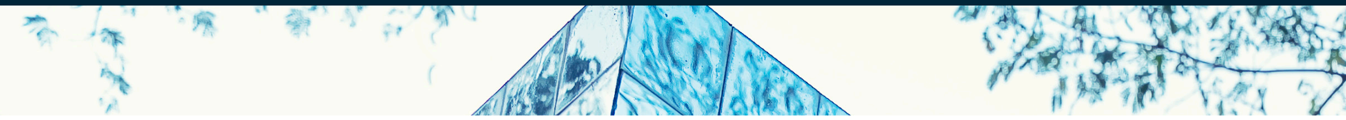

In partnership with

MSCI Real Estate Climate Value-at-Risk (Climate VaR) Methodology

A TRANSPARENT APPROACH TO CALCULATING CLIMATE VALUE-AT-RISK

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Methodology overview

An integrated and transparent approach

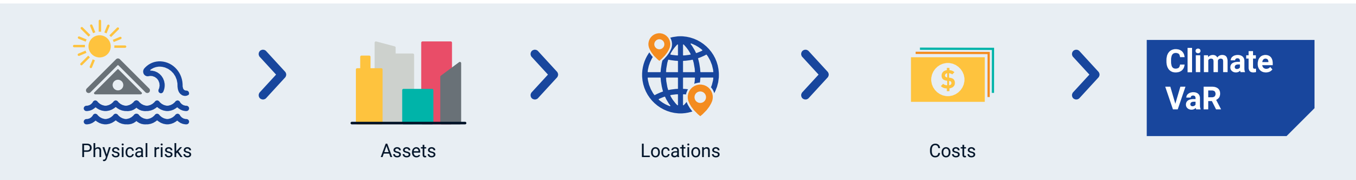
The physical impacts of climate change on the built environment are becoming more significant and have the potential to be extremely costly. With their locations fixed, buildings themselves may be at risk of suffering significant damage costs from climate change impacts.

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').

Transition scenarios

Policy risks

MSCI Real Estate employs a top-down and bottom-up hybrid methodology to calculate risks from future policies aimed at addressing climate change. The modeling begins with the quantification of country level greenhouse gas (GHG) emission reduction targets embedded within policies that have been proposed within the Nationally Determined Contributions (NDCs) of the Paris Agreement. Country emission reduction targets are then broken down into sector level targets based on details within the NDCs as well as recently proposed national level climate regulations. Sector-specific emission reduction targets are then assigned and these are compared to the emission intensities of the assets contained within a portfolio.

Global climate policies
189 NDCs
(Paris pledges)

›

Evidence-based transition scenarios
3°C, 2°C, 1.5°C

›

Sector & country-based pathways
Residential, Office, Industrial, Retail

›

Building-specific trajectories
Emissions, reduction costs

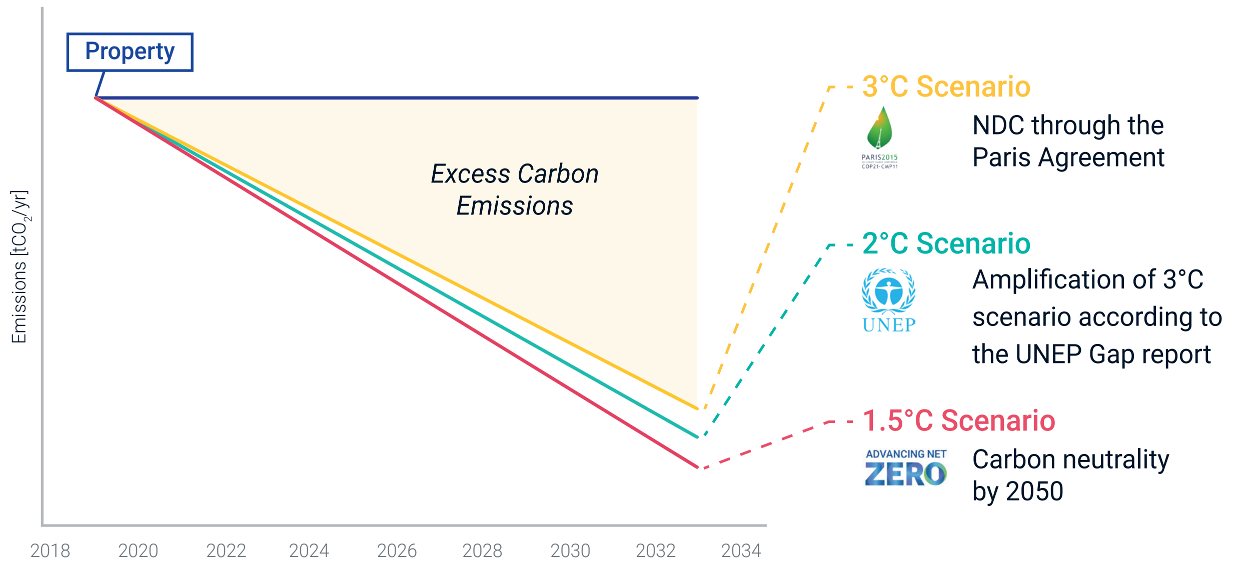
›

Asset-level policy risks Climate VaR
Asset % downside

Cost calculation

The reduction pathways are based on the policies embedded in the NDCs of the Paris Agreement. The 1.5°C-scenarios defines an even more ambitious target, where carbon neutrality is reached in 2050 ("CarbonNetZero" target).
To compute specific pathways for the three scenarios, this information is combined with asset-specific data such as value, and emission details.

Total Cost = Required GHG Reduction Amount * Price per tCO_2e.



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 Estate brings current and future extreme weather developments into perspective.

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

Extreme heat and cold	Coastal and fluvial flooding	Tropical cyclones
Re-analysis[1]	*Climate models*	*Probabilistic model – Climada*

Additional climate datasets will be added to the Climate VaR model in 2020, computing other physical impacts.

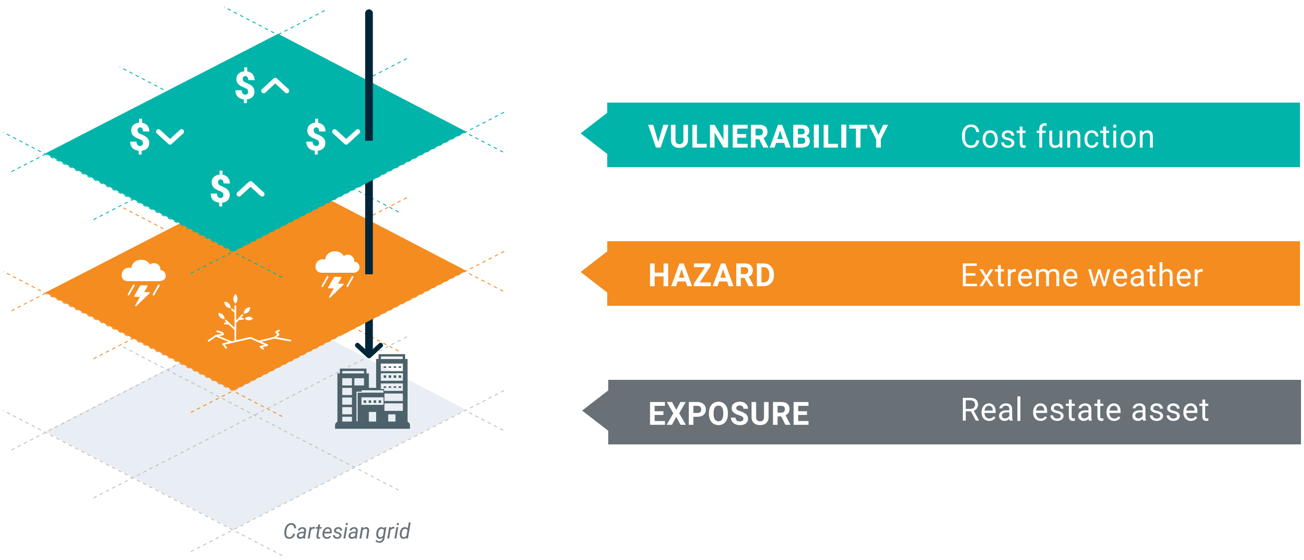
Physical climate impacts vary greatly depending on geographical positioning. This is why MSCI Real Estate employs global gridded data for assessing physical impacts. To model high-resolution spatial distributions of extreme weather impacts across the globe, MSCI has produced a Cartesian grid with a resolution of up to 3" x 3" for acute risks such as coastal flooding, whereby hazard data is overlaid. The coverage is global and the grid cell width in mid-latitudes is around 90m. For chronic risks such as heat stress, a grid resolution of 0.5° x 0.5° is used. The global coverage (reaching across all land covered area) has a cell width in mid-latitudes of around 50km.

1 Re-analysis based on historical datasets of observed weather patterns and events.

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 = vulnerability * hazard * exposure.



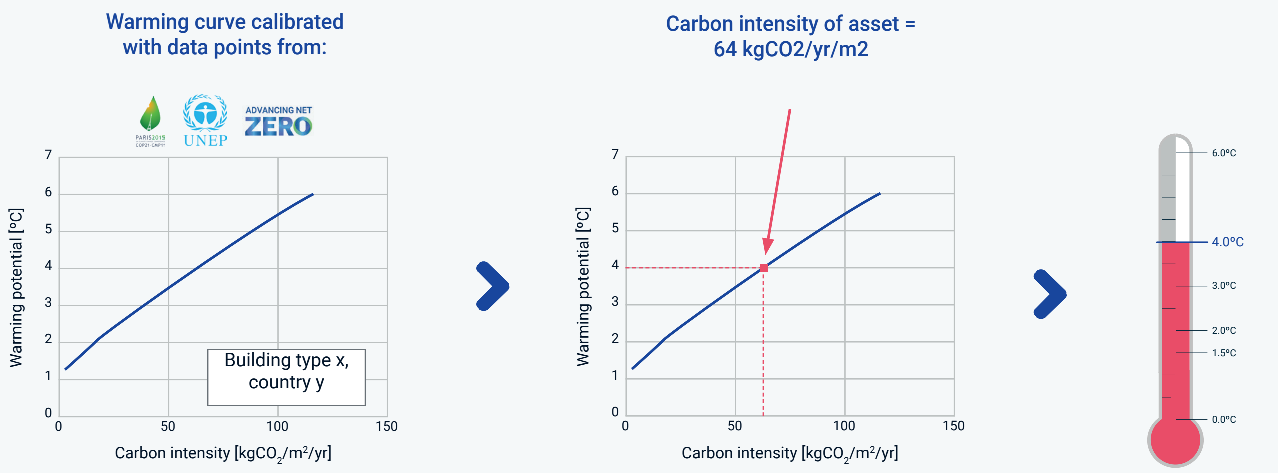
The physical risk impact on an asset is quantified by assessing the exposure of a property to a hazard and computing the costs associated with that risk using vulnerability functions specific to the real estate market. For Extreme Heat and Cold, costs from higher or lower heating and cooling requirements are determined by defining a cost of exceeding a specific temperature threshold.

2°C alignment

Real Property Portfolio warming potential

MSCI's "warming potential" methodology computes the alignment of a portfolio towards climate change. It delivers an exact temperature value that signifies which warming scenario (e.g., BAU, 3°C, 2°C, 1.5°C, etc.) the asset's activities are currently aligned with. Thereafter, a "real property portfolio warming potential" can be computed as a weighted aggregate of the company-level warming potential. The warming potential methodology can be applied to companies as well as real estate assets.

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

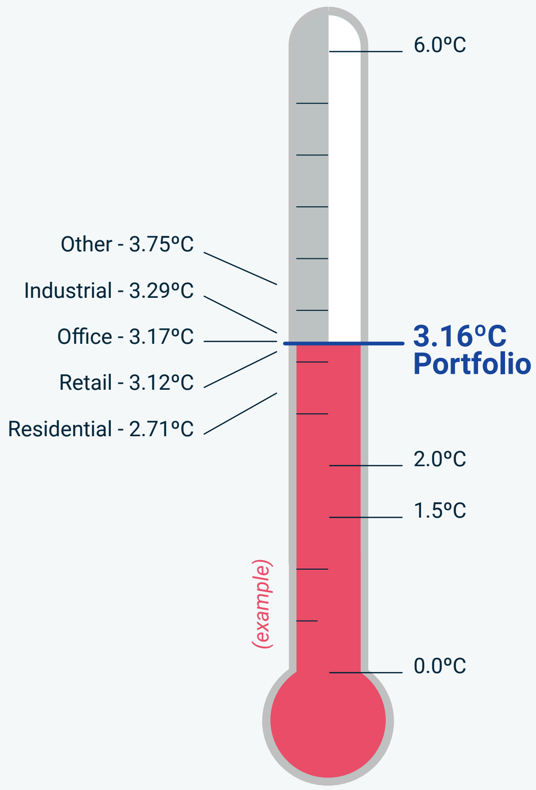


	Temperature	Source / intensity
Business-as-usual	3.8°C	The carbon intensity is derived from the current average energy intensity and fuel mix for the building type in the country
NDC/3°C	3°C	The temperature – carbon intensity pair corresponds to the NDC's. The reduction requirements defined in the NDC are combined with estimates of floor area growth and the target carbon intensity is then derived by combining the reduction requirements with the average carbon intensity for the property type.
2°C	2°C	The temperature – carbon intensity pair corresponds to the reduction requirements defined in the UNEP Gap report to limit global warming to 2°C.
CarbonNetZero until 2050 (1.5°C)	1.5°C	The temperature – carbon intensity pair corresponds to the net zero carbon target. Carbon neutrality in the building sector is assumed by 2050. The 2050 target is interpolated to derive the target intensity in 15 years.

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 it. The chart on the opposite side illustrates how the warming potential is calculated for a hypothetical property, X, of a specific property type in country Y.

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 (see Table 1). 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.



Real Property 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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