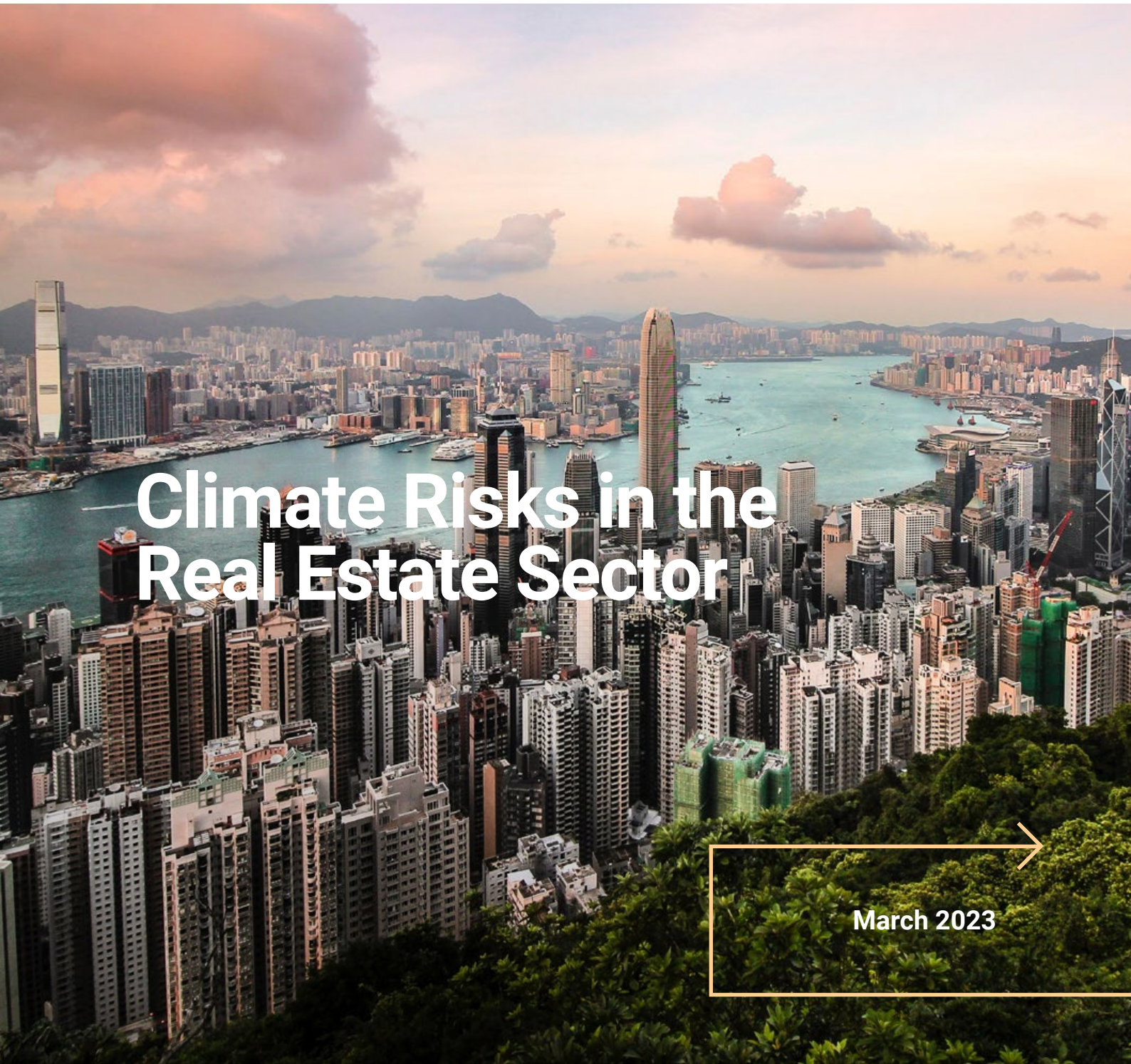
Sectoral Risk Briefings:
Insights for Financial Institutions

UN environment programme

finance initiative



Climate Risks in the Real Estate Sector

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Acknowledgments

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Introduction

In the past few years, the global economy has been lashed by the COVID-19 pandemic, geopolitical conflict, supply chain disruptions, an energy crisis, and high inflation. These challenges are occurring against the backdrop of the mounting planetary emergency of climate change. Climate change can exacerbate all other challenges; increasing geopolitical conflicts over resources, crippling infrastructure and supply chains, extending the range of dangerous pathogens, and causing the collapse of the natural systems upon which we depend. As the US Pentagon presciently stated: "climate change is a threat multiplier". While the transition to a sustainable, net-zero future is critical, it demands fundamental shifts in nearly all economic sectors. These shifts are not without risk for companies and the communities impacted by them.

Financial institutions face an array of risks from this rapidly changing, and often chaotic, global context. Their clients are exposed to physical hazards as well as transition risks. These can have major credit, market, and operational implications. The prudent financial institution will explore these climate-related risks and prepare strategies to meet them. Ensuring resiliency and success in the future depends on making good decisions and thoughtful plans today.

UNEP FI has been working at the intersection of sustainability and finance for over 30 years. Its programmes for financial institutions develop the tools and practices necessary to positively address the most pressing environmental challenges of our time. UNEP FI's Climate Risk and TCFD programme has now worked with over 100 financial institutions to explore physical and transition risks posed by climate change. Through this work, a need has been identified to provide financial institutions with a baseline understanding of climate-related risks and their manifestations across different sectors.

This brief is part of a series of notes that cover major economic sectors and their associated climate risks. UNEP FI intends for the resources and perspectives included within these notes to empower financial colleagues to communicate these risks throughout their institutions and across the financial sector more generally. The hope is that the communication process will not only enhance awareness of climate risks, but also begin conversations that will lead to tangible changes in strategy and operations. The extent to which these insights are integrated will be the truest test of this series' effectiveness. This particular brief covers the physical and transition risks facing the real estate sector.

Real estate sector overview

Climate risks are already materialising for the real estate sector, and their frequency and severity are expected to increase in the coming years. Physical and transition risks threaten real estate asset cashflows as well as the future value of the assets themselves. Extreme weather and physical hazards, such as hurricanes, floods, and wildfires, can cause substantial damage to real estate located in vulnerable areas. The sector (directly and indirectly) is responsible for about 40% of all greenhouse gas (GHG) emissions globally (UNEP FI, 2022). As a result, actions taken to decarbonise the global economy to meet climate goals will have strong cost implications for the sector. The figure below shows the projected physical and transition risk for real estate from MSCI's Global Property Index using its real estate Climate Value-at-Risk Model (Figure 1) (MSCI, 2022).

Figure 1: Projected transition and physical risk in MSCI's Global Annual Property Index (MSCI, 2022)

Below, we explore in depth the key physical and transition risks faced by the real estate sector (Table 1).

Table 1: Key climate risks for the real estate sector

	Risk	Summary
Transition Risks	**Increasing regulation and policy pressure**	The sector will be impacted by increasing regulation and new policies, such as stricter building standards, carbon pricing, and additional reporting standards.
	Cost of indirect emissions	Activities like construction, refurbishment, and demolition contribute significantly to indirect emissions. Although a real estate company may not have direct control over these emissions, it could exert influence over their magnitude. As carbon-intensive building materials become more costly in the coming years, construction costs will rise.
	Shifting market preferences	As awareness of climate change grows, tenants and potential buyers are beginning to expect more from the real estate sector regarding emissions reductions. The sector faces new risks as preferences shift towards high-efficiency buildings with renewable energy sources.
	Change in investor sentiment	To align portfolios to climate goals, investors could attempt to offset emissions elsewhere in their portfolio to counter high-emitting buildings or favour low-emitting real estate assets.
	Reputational risk	Inaction to decarbonise could result in the real estate sector facing public pressure to reduce its share of emissions.
Physical Risks	**Sea level rise and coastal flooding**	Sea level rise and coastal flooding will become more frequent and severe, increasing property damage and causing higher repair and maintenance costs.
	Inland flooding	Inland flooding due to the greater frequency and severity of coastal storms or extreme precipitation events can increase property damage. Driven by rapid urbanisation, it can also cause the costs of repairing and maintaining properties to rise.
	Extreme storms and wind	Greater severity and frequency of extreme storms, such as hurricanes, can cause damage worth billions of dollars. Extreme storms can negatively impact the value of commercial real estate in the near term.
	Wildfires	Millions of residential and commercial buildings have been built in areas prone to wildfires. With the intensity and severity of such fires increasing, the likelihood of these properties being destroyed by a wildfire rises.
	Subsidence	An increasing number of real estate assets are likely to be at risk of subsidence in the coming years, potentially causing serious structural damage to buildings.
	Heat and water stress	Rising heat will create new cooling needs for buildings, increasing operating costs. Water stress will also lead to higher operating costs due to increased water prices, the need to improve water efficiency, and the regulation of water use.

Table 2 below highlights how these key physical and transition risks can impact stakeholders in the real estate sector, especially in housing.

Table 2: Overview of climate-related risks to stakeholders in housing (adapted from Mortgage Bankers Association, 2021)

Risk	Owners	Buyers	Renters	Lenders	Servicers	Government Sponsored Enterprises	Investors	Insurers	Government
Property damage	x		x	x				x	x
Mortgage default risk	x			x	x	x	x		
Mortgage prepayment risk					x	x	x		
Adverse selection of loans sold		x				x		x	x
Moral hazard								x	x
House price risk	x	x				x	x		x
Climate migration	x			x		x	x		x

SECTION 1:

Transition risks

The role of the real estate sector in constructing and operating buildings around the world makes it responsible for around 40% of global GHG emissions. As a result, the ambition to achieve net zero demands major changes to the sector and presents it with various transition risks, such as declining market attractiveness, increasing regulation, and reputation risk. Table 3 below highlights key transition risks for the real estate sector.

The transition risks facing the real estate sector also pose a risk for workers and communities that rely on the the sector for jobs and income. It is therefore important to align financing with a just transition approach that considers the impact of the transition on groups at risk to operations in the real estate sector, including workers, Indigenous Peoples and local communities.

Case study 1: Operational and market preference risk

Landsec Annual Report, 2021

The UK's largest commercial property development and investment company

Climate scenario analysis: >2°C pathway (until 2030)

High transition risks associated with aggressive mitigation actions to reduce emissions

- Minimum Energy Efficiency Standards (MEES) raise requirements for all non-domestic rented properties to meet a minimum EPC B, potentially impacting nearly 80% of floor area
- Increased pricing of carbon emissions expected to reach GBP87/tCO_2 (US$100/$tCO_2$), impacting operational costs
- Change in customer expectations regarding offices, as more companies committed to becoming net zero and set science-based targets

Table 3: Examples of transition risks for the real estate sector (UNEP FI, 2022)

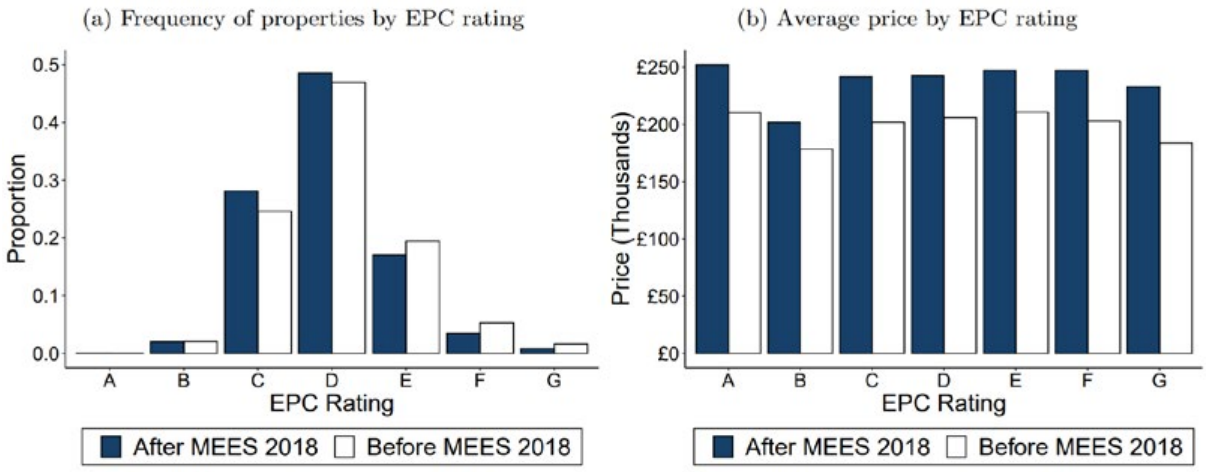
Transition Risk	Impact on real estate
Declining market attractiveness Declining attractiveness of submarkets due to increased vulnerability and exposure to higher costs	▪ Lower demand (investor and tenants) ▪ Lower competitive advantage by increasing energy costs for properties with high-energy intensities ▪ 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, carbon pricing, carbon credits, etc.	▪ Tax increases, e.g. carbon tax ▪ Decrease in subsidies for certain technologies ▪ Extra 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

1. Increasing regulation and policy pressure

The real estate sector could face increasing regulation and the implementation of new policies, such as stricter building standards, carbon pricing, and additional reporting standards. For example, some jurisdictions are considering new efficiency requirements to improve energy efficiency and the electrification of buildings, such as by improving thermal insulation and a ban of fuel- and gas-based heating systems (UNEP FI, 2022). This can be seen in Hong Kong's Climate Action Plan 2050, which includes measures emphasising the importance of energy saving and green buildings. The city's goal is to reduce the electricity consumption of commercial buildings by 30 to 40% and residential buildings by 20 to 30% by 2050, compared to 2015 levels. Hong Kong also plans to expand the scope of its energy efficiency regulation to cover all buildings with high energy consumption, including data centres. Other measures comprise: promoting retro-commission; mandating the implementation of energy management opportunities; conducting regular energy audits; tightening standards related to air-condition electricity in commercial buildings; and accepting accredited certification schemes for energy efficiency (Hong Kong Government, 2021).

Though such regulations are likely to be accompanied by governmental subsidies, households and businesses may incur high retrofitting costs or risk their assets being priced out of the market. A 2021 report to the UK Parliament estimated that investments worth between GBP35 billion and GBP65 billion are needed to bring all homes up to Energy Performance Certificate (EPC) Standards by 2035. However, costs could be significantly higher, with some estimates being up to five times larger (UK Parliament, 2021). In 2018, the UK government implemented the Minimum Energy Efficiency Standard (MEES) in England and Wales to encourage landlords and property owners to improve their energy efficiency. The standard sets a minimum energy efficiency level for domestic private rented properties (UK Government, 2020). The policy restricts the continuation of existing tenancies where the property is not energy efficient, based on its EPC rating. Alternatively, landlords could face a fine of up to GBP5,000. A study by the Bank of England showed prices of properties affected by the policy decreased by GBP5,000 to GBP9,000 compared to unaffected properties. Despite prices rising for all EPC-rated properties, they increase more for properties that are less energy efficient initially. However, properties become more energy-efficient over time due to higher demand (Figure 2). The study also determined that the MEES 2018 policy only impacted mortgages against the least energy-efficient properties with EPC ratings of "F" and "G". The loan-to-value ratio of their outstanding mortgages was slightly less than the total sample analysed (Bank of England, 2021).

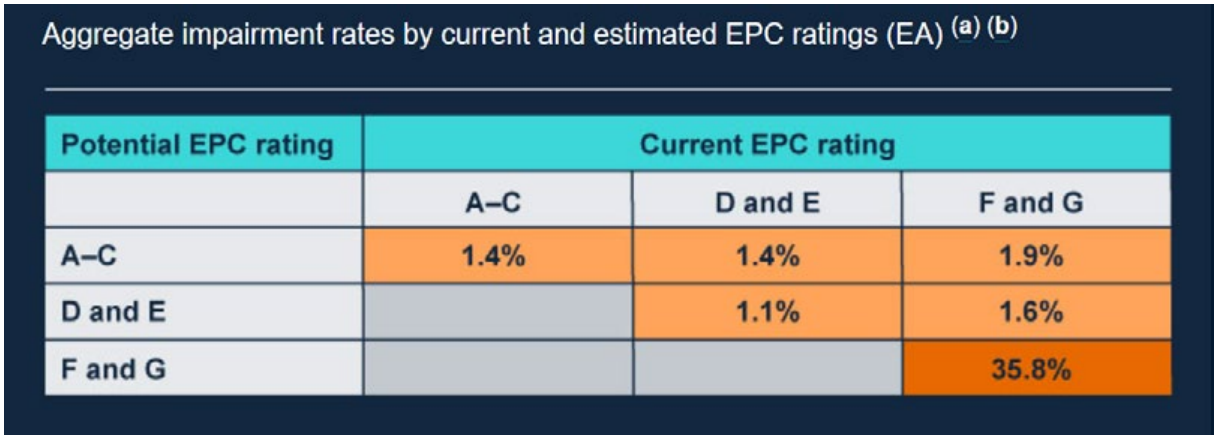
Figure 2: Price of EPC rated properties over time (Bank of England, 2021)



Note: Panel a) shows the relative frequency of EPC ratings before and after the MEES 2018 policy intervention. Panel b) shows barplots of the average transaction price by EPC ratings before and after the MEES 2018 policy intervention. Source: House price data are from HM Land Registry. EPC ratings are from the MHCLG.

The Bank of England's 2021 Climate Biennial Exploratory Scenario assessed the impact of an early action (early and orderly transitioning beginning in 2021) and late action (late and disorderly transition beginning in 2031) scenarios on mortgage losses for banks till 2050. The exercise showed that impairment rates will be high for properties whose potential energy efficiency ratings belong to the lowest categories of "F" and "G", making these properties unmarketable by 2050. Delayed policy implementation leads to higher mortgage losses due to a macroeconomic downturn. This, in turn, leads to higher unemployment and falling house prices. In both early action and late action scenarios, households are assumed to bear the cost of improving the energy efficiency of homes, with total aggregate costs of around GBP75 billion (Bank of England, 2022).

Figure 3: Aggregate impairment rates by current and estimated EPC ratings under the early action scenario (Bank of England, 2022).



Aggregate impairment rates by current and estimated EPC ratings (EA) [a] [b]

Potential EPC rating	Current EPC rating		
	A–C	D and E	F and G
A–C	1.4%	1.4%	1.9%
D and E		1.1%	1.6%
F and G			35.8%

New buildings are also likely to become subject to more demanding construction and energy efficiency standards, thereby increasing costs. In May 2022, the Los Angeles City Council voted to ban the majority of gas appliances in new construction projects to increase the rate of electrification of buildings and to make new buildings reach zero emissions using a phased-in approach (Los Angeles Times, 2022). It may subsequently become uneconomical to upgrade or retrofit some assets. In addition, buildings that do not meet certain standards may become illegal to build, rent, or sell, thus resulting in premature obsolescence and significant write-downs.

Case study 2: Technological and construction risk

City Developments Limited (CDL) Integrated Sustainability Report, 2021

Singaporean multinational real estate company

Transition risks

Building standards

Standards that mandate building and energy efficiency would directly affect CDL's costs from increased investment in technology. However, there may be future opportunities to embrace the technology types that are currently not cost-efficient but may become so under a high carbon price scenario. CDL may also enjoy energy cost savings if all CDL hotels are retrofitted to the highest energy efficiency standard.

Construction costs

Higher expectations on energy efficiency will result in higher construction costs due to the inclusion of green features in new development properties. Potential mandates that call for the use of sustainable construction materials will also raise construction costs

Mitigating actions

Meet net-zero carbon commitment through building design and material selection: formulate clear steps to achieve net-zero operational carbon; offset unavoidable emissions using emerging and innovative technologies; may include green building materials, district cooling, incorporating renewables through BIPV and leveraging AI technology to reduce water and energy use.

Promote construction designs for waste reduction and management: embed dedicated waste segregation capabilities within buildings; use materials and components that can be easily reused or adapted to reduce waste.

2. Cost of indirect emissions

Key emission sources from buildings are also linked to their construction and their demolition. Activities related to construction, refurbishment, and demolition contribute significantly to indirect emissions, for example, through the production and transport of materials and waste disposal. Carbon-intensive building materials will become more costly, making construction more expensive. Higher energy and carbon prices will also comprise a larger fraction of operating budgets for existing structures. Currently, energy use is the largest operating expense for commercial office buildings, making up about one third of operating budgets. However, a 10% fall in energy use can cause a 1.5% increase in net operating income (Energy Star, n.d.).

Research has also shown a correlation between higher energy bills and lower property values. A study by the Bank of England suggested that energy efficiency can be a predictor of mortgage defaults. Results showed that mortgages of energy-efficient properties have a lower chance of payment arrears than those of energy-inefficient properties (Bank of England, 2020). A report from the Joint Research Centre (JRC) of the European Commission also determined that energy efficiency is important in determining real estate values. The report found that energy efficiency improvements can increase the price of residential assets by 3 to 8% and by 10 to 20% for commercial buildings (Zancanella *et al.*, 2018). Similarly, a study on the relationship between energy efficiency and property values of German single-family homes identified that 98% of future energy cost savings are already reflected in greater housing values (Taruttis and Weber, 2022).

3. Shifting market preferences

Market preferences for residential and commercial buildings are changing as awareness of climate change and its impacts grows. Tenants and potential buyers are beginning to expect more from the real estate sector on reducing emissions (Deloitte, 2020). In India, the demand for green buildings has grown exponentially in the last decade (Finance Express, 2021). The Indian green building market, estimated to be valued at US$21 billion in 2021, experiencing annual growth of 7.2% from 2017 to 2021 (Global Data, n.d.). Changes in market preferences can pose new risks for the sector as preferences shift towards high-efficiency buildings with electricity sourced from renewable energy. Energy-efficient buildings possess a competitive advantage due to lower energy costs (UNEP FI, 2021).

Buildings with higher energy standards are also more modern and better equipped, attracting a greater number of tenants and potential buyers. Energy efficiency provides additional perks for residential buildings related to comfort, safety, and maintenance (JRC, 2018). As a growing number of individuals return to offices after working from home during the height of the COVID-19 pandemic, commercial tenants are favouring newer office buildings with improved ventilation and green credentials to improve the employee experience (Aviva, 2021). Shifting market preferences are expected to decrease demand for low-efficiency and carbon-intensive properties. Low demand will result in lower rental and occupancy rates and greater difficulties in re-letting a property. This can result in a loss of income and reduce asset valuations for owners, potentially leading to decreased market values (UNEP FI, 2021).

Climate change is also altering the insurability of properties. Current insurance rates are based on calculations using historical data for climate risks. However, as climate impacts grow in frequency and severity, there is concern that current insurance rates are too low to cover future climate risks. For example, the National Flood Insurance Program (NFIP), the United States' primary system for flood insurance, calculates its insurance rates based on historical flooding experience. Following Hurricane Katrina (2005) and Hurricane Sandy (2012), the NFIP was forced to borrow heavily and reached its borrowing limit of US$30.5 billion. Claims by flooded properties make up the majority of the share of the NFIP's costs. Repeatedly flooded properties comprise 1% of the properties with NFIP insurance but they account for 25 to 30% of flooding claims. The NFIP's debts account for US$20.5 billion, with US$1 million per day in interest. The cumulative cost of claims by repeatedly flooded properties is more than half of NFIP's current debt. With the increasing risk of chronic flooding, these costs are expected to grow rapidly (Research Institute for Housing America, 2021).

Similarly, insurers are leaving the highly valued Californian real estate market due to wildfires. Recently, owners of multimillion-dollar properties have been dropped by insur-

ers and are finding it difficult to obtain insurance to cover their properties. California is considering new insurance pricing proposals with insurers using artificial intelligence to price future climate risks and start-ups developing new insurance structures. Other geographies will likely follow a similar trend to that of California due to a rise in climate change-related disasters (JP Morgan, 2022).

Insurance premiums for vulnerable properties are expected to climb. In the United States, for example, insurance premiums in 2022 rose by 12.1% compared to the year before due to inflation and natural disasters. On average, homeowners' premiums increased by US$134 (Policygenius, 2022). Insurance companies are also expected to begin limiting coverage or declining to renew policies for certain properties, decreasing the desirability of the properties in question. Owners of uninsurable properties will suffer significant capital losses and could face a high risk of mortgage default (Research Institute for Housing America, 2021).

Case study 3: Shifting market preferences risk

CBRE Global Climate Report, 2021

An American commercial real estate services and investment firm

Transition risk costs

- Operating expenses ("OPEX") could increase with a rapid switch to renewable energy, putting greater pressure on national and local grids, and consequently push electricity prices higher. Highly efficient buildings may be impacted less since occupancy rates could be affected by an increased appetite for decarbonized buildings as tenants set their own climate-related targets and seek buildings with lower OPEX. Highly efficient assets are expected to benefit, while laggards might see a decrease in rental income. Additionally, for infrastructure, portfolio companies that are proactive in their approach to energy transition could be well-positioned both to hedge against risks presented by rising electricity prices and to capitalize on the opportunities presented by a rapid switch to renewable energy.

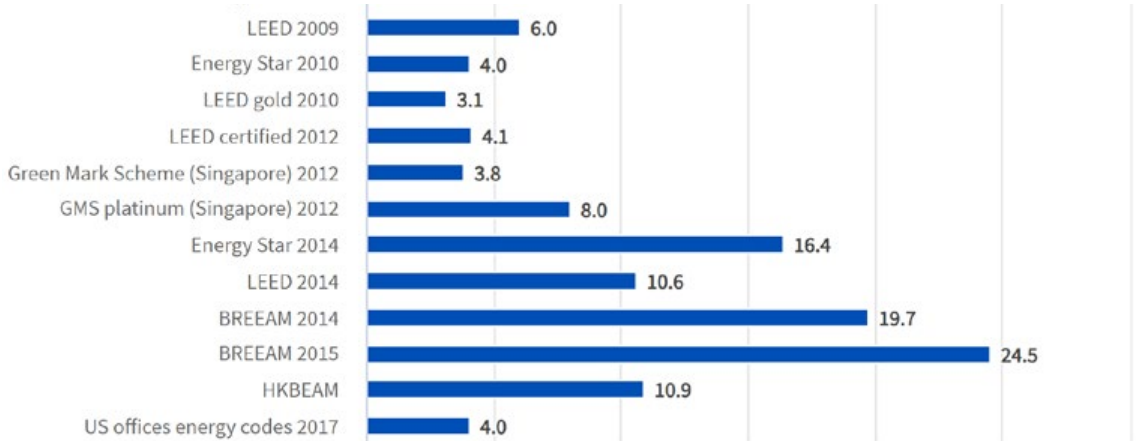
Mitigating actions

- To achieve net-zero targets, additional capital expenditures ("CAPEX") may be required for building retrofits. Some assets are more costly to decarbonize than others and could add risk to investment return profiles.
- Increasingly comprehensive reporting regulations require a growing number of metrics, which increases the pressure on the asset and property managers as well as portfolio managers to obtain and track the new metrics from tenants, customers, suppliers, portfolio companies and other stakeholders.

4. Change in investor sentiment

A growing number of investors are aligning their portfolios with the Paris Agreement through net-zero commitments by joining initiatives such as the Net-Zero Asset Owner Alliance and Climate Action 100+. As a result, sustainability and climate change have become primary considerations in their property investment decisions (Urban Land Institute, 2020). In order to align portfolios, investors can either attempt to offset emissions elsewhere in their portfolio to counter the high-emitting buildings or favour low-emitting real estate assets. With the price of carbon rising in markets like the European Union's Emissions Trading System and the increasingly negative outlook for carbon-intensive buildings, investors may well gravitate in greater numbers to more energy-efficient property investments. Premiums for energy efficiency can already be seen in studies comparing rents under various energy efficiency certification schemes, as shown in Figure 4 (Aviva, 2021).

Figure 4: Correlation between energy-efficient buildings and higher rents found in the literature, shown as rental premiums (%) (Aviva, 2021).



(Source: Chegut, A. *et al.*, 2014; Reichardt, A. *et al.*, 2012; Fuerst, F. *et al.*, 2009; Wiley, J. *et al.*, 2010; Hopkins, E., 2016; Heinzle, S. *et al.*, 2012; Das, P. *et al.*, 2013; Fuerst, F. *et al.*, 2015; Papinaeu, M., 2017)

Lower investor demand for energy-inefficient and highly carbon-intensive properties poses a significant risk for the real estate sector. Decreased investment can result in depressed asset values and decreased market values (UNEP FI, 2021).

5. Reputational risks

Inaction to decarbonise the real estate sector can present reputational risks for real estate companies. As climate change concerns grow, the real estate sector faces greater public pressure to reduce its large share of emissions. Real estate firms that do not sufficiently integrate climate change into their business strategy can face reputational risks from relevant stakeholders. Companies can also suffer reputational damage if decarbonisation actions are taken too late. Similarly, the owner or tenant of a building with poor environmental performance may face a loss in reputation.

Property developers also face growing reputational risks for developing properties in carbon sinks and using construction materials sourced from deforestation. Construction activities driving climate change through deforestation can impact the reputation of the associated parties. Timber used for construction is one of the main drivers of deforestation. The construction industry uses timber for building both the interior and exterior of buildings and for flooring, window frames, fencing, doors, decking, and skirting (Building Materials, 2021; Ecologi, 2021). Non-profit organisations and other entities have begun running campaigns against stakeholders linked to deforestation. Global Witness, an international campaign group, found that hotels in the Philippines used illegally sourced wood to build hotels (Global Witness, 2019). According to Global Forest Watch, another non-profit group, the Philippines lost 158,000 hectares of primary forest in 2021–2022, equivalent to 788 metric tons of carbon emissions (Global Forest Watch, n.d.). One of the leading drivers for deforestation in the Philippines is the country's booming tourist industry, which has led to a rapid rise in demand for wood for construction (Quartz, 2022).

Box A: Revision of the European Union's Energy Performance of Buildings Directive (EPBD)

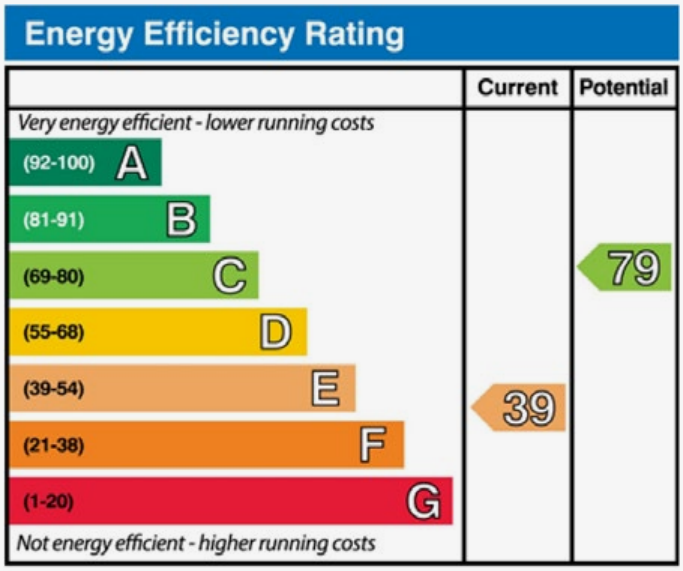
In December 2021, the European Commission proposed the introduction of minimum energy performance standards for the worst performing buildings in Europe. The proposed measures, which are aimed at the lowest ranked 15% of building stock, show how Europe is taking steps to achieve net-zero emissions and a fully decarbonised building stock by 2050. The revised EPBD is also part of the European Union's wider legislative drive to halve GHG emissions by 2030. In addition, it forms an important part of the Renovation Wave Strategy, which aims to double the annual energy renovation rate by 2030. The EPBD offers flexibility to Member States by considering differences in building stock across countries.

The Commission proposes a rating scale for energy efficiency in which the 15% least efficient buildings belong to class "G" and zero-emission buildings belong to "A" class. The Commission proposes that commercial and public buildings should at least reach "F" by 2027 and class "E" by 2030. Similarly, residential buildings must reach class "F" by 2030 and class "E" by 2033. However, Member States can define their own energy performance scale and set their own standards. Improving the energy efficiency of these buildings will require massive investment from both the public and private sectors.

Furthermore, the European Union's Climate Target Plan emphasises the need to phase out heating by fossil fuels by 2040 and decrease direct emissions of the building sector by 80 to 89%. The EPBD proposal requires zero-emission buildings not to generate carbon emissions on site. Even though the proposal does not suggest an outright ban of fossil fuel boilers, it provides a legal basis for national-level bans. It also allows Member States to set their requirements for heat generators, which many consider a necessary step to ensure the decarbonisation of buildings.

(European Commission, 2021)

Figure 5: Example of an energy performance certificate (EPC) for a building (European Court of Auditors, 2020)



6. Transition risk guidance

Key transition risk questions for financial institutions to consider

1. **Gathering information**
   - Are there any new governmental standards (on energy efficiency, on fossil fuel use, on pollution/waste, etc.) that impact assets within our portfolio's footprint?
   - How rapidly is the low-carbon transition progressing across our portfolio footprint? What do energy costs, demand, and efficiency look like across our portfolio footprint?
   - What have our clients disclosed in their financial, sustainability, and climate reports regarding their transition risks?
   - How many of our clients have transition plans? Do they incorporate just transition considerations into these plans?
   - Do we have emissions data for our clients? Do we also have data on non-CO_2 emissions (e.g. fluorinated gases)?

2. **Assessing the risks**
   - Have we looked at transition scenarios to see how those risks will evolve over time? Have we considered short-term, medium-term, and long-term risks?
   - What does our exposure to higher-risk assets look like? What are the terms of our financial relationship (e.g. debt/equity, tenor)?
   - How do the emissions intensity, energy demand, and energy costs of our client assets compare to industry and regional averages?
   - How much are clients investing in low-carbon retrofits?
   - What investments have our clients made in on-site generation?
   - What energy standards are new builds being constructed to?

3. **Engaging with clients and updating strategy**
   - Do our senior leaders understand the transition risks of our clients?
   - How are we helping our clients to transition to a low-carbon future? How are we supporting their efforts to advance a just transition?
   - How will the transition risks identified and assessed influence our strategy in the real estate sector?
   - What specific updates to risk management practices or business activities will be needed to appropriately consider these transition risks in our operations?

Recommendations for risk management

1. **Understand the energy demands of real estate assets**
   - The energy use and emissions footprint of a building provide valuable information about transition risk. As the 2022 energy crisis has demonstrated, major volatility in energy markets can impact the affordability, desirability, and value of real estate assets. With the climate transition underway, future volatility in the energy system is a distinct possibility. Government policies such as carbon taxes and efficiency standards can affect the bottom line of real estate assets, with the most carbon-intensive assets facing a distinct disadvantage. In some regions, costly retrofits may be required to bring inefficient buildings up to standard before being sold or leased. These challenges make it critical for financial institutions to be able to get a baseline estimate of an asset's energy use and emissions profile. This data can be used to compare assets to each other and determine which are most exposed to transition risks. A solid knowledge of energy use and emissions can also provide clarity regarding the economics of potential retrofits and new builds.

2. **Support sustainable building materials, on-site generation, and efficiency measures**
   - Real estate assets are particularly vulnerable to carbon lock-in due to their long operating lives. As economies decarbonise, carbon-intensive assets that may have been desirable previously may face transition risks. Financial institutions can look to future-proof investments and the financing of real estate assets by considering a number of sustainability measures. These begin with the choice of construction materials. Buildings that use sustainable materials can sequester significant amounts of carbon and reduce the initial emissions footprint of the building. Ensuring high efficiency standards in construction will reduce future energy requirements. Once built, energy costs can form a significant component of operating expenditure, so opportunities for on-site generation and efficient district heating/cooling can limit costs, protect against energy market volatility, and improve resiliency to climate-related events. Financial institutions should take a life cycle approach to real estate assets, considering the energy and emissions implications of construction and operational decisions.

Adaptive and mitigating actions of clients

1. **Improving energy use and on-site generation**
   - As discussed in the recommendations for financial institutions, energy efficiency and decarbonisation are central to the economic future of real estate assets in a low-carbon world. Asset owners can take steps that may reduce future costs and increase desirability of properties by proactively improving energy efficiency, purchasing low-carbon energy, and increasing on-site generation (where practicable). Energy efficiency actions may include improving building insulation, installing heat pumps, and applying smart controls to lights and other building operations. On-site generation is most frequently seen in the

installation of rooftop solar arrays, which can enable a property to sell energy back to the grid and protect itself from potential volatility in energy markets. Efficiency measures and on-site generation provide complimentary benefits, both in reducing energy costs and boosting the future desirability of the asset in question.

2. **Environmental and social stewardship and nature-based solutions**
   - Strong environmental and social practices are essential across all economic sectors. Real estate and especially new construction may have impacts on local environments, ecosystems and community livelihoods. Specific concerns may include the disposal of waste produced from building operations and the encroachment of the built environment into natural ecosystems. Asset owners should promote zero-waste solutions that minimise pollution and prevent waste created from damaging neighbouring natural areas. Asset owners should also consider the potential benefits of nature-based solutions, such as wetlands that protect against flooding or tree cover that lowers heating and cooling costs. New construction should consider how to create buildings that function in concert with existing ecosystems and maximise the potential of mutual benefit.

Aligning to net zero

Financial institutions looking to manage their transition risks in the real estate sector should engage directly with clients and support client transitions. However, while necessary, this client-level approach must complement a more strategic approach to reducing the firm's financed emissions. Over the past few years, hundreds of major financial institutions have committed to net zero by 2050 across their portfolios. Most of these institutions have joined one of the industry-specific decarbonisation alliances (e.g., Net-Zero Banking Alliance, Net-Zero Asset Owner Alliance) to support them in fulfilling their climate goals. Beyond the financial sector, net-zero alignment has also gone mainstream in government policies worldwide, with nearly 90% of global emissions now covered by a net-zero commitment. Amid growing pressures on high-carbon sectors and the decarbonisation ambitions of financial and government actors, financial institutions can consider a credible and actionable net-zero commitment a way to mitigate both the systemic and idiosyncratic risks of the transition. The process of operationalising a net-zero commitment begins by assessing baseline financed emissions. Then, institutions set targets for their portfolios and specific sectors, such as the real estate sector, using science-based scenarios. After the targets are set, financial institutions develop holistic strategies to reduce their financed emissions. These processes can be explained to stakeholders in a transparent transition plan that demonstrates not only the net-zero commitment but how the firm is mitigating its transition risks.

SECTION 2:

Physical risks

Extreme weather events pose major risks for the real estate sector. These extreme weather events include exceptionally high precipitation and flooding, hurricanes, and wildfires, as well as chronic risks such as subsidence and sea level rise in low-lying areas. Physical risks for the real estate sector are related to the damage caused to properties from weather events that are intensified by climate change.

Case study 4: Extreme weather risk (i)

Landsec Annual Report, 2021

UK's largest commercial property development and investment company

Climate scenario analysis: 4°C pathway (2030–2100)

Failure to transition leading to significant increase in physical risks and adaptation risks

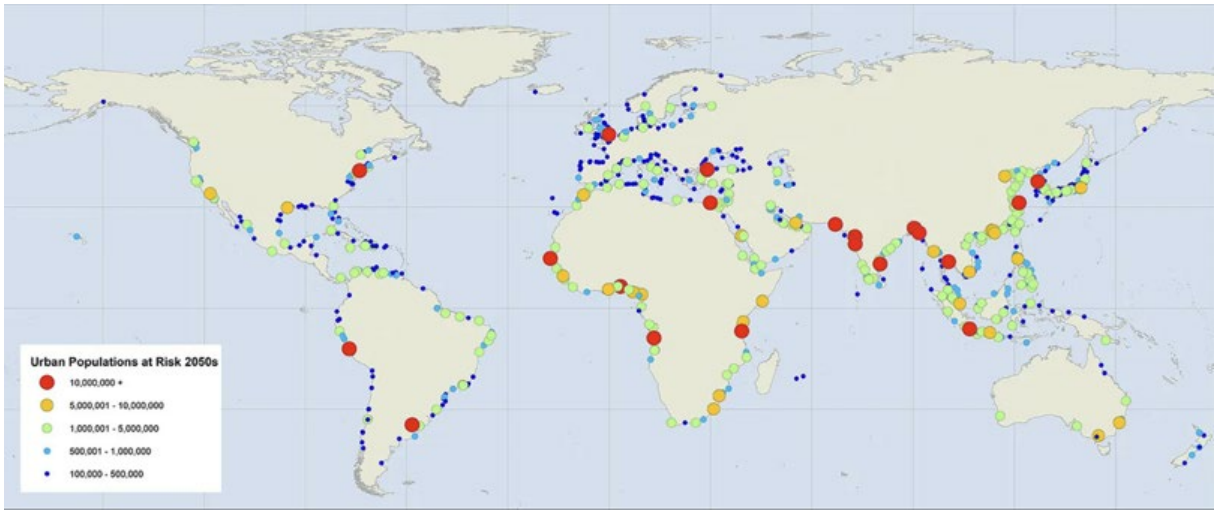
1. Significantly hotter summers with +4°C to +7.6°C maximum temperatures
2. 88% of the portfolio could be exposed to 10–20 days in heatwaves
3. Sea level rise between 21–80cm on average which would put additional strain on the Thames Barrier
4. 21 to 56% increase in river peak flows and potential flood defense failures across the UK, leading to higher portfolio exposure
5. 40% expected increase in flooding losses
6. 7% expected increase in storm losses
7. >64% of portfolio exposed to subsidence risk

As consequence of the changes in climate and associated physical risks, there will be a significant increase in risks linked with adaptation measures

1. Sea level rise and coastal flooding

Due to climate change, the real estate sector is vulnerable to coastal flooding. This is down to predicted rises in sea levels, as well as a greater frequency of inland flooding caused by heavy rains during coastal storms that overwhelm existing drainage infrastructure (NYC Planning, 2018). Many communities in emerging and developed countries are situated in coastal areas. About 23% of the global population is directly exposed to flooding of more than 0.15 metres (World Bank, 2020). For example, in the Indonesian capital of Jakarta, a city of 9.6 million people, the ground has sunk by 2.5 metres in less than a decade (World Economic Forum, 2019). Over 90 coastal cities in the United States are experiencing chronic flooding, which is expected to worsen (Fu *et al.*, 2017), while three-quarters of cities in Europe are expected to be affected by rising sea levels (World Economic Forum, 2019). Figure 6 below shows the cities at risk of a 0.5-metre rise in sea levels by the 2050s (C40 cities, 2018). A study by Climate Central has shown that land currently inhabited by 300 million individuals globally will be subject to annual coastal flooding caused by predicted rises in sea levels by the 2050s (Forbes, 2022b; Climate Central, 2019).

Figure 6: Cities at risk from sea level rise of 0.5 metres by the 2050s (C40 cities, 2018)



Many high-value real estate assets are also located in coastal areas that are becoming increasingly vulnerable to storm surges and flooding. For example, a climate risk assessment by the Risky Business Project estimated that between US$66 billion and US$160 billion worth of real estate in the United States will be below sea level by 2050, increasing to between US$238 billion and US$507 billion by 2100 (Mortgage Bankers Association, 2021). Meanwhile, a study by the Union of Concerned Scientists estimated that a six-foot

sea level rise from 1992 levels by the end of this century would subject around 300,000 existing coastal residential and commercial properties (valued at US$136 billion) in the United States to chronic flooding by 2045. By 2100, the study estimates that 2.5 million properties (valued at US$1.07 trillion) will be exposed to chronic flooding due to sea level rise (Union of Concerned Scientists, 2018). Nevertheless, in desirable coastal areas, construction and valuations of real estate have been rising. The result is that more real estate assets are becoming exposed to the dangers of sea level rise, storms, and coastal flooding. Damages caused by sea level rise increase the costs of repairing and maintaining properties. Floods can also overflow facilities and disrupt businesses.

According to a study by the non-profit research group, First Street Foundation, and global engineering and consulting firm, Arup, a total of 739,699 retail, office, and multi-unit residential properties in the United States are at risk of flood damage. Annual costs to repair such damage are predicted to rise 25% over the coming decades, from US$13.5 billion in 2022 to US$16.9 billion by 2052. In 2022, flood damage to commercial buildings caused an estimated 3.1 million days of lost business operations due to repairs. This is projected to rise by 29% in the next 30 years to four million days. Damaged commercial buildings and their impact on business operations could cost local economies up to US$63.1 billion in 2052, a 26.5% rise from 2022 levels (First Street Foundation, 2021).

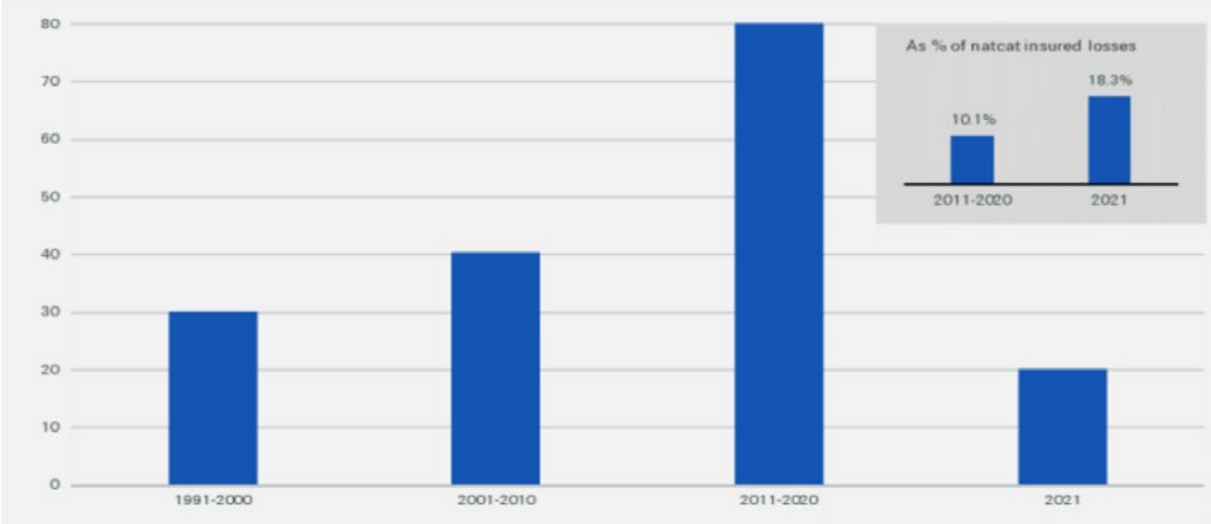
These rising costs cause an increase in insurance premiums. In turn, this impacts real estate prices and affordability, which can have both market and credit risk implications. This effect on insurance premiums has seen property prices in some vulnerable areas lag behind property prices in unaffected areas. It is estimated that properties exposed to sea level rise in the United States sell at a 7% discount compared to properties with less exposure (Bernstein *et al.*, 2019). However, properties in exposed areas that are flood resilient can rise in value due to higher demand. As demand and prices of real estate assets shift due to climate change impacts, property owners in areas vulnerable to sea level rise and coastal flooding may experience lower profits (UNEP FI, 2021; Forbes, 2022b).

2. Inland flooding

Inland flooding does not occur on the coast but typically arises from coastal storms or extreme precipitation events (US Climate Resilience Toolkit). A combination of population rise and urbanisation has caused society's exposure to urban flooding to rise (Swiss Re, 2022). Climate change has exacerbated the risk of inland flooding (Ajjur & Al-Ghamdi, 2022), with severe rainfall and flooding events recently witnessed in South Korea, Pakistan, the United States, Europe, and South Africa, among other countries (Swiss Re, 2022). Unplanned urban development has worsened the devastation caused by flooding events in certain areas (Ajjur & Al-Ghamdi, 2022). Inland flooding caused by heavy rainfall can occur anywhere and is increasingly driven by soil sealing[1] caused by urbanisation and rising temperatures. Inland flooding can cause damage to real estate and increase the costs of repairing and maintaining properties for owners. Floods can also damage critical infrastructure and disrupt businesses. A study by Swiss Re found that global insured losses from flooding have grown rapidly. From 1991 to 2000, for example, such losses amounted to about US$30 billion. From 2011 to 2020, however, they more than doubled, to US$80 billion (in 2021 alone, they hit US$20 billion)(Figure 7). The vast majority of these losses (82%) were uninsured. To this day, uptake of household flood insurance continues to remain low, at 4% (Swiss Re, 2022).

1 The destruction or covering of the ground by an impermeable material, leading to soil degradation (European Environmental Agency, n.d.)

Figure 7: Global insured losses from flooding from 1991 to 2021 (in US$ billion) (Swiss Re, 2022)

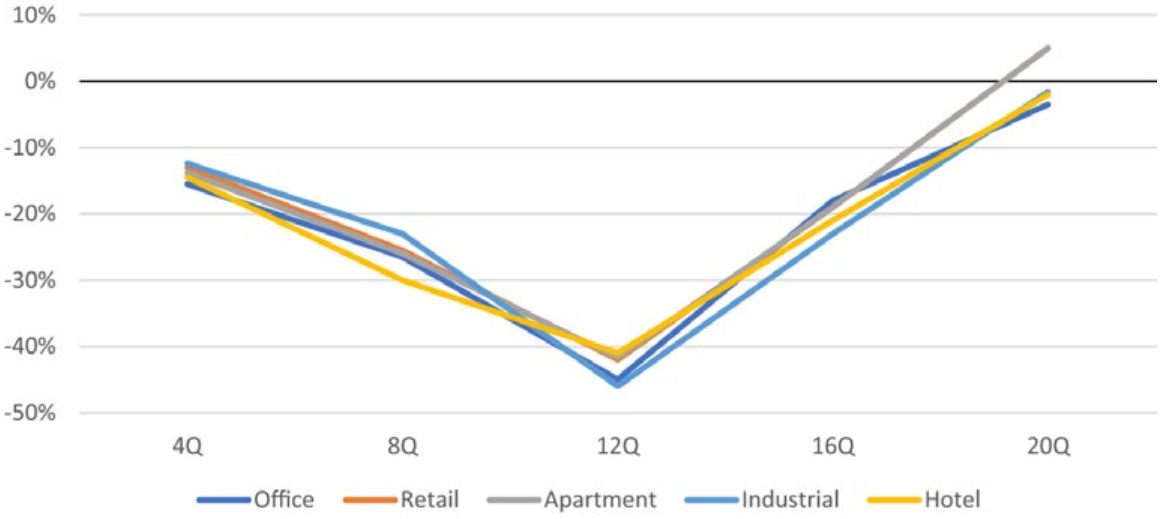


Insurance costs can impact real estate prices and affordability in some regions. Research has shown that, between 1995 and 2015, the price of property affected by inland flooding in England was 24.9% lower than unaffected property. However, the impact seems to be short-lived, with the price of properties affected by inland flooding returning to normal levels after five years (Beltran *et al.*, 2019). A similar trend was observed with respect to inland flooding in Boulder County, located in the US state of North Dakota. Due to flooding, property prices decreased by 6.26%, before rebounding after two or three years (Miller & Pinter, 2022). In some regions, inland flooding has caused affected areas to face permanently lower property prices.

3. Extreme storms and wind

Global warming will drive more intense and frequent tropical storms, such as hurricanes, cyclones, and typhoons. The United States witnessed 14 named storms in 2022, of which 8 were hurricanes and two were major hurricanes (NOAA). As demand for coastal properties continues to grow, these assets will be increasingly exposed to risks from tropical storms. More than 32 million homes on the Atlantic and Gulf coasts, with a combined property value of US$8.5 trillion, are at risk of hurricane wind damage. Furthermore, about 7.8 million homes, with US$2.3 trillion in combined reconstruction cost value, are exposed to damage by hurricanes. In 2021, Hurricane Ida caused an estimated US$27 to US$40 billion worth of property damage in the US states of Louisiana, Mississippi, and Alabama, plus US$16 to US$24 billion in flood damage in the Northeast (CoreLogic, 2021). Past events show that hurricanes have a significant negative impact on the value of commercial real estate. Effects on property values and investor returns can last up to five years, peaking three years after a major hurricane due to higher risk premiums and lower tenant demand (Fisher & Rutledge, 2021). Figure 8 shows the cumulative value change of a property after a hurricane, with a negative impact on the value of property lasting up to three years. Five years after Hurricane Sandy of 2012, for example, housing prices in New York's flood zones were shown to have decreased by up to 8% (McKinsey, 2022; Journal of Urban Economics, 2018).

Figure 8: Cumulative value change of real estate for quarters after hurricanes, by property type (Fisher & Rutledge, 2021)



Other extreme storms, such as hailstorms and tornadoes, are expected to increase in frequency and severity in the coming years. Extreme storms can cause financial losses

for real estate owners through damage to buildings, gaps in rent after a storm, lower tourist numbers, and rising insurance premiums (Urban Land Institute, 2019; Brown, 2022). In 2021 alone, for example, severe weather events caused US$7.46 billion worth of property damage in the United States. (CoreLogic, 2021; Forbes, 2022a). In 2022, Typhoon Rai in the Philippines damaged around 925,000 homes, as well as roads, electricity lines, and water infrastructure, incurring costs of US$330 million (Oxfam, 2022). Hurricane Dorian, meanwhile, caused US$3.4 billion in damages in the Bahamas, equivalent to a quarter of the country's gross domestic product (GDP). In addition, an estimated 29,500 individuals lost their homes and jobs as result of the storm (IDB, 2019).

Case study 5: Extreme weather risk (ii)

CBRE Global Climate Report, 2021

A global commercial real estate services and investment firm

Physical risk costs

- OPEX could increase in areas where temperature rise and heatwaves become increasingly likely. Utility prices could also increase in areas where the energy and water networks are already stressed. Reliable access to energy and water is critical to human wellbeing and continued operations for commercial buildings.
- Additionally, the availability and cost of insurance and financing options may become limited. Significant CAPEX could be required to repair and maintain assets that are exposed to physical risks such as floods, extreme winds, wildfires and sea level rise.
- Occupancy levels of assets following and during extreme weather events can decrease if the asset is unavailable or unable to cope with environmental stressors such as increased heat. This could lead to reduced rental income and has the potential to take whole neighbourhoods offline.

Mitigating actions

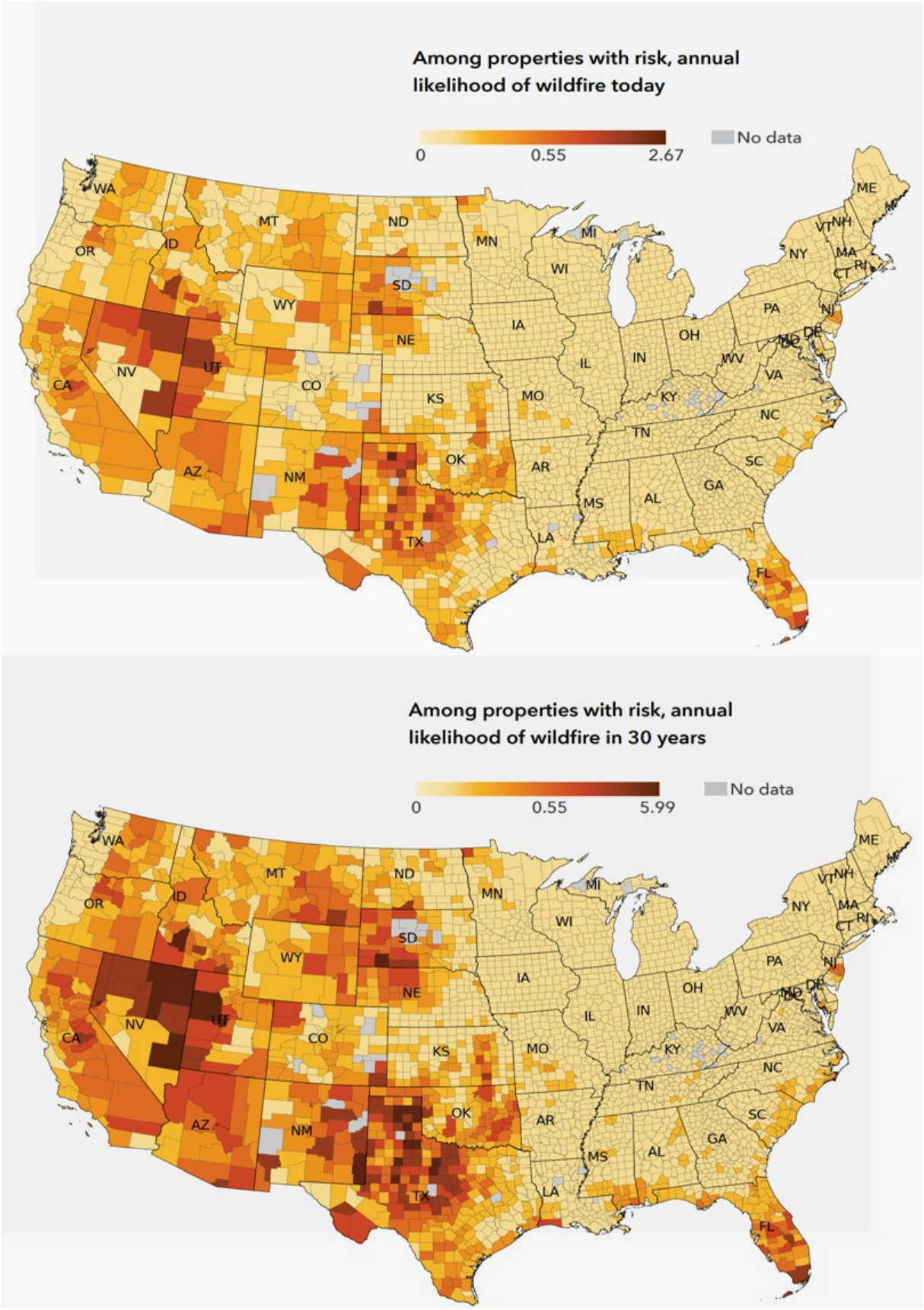
- Significant CAPEX could be required to repair and maintain assets that are exposed to physical risks such as floods, extreme winds, wildfires and sea level rise.
- Manage targets to reach net-zero carbon by 2040, with annual interim targets for our direct long-term core real estate strategies where we have direct control and management discretion for the portfolio.
- Reduce emissions through energy, efficiency, improvements and collaboration with downstream stakeholders, such as tenants, customers, supplies and local communities.
- Switch from carbon intensive fuels to renewable electricity, where feasible.
- Remove residual emissions through permanent carbon removal and storage solutions.

4. Wildfires

As the intensity and severity of wildfires increase due to climate change, the risk to real estate in vulnerable regions rises (Figure 9). Millions of residential and commercial buildings have been built in wildfire-prone areas. Between 2005 and 2020, wildfires destroyed about 90,000 structures in the United States (Barrett, 2020). An illustrative case in point is the 2018 Camp Fire in California, which ruined 19,000 buildings and caused US$18 billion in property damage (Bloomberg, 2022). Climate change means that areas that have historically seen very little fire damage are more likely to become affected. Examples include Florida, Massachusetts, and New Jersey, where the risk of wildfires is expected to more than double in the next 30 years (First Street Foundation, 2022).

The growing risk of a property falling victim to a wildfire can dissuade potential buyers and renters. This can further decrease property values in areas prone to such events. The real estate brokerage firm, Redfin, for example, recently carried out a study of the impact on home purchases in the wake of the five most destructive wildfires in California between 2010 and 2020. For houses within the perimeter of the respective fires, the analysis revealed an average decline in purchases of 38%. While an overall increase in housing prices was observed, the house price increase (21%) was lower in areas impacted by wildfires than the increase (33%) in areas just outside the perimeters of the wildfires (Redfin, 2021). As with flooding, more intense and frequent wildfires will cause damage to properties more consistently, resulting in higher costs for maintenance and repairs. High property costs can result in higher insurance premiums (Forbes, 2022b). This was seen in Australia's 2019/2020 wildfires, which impacted real estate prices and listings during the second half of 2019, especially in Victoria and New South Wales. The wildfires caused property prices to remain low and listings to decrease due to falling demand. Some owners even removed their properties from the market, fearing they would not receive their desired price. However, rebuilding damaged properties with improved quality and modern fire protection can make them more valuable than properties located in areas less affected by wildfires. Renters in areas vulnerable to wildfires could also be affected by a reduced supply of rental properties (Smartline, n.d.).

Figure 9: Likelihood of wildfires among properties at risk today and in 30 years (First Street Foundation, 2022)

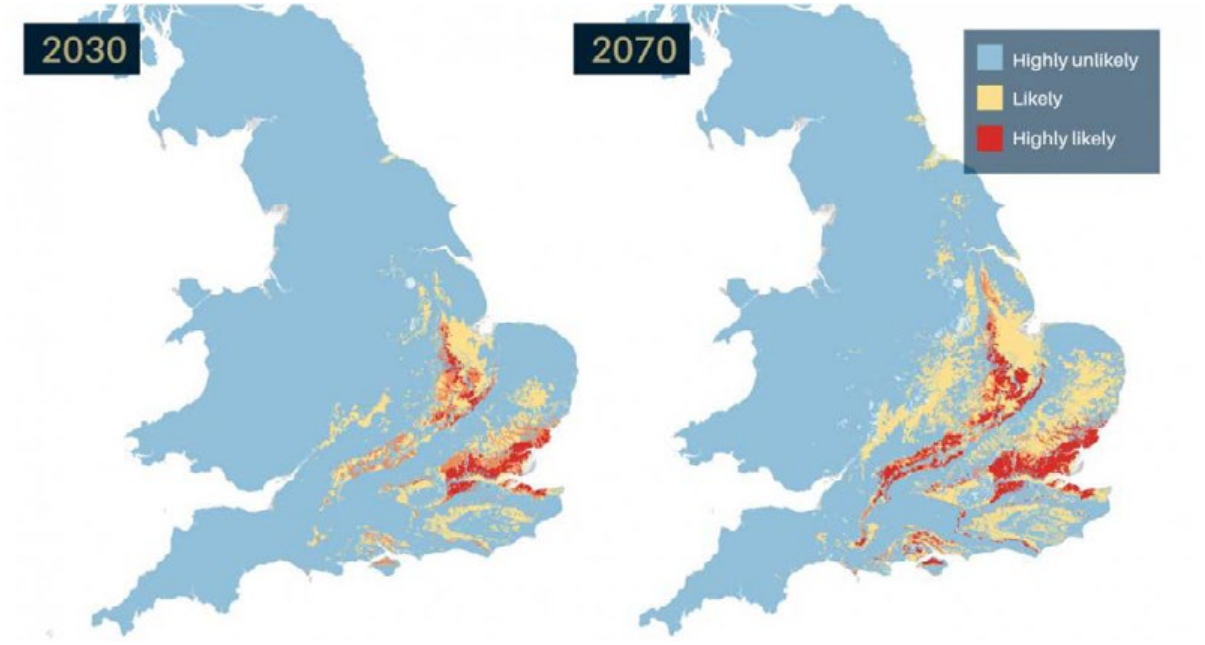


Furthermore, wildfires can impact borrowers' ability to pay their mortgages. The 2016 wildfires in Fort McMurray, Canada, provide an illustrative case in point. The percentage of mortgage holders who fell into arrears (i.e. behind on payments by 90 days or more) as a consequence of the wildfires rose from 0.3 to 1.4%. The Bank of Canada attributes, in absolute terms, 0.9% of the rise to the impact of the wildfires. In comparison, mortgage arrears peaked at 0.45% during Canada's last recession. That said, the impact of wildfires on mortgages in the case of Fort McMurray was short-lived (Bank of Canada, 2020). Wildfires can have drastic impacts on costs for insurance companies, nonetheless. In the United States, for example, wildfire losses paid by the insurance industry increased from US$100 million in 1990 to US$4 billion annually from 2011 to 2018. The 2018 Camp Fire in California alone caused US$18 billion in property damage, of which US$9 billion was insured. In 2017, Californian wildfires accounted for US$12 billion in insurance claims. Damages from the 2017 and 2018 wildfire seasons erased 25 years of underwriting profits from the Californian insurance markets (Bloomberg, 2020; CRC Group, 2021). Property owners in vulnerable areas may find it difficult to obtain insurance. It has been reported that homeowners in high-risk areas of California, for example, have found it increasingly difficult to get property insurance from traditional insurance companies. Between 2018 and 2019, the number of homeowner policies declined by insurers went up by 31% (Jergler, 2021). Finally, smoke from wildfires in rural areas can travel to urban areas, which can indirectly affect residential and commercial properties in these areas. Increased smoke in cities will require owners to improve their properties' air quality, measured by air circulation and filtration (NASA, 2020; Corenet Global, 2020).

5. Subsidence

As the global temperature rises and the occurrence of dry weather increases, the emergence of subsidence due to climate change will become more likely. Subsidence—which occurs when the ground beneath a property sinks, pulling the foundations of a property down and causing the walls and floors to shift—has the potential to destabilise the structure of a property (Hamilton Fraser, n.d.). An increasing number of real estate buildings could potentially be at risk of subsidence in the coming years. An analysis by the British Geological Survey estimated that the number of buildings across Britain likely to suffer will increase from 3% in 1990 to 6.5% by 2030 (Figure 10) (British Geological Survey, 2021). Subsidence can cause a rise in insurance premiums and a decrease in real estate prices. Properties exposed to subsidence may also require engineering work for land stabilisation or replacement of damaged infrastructure, which can increase costs (British Geological Survey, 2021).

Figure 10: Areas expected to experience significant increase in susceptibility to subsidence by 2030 and 2070 (British Geological Survey, 2021)



6. Heat and water stress

Higher temperatures and heat stress will increasingly manifest themselves in the coming decades, presenting a significant risk to the real estate sector. The sector is already considered the largest energy consumer globally, with buildings accounting for 40% of primary energy generated in the European Union and the United States (Valancius *et al.*, 2022). Heat stress can create new cooling needs for buildings (as shown in Table 4 for European countries), which increase operating costs for real estate assets. As global temperatures rise, the energy required for cooling buildings is expected to rise (Deroubaix *et al.*, 2021). Energy needs for space cooling are projected to triple by 2050, especially in hot and tropical countries (IISD, 2020). The Intergovernmental Panel on Climate Change (IPCC) estimates that four billion cooling appliances are already installed in properties; a figure that could rise to 14 billion by 2050 (IPCC, 2022). A recent study showed that global warming will impact the heating and cooling energy demands of buildings in urban areas of Canada, with an average decrease of 18–33% for heating-related energy use intensity and an average increase of up to 126% for cooling-related energy use intensity by 2070 (Berardi and Jafarpur, 2020). These extra costs are particularly significant for real estate properties with pre-existing cooling needs, such as data centres, hospitals, homes, and retirement residences (Four Twenty Seven, 2019). Extreme heat can also disrupt businesses and affect consumer behaviour. For example, retail businesses can suffer if foot traffic decreases due to high temperatures (McKinsey, 2022; Four Twenty Seven, 2019).

Table 4: Effect of climate change on energy demand for residential buildings in Europe (Valancius *et al.*, 2022)

Country	Period	Climate Scenario	Conclusion	Reference
Sweden	2050–2100	RCP [1] scenario 4.5 (the radiative forcing of GHG is reduced to 4.5 W/m^2) and RCP scenario 8.5 (GHG increases, its radiative forcing going up to 8.5 W/m^2) [17]	A 13–22% drop in the demand for heating, a 33–49% increase in the demand for cooling	[18]
Finland	2030–2050–2100	Drafted on the basis of the CMIP3 global climate model [19]	A 20–40% drop in the demand for heating, a 40–80% increase in the demand for cooling	[20]
Switzerland	2100	It is assumed that the average annual air temperature will increase by 4.4 °C compared to the climatologic standards of 1961–1990	A 33–44% drop in the demand for heating (cooling is not considered)	[21]
Germany	2060	It is assumed that the average annual air temperature will increase by 1–3 °C	A 44–75% drop in the demand for heating and a 28–59% increase in the demand for cooling	[16]
Greece	2100	Three scenarios by the Intergovernmental Panel on Climate Change are used [15]	A 44–75% drop in the demand for heating and a 28–59% increase in the demand for cooling	[22]

[1] RPC—Representative Concentration Pathway.

About 60% of global real estate investment trusts are located in areas such as Malaysia, the Philippines, Japan, Hong Kong, and Australia, which are expected to experience high water stress by 2030. Properties in water-stressed regions can face higher costs related to sourcing water and improving water efficiency measures. Increased costs, including water rates, can be passed on from owners to tenants. Water-efficient buildings with lower operating costs could outperform traditional properties. Apart from direct water costs, properties in high water-stressed regions could face strict regulations on water efficiency. The desirability of properties in water-stressed areas could decrease due to limited water availability and risks to the local electricity supply (Blackrock, 2020).

Workers in construction will see the physical demands of their job—which are already high—increase as they are exposed to potentially significant heat stress resulting from a global temperature rise. Temperatures on construction sites can often be higher than the outside air temperature, especially for workers involved in roof work, road construction, and interior work in buildings with no air conditioning or with poor ventilation. Many construction workers are already exposed to high temperatures. During the hot summer months in Hong Kong, for example, construction workers are exposed to extreme heat conditions above 32.1°C for 17.5% of their work time (Yi and Chan, 2017). Studies have shown that heat stress can lower productivity and increase health problems and injuries (EHS Daily Advisor, 2022). In a separate study, meanwhile, researchers analysed the performance of construction workers in Dubai during hotter months compared to colder months. Their findings showed that workers were significantly less productive during the hotter months due to greater levels of fatigue and higher numbers of workplace accidents (Bendak *et al.*, 2022). In light of growing safety concerns for construction workers, governments will increasingly implement safety regulations related to heat stress in workplaces. Consider the United States, where the Department of Labor has already announced a heat prevention campaign and enforcement programme to protect outdoor workers (EHS Daily Advisor, 2022). The National Emphasis Program aims to protect workers from heat-related illnesses and injuries. The Occupational Safety and Health Administration will conduct heat-related workplace inspections as part of the programme (Occupational Safety and Health Administration, 2022).

Case study 6: Heat stress and wildfire risk

City Developments Limited (CDL) Integrated Sustainability Report, 2021

Singaporean multinational real estate company

Climate-related risks

Revenue losses can be estimated be on the damage to CDL's properties in the development. Property at hotel operations business units. Airport closures or significant damage to nearby supporting infrastructure may cause prolonged loss of revenue from loss of occupancy in hotels. Delay from supply chain disruption and increase cost of financing may also result in losses.

Mitigation actions

Increment additional practices to combat rising heat, stress, and provide safe, working conditions for construction workers: include heat management as part of risk assessments; establish a comprehensive response plan for workers, showing signs of heat stress.

Design and construct buildings, by considering changing weather patterns: incorporate natural cooling features into the design of new buildings; adjust existing building infrastructure to cope with heating and cooling capability demands

Strengthen business continuity plan is for wildfire events and enhance building resilience to make them less prone to impacts of wildfires: develop robust recovery plans and incorporate preventative features to limit damage in properties in wildfire-prone states.

Box B: Coastal Erosion in Atlantic Canada

A report released by the Council of Canadian Academies concluded that rising sea levels threaten many coastal communities in Canada, causing flooding and property damage (CCA, 2019). The predicted sea level rise in Atlantic Canada is estimated to be higher than the global average, bringing more significant risks. Sea level rise and storm surges are estimated to cost billions of dollars in damage to the 6.5 million people living along the Canadian coastline (Dalhousie University, 2019). Nova Scotia, located on Canada's Atlantic seaboard, is growing increasingly exposed to rising sea levels, leading to the accelerated erosion of its coastline (CNBC, 2022).

Rising rates of erosion are increasing the incidence of property loss. This has created concern among property owners up and down the entire coast (CBC, 2022). Coastal properties in the Nova Scotia region have experienced significant damage from severe weather events over the last decade. In November 2021, the Nova Scotian government allotted CAD200,000 (US$149,000) to each uninsured household for damages caused by heavy precipitation and wind. Earlier in 2021, a similar storm across Canada's Atlantic provinces caused CAD50 million (US$37 million) in insured damages. Rising damages from the impact of climate change are forcing owners to rely on taxpayer-funded provincial disaster relief programs for support (Canadian Underwriter, 2022).

Due to the growing threat of coastal erosion, the Nova Scotian government passed the Coastal Protection Act in 2019 with the aim of protecting real estate construction from the rising coastal shorelines (Nova Scotia Government, n.d.). The law will restrict the development of new properties in areas exposed to coastal erosion, sea level rise, and flooding. New properties must be constructed at a minimum distance of 80 to 100 metres from the sea. The legislation will also apply to owners of current residential buildings who wish to either expand or rebuild (Canadian Underwriter, 2022).

7. Physical risk guidance

Key physical risk questions for financial institutions to consider

1. **Gathering information**
   - What are the most prevalent physical risks across our portfolio footprint?
   - What have our clients disclosed in their financial, sustainability, and climate reports regarding their physical risks?
   - How many of our clients have business resiliency plans?
   - Do we have locational data on the major assets of our clients?

2. **Assessing the risks**
   - How much of our portfolio operates in areas of high physical risk?
   - What does our exposure to higher-risk assets look like? What are the terms of our financial relationship (e.g. debt/equity, tenor)?
   - Have we looked at physical risk scenarios to see how those risks will evolve over time? Have we considered short-term, medium-term, and long-term risks?
   - What direct damages might physical hazards cause to real estate assets?
   - What indirect damages might result from physical hazards (e.g. business disruption, changes in market demand?
   - What might be the potential loss in revenues or impacts on valuation of physical hazards?
   - How might insurance markets (and insurability) change in the face of worsening physical risks? What proportion of our clients are covered? Which hazards are covered? Is uninsurability a risk in areas of more frequent physical hazards?
   - Have we explored local adaptation measures being taken that will increase the resilience of assets to climate change?
   - How much are clients investing in adaptation and resiliency measures?

3. **Engaging with clients and updating strategy**
   - Do our senior leaders understand the physical risks of our clients?
   - How are we helping our clients to transition to more resilient infrastructure?
   - How will the physical risks identified and assessed influence our strategy in the real estate sector?
   - What specific updates to risk management practices or business activities will be needed to appropriately consider these physical risks in our operations?

Recommendations for risk management

1. **Use hyper-local data to identify key hazards**
   - As climate data have advanced, financial institutions have access to a wide range of asset-level datasets. Many of these datasets are supplied by commercial third parties, but a wealth of open-source tools also exists. Asset-level information can include asset type, residual life, capacity, geographical and geolocational data, asset prices, and resiliency of assets.
   - Financial institutions should work to integrate insights from these datasets and models into their risk management processes. These data can be used to identify the dominant hazards in a particular area and explore how these are likely to evolve over time. Financial institutions can then consider the adaptation plans and resiliency measures created by local governments. As a next step, this information can be combined with asset-specific information about mitigating and exacerbating factors (e.g. reinforced windows, flood barriers). As suggested in the guidance of the Taskforce on Climate-Related Financial Disclosures (TCFD), financial institutions should conduct scenario analyses and explore their own exposures and resiliency under different conditions. While there will always be uncertainties about the future, local data can enable a firm to assess its exposure across a broad set of climate impacts.

2. **Understand insurance coverage and its potential evolution**
   - Insurance coverage is a critical component in assessing the climate exposure of real estate assets. In many jurisdictions, only certain hazards are covered by insurance. Financial institutions with exposure to climate-sensitive assets need to be familiar with local insurance markets and know the extent of coverage for each portfolio asset. Insurance also has implications for future asset values since higher levels of climate impacts can drive insurance costs up while pushing affordability and desirability down. Financial institutions should be aware of the evolution of insurance markets in the areas in which they operate and identify potential risks of uninsurability. In many geographies, insurance coverage may be linked to government policies, so changes in such policies can have implications on insurability and coverage.

Adaptive and mitigating actions of clients

1. **Resiliency planning**
   - In the face of an increasingly variable and dangerous climate, ever more real estate assets are placed at risk. Real estate owners should develop resiliency and adaptation plans for their most important sites. These plans can begin with an assessment of current climate risks and asset vulnerabilities. They should also explore different climate scenarios that focus on how the frequency and severity of climate risks may change over time. Resiliency planning should also create procedures for operational continuity (e.g. minimising power and service disruptions). In addition, firms should be aware of changes in the insurance market and potential costs associated with increased climate risks.

2. **Climate-ready construction and retrofits**
   - New construction should actively consider not only current climatic conditions but expectations for the future by selecting appropriate materials and designs. Climate-ready buildings should be prepared to remain viable across a variety of potential futures. For existing buildings, retrofits and improvements in building infrastructure may be advisable. However, asset owners should consider both the cost of retrofits as well as the potential value of the property. In some instances, climatic conditions and changing market preferences may make it more economical to exit the asset. Climate-readiness for both new and existing buildings is particularly relevant in coastal real estate markets, which often have high value assets as well as high levels of vulnerability to damaging flooding and storms.

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