas, including:

- **Product offering—**By focusing on offering local products with a lower carbon footprint, products that are sustainable certified (e.g., reduce emissions from land use), and offering more plant-based foods, which are lower emitting compared with animal protein
- **Packaging—**Reducing the amount of packaging and modifying its types of packaging could help the company realize lower scope 3 emissions, given the variability in energy required to producing packaging materials
- **Supplier engagement—**Requested commitments from its network of hundreds of suppliers to reduce their own emissions
- **Consumer transparency—**Highlights lower-carbon products in its offerings so that consumers understand which products are more/less emissions intensive
- **Transportation engagement—**Looking to completely phase out diesel in its transportation chain by 2030

Because of the complexity of scope 3 emissions, the company continues to partner with stakeholders in the aforementioned categories in order to measure these indirect emissions with a higher degree of confidence and then report those findings to the market. In our engagement with the company, we requested that management set a target for this disclosure within the next two years.

Targets

By seeking to address climate change across our asset management activities, we move closer to fulfilling our ambition of giving our customers and broader stakeholders the confidence to plan for the future.

We're actively incorporating climate change considerations into our decision-making, including how we manage our operations, how we make investment decisions, and how we develop and offer financial products and services. As a business deeply rooted in long-term thinking, we're made stronger when our people and our planet thrive.

Sustainability targets and milestones

We've integrated ESG analysis into our investment process across the majority of our investment teams and we continue to strengthen this year over year, recognizing that sustainable investing is a journey of ongoing improvements as our understanding of the underlying issues affecting our planet evolves.

In addition to ESG integration, we will continue to expand our range of sustainable investing products and services, including building out our offerings for clients looking for net zero investment solutions.

Real estate

We're aiming to reduce GHG emissions by 80% across our real estate portfolio.[1] Our properties are located in 11 geographies and 28 cities globally, and in 2021, we formed the carbon management working group to develop a strategy to meet our GHG reduction target.

Long-term action plans are in development, and we're identifying key properties with the best potential for GHG reduction implementation. Informed by climate science, our approach to reducing our carbon output in real estate is focused on four pillars.

1 **Efficiency measures—**Conventional, cost-effective, incremental energy improvements through ongoing building commissioning and efficient operations

2 **Fuel switching—**Switching from high- to low-carbon intensity infrastructure through infrastructure renewal (delivering immediate emissions reduction where the electrical grid is less carbon intensive today and additional emissions reduction as the grid improves)

3 **On-site renewables and storage—**Installing items such as rooftop solar panels, especially in regions with carbon-intensive electrical grids

4 **Carbon offsets and PPAs—**Purchasing carbon offsets and power purchasing agreements (PPAs) to address the energy/carbon remaining after the above actions are completed

Timberland and agriculture

While we await the guidance that will inform our own quantitative climate-related targets, we remain committed to third-party sustainable management certification and have accomplished the key short-term goals we set for ourselves in 2020: verification of our GHG inventories by a third party* and the launch of a carbon sequestration-focused impact investment product that's designed to respond to investors' growing needs to meet their own net zero targets.

* The verification of our GHG inventories includes emissions and removals for timberland and only emissions from agriculture.

As one of the world's largest timberland and farmland investment managers, we are well-positioned to provide and manage investments in nature-based solutions in the fight against climate change. We also recognize that emissions reductions are essential in order to meet the goals of the Paris Agreement. This is relevant to every asset class we invest in, and we're currently developing plans to further decarbonize our timberland and agriculture investments

Listed equity and fixed income

We understand the crucial importance of reducing GHG emissions and recognizing our responsibility for the emissions associated with the portfolios we manage on behalf of our clients. However, we believe it's important not to oversimplify matters by measuring emissions with a single metric—or by targeting a single metric such as WACI—as that process may not move the dial toward real emissions reduction. Instead, we adopt an approach of reviewing a range of metrics pertaining to our portfolio emissions exposure and using this data to optimize our engagement with investee companies to make strides toward—and ultimately achieve—meaningful change over time.

Lack of company-disclosed data in the fixed-income asset class as well as credibility of estimated data points is a reality we are challenged with while striving to improve it through engagement. Investment managers, asset owners, and investee companies are on similar journeys toward overcoming these data and disclosure challenges. As a global investor, we're committed to publishing our GHG emissions analysis, capturing a greater proportion of our AUM, and increasing the usefulness of the metrics we provide. At the same time, we're also committed to expanding our offering of sustainable and thematic products and solutions to make more meaningful contributions to reducing global GHG emissions for the benefit of society.

Looking ahead

In this report, we've built on our previous TCFD report and the responses to the recommendations related to the 4 core elements and 5 supplemental recommendations for asset managers. We outline our approach to climate-related risks and opportunities, as well as where we strive to show leadership and demonstrate innovation.

In recognition of how climate overlaps with other natural systems, we've also touched on some of our efforts to positively affect nature and biodiversity through our business and investment activities. In the near future, we look forward to developing more robust disclosures that specifically address our impact on nature and biodiversity, in line with recommendations from the Taskforce on Nature-related Financial Disclosures.

Sustainable investing is an evolving field, so we'll continue this journey with our clients as we navigate the evolving regulatory and global environment. We look forward to continuing to enhance our efforts, disclosures, and impact.

Manulife Investment Management

We consider that the integration of sustainability risks in the decision-making process is an important element in determining long-term performance outcomes and is an effective risk mitigation technique. Our approach to sustainability provides a flexible framework that supports implementation across different asset classes and investment teams. While we believe that sustainable investing will lead to better long-term investment outcomes, there is no guarantee that sustainable investing will ensure better returns in the longer term. In particular, by limiting the range of investable assets through the exclusionary framework, positive screening, and thematic investment, we may forego the opportunity to invest in an investment that we otherwise believe likely to outperform over time.

A widespread health crisis such as a global pandemic could cause substantial market volatility, exchange-trading suspensions and closures, and affect portfolio performance. For example, the novel coronavirus disease (COVID-19) has resulted in significant disruptions to global business activity. The impact of a health crisis and other epidemics and pandemics that may arise in the future, could affect the global economy in ways that cannot necessarily be foreseen at the present time. A health crisis may exacerbate other preexisting political, social, and economic risks. Any such impact could adversely affect the portfolio's performance, resulting in losses to your investment

Investing involves risks, including the potential loss of principal. Financial markets are volatile and can fluctuate significantly in response to company, industry, political, regulatory, market, or economic developments. These risks are magnified for investments made in emerging markets. Currency risk is the risk that fluctuations in exchange rates may adversely affect the value of a portfolio's investments.

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Manulife Investment Management

Manulife Investment Management is the global wealth and asset management segment of Manulife Financial Corporation. We draw on more than a century of financial stewardship to partner with clients across our institutional, retail, and retirement businesses globally. Our specialist approach to money management includes the highly differentiated strategies of our fixed-income, specialized equity, multi-asset solutions, and private markets teams—along with access to specialized, unaffiliated asset managers from around the world through our multimanager model.

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Hancock Natural Resource Group, Inc. became Manulife Investment Management Timberland and Agriculture Inc. on November 15, 2021.