MSCI

MSCI Real Assets Climate Analysis:

A TRANSPARENT APPROACH TO CALCULATING CLIMATE RISK

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Methodology overview

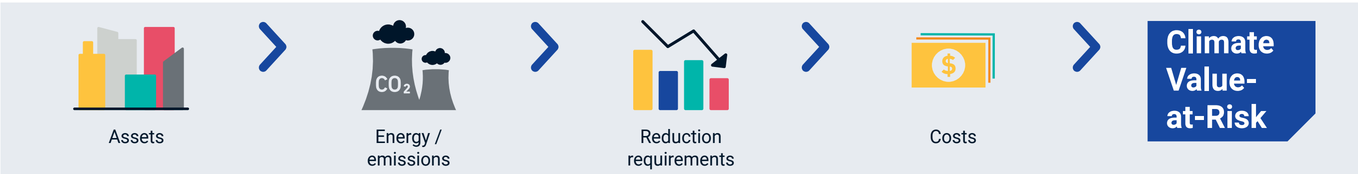
An integrated and transparent approach

The physical impacts of climate change on the built environment are becoming more significant and have the potential to be extremely costly. With their locations fixed, buildings may be at risk of suffering significant damage costs from climate change impacts.

More so, buildings are often energy-intensive to build and operate. They are responsible for over a third of global final energy consumption and CO2 emissions, with operational emissions mostly through space heating and cooling, and water heating (IEA, 2019).

MSCI's scenario analysis for commercial and residential real estate enables investors and real estate managers to evaluate both transition and physical climate-related impacts in their portfolios.

Regulatory transition scenario analysis for real estate



Physical risk analysis for real estate

Transition and physical scenarios

Climate change impacts can be placed into two broad categories commonly used in market practice for how environmental threats, and efforts to address them, can create financial impacts:

Transition risks and opportunities

Risks and opportunities arising from efforts to address environmental change, including but not limited to abrupt or disorderly introduction of public policies, technological changes, shifts in consumer demand, investor sentiment, and disruptive business model innovation.

Physical risks and opportunities

Risks and opportunities arising from the impact of climatic events, such as extreme weather, or widespread changes in eco-system equilibria, such as soil quality or marine ecology. Physical changes can be event-driven ('acute') or longer-term in nature ('chronic').

Our climate risk model is a forward-looking model that assesses the future costs incurred by real estate assets due to climate change. The costs include both physical risks and transition risks and the time horizon is 2100. The costs are estimated using scenario analysis.

Transition scenarios

Climate scenario analysis has existed for many years in the scientific and academic domains and provides policy makers and investors a range of plausible futures based on different combinations of policies, economic development and technology availability. They are based on the scenarios published by the International Panel of Climate Change (IPCC) and can be used to provide advice and recommendations on risks related to climate change.

Policy risks

The Transition Policy Risk model assesses the potential cost impact from the transition to a low-carbon economy under different scenarios. Using a hybrid approach, bottom-up emission trajectories and top-down reduction requirements are defined for individual properties.
In the Transition Policy Risk computation, reduction requirements pathways are derived from the emissions pathways of each region and sector, which are the outputs of Integrated Assessment Models (IAM). These reduction requirements are combined with property-specific data such as energy intensity and building carbon intensities.

Climate scenarios
Use Integrated Assessment Models to establish different potential future climate scenarios

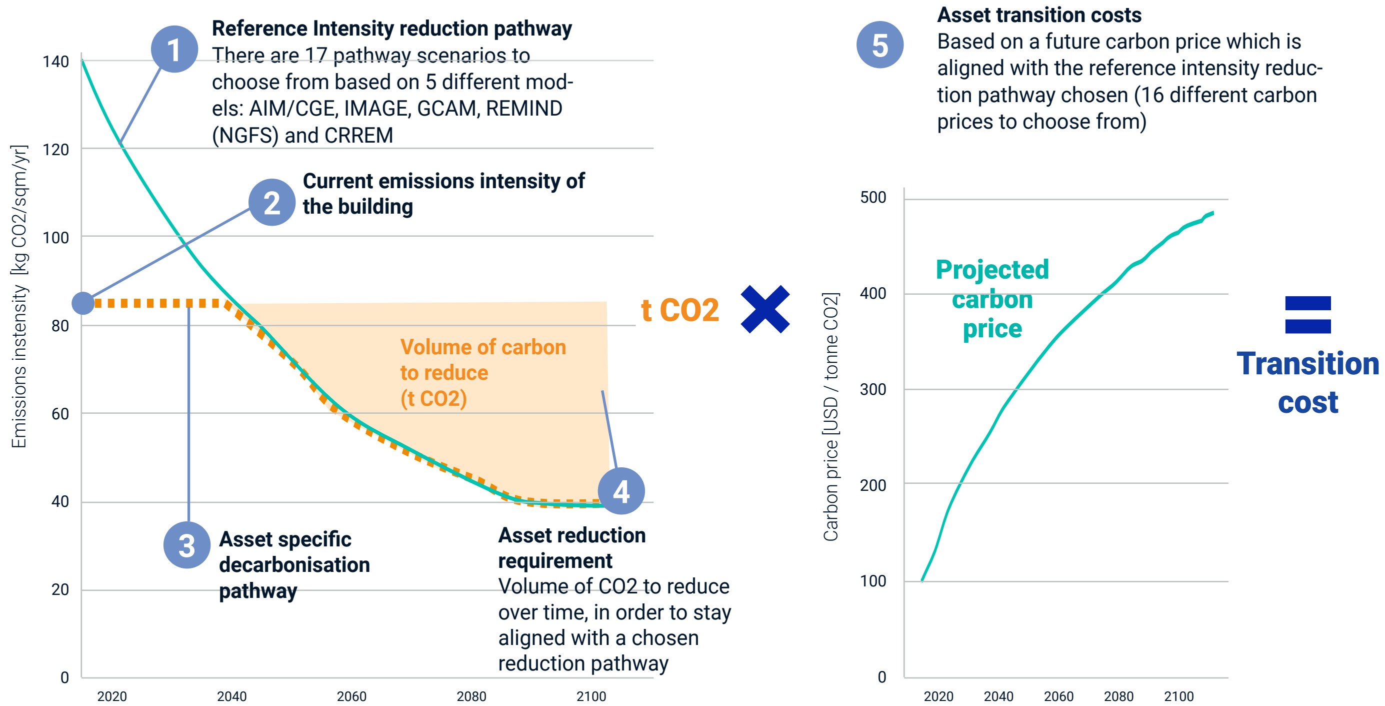
Calculate intensity reference pathways
Retail, Office, Industrial, Residential, Other

Asset-specific reduction requirements
Based on asset's actual emissions and relevant reference pathway

Asset-level transition Climate VaR
Asset % downside

Cost calculation

Reference carbon reduction pathways at country and sector level are combined with asset-specific emission details to calculate the transition cost.



Physical risks

Extreme weather

Physical climate scenarios define possible climate consequences resulting from increased concentration of GHG emissions. They describe changes in global temperatures, precipitation levels, extreme weather events such as storms, snowfall, wildfires, etc. Using the past 35 years of observed extreme weather to set a historical base-line, MSCI Real Assets brings current and future extreme weather developments into perspective.

Current physical climate scenarios modeled by MSCI Real Assets include costs of extreme weather events relating to: temperature changes (extreme heat, and extreme cold), tropical cyclones, wildfire and flooding (coastal and fluvial).

These are combined with various possible warming scenarios (from 1.5 to 5 degrees) to explore several future climate conditions.

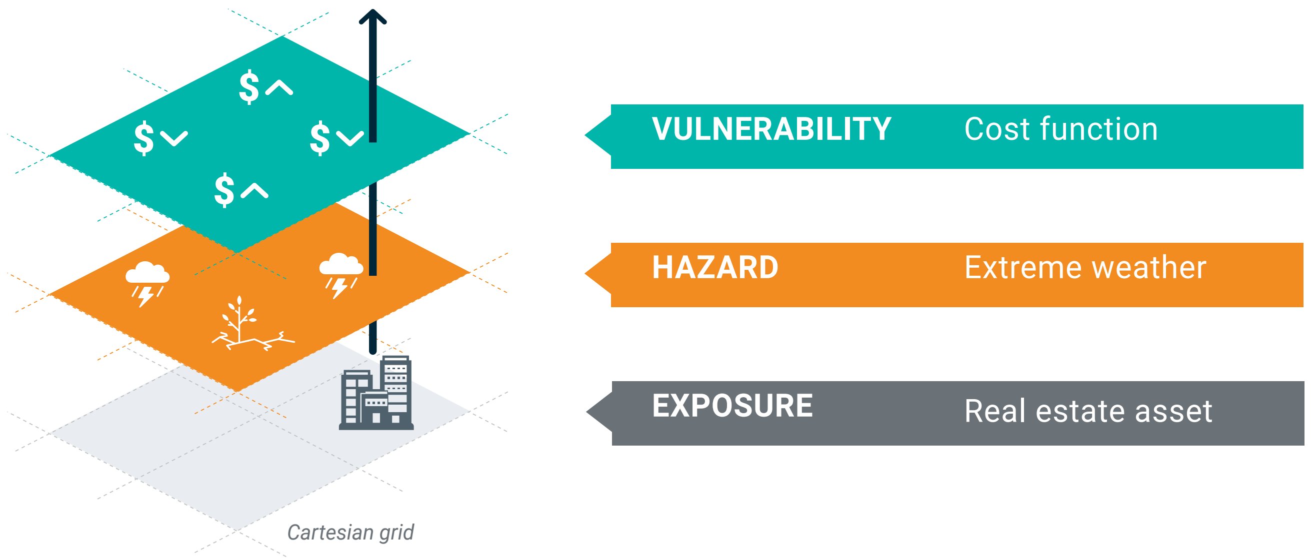
Chronic Risks operational cost	**Acute Risks** asset damage	
Extreme Heat (Climate Models) Number of days/year with temperature above 30/35°C	**Coastal Flooding** (Climate Models) Flood height	**Fluvial Flooding** (Climate Models) Flood height
Extreme Cold (Climate Models) Number of days/year with temperature below 0/-10°C	**Tropical Cyclones** (Probabilistic Models) Wind speeds	**Wildfires** (Climate Models) Fire probability

Physical climate impacts vary greatly depending on geographical positioning. MSCI uses different model resolutions depending on the type of hazard. Flood risk uses a 90x90m grid, wildfire a 460x460m, cyclones 11x11km and extreme temperature a 56x56km (at the equator). The different models also consider further spatial information such as land cover, elevation or sea level rise.

Cost calculation

To quantify physical risks and opportunities, MSCI applies a process used in most hazard models in the insurance industry, which can be represented as follows:

Expected cost = exposure x hazard x vulnerability.



The physical risk impact on an asset is based on the value of the exposed property, the frequency and intensity of the hazard and the real asset-specific vulnerability to this hazard.
MSCI estimates the additional (or reduced) costs from these hazards until 2100 for different future climate scenarios.
The Physical Climate Value-at-Risk is the net present value of these future costs.

Temperature Alignment

Real Property Portfolio warming potential

MSCI's "warming potential" methodology computes the alignment of an asset or portfolio towards climate change. It estimates the theoretical warming potential by the year 2100 based on the current emissions of an asset, assuming the emissions will remain constant until 2100 and assuming every asset in the world has the same emissions profile as this asset.

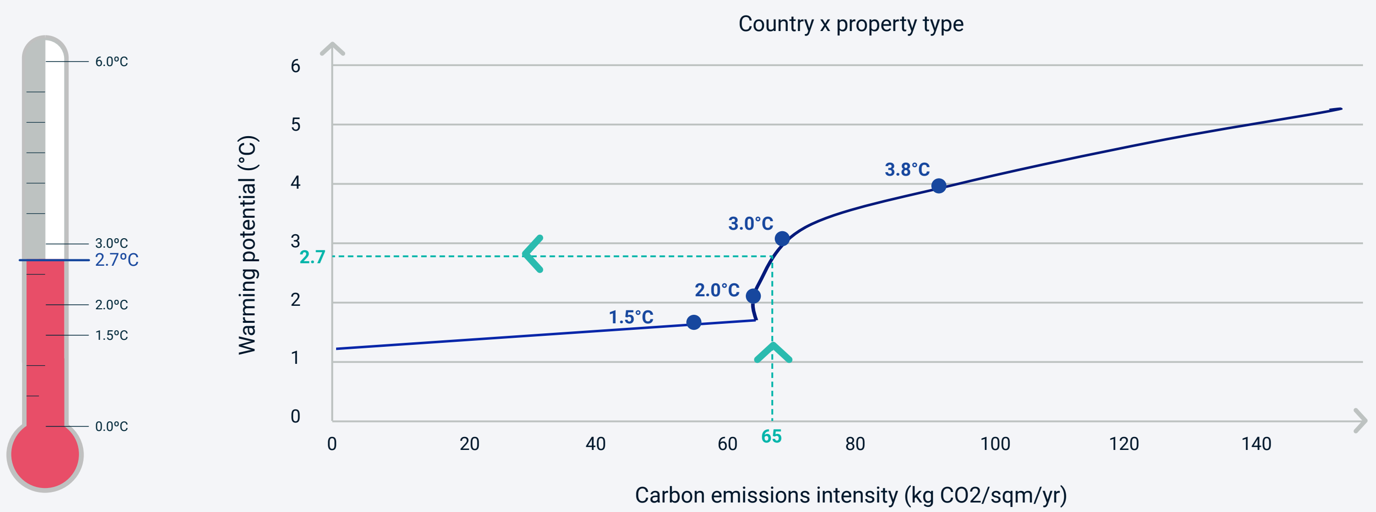
Methodology

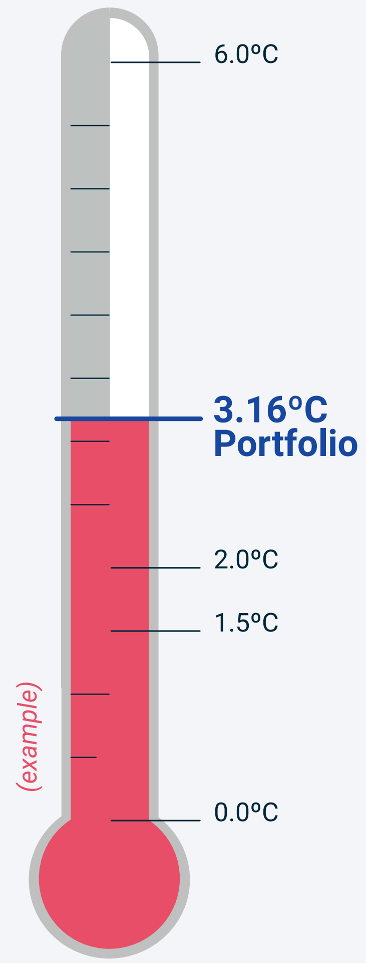
The warming potential for a real estate property is computed by assessing the property's carbon intensity against a warming curve valid for the property type and country in which the property is located. The chart on the opposite side illustrates how the warming potential is calculated for a hypothetical property, of a specific property type in a particular country.

Warming functions are defined by the relationship between the carbon intensity (I) and the temperature (t). A logarithmic t/I relation is assumed, which is calibrated with country and building-type specific temperature- carbon intensity pairs. The curve has a floor and ceiling of 1.3°C and 6°C, aligned to the best- and worst-case global scenarios cited by the IPCC. Finally, a building's specific carbon intensity is inputted into the t/I function, and the corresponding temperature can then be computed.

Overview of steps to compute the warming potential for a real estate property.

A theoretical temperature metric to understand the alignment of the portfolio





Real Estate Portfolio temperature gauge

Investors and other stakeholders increasingly want to know whether their asset or portfolio is aligned with global targets, such as a 2°C or 1.5°C world. Using a carbon emissions intensity on its own can assist, but there are two drawbacks to this approach. Firstly, it relies on an advanced level of climate literacy to understand what carbon values mean and where they sit in the context of global decarbonisation needs. Secondly, each country has different reduction requirements depending on its regional climate and the host country's distribution of reduction efforts. MSCI has therefore developed a more intuitive approach to help investors understand what level of anthropogenic warming its investments correspond to.

About MSCI Inc.

MSCI is a leading provider of critical decision support tools and services for the global investment community. With over 50 years of expertise in research, data and technology, we power better investment decisions by enabling clients to understand and analyze key drivers of risk and return and confidently build more effective portfolios. We create industry-leading research-enhanced solutions that clients use to gain insight into and improve transparency across the investment process.

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