CLIMATE-RELATED RISK FRAMEWORK FOR PROPERTY ADVISORY AND CONSULTANCY SERVICES

1. Introduction

Greenhouse gases occur within our atmosphere. They allow energy from the sun to pass through to the Earth's surface but prevent some of the energy escaping. Although greenhouse gases are minor components of the atmosphere, Earth would be much colder without them. The average temperature would drop from 15 degrees Celsius down to about minus 18 degrees Celsius, making Earth unsuitable for life. Since the Industrial Revolution, human activities, like the burning of fossil fuels and deforestation, have increased the concentration of these gases in the atmosphere. As a result, more energy is "trapped" which enhances the greenhouse effect leading to changes in the Earth's energy balance and temperatures. (Source: MPI)

Since the pre-industrial period, the land surface air temperature has risen nearly twice as much as the global average temperature. Climate change, including increases in frequency and intensity of extremes, has adversely impacted food security and terrestrial ecosystems as well as contributed to desertification and land degradation in many regions. Warming has resulted in an increased frequency, intensity and duration of heat-related events, including heatwaves in most land regions. Frequency and intensity of droughts has increased and there has been an increase in the intensity of heavy precipitation events at a global scale. (Source: IPCC)

The latest science from the Intergovernmental Panel on Climate Change (IPCC) states that climate change is widespread, rapid, intensifying and affecting every region. Unless there are immediate, rapid and large-scale reductions in greenhouse gas emissions, limiting warming to 1.5°C or even 2°C will be out of reach. Global warming could exceed 4°C by the end of the century in a high-emission scenario and we are currently on track for 3°C warming.

The mid-range estimate for projected New Zealand temperature change is for an expected increase of about 0.8°C by 2040, 1.4°C by 2090, and 1.6°C by 2110, relative to the 1986–2005 period. Owing to the different possible pathways for the concentrations of greenhouse gases in the atmosphere, however, as well as the differences in climate model response to those pathways, the possible projections for future warming span a wide range: 0.2–1.7°C by 2040, 0.1–4.6°C by 2090, and 0.3–5.0°C by 2110. (Source: Climate Change Projections 2nd edition)
Projected changes in rainfall show a marked seasonality and variability across regions. It is very likely that for winter and spring there will be an increase in rainfall for the west of both the North and South Islands, with drier conditions in the east and north. This is a robust prediction both in 2040 and 2090, caused by the westerly winds over New Zealand increasing during these seasons. For summer it is likely that there will be wetter conditions in the east of both islands, with drier conditions in the west and central North Island.
Moderately extreme rainfall is likely to increase in most areas, with the largest increases being seen in areas where mean rainfall is also increasing, such as the West Coast. Very extreme rainfall is likely to increase in all areas with increases more pronounced for shorter duration events.

Drought severity is projected to increase in most areas of the country, except for Taranaki-Manawatu, West Coast and Southland. Although these last two findings on extremes are not new, they are more robust because of more detailed regional information compared to the 2008 assessment, made possible through the inclusion of the latest regional climate modelling results (Source: Climate Change Projections for New Zealand, Prepared for the Ministry for the Environment by Mullan B, Sood A, Stuart S, Carey-Smith T, National Institute of Water and Atmospheric Research NIWA). (Source: Climate Change Projections 2nd edition)

The building and construction sector is a significant contributor to greenhouse gas emissions which are emitted when building materials are produced, buildings are constructed and energy is used in buildings during their operation. (Source: Building.govt.nz/building-for-climate-change)
Important sustainability factors in real estate industry which face the global financial markets are: operational and embodied carbon emissions, waste management, impact on biodiversity, water consumption, buildings adaptation to the effects of climate change and resilience of products, materials & components.
New Zealand has committed to net zero carbon emissions by 2050. The building and construction sector plays important part in meeting this goal as the sector currently accounts for around 20% of New Zealand's carbon emissions, through the energy and materials used in buildings.
Emissions produced over the life cycle of a building are generally put into two groups, operational emissions and embodied emissions. Embodied carbon emissions are caused by CO2 and other greenhouse gases from non-renewable energy sources or otherwise being released into the atmosphere as a consequence of activities associated with a particular material or product. Embodied carbon is assessed on a life-cycle basis; thus, emissions that arise at all points in the supply chain and over the lifetime of that material or product are considered. For a building, typically the most significant embodied carbon emissions happen before the building is used, in the production of construction materials and products. However, embodied carbon emissions also occur during the building's operation due to maintenance activities, and also at the end of the life of the building due to demolition activities, and disposal or recycling of materials and products. To achieve reductions in whole-of-life embodied carbon, there are three objectives: maximise new build efficiency, increase building material efficiency, reduce the carbon intensity. (Source: MBiE)
The Greenhouse Gas Protocol defines three types - or scopes - of emissions: Scope 1 emissions are direct emissions, e.g., on-site fuel combustion, company vehicles etc.; scope 2 refers to indirect emissions, e.g., from purchased energy; and scope 3 relates to all indirect emissions, including upstream and downstream emissions. Scope 3 emissions (business travel, waste generation, value chain) usually represent the largest share. (Source: WorldGBC) World Green Building Council focuses on operational (Scope 1 and 2 energy related emissions including refrigerants and process loads) and embodied carbon emissions of building assets over which the entity has direct control (accounted for as part of Scope 3 emissions). Together, these combine to cover the majority of whole life emissions of an asset across its lifecycle. (Source: WorldGBC)
Regulatory measures such as carbon pricing as well as transition to low-carbon properties may affect the financial viability of existing properties. Understanding the percentage certified as sustainable (against relevant indices) provides investors with an indication about the potential

impact of regulatory measures and demand changes on earning capacity of real estate portfolios. (Source: TCFDHub)

As a result of climate change, many areas in New Zealand are expected to be subject to more extreme weather events which have the potential to impact on buildings and their occupants. The important element of adaptation to climate change hazards is the type of land a building sits or will sit on and how that land will perform during a natural disaster. Land vulnerability includes: liquefaction in the event of an earthquake, flooding, high winds, landslips, inundation from a tsunami, volcanic or hydrothermal activity. (Source: EQC.govt.nz) In New Zealand, climate change is forecast to result in rising sea levels, stronger/more frequent storms and more extreme rainfall, bringing severe flooding. Many councils are creating resources and tools to help with planning around flooding and sea level rise. Waikato Regional Council, for example, has created an online Coastal inundation tool that helps give a general indication of the areas that may be at risk. Greater Wellington Regional Council has also produced a website with a dynamic map of areas likely to be affected by sea level rise. Northland Regional Council has maps of areas at risk of coastal flooding and coastal erosion. (Source: Renovate.org.nz)
Additional source of information for a risk of natural hazards is Land Information Memorandum (LIM) and Project Information Memorandum (PIM).

"Property rating systems are increasingly being developed and applied in order to create risk profiles of property assets. In turn, these risk profiles have the potential to create further opportunities for the creation of a market for sustainable property. Areas of further research consist in the creation of an evidence base for the further calibration of rating systems and in the development, agreement and standardization of measurement standards.

Primarily three instruments can be deployed to express the financial advantages of sustainable buildings and vice versa the disadvantageous or financial risks of conventional ones:

- calculation of property worth
- property market valuation
- property risk assessment/property rating."

(Source: Integrating sustainability into property risk assessments for market transformation, Thomas Lützkendorf and David Lorenz)

In recent years, the cost of weather-related catastrophes in New Zealand has been consistently higher than long-term averages. General insurers typically rely on years with benign weather conditions to offset elevated claim costs from years with more extreme events, without needing to make significant adjustments to premiums for insured businesses and individuals. With climate change, extreme weather events are becoming more commonplace and the frequency of years with benign weather will be greatly reduced. The Reserve Bank of New Zealand expects that insurers will respond to these changes by continuing to develop their granular, risk-based pricing models. This may lead to greater variations in the level of premiums charged to customers, with

higher premiums or reduced coverage in locations with high risks, such as those prone to flooding. These changes in pricing and coverage will come on top of changes already being introduced for updated assessments of earthquake risks. As a result, this will allow households and businesses to appropriately internalise the risks associated with climate change in their decision making. (Source: RBNZ) Insurance companies work with Annual Exceedance Probability (AEP) to decide what to charge and when not to insure a property. A 1% AEP event is likely to occur once in 100 years, a 2% AEP event will likely occur once in 50 years, and a 5% AEP event will likely occur every 20 years. Sea level rise allows storm surges to reach further inland. Just 10cm of sea-level rise in Wellington, for example, will change the probability of a flood event by five times. That is, an event that might have occurred once every 100 years will soon occur every 20 years. International experience and anecdotal evidence from those in the industry suggest that companies start pulling out of insuring properties at around 2% AEP. By 5% AEP insurance is completely unavailable. That is, insurance companies withdraw insurance from an area when disasters (like floods) begin to occur between every 50 to 20 years. This is probably a conservative estimate. Extreme sea level analysis for the Auckland, Wellington, Christchurch and Dunedin coastlines has been done using coastal flood inundation maps. Analysis indicates that many homes that might currently flood only once every 100 years are likely to experience insurance retreat over the next 15 years. Insurance retreat happens when a private or public insurer declines insurance coverage or stops renewing existing coverage, because of a property's exposure and vulnerability to a hazard. Partial retreat is where an insurer transfers a significant proportion of a property's risk back onto the policy holder. An insurer might do this by increasing excesses and/or premiums, or by reducing the extent of coverage through monetary caps or by excluding specific hazards. Insurance retreat has implications for mortgage and ability to sell a property. Also, in the face of increasing climate hazards, local councils may eventually decide to stop maintaining infrastructure (such as sewerage, roads or sea walls) or to remove it altogether. (Source: The Deep South Challenge)

The agriculture sector in New Zealand as a whole faces increased variability in climatic conditions as climate change intensifies. The expected full entry of the sector to the Emissions Trading Scheme (Source: NZ ETS) from 2025 will likely raise compliance costs and weigh on profitability. (Source: RBNZ) Almost half of New Zealand's greenhouse gas emissions come from agriculture. Methane (CH_4) and nitrous oxide (N_2O) are the two main agricultural greenhouse gases. Methane is known as a short-lived gas because it only remains in the atmosphere for around 12 years before breaking down. In contrast, CO_2 is a long-lived gas that can remain in the atmosphere for centuries. Despite being short-lived, methane is around 30 times more effective at trapping heat in the atmosphere than CO_2, making methane a powerful greenhouse gas. Releasing one tonne of methane into the atmosphere would create the same amount of warming as 30 tonnes of CO_2 over 100 years. As the human population has grown, the number of farmed animals has increased significantly to meet the demand for food through meat and dairy products, as well as other products such as leather and wool fibre. In turn, atmospheric methane levels have noticeably increased over this period. In fact, it is estimated atmospheric methane levels have risen by more than 150 percent since the 1700s. (Source: NIWA)

The Climate Change Response (Zero Carbon) Amendment Act 2019 sets domestic targets for reducing New Zealand's total greenhouse gas emissions which are: greenhouse gas net emissions reduction of all greenhouse gases (except biogenic methane) to zero by 2050, emissions reduction of biogenic methane to 24–47 per cent below 2017 levels by 2050, including to 10 per cent below 2017 levels by 2030. These are separate to our international commitments to contribute to global climate change targets through the Paris Agreement. (Source: (Zero Carbon) Amendment Act 2019)

The main source of agriculture emissions is methane from livestock digestive systems. It makes up almost three quarters of our agriculture emissions. The next largest source is nitrous oxide from nitrogen added to soils, followed by manure management. (Source: Environment.govt.nz)

Several techniques have been developed to measure greenhouse gas emissions from agriculture. Some of these include: Respiration chambers – animals are contained within a chamber to measure the amount of methane they are producing; Soil chambers – samples of air from patches of soil can be collected to measure nitrous oxide; SF6 tracer technique – animals are fitted with equipment that measures emissions while the animal is grazing freely in a paddock; Paddock-scale micro-meteorological techniques – used to calculate greenhouse gas emissions from all livestock in a paddock; This can be used for both methane and nitrous oxide; Regional atmospheric inverse modelling, where whole regions emissions of CO2 or CH4 can be quantified from a network of concentration measuring stations. (Source: NIWA) Although, there is no 'perfect' tool for estimating on-farm GHG emissions better and farm-specific tools can capture the management changes and the direct mitigation options (Source: Assessment of Tools, MPI) Also, TCFD provides key metrics for Agriculture, Food, and Forest Products Group organizations related to the implications of GHG emissions, energy and water on the financial aspects related to revenue, costs, assets, liabilities, and capital allocation. (Source: E11 TCFD)

Climate change presents a longer-term risk to financial stability, with the physical impacts of climate change likely to increase. Transitioning to a low-carbon economy will reduce financial stability risks in the long term, but there are costs for some sectors. (Source: RBNZ) The new legislation for New Zealand will require certain entities, to be known as Climate Reporting Entities (CREs), to provide annual climate statements that identify and report on the impact of climate change on their organisations and disclose greenhouse gas emissions. Additionally, new non-residential governments buildings will have to meet energy rating requirements.

Mandatory climate-related disclosures (CRD) are to demonstrate risks and responsibility in climate issues, manage effects of climate change and allocate capital more efficiently.

The drafted External Reporting Board Standard (Source: XRB), also investment and finance literature broadly distinguish between 'physical risk' and 'transition risk'. The term 'physical risk' is closely related to risks arising from climate change impacts and climate-related hazards, while the term 'transition risk' typically refers to risks associated with transition to a low carbon economy. (Source: IPCC)

2. Definitions

- **Brown Discounts** – lower rents for properties with weaker environmental and sustainable performance (non-green and non-energy rated properties).
- **Building Energy Efficiency Certificates** – certificates provided by e.g., NABERSNZ, LEED and BREEAM and being measurements of buildings' energy and environmental performance. NABERSNZ (National Australian Built Environmental Rating System New Zealand) (Source: NABERSNZ.govt.nz/about-nabersnz/types-of-ratings), LEED (Leadership in Energy and Environmental Design), BREEAM (Building Research Establishment's Environmental Assessment Method). (Source: TOITU , Certifiedenergy)
- **Climate Change** - Climate change refers to a change in the state of the *climate* that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external *forcings* such as modulations of the solar cycles, volcanic eruptions and persistent *anthropogenic* changes in the composition of the *atmosphere* or in *land use*. Climate change also means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.' The UNFCCC thus makes a distinction between climate change attributable to human activities altering the atmospheric composition and climate variability attributable to natural causes. (Source: IPCC , UNFCCC)
- **Carbon Footprint** - carbon footprint is calculated by estimating the carbon dioxide (CO2) emissions for each lifestyle activity, as well as five other greenhouse gasses which contribute to warming the planet. Those include methane, nitrous oxide and hydroflourocarbons. All these emissions are added together, and expressed as a single number in terms of carbon dioxide equivalent (CO2-e). CO2-e is measured in either kilograms or tonnes, and is calculated by multiplying the emissions of each of the six greenhouse gases by its 100-year global warming potential. The world (OECD) average carbon footprint is 10.8 tCO2-e and the NZ average is 7.7 tCO2-e. New Zealand's current target is to reduce greenhouse gas emissions by 30 per cent below 2005 levels by 2030. (Source: Futurefit.nz)
- **Carbon Offsetting** - Reducing GHG emissions (including through avoided emissions), or increasing GHG removals through activities external to an actor, in order to compensate for GHG emissions, such that an actor's net contribution to global emissions is reduced. Offsetting is typically arranged through a marketplace for carbon credits or other exchange mechanism. Offsetting claims are only valid under a rigorous set of conditions, including that the reductions/removals involved are additional, not over-estimated, and exclusively claimed. Further, offsetting can only be used to claim net zero status to the extent it is "like for like" with any residual emissions. (Source: Racetozero.UNFCCC) Any organisation has an ability to carry out voluntary carbon offsetting to claim carbon neutrality or meet self-imposed targets to reduce their carbon footprint. A third party can be used to voluntarily offset your emissions on your behalf. (Source: Environment.govt.nz)

The main types of carbon reducing projects are: Tree planting, e.g. restoration and forestry that sequesters or 'locks in' carbon; Conservation projects that preserve existing native forests as permanent carbon 'sinks'; Renewable energy (non fossil fuel) projects or other initiatives that reduce emissions in developing countries (often referred to as 'Clean Development Mechanism' as defined in the Kyoto Protocol – a complex ratification process which extended the 1992 United Nations Framework Convention on Climate Change (UNFCCC) that commits state parties to reduce greenhouse gas emissions. (Source: UNFCCC, Futurefit.nz/carbon-offsetting)

- **Climate-related Disclosure (CRD)** - Sustainability reporting is a mechanism for measuring and communicating performance against environmental, social and corporate governance (ESG) factors. Sustainability reports enable financial market participants (such as firms, investors and insurers) to accurately price assets and new investments, improve their reputation and stakeholder relations, enhance their ability to manage transitional and physical risks, and align branding with consumer preferences. ESG indicators act as effective proxies for low risk, long term investments that deliver high financial returns. Over time, sustainability reporting can support sustainable transitions as capital is directed towards sustainable activities. (Source: MBiE) Climate change poses a major risk to the stability of financial systems globally and there is increasing pressure on organisations to provide greater transparency with respect to their exposure to climate-related financial risk. Mandating climate-related financial disclosures for large New Zealand entities is expected to achieve greater transparency, enable climate risk to be adequately priced in capital markets using materiality based comparable information, and help the Government in achieving its zero-carbon target by 2050. (Source: PWC)
- **Climate Targets** – A temperature limit, concentration level, or emissions reduction goal used towards the aim of avoiding dangerous anthropogenic interference with the climate system. For example, national climate targets may aim to reduce greenhouse gas emissions by a certain amount over a given time horizon. (Source: IPCC) Interim and long-term targets to reach Net-Zero GHGs emissions. (Source: Racetozero.UNFCCC) 'Science-based' and in line with what the latest climate science deems necessary to meet the goals of the Paris Agreement – limiting global warming to well-below 2°C above preindustrial levels and pursuing efforts to limit warming to 1.5°C, with no or low overshoot. (Source: UNFCCC Racetozero.UNFCCC.int/Race-to-Zero-Lexicon)
- **Global Warming** - An increase in global mean surface temperature (GMST) averaged over a 30-year period, or the 30-year period centred on a particular year or decade, expressed relative to pre-industrial levels unless otherwise specified. For 30-year periods that span past and future years, the current multi-decadal warming trend is assumed to continue. (Source: IPCC)
- **Green Building** – A 'green' building is a building that, in its design, construction or operation, reduces or eliminates negative impacts, and can create positive impacts, on our climate and natural environment. Green buildings preserve precious natural resources and improve our quality of life. There are a number of features which can make a building 'green'. These include: Efficient use of energy, water and other resources; Use of

renewable energy, such as solar energy; Pollution and waste reduction measures, and the enabling of re-use and recycling; Good indoor environmental air quality; Use of materials that are non-toxic, ethical and sustainable; Consideration of the environment in design, construction and operation; Consideration of the quality of life of occupants in design, construction and operation; A design that enables adaptation to a changing environment. (Source: WorldGBC)

- **Green Leases** – The concept is to share the tenant's savings with the landlord so that both benefit, and there is an incentive for the landlord to undertake investment to improve the sustainable performance of the asset. Some leases may place the tenant under potentially onerous liabilities in relation to repair, including specification of materials and hand-back clauses. In all cases where contractual arrangements exist relating to sustainability performance, valuers should assess whether they may have an impact (positive or negative) on value. The use of leases containing specific sustainability criteria is a feature of some markets and jurisdictions. Such leases contain clauses within the lease, or the addition of a memorandum of understanding attached to the lease, that place additional responsibilities and potentially additional costs on the tenant. While these clauses are not necessarily punitive, some are. If they involve the tenant in actual or potential additional costs, they could result in a lesser rental bid. Alternatively, some tenants could regard the acceptance of a 'green lease' as fulfilment of their ESG requirements. As with all matters of lease interpretation, valuers should take care to analyse the inter-relationship of clauses against each other, and between the subject property and those of comparable properties. In some markets, such as the US with its 'C-pace' system, finance is available to fund retrofitting which then involves a subsequent charge against the property. Other forms of finance and secured lending based on sustainability and ESG criteria are also available. (Source: RICS/Valuation/Sustainability-and-ESG-Guidance-Note)
- **Green Premiums** – higher rents for buildings with strong environmental performance. Higher rents together with higher occupancy rate imply higher capital values with lower monthly operating and maintenance costs (e.g., water, energy and waste savings).
  Any voluntary initiatives that exceed regulatory requirements and national building codes could potentially create 'green value' which should, at least hypothetically, be capitalised into prices and rents. The existence of a green premium would also reflect consumer willingness to pay, which studies have found to be primarily related to increased energy efficiency; therefore, a premium may also indicate the ability to successfully and credibly convey a property's energy efficiency. (Source: Sustainability_Handbook)
- **Greenhouse gases** - means those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation. (Source: UNFCCC) Natural greenhouse gases include water vapour (H_2O), carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Man-made greenhouse gases include CO_2, CH_4, N_2O, and various chlorine and bromine containing compounds such as sulphur hexafluoride (SF_6) and chlorofluorocarbons (CFCs). (Source: NIWA)
- **Embodied carbon emissions** – materials and construction processes during the entire building lifecycle.

- **Emissions** – means the release of greenhouse gases and/or their precursors into the atmosphere over a specified area and period of time. (Source: UNFCCC)
- **Emissions Trading** - Parties with commitments under the Kyoto Protocol (Annex B Parties) have accepted targets for limiting or reducing emissions. These targets are expressed as levels of allowed emissions, or assigned amounts,at over the 2008-2012 commitment period. The allowed emissions are divided into assigned amount units **(AAUs).** Emissions trading, as set out in Article 17 of the Kyoto Protocol, allows countries that have emission units to spare - emissions permitted them but not "used" - to sell this excess capacity to countries that are over their targets. Thus, a new commodity was created in the form of emission reductions or removals. Since carbon dioxide is the principal greenhouse gas, people speak simply of trading in carbon. Carbon is now tracked and traded like any other commodity. This is known as the "carbon market." The other units which may be transferred under the scheme, each equal to one tonne of CO2, may be in the form of: A removal unit (RMU) on the basis of land use, land-use change and forestry (LULUCF) activities such as reforestation; An emission reduction unit **(ERU)** generated by a joint implementation project; A certified emission reduction (CER) generated from a clean development mechanismproject activity. In order to address the concern that Parties could "oversell" units, and subsequently be unable to meet their own emissions targets, each Party is required to maintain a reserve of ERUs, CERs, AAUs and/or RMUs in its national registry. This reserve, known as the "commitment period reserve", should not drop below 90 per cent of the Party's assigned amount or 100 per cent of five times its most recently reviewed inventory, whichever is lowest. (Source: Emissions Trading | UNFCCC) **The New Zealand Emissions Trading Scheme (NZ ETS)** helps reduce emissions by doing three main things: requiring businesses to measure and report on their greenhouse gas emissions, requiring businesses to surrender one 'emissions unit' (known as an NZU) to the Government for each one tonne of emissions they emit, limiting the number of NZUs available to emitters (i.e. that are supplied into the scheme). (Source: Environment.govt.nz/ETS) An ETS sets a regulatory limit on emissions by covered sectors and translates that limit into a market price which changes behaviour to reduce emissions. Obligated parties are required to surrender to the government a tradable emission unit for each tonne of emissions for which they are liable. The government limits the supply of emission units into a trading market which then sets the emission price based on unit supply and demand. The cost to obligated parties of surrendering emission units gets passed on across the supply chain, raising the relative cost of higher-emission goods and services, making lower emission behaviour more competitive, and creating an incentive for businesses and consumers to reduce or avoid emissions. The New Zealand Emissions Trading Scheme (NZ ETS) began operation in 2008. It has the dual purpose of helping New Zealand to meet its international obligations under the United Nations Framework Convention on Climate Change and the Kyoto Protocol, and reducing New Zealand's net emissions to below business-as-usual levels. (Source: Motu.nz)
- **Energy Efficiency** – The ratio of output or useful energy or energy services or other useful physical outputs obtained from a system, conversion process, transmission or storage

activity to the input of energy (measured as kWh kWh–1, tonnes kWh–1 or any other physical measure of useful output like tonne-km transported). Energy efficiency is often described by energy intensity. In economics, energy intensity describes the ratio of economic output to energy input. Most commonly energy efficiency is measured as input energy over a physical or economic unit, i.e., kWh USD–1 (energy intensity), kWh tonne–1. For buildings, it is often measured as kWh m–2, and for vehicles as km liter–1 or liter km–1. Very often in policy 'energy efficiency' is intended as the measures to reduce energy demand through technological options such as insulating buildings, more efficient appliances, efficient lighting, efficient vehicles, etc. (Source: IPCC) Energy efficiency is about using the least possible energy to perform a task. Reducing energy loss and using passive design elements such as effective building orientation, glazing and insulation can make it warmer, healthier and cheaper to run. (Source: BRANZ)

- **Energy Rating** – regulations that aim to improve energy efficiency and affordability. (Source: MBiE.govt.nz , https://www.eeca.govt.nz/)
- **Environmental, Social and Corporate Governance (ESG)** - Environmental, Social, and Governance (ESG) are criteria increasingly used to assess the impact of the environmental, social and ethical practices of companies on their operations, financial performance and attractiveness to investors. The three components; Environmental, Social and Governance which are metrics considered to evidence effective performance, reach beyond the individual organization out to the wider markets, society and world as a whole. (Source: IVSC/Perspectives Paper ESG and Real Estate Valuation)
- **External Reporting Board (XRB)** - The External Reporting Board (XRB) is an independent Crown Entity responsible for accounting and auditing & assurance standards in New Zealand. (Source: XRB)
- **International Sustainability Standards Board (IFRS)** - the IFRS Foundation Trustees announced the creation of a new standard-setting board — the International Sustainability Standards Board (ISSB). The intention is for the ISSB to deliver a comprehensive global baseline of sustainability-related disclosure standards that provide investors and other capital market participants with information about companies' sustainability-related risks and opportunities (ESG) to help them make informed decisions. It sets out general sustainability-related disclosure requirements (IFRS Sustainability Disclosure Standards) and the other specifies climate-related disclosure requirements. (Source: IFRS)
- **Intergovernmental Panel on Climate Change (IPCC)** - The IPCC was created by the United Nations Environment Programme (UN Environment) and the World Meteorological Organization (WMO) in 1988 to provide policymakers with regular scientific assessments on climate change, its implications and potential future risks, as well as to put forward adaptation and mitigation options. (Source: IPCC)
- **Net-Zero Emissions** - Net-zero emissions are achieved when emissions of greenhouse gases (GHGs) to the atmosphere are balanced by anthropogenic removals. Where multiple greenhouse gases are involved, the quantification of net-zero emissions depends on the climate metric chosen to compare emissions of different gases (such as global warming

potential, global temperature change potential, and others, as well as the chosen time horizon). (Source: IPCC)

- **Net-Zero Carbon Building and Construction Sector** – transition towards total sector decarbonisation through a more sustainable built environment which involves radical transformation in the way buildings are designed, built, occupied and deconstructed. (Source: WorldGBC)
- **Operational carbon emissions** – Operational carbon relates to emissions occurring when the building is in use like energy and water usage. Good design and effective management and monitoring is necessary for efficient energy and water usage.
- **Paris Agreement** - The Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC) was adopted on December 2015 in Paris, France, at the 21st session of the Conference of the Parties (COP) to the UNFCCC. The agreement, adopted by 196 Parties to the UNFCCC, entered into force on 4 November 2016 and as of May 2018 had 195 Signatories and was ratified by 177 Parties. One of the goals of the Paris Agreement is 'Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels', recognising that this would significantly reduce the risks and impacts of climate change. Additionally, the Agreement aims to strengthen the ability of countries to deal with the impacts of climate change. (Source: IPCC)
- **Paris aligned** - targets are considered 'science-based' if they are in line with what the latest climate science deems necessary to meet the goals of the Paris Agreement – limiting global warming to well-below 2°C above preindustrial levels and pursuing efforts to limit warming to 1.5°C, with no or low overshoot. (Source: Racetozero.UNFCCC)
- **Physical Risks -** closely related to risks arising from climate change impacts and climate-related hazard. (Source: IPCC)
- **Risk** - The potential for adverse consequences for human or ecological systems, recognising the diversity of values and objectives associated with such systems. In the context of climate change, risks can arise from potential impacts of climate change as well as human responses to climate change. Relevant adverse consequences include those on lives, livelihoods, health and well-being, economic, social and cultural assets and investments, infrastructure, services (including ecosystem services), ecosystems and species. (Source: IPCC) In the context of climate change impacts, risks result from dynamic interactions between climate-related hazards with the exposure and vulnerability of the affected human or ecological system to the hazards. Hazards, exposure and vulnerability may each be subject to uncertainty in terms of magnitude and likelihood of occurrence, and each may change over time and space due to socio-economic changes and human decision-making (see also risk management, adaptation, and mitigation). (Source: IPCC) In the context of climate change responses, risks result from the potential for such responses not achieving the intended objective(s), or from potential trade-offs with, or negative side-effects on, other societal objectives, such as the Sustainable Development Goals (see also risk trade-off). Risks can arise for example from uncertainty in implementation,

effectiveness or outcomes of climate policy, climaterelated investments, technology development or adoption, and system transitions. (Source: IPCC)

- **Risk Assessment** - The qualitative and/or quantitative expert estimation of risks.
- **Risk Management** - Plans, actions, strategies or policies to reduce the likelihood and/or magnitude of adverse potential consequences, based on assessed or perceived risks. (Source: IPCC)
- **Renewable Energy** - Renewable energy is energy from sources that are naturally replenishing but flow-limited; renewable resources are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. The major types of renewable energy sources are: Biomass (wood and wood waste, municipal solid waste, landfill gas and biogas, ethanol, biodiesel), Hydropower, Geothermal, Wind, Solar. (Source: EIA) Renewables are the backbone of any energy transition to achieve net zero. As the world increasingly shifts away from carbon emitting fossil fuels, understanding the current role renewables play in the decarbonisation of multiple sectors is key to ensuring a smooth pathway to net zero. (Source: IEA) New Zealand currently has the fourth-highest renewable electricity percentage in the OECD, currently at around 84% and growing. (Source: NZTE) New Zealand is a country rich in geothermal resources because of the many volcanic areas, and faults and tectonic features. Geothermal energy is the fuel type with the largest contribution to the total primary energy supply (TPES) but electricity generated from geothermal energy is a much lower proportion. Because geothermal fluid is much lower in temperature than steam produced by coal or a gas boiler, the transformation efficiency to electricity is much lower. The efficiency is around 15%, and for this reason geothermal energy supplies less than a fifth of New Zealand's electricity even though it contributes to over half of the renewable energy supply. (Source: MBiE.govt.nz)
- **Scopes 1, 2, 3** - Scope 1 emissions are direct greenhouse (GHG) emissions that occur from sources that are controlled or owned by an organization (e.g., emissions associated with fuel combustion in boilers, furnaces, vehicles). Scope 2 emissions are indirect GHG emissions associated with the purchase of electricity, steam, heat, or cooling. Although scope 2 emissions physically occur at the facility where they are generated, they are accounted for in an organization's GHG inventory because they are a result of the organization's energy use. Scope 3 emissions are the result of activities from assets not owned or controlled by the reporting organization, but that the organization indirectly impacts in its value chain. Scope 3 emissions include all sources not within an organization's scope 1 and 2 boundary. The scope 3 emissions for one organization are the scope 1 and 2 emissions of another organization. Scope 3 emissions, also referred to as value chain emissions, often represent the majority of an organization's total GHG emissions. According to the GHG Corporate Protocol, all organizations should quantify scope 1 and 2 emissions when reporting and disclosing GHG emissions, while scope 3 emissions quantification is not required. However, more organizations are reaching into their value chain to understand the full GHG impact of their operations. In addition, because scope 3 emission sources may represent the majority of an organization's GHG emissions, they often offer emissions reduction opportunities. Although these emissions

are not under the organization's control, the organization may be able to impact the activities that result in the emissions. The organization may also be able to influence its suppliers or choose which vendors to contract with based on their practices. (Source: EPA.gov/scope-1-and-scope-2-inventory-guidance, GHGProtocol.org/standards)

- **Sustainable Development Goals (UN SDGs)** - the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership. They recognize that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests. (Source: SDGS)
- **Task Force on Climate-Related Financial Disclosures (TCFD)** - The TCFD was created in 2015 by the Financial Stability Board (FSB) to develop consistent climate-related financial risk disclosures for use by companies, banks, and investors in providing information to stakeholders. (Source: XRB)
- **Transition Risks** - refers to risks associated with transition to a low carbon economy and can entail extensive policy, legal, technology and market changes. (Source: IPCC)
- **Uncertainty** - A state of incomplete knowledge that can result from a lack of information or from disagreement about what is known or even knowable. It may have many types of sources, from imprecision in the data to ambiguously defined concepts or terminology, incomplete understanding of critical processes, or uncertain projections of human behaviour. Uncertainty can therefore be represented by quantitative measures (e.g., a probability density function) or by qualitative statements (e.g., reflecting the judgment of a team of experts). (Source: IPCC)
- **World Green Building Council** - The New Zealand Green Building Council (NZGBC) follows their vision for New Zealanders to live, work and play in healthy, efficient and productive buildings in a sustainable built environment. NZGBC works to achieve this vision through promoting the benefits of sustainable buildings by creating a common language and demonstrating the value, assisting the property and construction sector to acquire the skills and knowledge to be able to deliver a sustainable built environment and motivating and rewarding the sustainable development and operation of buildings across New Zealand. (Source: WorldGBC)

3. Climate-related Risks Framework

3.1. New Zealand Policy and Regulations

New Zealand has made commitments to the international and domestic greenhouse gas emissions targets. Domestic targets are targets that New Zealand decided as part of its domestic policy decisions. International targets are targets that New Zealand accepted as part of international climate change agreements.

Domestic targets under the Climate Change Response Act (CCRA) are:

- Net zero emissions of all GHG other than biogenic methane by 2050;
- 24 to 47 per cent reduction below 2017 biogenic methane emissions by 2050, including 10 per cent reduction below 2017 biogenic methane emissions by 2030.

Under the Paris Agreement each country adopts an international target known as a Nationally Determined Contribution (NDC). This sets out the contribution the country will make towards the goals of the Paris Agreement. (Source: Beehive/release)

International targets - 2030 Target (2021-2030):

- Nationally Determined Contribution (NDC1) sets a headline target of a 50 per cent reduction of net emissions below our gross 2005 level by 2030. (Source: Environment.govt.nz)

3.1.1 Mandatory Climate-related disclosure

The Government has passed legislation making climate-related disclosures mandatory for some organisations. The requirement will apply to large publicly listed companies, insurers, banks, non-bank deposit takers and investment managers. The Financial Sector (Climate-related Disclosures and Other Matters) Amendment Act 2021 has amended the Financial Markets Conduct Act 2013 (FMC Act), the Financial Reporting Act 2013, and the Public Audit Act 2001. The new law will require around 200 large financial institutions covered by the FMC Act to start making climate-related disclosures. Affected organisations are expected to publish disclosures from financial years commencing in 2023, subject to the publication of climate standards from the External Reporting Board (XRB). Mandatory climate-related disclosures are to help New Zealand meet its international obligations and achieve its target of net zero carbon by 2050 by improving transparency and revealing climate-related information within financial markets. Around 200 entities in New Zealand will be required to produce climate-related disclosures. These climate reporting entities include:

- All registered banks, credit unions, and building societies with total assets of more than $1 billion.
- All managers of registered investment schemes (other than restricted schemes) with greater than $1 billion in total assets under management.

- All licensed insurers with greater than $1 billion in total assets or annual premium income greater than $250 million.
- Listed issuers of quoted equity securities with a combined market price exceeding $60 million.
- Listed issuers of quoted debt securities with a combined face value of quoted debt exceeding $60 million. (Source: Environment.govt.nz)

The External Reporting Board (XRB) plays important part in addressing climate change through the establishment of a climate-related disclosure framework, which is based on the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) on Governance, Risk Management, Strategy, and Metrics and Targets. XRB will propose three Consultation Documents: Governance and Risk Management, Strategy, and Metrics and Targets as parts of the Aotearoa New Zealand Climate Standard 1: Climate-related Disclosures (NZ CS 1), which is expected in December 2022. (Source: XRB/CRD)

XRB also provides guidance on measuring greenhouse gas emissions XRB Standards Climate Related Disclosures.

3.1.2 **Mandatory Energy Efficiency Rating for Government Office Buildings** (Source: Procurement.govt.nz)

Government office buildings are based within the commercial sector therefore they can deliver benefits associated with emissions reduction.

The improved energy performance of government office buildings can also directly, and indirectly, contribute to several strategic priorities:

- The New Zealand Energy Strategy 2011-2021 has an environmental responsibility priority that includes a focus on reduced energy-related greenhouse gas emissions.
- The New Zealand Energy Efficiency and Conservation Strategy 2017-2022 includes an action to increase the number of government owned or leased buildings that get regular NABERSNZ ratings.
- The Government has set a target for 100% of electricity to be renewable by 2035.

The National Australian Built Environment Rating System (NABERS), is an initiative launched by the Australian government in 1999 to measure and compare the environmental energy and carbon performance of commercial buildings and tenancies.
NABERSNZ has been introduced as a voluntary tool to rate the energy performance of New Zealand offices in 2013.
A NABERSNZ rating assesses the energy use consumed by the office building and its tenants.
There are three types of energy ratings:
Tenancy: the energy performance of the floors and areas occupied mainly by the tenant, including computers, lighting, server rooms, and staff kitchens.

Base building: this rating has the biggest impact on improving a building's energy performance and measures the energy performance of a building's core services – lifts, stairwell lighting, common toilets, air conditioning, and ventilation.
Whole building: measures both base building and tenancy ratings.

Tenancy energy use accounts for around 42% of total energy use in the building. However, improvements to a building's NABERSNZ rating can be achieved with collaboration between the tenant and landlord to minimise wastage, like after-hours air conditioning use.

Electric vehicles energy use is excluded from a NABERSNZ rating provided that a compliant electricity meter is being used, as the energy consumed by the vehicle is outside the building envelope.

From 1 January 2021, these standards are compulsory for all mandated agencies who occupy single-tenant, co-tenanted, or co-located government office accommodation (non-mandated agencies are encouraged to follow these standards):

Existing buildings

Agencies entering a new lease, or renewing an existing lease should target a rating above 5 stars, and achieve a minimum of 4 stars.
Agencies that own/lease office accommodation at or above 2,000m² will need to get an NABERSNZ rating by December 2025.

New buildings

Agencies planning a new build project need to achieve a minimum of 5 stars.

Co-assess ratings

Co-assess is a process that enables tenancy ratings to be conducted as part of a whole building or base building rating. For example, a collection of tenancy assessments undertaken for multiple agencies in a co-tenancy building. The method is designed to help building managers, building owners, and tenants to better understand their energy use and work together to improve the performance of their building and tenancies, while reducing assessment costs.

Frequency of ratings

Assessments are valid for 12 months. If the target rating has been met, a re-rating is required every three years. If the target rating has not been met, an agency must implement a work programme within 12 months to achieve the target rating and re-rate the building annually until the minimum star rating is achieved.

Assessment costs

Generally, for a Tenancy assessment, this would be paid for by the agency. We would expect a Base Building assessment will be paid for by the landlord, and this may be incorporated into negotiations between the tenant and the landlord.

Disclosure of ratings

As part of the NABERSNZ assessment and under the Carbon Neutral Government Programme, agencies must disclose their ratings and also report their progress through the Government Property Portal (GPP). If a building is not rated, it will have to go through the assessment process.

In all other situations, agencies can achieve greater benefits if they carry out separate base building and tenancy assessments, rather than completing a whole building assessment. A whole building assessment can skew either the base building or tenancy assessment results where space is not occupied by Government agencies; examples include crèches, retail or commercial premises. In these multi-tenanted buildings common areas are allocated on a pro-rata basis to more than one tenant. Separate assessments provide agencies with better control over making improvements and this approach also provides a more accurate reflection of energy usage.

A whole building rating includes both a base build rating and also tenancy rating(s). In assessing a tenancy rating it measures items under an agencies direct control, which encompasses the areas occupied exclusively by the tenant, including energy use such as computers, lighting, data centres, and staff kitchens.

A base build rating measures the energy performance of a building's core services which an agency will have little or no control over such as lifts, stairwell lighting, common toilets, air conditioning and ventilation. (Source: Procurement.govt.nz) (NABERSNZ self-assessment-tool)

3.1.3 Transformation of Operational Efficiency

Emissions produced over the life cycle of a building are generally put into two groups, operational emissions and embodied emissions. Operational carbon emissions occur only during the use stage of a building's life and are from the energy and other resources used when operating the building. Embodied carbon emissions are from the materials and products that form the building and can occur right across the building's life cycle.

Reducing operational emissions is important for climate change mitigation and an important part of the Building and Construction Sector's contribution to the national Emissions Reduction Plan. Carbon emissions come directly from fossil fuel combustion and indirectly from using electricity and water in buildings. Increasing operational efficiency, and thereby reducing these three components, reduces operational emissions. The emissions are measured in kilograms of CO2 equivalent per square meter per annum, kg CO2 -e/(m2 .a).

The Transforming Operational Efficiency Framework proposes that:

1. There will be a mandatory Operational Emissions Cap setting out the total allowable annual emissions per square meter per annum for all new buildings.
    1.1. The Operational Emissions Cap will have requirements for fossil fuel combustion, electricity use and water use.
    1.2. Electricity use will have requirements for thermal performance, services efficiency and plug loads.

2. There will be a mandatory Water Use Cap setting out the total allowable potable water use per square meter per annum for all new buildings.
3. There will be defined Indoor Environmental Quality parameters for all new buildings to comply with. (Source: MBiE)

The focus on reducing the environmental impact of buildings has been mainly focused on increasing operational efficiency. However, there is a growing interest in reducing whole of life embodied carbon, both in New Zealand and globally. This is due to the increasing scrutiny of the carbon emissions generated from building materials and products, not just the operation of buildings, and the realisation that over time new buildings will become more efficient in use through improved design and technology, thereby increasing the significance of whole of life embodied carbon.

Whole of life embodied carbon is largely determined by the time a building or construction project arrives at the construction stage through key design decisions made on the systems and materials to be used. It includes embodied carbon generated through life cycle replacement of materials like windows or doors, as well as the disposal of a building at the end of its life (e.g., demolition). The opportunity to significantly reduce embodied carbon will be influenced by the choices made during the initial design stages. Because whole of life embodied carbon is not subject to how the building is used, we can predict these emissions more accurately.

Operational carbon relates to emissions occurring when the building is in use like energy and water usage. Good design and effective management and monitoring is necessary for efficient energy and water usage.

Rating systems

There are a number of points-based rating systems that consider a wide range of factors to assess the overall environmental impact of a building. These systems typically allow building owners to select a mix of features that can contribute to a score or rating to demonstrate the overall performance. Some of these systems include components that can be used for assessing the whole of life embodied carbon or operational carbon generated for different options being considered for a project.

Generally, a large part of the whole of life embodied carbon from a building project is captured in the structural frame, floors and foundations followed by the envelope and internal fittings.

Specific tools

System or tool	Type	Focus areas		
		Overall sustainability performance	Whole of life embodied carbon	Operational efficiency (Operational Carbon)
Green Star	Rating tool (non-residential)	✓	✓	✓
Homestar	Rating tool (residential)	✓	✓	✓
NABERSNZ	Rating tool (office buildings)			✓
Passive House	Energy Performance Standard			✓
Living Building Challenge (International Living Future Institute)	Rating tool	✓		
Zero Carbon Certification (International Living Future Institute)	Rating tool		✓	✓
eTool	LCA tool		✓	✓
LCAQuick	LCA tool		✓	✓
One Click LCA	LCA tool		✓	✓
EC3	LCA tool		✓	
Tally	LCA tool		✓	

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System or tool	Type	Focus areas		
		Overall sustainability performance	Whole of life embodied carbon	Operational efficiency (Operational Carbon)
PHRibbon	LCA tool		✓	
EnergyPlus	Energy modelling tool			✓
IES	Energy modelling tool			✓
PHPP	Energy modelling tool			✓
Design Builder	Energy modelling tool			✓
AccuRateNZ	Energy modelling tool			✓

Table 1. Comparison of rating systems and tools available for assessing overall sustainability performance, whole of life embodied carbon, and operational carbon.

(Source: [Beehive.govt.nz/Carbon emissions building and construction)](Beehive.govt.nz/Carbon emissions building and construction)

3.1.4 **New Zealand 2021 Building Code Update** (Source: Building.govt.nz)

The Ministry of Business, Innovation and Employment (MBIE) are proceeding with updates to acceptable solutions and verification methods to make new homes and buildings more energy efficient.

The effective date for the new acceptable solutions and verification methods is 29 November 2021 with a transition period of one-year ending on 3 November 2022.

Summary of decisions:

- Energy efficiency for housing and small buildings
- Energy efficiency for large buildings
- Energy efficiency for heating, ventilation and air conditioning (HVAC) systems in commercial buildings
- Natural light for higher-density housing
- Weathertightness testing for higher-density housing
- Standards referenced in B1 Structure
- Editorial changes to Acceptable Solution B1/AS1. (Source: Building.govt.nz)

Building Code update 2021 – Summary of decisions

Proposal	Decision
1. Energy efficiency for housing and small buildings	MBIE is proceeding with changes to roof, window, wall and underfloor insulation requirements and issuing the new edition of H1/AS1 and H1/VM1 for housing and small buildings. The new R-values aims to reduce the energy needed for heating residential homes of approximately 40% over minimum previous status quo requirements
2. Energy efficiency for large buildings	MBIE is proceeding with changes to roof, window, wall and underfloor insulation requirements and issuing the new H1/AS2 and H1/VM2 for large buildings. This aims to reduce the energy needed for heating and cooling of 23% on average across new large buildings over previous minimum status quo requirements
3. Energy efficiency for heating, ventilation and air conditioning (HVAC) systems in commercial buildings	MBIE is publishing the new verification method H1/VM3 with modifications to the proposed text to clarify the requirements and address items raised in the consultation.
4. Natural light for higher-density housing	MBIE is publishing the new acceptable solutions G7/AS1 and G7/AS2 with minor modifications to the proposal. The existing outdated G7/VM1 will be replaced with a verification method to demonstrate compliance using computer modelling.
5. Weathertightness testing for higher-density housing	MBIE is issuing the new edition of E2/VM2 without any modifications to the proposal.
6. Standards referenced in B1 Structure	MBIE is referencing the new versions of these standards in the acceptable solutions and verification methods for B1 Structure.
7. Editorial changes to Acceptable Solution B1/AS1	MBIE is proceeding with the editorial corrections to Acceptable Solution B1/AS1 without any modifications to the proposal.

(Source: Building.govt.nz)

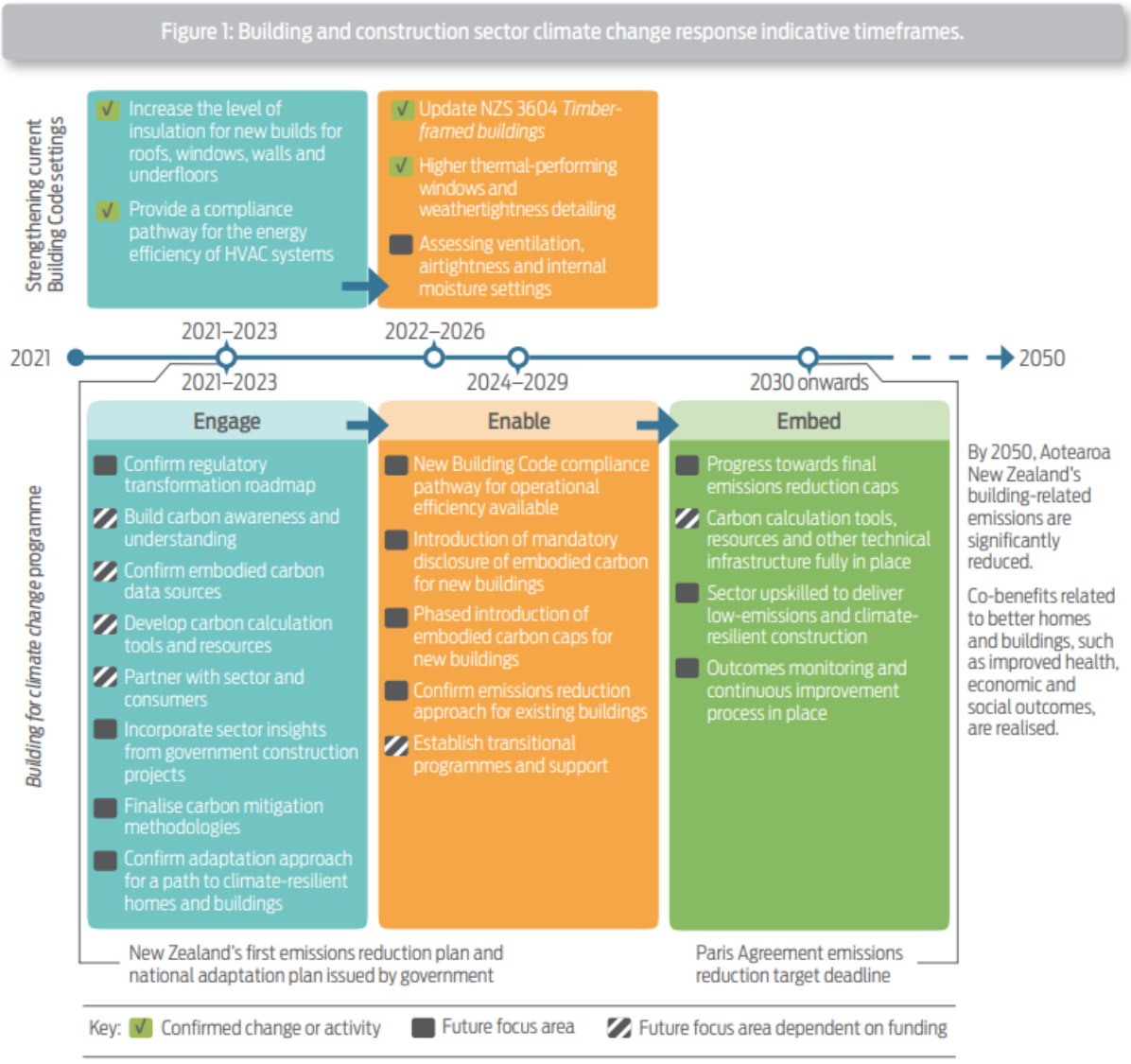
The goal of the programme is to reduce emissions from constructing, operating and deconstructing buildings and to make sure our buildings are prepared for the future effects of climate change.

Three broad areas of action to support the path to low emissions:

- Transforming operational efficiency
- Reducing life cycle embodied carbon emissions
- Adapting to extreme weather events.

(Source: Buildmagazine.org.nz)

Figure 1: Building and construction sector climate change response indicative timeframes.



(Source: Buildmagazine.org.nz)

3.2. Climate-Related Risks in Finance and Investment (Source: IPCC)

The use of the term 'risk' in finance and investment simply describes the potential for actual consequences to be different from (better or worse) their expected value.

Risks may arise from potential climate change impacts and/or responses to climate change (including the lack of a response to climate change). (Source: IPCC/Risk-guidance)

Risks are assessed where potential consequences can be quantified up front but also where consequences depend on qualitative judgements or deep uncertainties.

"The investment and finance literature and practitioner community broadly distinguish between 'physical risk' and 'transition risk'.

The term 'physical risk' is closely related to risks arising from climate change impacts and climate-related hazards, while the term 'transition risk' typically refers to risks associated with transition to a low carbon economy.

Physical Risk

In much of the business and financial literature, the term 'physical risk' relates to those derived from the hazard × exposure × vulnerability framework, but the focus of this literature is often exclusively on changes in the hazard rather than exposure or vulnerability. Physical risks involve risks from climate change including risk to facilities and infrastructure, impact on operations, water and raw material availability and supply chain disruptions. Literature on physical risks sometimes separates acute short-term events or chronic long-term changes in weather and climate. Physical risks have direct financial consequences for organisations where those risks are realised, as well as up-front insurance and investment related costs. How physical risks change over time through the dynamic relationship of the three core components of risk (hazard, exposure, vulnerability) is poorly understood and has yet to be dealt with in a coherent, consistent and widespread manner. Authors should be careful not to simply import the term 'physical risk' if a study considered only changes in hazard but not concurrent exposure or vulnerability, as this would be inconsistent with the IPCC definition of risk.

Transition risk

Climate change risk is still perceived by many organisations as long-term in nature and perceived to fall outside the temporal dimensions of decision-making processes, yet many of the potential consequences from a changing climate as well as the transition to a net zero carbon economy will occur, and are occurring, within the typical lifespan of businesses. Transition risks typically refer to risks associated with transition to a low carbon economy. Transitioning to a lower-carbon economy can entail extensive policy, legal, technology and market changes to address mitigation and adaptation requirements related to climate change. Depending on the nature, speed, and focus of these changes, transition risks may pose varying levels of financial and reputational risk to organizations. The nature and magnitude of risks will depend upon how rapidly organisations develop resilience attributes (awareness, objectiveness, diversity and flexibility). **Transition risks could include Policy; Legal; Technology; Market; Liability risk; and Reputational**. Transition risks, if realised, can result in stranded assets, loss of markets, reduced returns on investment and financial penalties. A key

issue is the stranding of assets that may not provide the expected financial returns and may end up as large financial liabilities.

Additional risk categories relating to business, finance and investments

Within the broad (and not always precisely defined) concepts of physical and transition risk, the following risk-related terms appear frequently in finance and investment literature. Apart from the specific issues identified above, these terms are broadly consistent with the IPCC definition of risk related to responses to climate change (which includes the lack of a response to climate change).

Risk related to **an asset losing its value**: the potential for loss of investment in infrastructure (dams, highways) including mortgages and mortgage-backed security in damaged real estate and assets.

Risk related to losing some or all of the principal of an investment (or **invested capital**): this risk arises due to the possibility of harm to people and damage to communities and infrastructure as a result of climate change impacts (drought, flood, hurricanes, typhoons) and inability of repayment.

Solvency risk: the risk from reduction in credit ratings due to potential adverse consequences of climate change or climate policy, resulting in higher financing costs for investors, countries and municipalities. This includes **liquidity risk** or the risk of not being able to access funds – for example, when constructing assets such as coal-fired power plants within a changing climate policy landscape, suffering cost overruns such that no further funds are accessible, but the plant is only half complete. Another example is suffering a downgraded credit rating due to exposure to climate change, retention of carbon-intensive assets, or failure to account for climate change, including regulatory response to climate change resulting in an increase in the cost of capital (See Policy Risk).

Risk of lower than expected return on investment: responses to climate change, including changing customer preferences, changing climate change regulations that lower investment returns (coal fired and natural gas power production plants within rising carbon prices, but also withdrawal of subsidies for renewables), and new climate innovations that render older carbon intense technology obsolete, give rise to risk surrounding investment in stranded or obsolete assets and technologies (See Transition risks).

Liability risk: lack of response to climate change creates risk of liability for failure to accurately assess risk of climate change to company infrastructure and business lines, failure to assess and plan for climate change impacts before decision-making, and failure to protect people from impacts of climate change when a duty of care or other legal obligation exists.

Technology risk: the term 'technology risk' generally refers to situations where reliance on a particular technology to achieve an outcome creates the potential for adverse consequences if the technology fails to be developed or deployed (for example, the potential for temperature limits to be exceeded if bioenergy with carbon capture and storage (BECCS) is not developed and deployed at large scales), or adverse side effects associated with using this technology (for example, risks to food security from large-scale deployment of BECCS). Adverse consequences can include lower than expected returns on investment, failure to achieve sectoral or national

policy objectives, and risk related to exceedance of temperature limits or increased exposure or vulnerability to climate impacts.

Multidimensional technology assessment is preferable whenever possible, because technology generally does not change in isolation but alongside wider socio-economic, cultural, behavioural, institutional and policy changes. Assessing the risk associated with a specific technology, but with all other socio-economic conditions held constant, may be analytically useful but of limited practical relevance over longer time frames.

Policy risk: changes in policy or regulations in response to climate change could result in the loss of value of assets e.g., climate policy creating stranded assets due to emissions pricing or regulatory changes. Climate policies that provide positive incentives for certain energy sectors can also result in investment risks by making other energy sources less competitive, or once subsidies or other incentives are withdrawn (see Risk of lower than expected return on investment). Similar risks can arise from policies directed at adaptation goals, such as changes to land-use zoning, water prices or water withdrawal rights.

Market risk: changes in relative prices from increased prices of CO2 and other greenhouse gas emissions could reduce financial returns and hence increase risks to investors.

Residual risk: in some corporate and finance literature, the term 'residual risk' refers to adverse consequences that cannot be quantified in probabilistic terms. This is different from how the term 'residual risk' is generally used in IPCC, where it means the risk remaining after adaptation and risk reduction efforts (see glossary for the IPCC Special Report on the Oceans and the Cryosphere). Authors should take care to check the meaning of the term 'residual risk' where it is used in primary literature and avoid copying the term if it refers to quantifiable vs non-quantifiable risk to avoid confusion." (Source: IPCC/Risk-guidance)

3.3. Scenario Analysis and Climate Related Risk Assessment (Source: TCFD & Climate Risk Assessment Guide Environment.govt.nz)

Some organizations are affected by risks associated with climate change today. However, for many organizations, the most significant effects of climate change are likely to emerge over the medium to longer term and their timing and magnitude are uncertain. This uncertainty presents challenges for individual organizations in understanding the potential effects of climate change on their businesses, strategies, and financial performance. To appropriately incorporate the potential effects in their planning processes, organizations need to consider how their climate-related risks and opportunities may evolve and the potential implications under different conditions. One way to do this is through scenario analysis. (Source: TCFD)

Scenario analysis is a process for identifying and assessing a potential range of outcomes of future events under conditions of uncertainty. In the case of climate change, for example, scenarios allow an organization to explore and develop an understanding of how the physical and transition risks of climate change may impact its businesses, strategies, and financial performance over time. (Source: TCFDHub)

Exposure to Climate-Related Risks

The effects of climate change on specific sectors, industries, and individual organizations are highly variable. It is important, therefore, that all organizations consider applying a basic level of scenario analysis in their strategic planning and risk management processes. Organizations more significantly affected by transition risk (e.g., fossil fuel-based industries, energy-intensive manufacturers, and transportation activities) and/or physical risk (e.g., agriculture, transportation and building infrastructure, insurance, and tourism) should consider a more in-depth application of scenario analysis.

a. Exposure to Transition Risks

Transition risk scenarios are particularly relevant for resource-intensive organizations with high GHG emissions within their value chains, where policy actions, technology, or market changes aimed at emissions reductions, energy efficiency, subsidies or taxes, or other constraints or incentives may have a particularly direct effect. A key type of transition risk scenario is a so-called 2°C scenario, which lays out a pathway and an emissions trajectory consistent with holding the increase in the global average temperature to 2°C above pre-industrial levels. In December 2015, nearly 200 governments agreed to strengthen the global response to the threat of climate change by "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels," referred to as the Paris Agreement. As a result, a 2°C scenario provides a common reference point that is generally aligned with the objectives of the Paris Agreement and will support investors' evaluation of the potential magnitude and timing of transition-related implications for individual organizations; across different organizations within a sector; and across different sectors.

b. Exposure to Physical Risks

A wide range of organizations are exposed to climate-related physical risks. Physical climate-related scenarios are particularly relevant for organizations exposed to acute or chronic climate change, such as those with:

- long-lived, fixed assets;
- locations or operations in climate-sensitive regions (e.g., coastal and flood zones);
- reliance on availability of water; and
- value chains exposed to the above.

Physical risk scenarios generally identify extreme weather threats of moderate or higher risk before 2030 and a larger number and range of physical threats between 2030 and 2050. Although most climate models deliver scenario results for physical impacts beyond 2050, organizations typically focus on the consequences of physical risk scenarios over shorter time frames that reflect the lifetimes of their respective assets or liabilities, which vary across sectors and organizations.

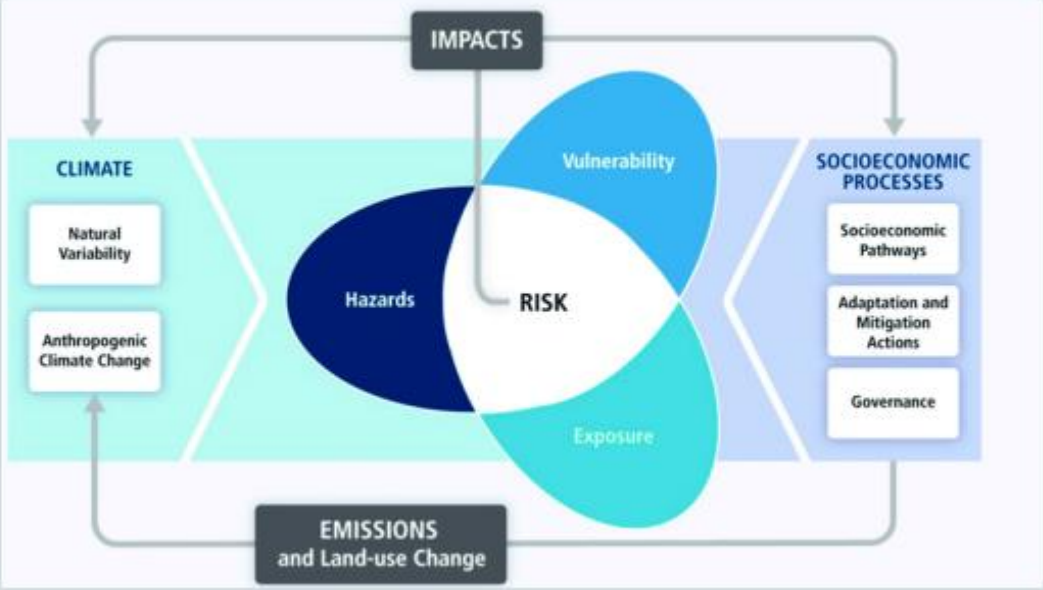
A critical aspect of scenario analysis is the selection of a set of scenarios (not just one) that covers a reasonable variety of future outcomes, both favorable and unfavorable. (Source: TCFD)

New Zealand Ministry for the Environment provides A guide to local climate change risk assessments Climate Risk Assessment Guide to support the nation's response and adaptation to climate change.

Figure 3: Physical risks, transition risks and opportunities

Source: adapted from Task Force on Climate-Related Financial Disclosures (TCFD, 2017)

Figure 4: Climate-related risk as the interaction of climate hazards with the vulnerability and exposure of human and natural systems



Source: Oppenheimer, et al., 2014

3.4. Measuring Emissions

In the context of GHG regulations, significant GHG emissions in a company's value chain may result in increased costs (upstream) or reduced sales (downstream), even if the company itself is not directly subject to regulations.

Compiling a comprehensive GHG inventory improves a company's understanding of its emissions profile and any potential GHG liability or "exposure." A company's GHG exposure is increasingly becoming a management issue in light of heightened scrutiny by the insurance industry, shareholders, and the emergence of environmental regulations/policies designed to reduce GHG emissions.

To help delineate direct and indirect emission sources, improve transparency, and provide utility for different types of organizations and different types of climate policies and business goals, three "scopes" (scope 1, scope 2, and scope 3) are defined for GHG accounting and reporting purposes. (Source: GHGProtocol.org/standards/)

Scope 1: Direct GHG emissions

Direct GHG emissions occur from sources that are owned or controlled by the company, for example, emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc.; emissions from chemical production in owned or controlled process equipment. Direct CO2 emissions from the combustion of biomass shall not be included in scope 1 but reported separately.

Scope 2: Electricity indirect GHG emissions

Scope 2 accounts for GHG emissions from the generation of purchased electricity2 consumed by the company. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organizational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated.

Scope 3: Other indirect GHG emissions

Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the company, but occur from sources not owned or controlled by the company. Some examples of scope 3 activities are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services. (Source: GHGProtocol.org/standards/)

The New Zealand Ministry for the Environment supports organisations acting on climate change with the guide to help them measure and report organisation's greenhouse gas (GHG) emissions to manage and reduce emissions more effectively over time: Detailed Guide. The guide aligns with and endorses the use of the GHG Protocol Corporate Accounting and Reporting Standard (GHG Protocol: Corporate Standard | Greenhouse Gas Protocol) and ISO 14064-1:2018: ISO 14064-1:2018 - Greenhouse gases (see section 1.5). It provides information about preparing a GHG inventory and emission factors and methods to apply them to activity data. The additional guidance is provided by the Emission Factors Summary: Measuring-Emissions-Factors-Summary-2020).

The everyday activities of businesses, communities and individuals create carbon emissions. The problem is that carbon emissions accumulate in the atmosphere and contribute to climate change. The first step to taking impactful climate action, is to understand how much carbon your operations generate. (Source: Toitu.co.nz Carbon Management Measure)
Carbon-low/intensive activities and investments may affect a financial statement in the context of the new policies. (Source: Tools.business.govt.nz)

3.5. CO2 Emissions Calculators

Genless - https://tools.genless.govt.nz/businesses/wood-energy-calculators/co2-emission-calculator

Toitu - https://www.toitu.co.nz/calculators

Sustainable Business Network - https://sustainable.org.nz/annual-carbon-emissions-calculator/

Ekos - https://ekos.co.nz/businesscalculator-lite

Business govt.nz - https://www.tools.business.govt.nz/climate/guides/measure-your-carbon-footprint/

Carbon Footprint - https://www.carbonfootprint.com/calculator.aspx

Stats NZ - https://www.stats.govt.nz/indicators/new-zealands-greenhouse-gas-emissions

3.6. Environmental, Social, and Governance (ESG) (Source: IVS Agenda Consultation 2020)

Environmental, Social, and Governance (ESG) are the criteria that together establish the framework for assessing the impact of the sustainability and ethical practices of a company on its financial performance and operations. ESG comprises three pillars; environmental, social and governance, all of which collectively contribute to effective performance, with positive benefits for the wider markets, society and world as a whole.

The key ESG factors for consideration typically include:

Environmental

- Air and water pollution
- Biodiversity
- Climate change and carbon emissions
- Deforestation
- Resource efficiency (i.e., energy and CO2)
- Waste management
- Water scarcity.

Social

- Community relations
- Conflict
- Customer satisfaction
- Data protection and privacy
- Development of human capital (health & education);
- Employee engagement
- Gender and diversity
- Health & safety
- Human rights
- Working Conditions.

Governance

- Audit committee structure
- Board diversity and structure
- Bribery and corruption
- Corporate governance
- Executive remuneration
- Institutional strength
- Donations and political lobbying
- Rule of law
- Transparency
- Whistle-blower schemes.

ESG (Environmental, Social, and Governance) investing and analysis has become of increasing interest to valuation professionals globally as governments, asset owners, and high net worth investors consider the impact of ESG factors on their investments and local markets. (Source: IVSCAgendaConsultation2020)

3.7. Sustainable Value Creation (Source: WEFORUM METRICS)

At the 2017 Annual Meeting in Davos, CEOs from the World Economic Forum International Business Council (IBC) issued the "Compact for Responsive and Responsible Leadership", which has been signed by more than 140 CEOs. The Compact states that "society is best served by corporations that have aligned their goals to the long-term goals of society," and it identifies the UN Sustainable Development Goals (SDGs) as the roadmap for that alignment.

The IBC launched an initiative to identify a core set of material ESG metrics and recommended disclosures that could be reflected in the mainstream annual reports of companies on a consistent basis across industry sectors and countries.

This set of 21 core and 34 expanded metrics and disclosures were published in September of 2020, in the World Economic Forum report Measuring Stakeholder Capitalism: Towards Common Metrics and Consistent Reporting of Sustainable Value Creation. Focused on four

themes, People, Planet, Prosperity and Principles of Governance, these metrics and disclosures reflect a six-month consultation process with more than 200 companies, investors and other interested parties. (Source: WEFORUM_METRICS)

Two related sets of metrics are proposed, core and expanded:

- **Core metrics**: a set of 22 well-established metrics and reporting requirements. These are primarily quantitative metrics for which information is already being reported by many firms (albeit often in different formats) or can be obtained with reasonable effort. They focus primarily on activities within an organization's own boundaries.
- **Expanded metrics**: these tend to be less well established in existing practice and standards and have a wider value chain scope or convey impact in a more sophisticated or tangible way, such as in monetary terms. They represent a more advanced way of measuring and communicating sustainable value creation, and companies are encouraged to report against them as well, when material and appropriate.

The metrics and disclosures proposed here have been organized in four pillars that are aligned with the SDGs and principal ESG domains: Principles of governance, Planet, People and Prosperity. They are drawn wherever possible from existing standards and disclosures (such as the Global Reporting Initiative, Sustainability Accounting Standards Board, Task Force on Climate-related Financial Disclosures etc.) with the aim of amplifying and elevating the rigorous work that has already been done by these initiatives – bringing their most material aspects into mainstream reports on a consistent basis – rather than reinventing the wheel by creating a new standard. (Source: WEFORUM_PAPER)

3.8. Transition Risk in Real Estate (Source: UNEPFI Managing transition risk in real estate)

The effects of climate change are increasingly being felt around the world, and social and economic pressure for a low-carbon transition is building. Climate risks have become a growing part of public discussions, media reports, and government policies. While decarbonization is critical to mitigate these climate risks, the large-scale economic changes required by a low-carbon transition will introduce significant 'transition' risks. For the real estate sector, much attention has been paid to extreme weather events and other climate-driven consequences (physical risks), but transition risks must also be considered. Potential transition risks include rising costs due to the pricing-in of carbon emissions (through carbon taxes and pricing schemes), market effects, technological disruptions, legal liabilities, energy efficiency and other regulations and reputational risks, all of which can impact property values. Transition risk is a topic of strategic relevance for real estate investors. Energy efficiency regulations and carbon pricing schemes are gaining prominence around the world. As the low-carbon transition accelerates, there is a growing risk of stranded assets and write-downs from properties that fail to meet market expectations and regulatory requirements.

To limit the global temperature rise to 1.5˚C, the world must reach net-zero GHG emissions by 2050. Real estate investors must support this global climate goal by setting net-zero targets.

For these targets to be effective, data transparency, appropriate metrics and management support are critical.

For real estate, a special focus must be placed on operational GHG emissions, since most buildings that will exist in 2050 have already been built. Aggressive retrofitting and refurbishment within the existing property stock is a strategic priority.

On-site renewable energy production offers untapped potential for further improvement of the GHG profile of assets.

Much of the world is moving to decarbonize the production of electricity, a development that supports decarbonization in the real estate sector. However, this effect does not mean market participants can avoid taking action; energy intensity must be continually improved within assets to stay competitive.

Transition risk for the real estate sector can result from rising costs due to the pricing-in of carbon emissions and other factors such as high energy costs, stringent building codes, shifts in market expectations (public attention, decreasing demand for assets with high energy consumption and poor GHG performance, etc.) (UNEP FI 2020). In addition, other risks, such as competition, reputational and legal risks, may also arise for firms.

To limit climate-related risks, all sectors, including real estate, need to decarbonize. Buildings no longer compliant with the 1.5°C Paris-aligned decarbonization requirements will be increasingly exposed to transition risks and may even become 'stranded assets'. The term 'stranding risk' implies potential write-downs due to direct climate change impacts and devaluations related to the transition to a low-carbon economy. Table 1 below provides examples of transition risks and their potential impacts on the real estate sector.

Table 1: Examples of transition risk and impacts on real estate

Transition Risk	Impact on Real Estate
Declining market attractiveness Declining attractiveness of submarkets due to increased vulnerability and exposure to higher costs	▪ Lower demand (investor and tenants) ▪ Lower competitive advantage by increasing energy costs for properties with high-energy intensities] ▪ Reduced asset values may lead to a depressed market environment ▪ Decreasing market values
Increasing regulation Legislation focused on climate change—e.g., disclosure of climate risks, stricter building standards, CO_2 pricing, carbon credits, etc.	▪ Tax increases, e.g. CO_2 tax ▪ Decrease in subsidies for certain technologies ▪ Additional costs from reporting requirements ▪ Additional investment costs to bring the real estate portfolio in line with national laws ▪ Enforced rules that properties can only be rented if they meet a certain energy standard
Risks to reputation and market positioning Stakeholder demand for real estate companies where climate risks are included in the investment calculation	▪ Loss of reputation if action is too late or if no action is taken ▪ Reputational risks for companies, that do not sufficiently consider ESG topics in their strategy

Source: CRREM 2022.

As key market stakeholders become increasing aware of potential climate risks, an inactive and passive approach to climate change is neither informed nor rational. Such risks are among the key reasons for the growing importance of climate risk disclosure. Well-informed decision-making requires transparency, available data, the right analytical tools and timely processing of information.

Without sufficient action, climate change has the potential to cause enormous disruption. The planet has already warmed more than 1˚C since pre-industrial times and a further 3 to 4°C rise in temperature by the end of the century cannot be ruled out on current emissions trajectories (IPCC 2021). The civilization-threatening risks of climate change have prompted the World Economic Forum to put climate change at the top of its annual Global Risk Report (World Economic Forum 2020). (Source: UNEPFI Managing-transition-risk-in-real-estate)

3.9. ESG Reports and Climate Change Risk Assessments - Case studies

National Climate Change Risk Assessment for New Zealand: National Climate Change Risk Assessment for New Zealand, National Climate Change Risk Assessment New Zealand Snapshot

Property for Industry: Property for Industry PFI Climate related disclosures

The Climate Risk Tool Landscape 2022 Supplement. Featuring an anthology of implementation case studies from financial institutions: UNEPFI Climate Risk Tool Landscape 2022

Carbon Trust / Carbon Neutral Real Estate Fund: CNRE-Net-Zero-Pathway

UNEP FI: UNEPFI.org/investment-publications/changing-course-a-comprehensive-investor-guide-to-scenario-based-methods-for-climate-risk-assessment-in-response-to-the-tcfd

JLL / The impact of sustainability on value: The impact of sustainability on value in Central London (jll.co.uk)

Investing Initiative: 2degrees-investing.org/Climate Targets

The Investor Group on Climate Change (IGCC)**:** IGCCReport Full-Disclosure

ANZ: Measuring Your Emissions ANZ

Westpac: November Climate Risk Report WestpacNZ, Sustainability Report 2021 WestpacNZ

Note: This paper is for information purposes only and is based on the resources mentioned in the text.