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IN FOCUS

Climate change and cities: Adapting real estate investment decisions

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Blending physical risk modelling with social, financial and regulatory information will be the difference between prepared real estate investors, and those failing to adapt to climate threats.

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"The choices and actions implemented in this decade will have impacts now and for thousands of years"
(Intergovernmental Panel on Climate Change (IPCC)).

It is becoming increasingly clear that some of the predicted impacts of climate change are now inevitable.

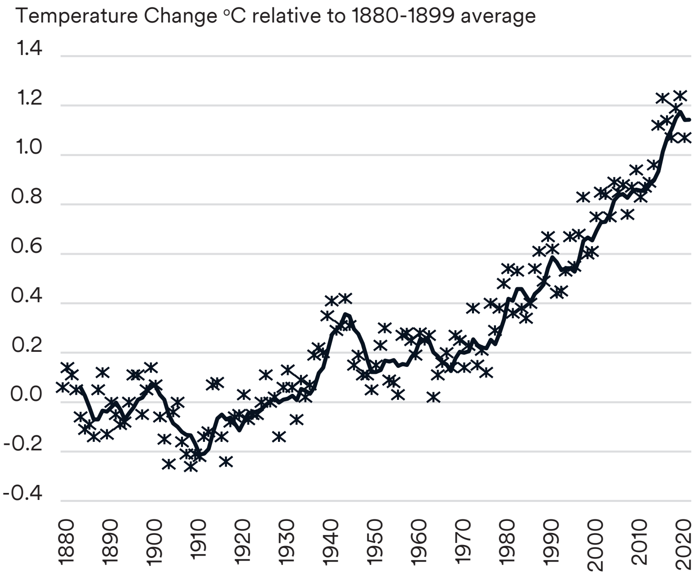
To date, our discussions and efforts have primarily focussed on mitigation and emissions reduction. However, the need for rapid, considered, and collaborative efforts to appropriately assess and adapt to the impacts of a changing climate are also pressing.

2020 was the hottest year globally. Both 2021 and 2022 rank in the top ten, with the number and severity of extreme weather events quadrupling since the 1980s.

Existing government and private sector commitments to greenhouse gas (GHG) emission reduction will not put the world on track to meet the essential target of keeping global temperature rise to below 1.5C. This is despite the pledges and efforts already made across sectors - such as across large parts of the real estate market – to achieve net zero carbon by 2050. In fact, the latest predictions are that without rapid, large-scale change to systems and infrastructure, the average global temperature could increase by around 2.8°C by the end of the century.

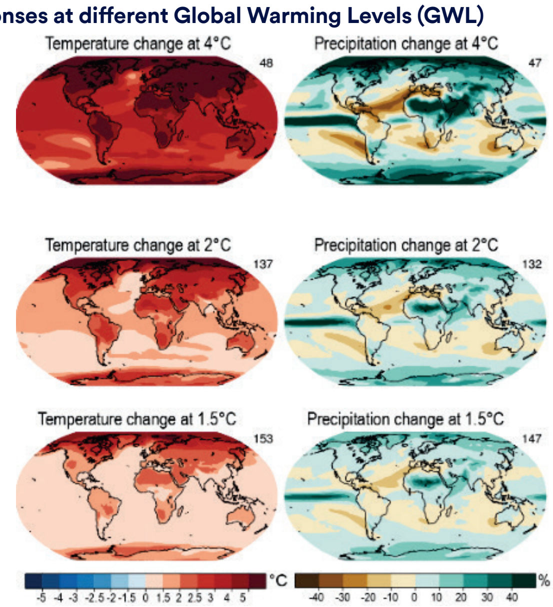
This poses a serious challenge for investors and asset owners, as the risks of losses and damages from climate change compound with every increment of global warming.

Figure 1
Average Global Air Surface Temperature Change



Source: IPCC AR6 Report, 2023.

Figure 2
Responses at different Global Warming Levels (GWL)



Source: IPCC AR6 Report, 2023.

Schroders capital

Cities across the world are at significant risk from climate change impacts. The World Economic Forum suggests that the coming decades will be defined by "ex-cities and climate migrants". The world could see up to 6.3 billion people living in urban centres by 2050, and estimates suggest there have already been 31 million environmental migrants globally. Estimates suggest that the cost to global cities from sea level rise and associated flooding alone could reach $1 trillion by 2050 (C40 Cities, 2018).

Hurricanes are already the most costly disaster category in the US, with losses of over $1 trillion in the last 40 years. These losses are expected to increase by 70% by the end of the century. With secondary impacts of rising utility costs, food insecurity, increased natural resource pressures and worsening climate-induced health risks, cities will be under extreme pressures to adapt. The impacts of severe climatic events are not new.

Table 1 below outlines some of the key physical risks facing cities globally, with recent case studies.

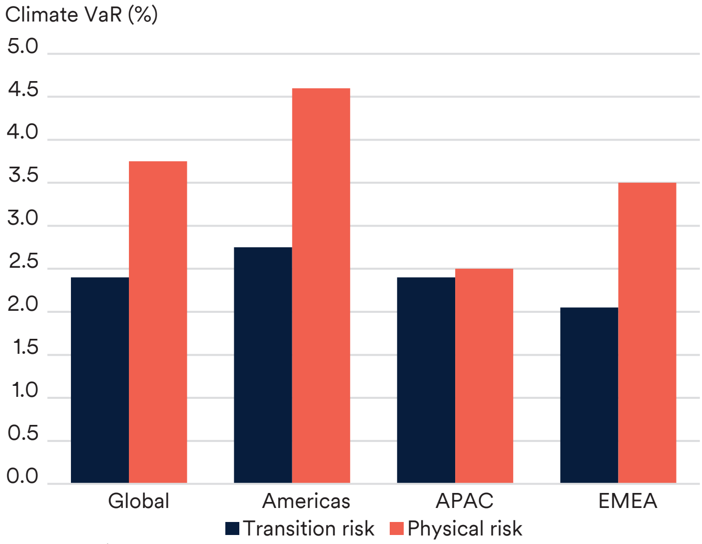
Climate change - the "threat multiplier"

Climate change can act as a threat multiplier when combined with the existing challenges and unique characteristics of cities. Some of these are already materialising:

- The "urban heat island" effect can further exacerbate the localised impacts of global temperature rises, creating pockets of extreme heat stress. By 2050, around 970 cities worldwide could see summer temperatures above 35C, compared to 350 in 2018.
- The decreased permeability of surfaces leaves little space for increased precipitation, surface water absorption etc.
- High-rise, mechanically ventilated spaces, with high energy demands
- Significant glazing leads to internal and external heat gain risks
- Tall buildings and narrow streets intensify wind speeds, and associated structural risks
- Dense populations increase pressure on energy, water and food resources
- Increased migration – exacerbated by climate change – adds pressure to ecosystems, low-lying populated regions, and increases need for support services offered by cities.
- Reliance on large-scale infrastructure which is at risk from climate change impacts

The impacts of climate change are already being realised for the real estate sector, and the frequency and severity of these impacts is expected to increase in the future. When considering the financial implications of climate-related risks, MSCi have suggested that for the real estate sector, physical risks present a higher Climate Value at risk (CVaR) than transition risks across all regions (**Figure 3**).

Figure 3
Projected climate risks to Real Estate as Climate Value at Risk (CVaR)



Source: MSCi Global Annual Property Index, 2022. Adapted by Schroders, 2023.

Table 1: Primary physical impacts of climate change in cities

Risk	Impact	Example
Extreme heat	Damage to structural integrity of buildings and infrastructure. Risk to occupants of poorly ventilated or cooled buildings. Increased energy demands.	Canada, 2021. Over 600 deaths, cooling infrastructure unable to cope with extreme temperatures.
Drought and water stress	Pressure on water-reliant infrastructure such as hydroelectricity. Potential for increased water costs and detrimental impact on water quality. Impacts to food production.	China, 2022. Over 2.5 millions people affected. Hydro-electricity generation affected causing industrial shut-downs. Food and water supplies impacted.
Wildfires	Millions of homes and commercial buildings have been built in wildfire prone areas. Risk of property damage and destruction. Air quality impacts at local and regional level.	Australia, 2019-20. 3000 homes destroyed. Airports, offices ,schools closed. Air quality across world affected.
Extreme storms and wind	Property damage and losses as a result of storm damage can reduce property values.	USA, Cuba, 2022. $50bn property damage and 130,000 homes destroyed.
Extreme precipitation and flooding	Severe flooding in urban areas with impermeable surfaces. Leaching of pollutants from hard surfaces and farmland. Property and infrastructure damage and loss of life.	Pakistan 2022: Approx. 33 million people in Pakistan – or 1 in 7 people in the country – have been impacted by devastating floods. 1700 deaths. Still dealing with the aftermath. UK, 2021. Hospitals and schools evacuated, underground rail infrastructure shut down. Cont. Europe, 2021: Germany, Austria, Netherlands saw severe flooding with c.200 deaths
Rising sea levels and subsidence.	Increased risk to coastal properties and those located on deltas. Salination of agricultural land. Subsidence leading to structural damage.	Indonesia, 2022. Severe flooding in Jakarta, combined with rapid subsidence. Proposals for relocation of city inhabitants.

Source: UNEP FI, Adapted by Schroders, 2023.

This is not surprising, given the "real asset" characteristics. Even so, it is still a cause for concern, when considering the existing investment and research focussed on primary transition risks such as net zero carbon, carbon pricing, and regulatory mechanisms such as MEES in the UK.

Significant effort is needed to better identify, interpret, and act on the physical risks facing the sector. The potential cost of inaction or maladaptation could lead to significant material and financial consequences, not just for the real estate owner, but transposing to the wider financial economy too. Investors need only consider bank collateral, pension portfolios, insurance premiums.

Fast and effective action now could set leaders apart, but this is not just competition – collective action is essential given the scale and regional impact of the consequences, besides impacting individual assets at risk.

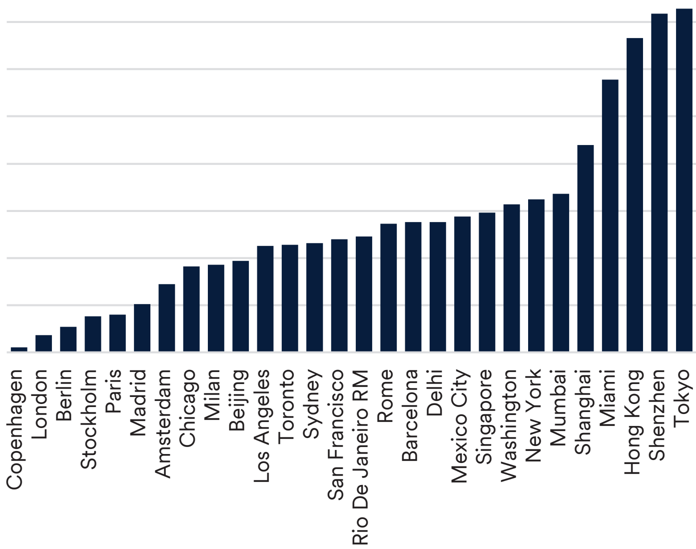
Identifying risk and resilience at regional, city and asset level

A lot is known – and models are available – of the predicted impacts of global warming around the world. Despite this, actually identifying which cities are most at risk from climate impacts can be challenging.

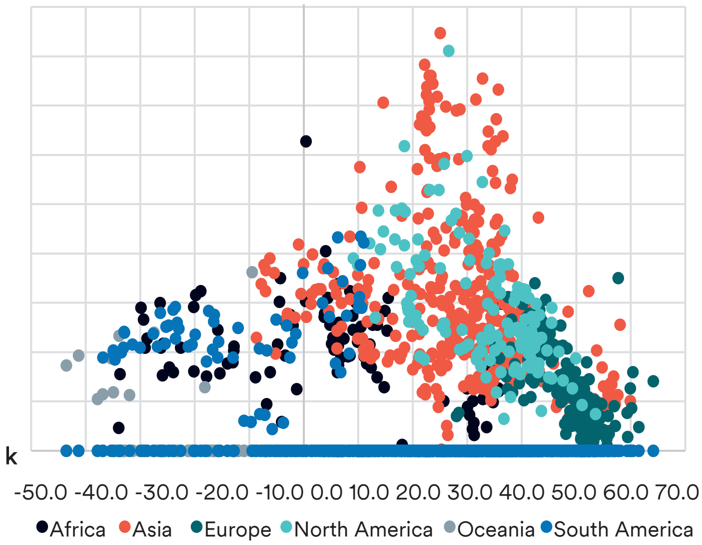
When assessed at a regional level, it could be determined that cities in Europe are less at risk than in other regions (**Figure 4**), and are less exposed to extreme high temperatures, storms, droughts and disruption to agriculture. However, assessed at the local or asset level, the specific site and location of a city, or the buildings within it, can provide a much more varied picture of risk and resilience. Sufficiently complex, well resourced, and granular climate risk modelling is essential – and current available datasets need to be considered in light of their limitations. CBRE in 2019 posited that ultra-local flood risk assessments can present materially different risk levels than Environment Agency reports in the UK. This could lead to significant under-valuations. Wider climate analytics platforms utilise different geographic ranges, varying underlying datasets, and a range of climatic scenarios which will influence risk outputs.

Physical risk analyses alone also do not account for the range of wider socio-economic factors that may improve or impede a city's resilience to physical risk. How a city has already, or plans to, develop resilient infrastructure must be accounted for. **Figure 5** compares the risk from extreme weather (the same data in **Figure 4**) with the preparedness of 59 major cities in developed economies. The preparedness score is based on a ranking of city infrastructure and environmental policies developed by Arcadis' 'Sustainable Cities Index'.

Figure 4
Selected major cities vulnerability to climate change

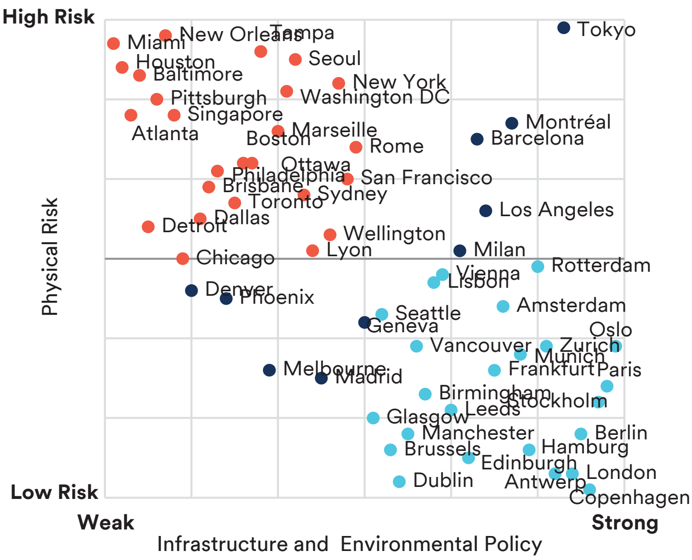


Vulnerability of cities to climate change by region



Source: Verisk Maplecroft, Schroders, 2023.

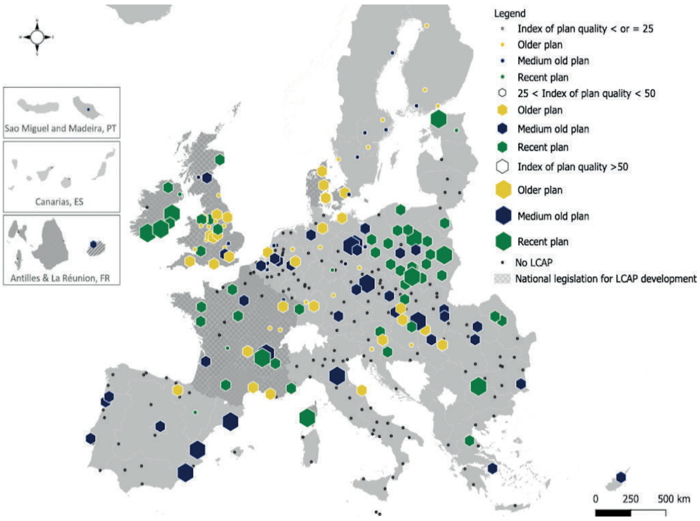
Figure 5
Theoretical



Source: Arcadis, Schroders, February 2023.

Figure 6 goes further, to consider age, appropriateness, and effectiveness of adaptation planning across Europe and finds many of the potentially resilient cities actually have outdated and narrow-focussed strategies. The conclusions around investable cities from Figure 4 are therefore overthrown by the further information outlined in Figure 6!

Figure 6



Source: Carbon Brief, Schroders, February 2023.

The recent UK Committee on Climate Change (UK CCC) report into climate resilience in England further highlights the considerable gaps in resilience planning. This is in contradiction to the findings in **Figure 4** and **Figure 5**. **The blending of physical risk modelling with social, financial and regulatory information is where the most benefit will be realised for real estate investors and owners**. As such, any proposed adaptation and decision-making processes at the asset or area-level will only be successful where this is fully considered and addressed, and analysis is sufficiently granular. A holistic approach to modelling and analysis will create significant opportunity to achieve environmental and social impact goals, alongside continued economic sustainability and performance for investors.

Physical climate-risk in financial modelling and decision making

Although research on the impact of climate on financial modelling and valuation of commercial real estate (CRE) is limited, it is supported by evidence within the residential sector which is expected to be realised in CRE in the coming years. However, the range of factors and inconsistencies observed in real asset valuations as a result of existing or potential climate-related risks and impacts, which will pose a significant challenge to the sector in the coming decade.

Currently, insurance premiums are based on historical data for extreme weather events or flood risks. This approach can lead to severe under-pricing of risk and inflated valuations of property in risk-prone areas that are expected to see increased quantity and severity of climate impacts in the future.

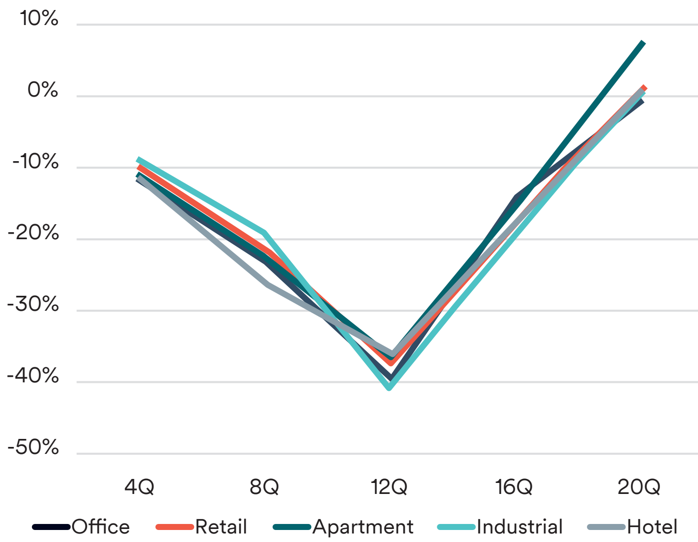
In response to wildfires seen across California, insurance providers are now refusing to offer protection, or increasing premiums significantly (**UNEP FI, 2023**). The boundaries of existing extreme events such as wildfires, tropical storms and hurricanes, are set to expand into hitherto unaffected regions (**IPCC, 2023**). It is critical therefore, that insurers and investors understand both the areas currently at risk, and areas that may become high-risk in the future in order to predict potential insurability.

Some specialist insurance firms seek to capitalise on natural hazard and climate risk by offering insurance backed by climate modelling research. It is possible to utilise existing physical risk models to determine potential risk premium increases, or economic losses, by determining expected increased likelihood of return-period events. This is particularly feasible for localised impacts such as flooding. However, this becomes increasingly difficult to model for broader climate-impacted natural disasters such as hurricanes, wildfires and extreme precipitation events.

There little to no evidence of valuers taking future climatic scenarios into account beyond flood risk (**UNEP FI, 2021**). Despite this, the real estate market provides indicators – sometimes conflicting – of price movement. Property values decrease following climate-related events (e.g. wildfires, hurricanes) however it can be short-lived (**Figure 7**). Properties impacted by regular severe storms or wildfire events demonstrate a slower rebound in value, so it can be surmised that with increased frequency and severity of disruptive events, permanent or sustained falls in value are likely to occur. It is obviously important to understand whether a property, or location, is already known to be at risk, as a more significant variance on valuation will be seen where risk has not previously been considered.

Figure 7

Valuation adjustments post extreme events



Source: Fischer & Rutledge, 2021.

Secondary financial and social impacts

There are numerous secondary impacts associated with the physical climate risks in cities, specific asset classes and buildings. These would include consequences as wide as lost business operations during repairs, reduction in food production, declines in social wellbeing, social unrest etc.

Here we look at some:

Floods

In 2022, flood damage to commercial buildings in the US caused an estimated three 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. Retail and leisure assets can be particularly prone to long-lasting impact as they are often smaller businesses, with less ability to adapt, and may lose brand reputation and consumer interest. Leisure, hospitality and retail markets can also be severely affected by loss of tourists and footfall where surrounding infrastructure may be damaged or put out of service. Inability for tenants to continue their business operations will ultimately lead to rental defaults or void units.

Heat

In cases of extreme heat, significant drops in productivity can be expected, with added risks to worker mental wellbeing, sleep quality, and wider health considerations. This may be particularly damaging to asset classes where occupiers cannot work from home during extreme heat or severe weather.

The potential for impact to construction and agricultural workers is significant. The world is expected to see increased "wet bulb" temperatures in the future. This is the highest temperature under a given amount of humidity where water will not evaporate – indicating how well a person can cool off by sweating. The maximum wet bulb temperature a typically healthy person can withstand is 35C for six hours. Some parts of South Asia are already exceeding this and the frequency of this event has doubled since 1979. This could have massive ramifications for human health, ability to work outdoors, and related food production or construction activities.

To combat these risks, asset owners will likely need to invest heavily in increased cooling capacity, increasing the expected energy needs for space cooling threefold by 2050. This will in itself particularly impact net carbon objectives, and will have a higher burden for asset classes already requiring significant cooling (e.g. data centres, healthcare, leisure etc.), or for business and occupiers with limited means to cope with increased energy costs.

It is interesting to note that particularly carbon efficient buildings will be impacted. **With some locations across Europe requiring up to 75% additional cooling energy**, the additional energy required for cooling needs is expected to outweigh any reduced heating energy demands. This could have a big impact on assets reliant on combined heat and power (CHP) engines – widely promoted for carbon reduction efforts – as they are switched off due to reduced efficiencies. Furthermore as **buildings are increasingly designed to reduce air permeability, with improved glazing and insulation in order to meet net zero carbon objectives, investors may find these assets are now not designed to cope with increasing temperatures as they cannot ventilate effectively!**

Droughts

In 2022, droughts and heatwaves across China, India and Pakistan resulted in numerous blackouts, closures to industry. Restrictions on lighting were implemented due to maximum energy grid capacities being breached. In Europe, hydroelectrical and nuclear power generation plants saw reduced outputs due to lack of available water for cooling, and rail networks and underground stations were closed due to extreme heat and potential damage to infrastructure. Assets in cities relying on these infrastructure provisions will need to factor in lost business days, or disruptions to operations, on an increasing level – in the absence of effective adaptation by governments and industry bodies.

Effective adaption in global cities

As shown in **Figures 4 and 5**, it can be difficult to determine how prepared a city is to future climate impacts. However, due to the varied nature of future climate impacts, and their effects on buildings and infrastructure, and human populations, major cities worldwide will need to adapt if they are to survive.

Nature-based solutions (NBS) is a method of adaptation utilising natural materials, planting, and use of green or blue technologies. NBS is prioritised by the EU Taxonomy, and is seeing an increasing focus in the wake of recent COP15 outcomes and sector uptake of the taskforce on nature-related financial disclosures (TNFD) recommendations. It has been shown that temperatures under tree cover can be up to 12C lower than average external temperatures.

The WEF (2023) suggest that the urban heat island effect can increase city temperatures 1-3C above average, causing thousands of additional deaths each year. Seville has successfully implemented a 'policy of shade' to plant 5,000 trees a year to combat excessive heat. Multiple cities are looking to tree cover as an effective adaptation technique. Paris is using NBS to reduce surface water flooding and improve water quality by implementing a green roof initiative across the city. Outside of NBS solutions, a number of soft-solutions and hard-engineering to cityscapes can be implemented, including:

- Innovative use of public and private buildings to incorporate "active cooling centres", by offering internal or shaded space to the public during extreme heat episodes
- Changing road and pavement surfaces to lighter coloured, or reflective, materials to reduce heat gain and urban heat island effect (e.g. LA's white pavement programme, reflective running surfaces during Tokyo Olympics)
- Adapted building design, including window film to reduce solar radiation, phase change materials to reduce internal heat gains, reduced glazing, improved shading and "brise soleil"
- Increased flood defences and storm surge protection (e.g. Thames barrier, storm drains in Tokyo, Delta programme in Netherlands)

It is critical that adaptation measures are factored into mitigation efforts early, to avoid unwanted trade-offs or contradictions in efforts to achieve wider ESG ambitions. Many hard-engineering efforts to mitigate climate impacts (e.g. structural improvements, flooding defences, energy plant replacements) will result in considerable embodied carbon emissions, and have potential to negatively impact wider ecosystems and infrastructure. Similarly, the potential for increased cooling energy demands may hamper efforts to achieve planned energy efficiency targets or worsen indoor air quality. These impacts may in turn require existing net zero carbon strategies to be re-calibrated, require further investment in renewables provisions, or entire building fabric and façade retrofits.

NBS also needs to be planned to account for potential watering needs, and ability to withstand climatic shifts, whilst not contributing to expected drought conditions. Use of NBS can also lead to 'gentrification' of urban areas, positively impacting rental yields or property prices. However, this may ultimately lead to exclusion or forcing out of lower income occupants adding to social deprivation risks.

According to a JPMorgan report in January 2023, investment into climate adaptation has the potential to deliver a "triple dividend". This refers to avoiding future losses, generating positive economic gains (through innovative solutions), and delivering wider social and environmental benefits. But to ensure the viability and success of adaptation at the asset and city-level, radical collaboration will be required.

Climate finance is currently focussed on mitigation and carbon reduction, with a gap in flow to adaptation. With an expected $3.2 trillion of climate finance needed per year, governments, regulatory bodies, private investors and public stakeholders will need to work together to ensure that efforts to adapt to future climatic impacts give adequate consideration to all environmental, socio-economic and public health variables, and can attract the required levels of investment.

Cities are stepping up to the challenge through innovative NBS solutions and resilient infrastructure investment, and with regulatory and market mechanisms (e.g. London Plan, NYC Resilient Design Guide). Sector groups are providing improved guidance for real asset investors (e.g. BBP Climate Resilience Guide, UNEP FI Climate Risks in Real Estate etc.) however, much more is needed to ensure the prominent role real estate can play in making cities liveable and sustainable is achieved.

Investment decision-making

It is clear that a paradigm shift is needed in how we approach physical climate risk analysis, and how the real estate sector incorporates this into financial decision-making.

The complexity of interconnected risks and opportunities in global cities will require insurers to re-evaluate premiums in risk-prone or resilient areas. It will require valuers to determine robust and standardised protocols for evaluating resilient buildings and cities., Asset owners will need to develop intricate and complex modelling and assessment tools to critically assess assets at all lifecycle stages to ensure physical and financial resilience.

To achieve this, a number of advancements across the sector will be necessary:

- Better, more complex tools and modelling techniques to overlay micro-economic trends, social needs and potential secondary impacts onto physical risks
- Focussed and considered engagement with insurers and valuation professionals to understand how the adaptation at building level and city level will impact asset values, financial business plans, and exit cap rates.
- Improved integration of associated energy & carbon impacts of future climatic scenarios into existing net zero strategies (i.e. increased cooling loads, ineffectual renewables on site, potential risk to energy demand capacity)
- Engagement with tenants and occupiers on perceived impact of potential risks and the ability for them to adapt to new practices/ expectations
- Focussed collaboration with local and regional public bodies involved in area-wide adaptation planning to understand potential exposure of, or opportunities for, assets and cities.
- Enhanced due diligence to require more climate risk analysis, and interplay between risk and adaptation measures – either existing or required – at both asset and area-level.
- Greater understanding of connectivity and reliance upon infrastructure that may be at risk

In the medium-term, insurance providers and valuation professionals may begin to account for future scenarios in their assumptions, resulting in decreased property values and potential stranding of maladapted or poorly located assets. In the short-term however, investors must begin to model expectations for increased premiums and reduced asset values in areas within, and in close proximity to, climate risks, and adapt their criteria for acquiring, managing and selling assets.

Important Information

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