



HEITMAN
A REAL ESTATE INVESTMENT MANAGEMENT FIRM

CLIMATE RISK AND REAL ESTATE

Emerging Practices for Market Assessment





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About the Urban Land Institute

The Urban Land Institute is a global, member-driven organization comprising more than 45,000 real estate and urban development professionals dedicated to advancing the Institute's mission of providing leadership in the responsible use of land and in creating and sustaining thriving communities worldwide.

ULI's interdisciplinary membership represents all aspects of the industry, including developers, property owners, investors, architects, urban planners, public officials, real estate brokers, appraisers, attorneys, engineers, financiers, and academics. Established in 1936, the Institute has a presence in the Americas, Europe, and Asia Pacific regions, with members in 80 countries.

The extraordinary impact that ULI makes on land use decision-making is based on its members sharing expertise on a variety of factors affecting the built environment, including urbanization, demographic and population changes, new economic drivers, technology advancements, and environmental concerns.

Peer-to-peer learning is achieved through the knowledge shared by members at thousands of convenings each year that reinforce ULI's position as a global authority on land use and real estate. In 2019 alone, more than 2,400 events were held in about 330 cities around the world. Drawing on the work of its members, the Institute recognizes and shares best practices in urban design and development for the benefit of communities around the globe.

More information is available at uli.org. Follow ULI on Twitter, Facebook, LinkedIn, and Instagram.

About Heitman

Founded in 1966, Heitman LLC is a global real estate investment management firm with approximately \$43 billion in assets under management. Heitman's real estate investment strategies include direct investments in the equity or debt capitalization of a property or in the securities of listed and publicly traded real estate companies. Heitman serves a global client base with clients from North American, European, Middle Eastern, and Asia Pacific institutions, pension plans, foundations and corporations, and individual investors.

Headquartered in Chicago, with additional offices in North America, Europe, and Asia Pacific, Heitman's more than 325 employees offer specialized expertise—from a specific discipline to local insight.

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Preface

ULI publishes this report amid a global pandemic and economic uncertainty. For many, it may feel as if the priority of addressing climate change is dissipating as we face the immediate challenge of COVID-19. Chief resilience officers have shifted focus from climate change to COVID-19 resilience. Cities have devoted significant resources to the public health crisis and, as a result, have needed to decrease funding for essential services, infrastructure, and sustainability initiatives.

Meanwhile, investors and developers are focused on swiftly adapting to new market dynamics and consumer preferences, many that have been accelerated as a result of the pandemic. Although it is still too early to draw conclusions about the long-term implications of COVID-19 for our cities and the real estate industry, such a wide-scale humanitarian crisis throws the connections between environmental, social, and governance (ESG) issues and our economies into sharper focus.

However, just as the coronavirus has exposed many weaknesses, it has also shown us that we have the ability to adapt and change our behaviors quickly and radically. For example, less travel, rapid adoption of technology, and more reliance on local goods and services have, at least temporarily, decreased global carbon dioxide emissions. Countries like France, Germany, and South Korea are investing in renewable energy, electric transportation, and green-sector jobs as part of economic stimulus plans. City officials are noticing heightened demand for all types of critical infrastructure—from hospitals to internet to parks and open spaces—and are considering how their investments and public private partnerships should shift.

For the property industry, it has also been a period of increased pledges to net-zero targets. These institutional investors have set targets as early as 2030 to as late as 2050.

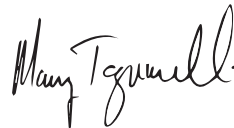
ULI first addressed climate risk in partnership with Heitman for the 2019 report, *Climate Risk and Real Estate Investment Decision-Making*. We are pleased that the industry saw this report as groundbreaking and that the research moved the conversation on resilient real estate investment and development forward.

This report is a continuation of ULI's collaboration with Heitman, which continues to be at the forefront of investment managers looking to quantify climate risk. The content of this report will focus on how climate risk affects investors' market selection and assessment. The findings are based on interviews with ULI members to understand how their thinking is evolving on the topic, and how climate risk is informing their perception of markets where they do or could invest.

We believe that an increased understanding of climate risk at the market level can help inform city efforts to address risk and protect people, businesses and property through sound policy and investment in infrastructure.

For this report, we are grateful to have the support and collaboration of consulting firm Arup and actuarial firm Milliman. Both contribute insights into specialist areas such as measuring city fiscal health and catastrophe models that enrich our understanding of what tools we need to assess, price, and address climate risk. This project was also an opportunity to reconnect with the investors and investment managers ULI interviewed for the original report. We are encouraged by their continued participation in ULI's research and by the resilience progress they reported implementing in the past 18 months.

We welcome your feedback and hope this research will continue to stimulate the real estate investment and development industries on how to address the critical and complex challenge of climate change.



Maury Tognarelli
Chief Executive Officer, Heitman



W. Edward Walter
Global Chief Executive Officer, ULI

1. Executive Summary

Market-Level Climate Risk Will Drive Future Investment Decisions



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Leading real estate investment managers and institutional investors are increasingly recognizing climate risk as a core real estate issue that is beginning to affect their decisions at the market level as well as at the asset level.

The consensus from interviews with leaders in the industry is that market-scale climate risk assessment will play a role in future investment decisions, mirroring the recent advances in assessing physical risk at the asset level. As this market-scale analysis of climate risks and cities' resilience strategies advances, investors will better assess both the economic impact of climate-related events and the cost and ability of cities to mitigate the impact of climate change through their resilience strategies.

Investors also recognize that many local governments, including those in areas particularly vulnerable to the impacts of climate change, are investing in resilience, through infrastructure, policy, and science-based decision-making. These efforts are critical to protecting communities, businesses, and property from the impacts of climate change, such as increasingly frequent and severe storms, heat waves, wildfires, sea-level rise, and drought. Many cities are also taking advantage of new technologies and funding structures to improve their resilience initiatives and work in partnership with the private sector. Understanding these resilience investments and their immediate and long-term costs to taxpayers and real estate owners is a critical aspect of benchmarking market risk.

Investors are looking for better data and frameworks to understand and compare risk at a market level and understand whether local investment in resilience is sufficient to mitigate the level of physical risk faced. Currently, many data sources used to measure economic impact from climate events, such as city fiscal indicators during disaster recovery, can be misleading because they do not fully take into account both climate risk and resilience efforts. Without clear data sources and analysis methods, there

is risk that investors will use anecdotal information or data that do not sufficiently benchmark resilience measures alongside risk faced to make consequential investment decisions.

Recent dialogues about future climate migration, accelerated in response to a 2020 study by ProPublica and the *New York Times*, have also heightened awareness of market risk and speculation about how to measure it.

In advance of more sophisticated methods for assessing climate risk in markets, most investors expressed interest in better understanding the following attributes in markets susceptible to physical climate risk:

- The physical risks present at the overall market level, as well as the asset level;
- The level of investment in resilient infrastructure, including the current protection offered, and its ability to perform under future climate scenarios;
- The capacity of the local government to adopt, fund, and implement resilience policies; this may become more relevant in the short term because of COVID-19 municipal fiscal constraints;
- The range of funding sources in place for resilience investments, and these funding sources' anticipated longevity and impact on investment prospects; and
- Market risk sentiments held by insurers, lenders, key employers, and residents, given anticipation of ripple effects on investor and lender views.



Market Risk

This report considers climate risk in the context of a real estate market, which could comprise a city, metropolitan area or region. Investors are increasingly considering climate risk and resilience solutions at this scale. Markets' governance models, fiscal autonomy, and overall access to resources to respond to climate risk also vary widely globally, introducing more complexity into standardizing practices for comparing market risk.

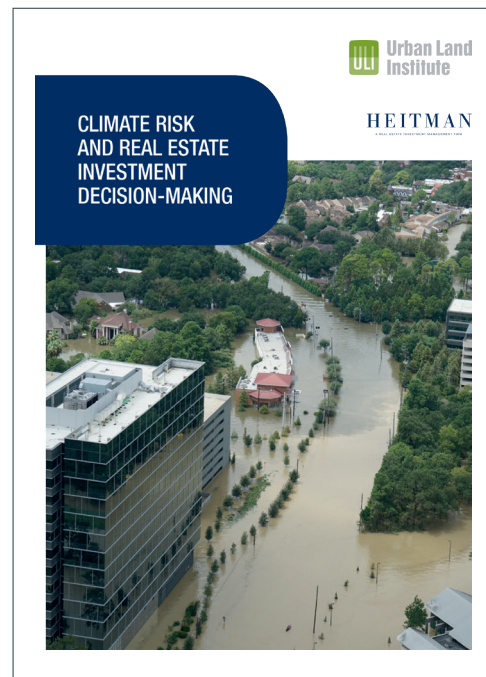
As investors increase understanding and prioritization of market resilience to climate risk, their real estate investment decisions at the market level are likely to become more climate conscious. In the meantime, some investors are starting to make decisions on whether to invest, or continue investing, in markets particularly vulnerable to the impacts of climate change. Examples of pulling back from entire markets completely because of climate risk are limited but do exist. In these cases, investors often see climate risk as a “tiebreaker issue” that makes a difference if other market-level concerns exist.

The stakes are high for local governments. They must provide sufficient infrastructure and implement smart climate change policy to protect vulnerable citizens, homes, and businesses to continue attracting investment in this time of accelerating climate impacts. As understanding of market risk increases, cities that proactively invest in resilience measures may become more economically attractive to real estate investors. Conversely, a lack of proactive investment in resilient infrastructure and prioritized policies could lead to a spiral of decreased capital, ultimately making it even harder to fund much-needed investments to protect their communities from the impacts of climate change.

Leaders in real estate investment and investment management agreed during research interviews that the understanding of market-level risk, and data sources to better comprehend and assess this risk, will advance considerably in coming years. At this time, key considerations and next steps for the industry to improve awareness and understanding of market-level climate risk include:

- Developing strategies to measure market-level climate risk and resilience considering physical risk, resilient infrastructure, and public policy;
- Linking asset-level physical risk assessments with market-scale analysis;
- Exploring the role that the real estate industry plays in supporting funding mechanisms for future infrastructure and resilience initiatives;
- Facilitating collaboration between policymakers, chief resilience officers, and real estate investors and investment managers;
- Working with the insurance industry and actuaries to refine tools to reflect current and future climate risks; and
- Partnering with the valuation industry to accurately build climate change risk into appraisals.

Investors are striving to better understand both data and data sources to compare risk and resilience at a market level.



Climate Risk and Real Estate Investment Decision-Making, published in 2019, was ULI and Heitman's first joint research project on this topic.

Types of Climate Risk



Physical risks relate to the physical impacts of climate change, such as increasingly severe storms, sea-level rise, extreme heat, and wildfires.



Transition risks are the broader risks associated with climate change and a transition to a low-carbon economy, such as regulatory change, resource availability, and reputational and market shifts.

Industry Understanding of Asset and Market-Level Climate Risk



Strong Understanding Asset-Level Risk + Resilience

Asset-level short- and medium-term physical risk

Asset-level resilient design measures

Energy efficiency measures and renewable energy solutions to lower transition risks

Current insurance pricing and availability

Improving Understanding Market-Level Risk

Market-level physical impacts from acute recurring risks like wildfires and hurricanes

Market-level physical impacts from chronic, long-term risks such as sea-level rise

Changing sentiment and preferences of investors, lenders, and consumers

Likelihood of rising insurance costs in riskier markets

Minimal Understanding Market-Level Resilience

City capacity to implement effective resilience strategies

Cost of implementing resilience strategies to real estate owners, developers, and residents

Climate events' fiscal impacts in the absence of recovery funding

Potential migration patterns

How the resilience of a city's infrastructure will affect the value of a property, taxes, and credit ratings

Research Process

ULI first documented emerging practices for addressing physical and transition risk in partnership with Heitman in 2019, in the report *Climate Risk and Real Estate Investment Decision-Making*. This report identified that leading investors were piloting new practices in asset-level physical risk assessment, due diligence, and portfolio diversification.

For this 2020 report, ULI and research partners Heitman, Arup, and Milliman asked the question: "How are climate-focused investors

factoring market-level climate risk into decision-making?" ULI helped answer the question by interviewing leading global real estate investment managers, institutional investors, and other public and private real estate and land use practitioners. These interviewees contributed their expertise and perspectives anonymously. Heitman, Arup, and Milliman contributed thought leadership and corresponding "deep dive" analyses to better understand how the industry's view of climate risk is progressing and why climate-related risks have not yet been comprehensively priced into the market.

2. Climate-Risk Context

Leading real estate firms' interest in climate risks at the market level reflects the acceleration of climate change, its widening effects, and some cities' and businesses' increased focus on climate action.

Anticipating the Physical Risks of Climate Change

Climate change is increasing the frequency and intensity of many different weather events that result in catastrophic losses, including extreme precipitation, drought, floods, tsunamis, wildfires, heat waves, and landslides. (Earthquakes and volcanic eruptions are also destructive, but there is no clear link between these events and climate change.)^{1,2,3}

Globally, 40 disaster events in 2019 each resulted in at least US\$1 billion in near-term, direct losses.⁴ The upward trend of billion-dollar disasters is significant, but that metric does not reflect the numerous events that result in fewer lost dollars that are still devastating to communities. Worldwide losses from extreme weather events from 2010 to 2020 totaled over US\$3 trillion, more than a trillion dollars over the previous decade.⁵

Investors, lenders, city officials, and others are increasingly recognizing these physical risks, with some financial consequences. For example, Moody's has followed through on its 2017 announcement to consider climate readiness in bond ratings by downgrading Cape Town, South Africa, after three consecutive years of drought led to fears the municipality would run out of water.⁶ In 2019, Moody's also downgraded Trinity Public Utilities District in California because of wildfire risk and purchased the climate firm Four Twenty Seven (427) to advance Moody's physical risk assessments.⁷ Many policymakers have cited Moody's and other rating agencies' interest in physical risk and climate change preparedness as a reason for new investments in climate resilience.

Financial Sector Focuses on Climate Risk

BlackRock, the world's largest asset manager, made headlines in January 2020 when Larry Fink, the firm's CEO, stated in his annual letter on corporate governance that "climate change has become a defining factor in companies' long-term prospects," and "we are on the edge of a fundamental reshaping of finance."⁸ The BlackRock announcement signified an increasing industry prioritization of climate change mitigation, or efforts to prevent or reduce greenhouse gas emissions.

Fink's letter aligned BlackRock with many rating agencies and private and public banks such as the Asian Development Bank, Barclays, Lloyds Bank, SwissRe, and BNP Paribas. This letter was a topic of discussion among interviewees, who noted the increased industry recognition of the issue and the need for action. Some also noted that this commitment is likely to lead

to change in capital allocations and an increased recognition of climate risk and broad environmental, social, and governance (ESG) topics, with consequences occurring far more swiftly than from the physical effects from climate change itself. Indeed, in less than one week after Fink's announcement, ESG funds received significant attention; for example, assets in iShares ESG exchange-traded fund (ETF) increased more than 30 percent.⁹

"We've seen an increase in questions from our investors . . . 'What are we going to do to mitigate climate risk?'"—Global investment manager

"We've seen an increase in questions from our investors on the topic of climate risks . . . [and] you can't open the newspaper or go on social media without seeing the impacts of climate risk," noted one global investment manager in an interview. "Those factors . . . led us to take a step back and say 'What are we going to do to mitigate climate risk and make sure we have taken that into consideration in acquisitions and in our day-to-day asset management?'"

For multiple sectors, the awareness of climate change risks and action has generated an increased need for transparency and disclosure. A 2019 white paper by asset manager J.P. Morgan Chase that evaluates climate risk in equity investing concludes that one of the three main factors to consider is disclosure of environmental issues.¹⁰

Leading real estate investors report participating in the Task Force on Climate-Related Financial Disclosures (TCFD) as established by the Financial Stability Board, and using the results to drive climate-risk decision-making. One interviewee representing a real estate investment trust in Southeast Asia noted, "[A]s TCFD methods are fleshed out, property managers will have a better understanding of those key risks."¹¹ The interviewee further noted, "We actually ran a TCFD analysis of our portfolio, and . . . this gives us insight into which regions we should be developing in, how we should respond, and what are the issues we need to look at right away."¹² GRESB, the Global Real Estate Sustainability Benchmark, has also recently integrated a Resilience Module, which scores respondents on their climate risk and resilience strategy.

If unprepared for potential policy changes, resource availability modifications, and shifts in economic development and market trends, investment managers and the private sector face transition risks as municipalities adapt to a changing climate. However, real estate investment managers interviewed

Natural Disasters, by Cause

■ Climatological

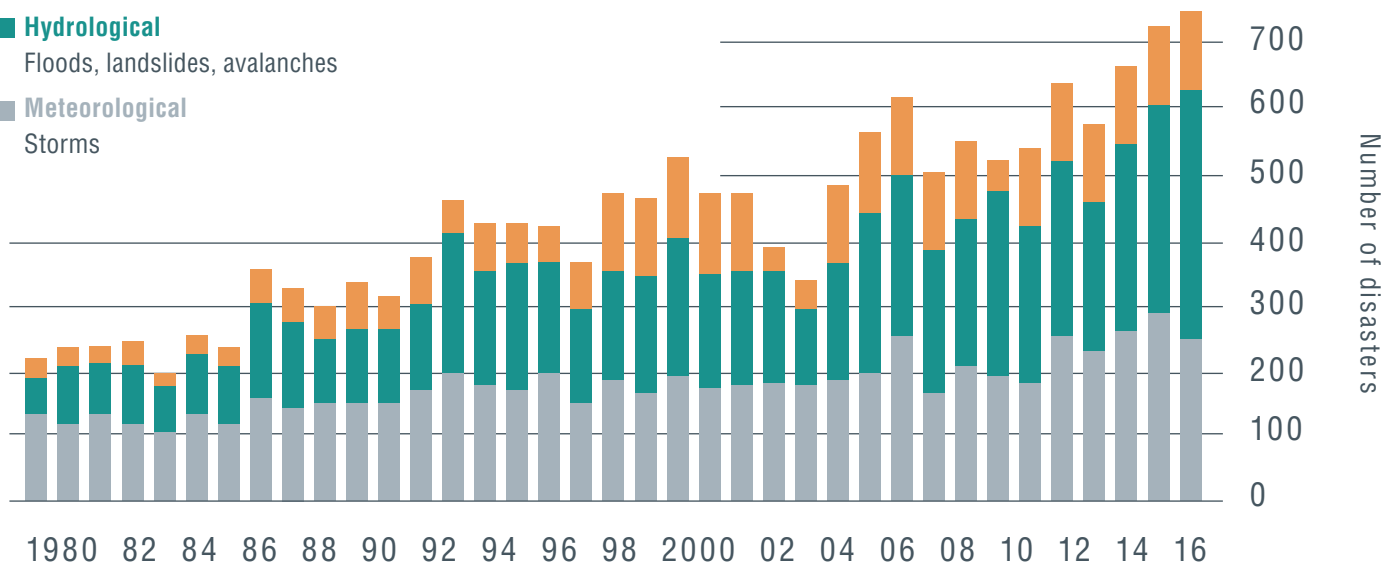
Extreme temperatures, droughts, forest fires

■ Hydrological

Floods, landslides, avalanches

■ Meteorological

Storms



Adapted from MunichRe.

emphasized awareness of these transition risks and noted that many have adopted value-driven climate mitigation strategies.

Trends in the Insurance Sector

Insurance providers are also affected by climate change, and early innovations demonstrate that experts are trying to ensure long-term profitability as well as provide faster postdisaster resources. According to Munich Re, insurers on average cover about 35 percent of global natural disaster losses: in 2019, that meant US\$52 billion of insured losses.¹³ Aon’s global loss estimates from extreme weather events are higher: about US\$71 billion of insured losses. Expensive events contribute significantly to the annual total of insured losses completed by both companies; for example, the 2019 typhoons Hagibis and Faxai in Japan accounted for about US\$10 billion of insured losses.¹⁴ Notably, in 2018, Merced Property & Casualty Co., a California insurer, went bankrupt after the Camp Fire, which caused US\$64 million in liabilities for Merced.¹⁵

Insurers also report that traditionally “lesser risks,” such as heavy rainfall and flash floods, are increasingly ruinous and expensive;¹⁶ a “complex severe weather outbreak” in late October 2019 led to flooding, landslides, winds, and wave action, which caused 30 fatalities and US\$3.4 billion in economic losses in Italy, for example.¹⁷ A 2019 study by Deloitte found that more than half of U.S. state insurance regulators “indicated that climate change was likely to have a high impact or an extremely high impact on coverage availability and underwriting assumptions.”¹⁸

In response, insurers have sometimes raised prices or refused to issue new policies in high-risk areas, and regulatory entities have imposed restrictions on higher rates. Following the California

wildfires in 2018 and 2019, for example, insurers canceled many homeowner policies in high-risk areas. In response, the state imposed a one-year ban on that practice.

Real estate investment managers interviewed for this report noted that they are currently seeing increases in property insurance premiums, a trend many attribute to climate change and the increased frequency of storm events. “We are looking at the possible physical damage, but insurance is a key factor for us,” noted a U.S.-based investment manager. “Pretty much all of our insurance is renewed annually at the discretion of the insurers, so that is part and parcel of the risk.”

Most interviewees also expressed overall uncertainty about future insurance prices and the likely market impacts of shifting insurance policy. In an extreme scenario, some investors envisioned a future in which properties could not qualify for insurance at all and therefore became ineligible for loans. In short, a loss of insurance could cause a downward spiral even in the absence of a peak climate event. Even without a worst-case scenario, the annual insurance pricing structure can underpredict risk for longer hold periods as well as for infrastructure.

Parametric insurance, where insurance payouts are linked to when predefined event parameters such as extreme weather events are met or exceeded, is an emerging option. Industry leaders note that parametric insurance may become more widespread, but it is not an appropriate solution for all scenarios. The Caribbean Catastrophe Risk Insurance Facility (CCRIF) is a regional fund launched in 2007 that uses parametric insurance to provide cash to small island nations and Central American governments recovering from disastrous natural hazard events.²⁰ The New York



Metropolitan Transportation Authority is another early adopter; it issued a parametric catastrophic bond in 2013 and renewed it in 2017. The US\$125 million policy covers earthquakes and storm surge.²¹

More recent parametric policies include Swiss Re's May 2020 expanded parametric hail coverage,²² and early U.S. federal proposals in response to mounting business interruption costs from COVID-19 include parametric triggers.²³ U.K.-based insurers have suggested similar parametric responses to the coronavirus.²⁴

Limitations of the current catastrophe models and potential future improvements to more accurately price climate risk are explored by Milliman in chapter 5 of this report.

“I expect in the long term we will change our whole valuation model. I believe . . . the future evaluation process will take into account extreme weather events and other physical risks.”—Asset manager

Valuation Impacts for At-Risk Assets

Major firms have started to rule out individual investments based on physical risk assessments with the expectation that sooner or later the market will catch up to pricing risks into valuations. For example, “In Australia a couple of assets had fire risk, which was one of the factors not to go for them,” said one global investment manager. Investors in a few cases also reported lower asset valuations because of climate risk, but all interviewees

acknowledged that climate risk is not currently a common factor in valuation for most of the industry.

“If we are looking to buy an asset, improve it, and sell it on, certainly climate risk is not a huge risk, but there is an opportunity to add value to make assets more climate resilient and market it as such.”—Global investment manager

Other than the fundamental decision to not move forward with a purchase, most interviewees stated that they had not seen a material impact on pricing in core markets specifically caused by climate risk. Several interviewees, however, offered examples of lower valuation because of operations risk, which was influenced by extreme weather events. For example, one investor put in lower bids for two assets in the United States based on concern about business continuity if the buildings had to be evacuated. “Someone else bought it, so it hasn't affected the price for that property. As a slightly more risk-averse investor, we didn't feel comfortable buying it at that price, but we would've been happy buying it at a slightly lower price,” said the investment manager. Similarly, several investors reported sometimes applying a higher discount rate to an asset in areas without sufficient existing infrastructure.

Valuation has become more urgent for investors considering longer time horizons. Accordingly, another practice that is becoming more common among investors and investment managers prioritizing climate risk is viewing investments across longer time horizons, often well beyond their expected holding

period. In short, firms perceive additional risk because of the potential scenario for the new buyer at the exit point. Some investors have also informally discussed properties having “expiration dates” after which they may no longer be safe or suitable for residential or business use without extensive investment in surrounding infrastructure.

“We’re working with scenarios in 2050, 2100, which are still a long time into the future. Let’s say our typical hold period is seven to 10 years. At the end, we need an exit or we’re going to sell to someone else who’s also got to have a seven to 10-year hold period. At that point, we will also have to think about their exit,” said a global institutional investor.

Although considering climate risk in valuation is an emerging practice, all interviewees emphasized it would become more granular and sophisticated with time and they anticipated positive

benefits, particularly given the longer-term viewpoint. “If we are looking to buy an asset, improve it, and sell it on, certainly climate risk is not a huge risk, but there is an opportunity to add value to make assets more climate resilient and market it as such,” said one global investment manager.

Anticipating steep declines in building value because of climate impacts runs counter to how buildings are currently valued. In the current model, value is derived from the residual value of the land and structure, plus discounted cash flows over time that drive net present value and cap rates. However, if dramatic changes lead the value of the structure and land to approach zero, cap rates would change significantly, with a steep decrease in value after purchase, and would need to be offset with increased cash flow and profitability to maintain net present value.

Devaluation in Coastal Markets for Single-Family Residential: U.S. Examples

An active area of real estate–related climate risk research is the question of whether devaluation for single-family homes in coastal areas is occurring because of flooding related to sea-level rise, and if yes, by how much. Three studies on the value of single-family residential in coastal areas have concluded climate risk is affecting home prices:

- A 2018 study by researchers from Pennsylvania State University and the University of Colorado documented an average **7 percent “sea-level-rise discount”** for coastal residential properties that are non-owner occupied (i.e., investor-owned buildings).²⁵
- A Harvard University analysis of values in Miami–Dade County found that **properties at higher elevations are appreciating more quickly** than similar homes in lower elevations.²⁶ This study considered both nuisance flooding and sea-level rise.
- Based on its FloodFactor tool, the First Street Foundation released data in 2018 showing that **eight states have lost a total of US\$14.1 billion in home values in coastal areas** because of sea-level-rise flooding since 2005.²⁷ The analysis considered coastal home values in New York, New Jersey, Connecticut, Florida, Georgia, South Carolina, North Carolina, and Virginia.

Critics of the studies note that these studies have largely considered well-developed markets such as Miami–Dade, which may not necessarily reflect national trends for regional coastal markets. Critics also note that demand for single-family homes in coastal communities remains high, even if devaluation is occurring.



Chuttersnap / Unsplash

Progress in Assessing Climate Risk at the Asset Level: What a Difference a Year Makes

Among the leading real estate investment management firms interviewed for this report, almost all had more consistently integrated climate risk into their business processes, when considering individual transactions, in comparison to documented efforts in 2019. One global investor noted: “We are ever more active . . . [and are looking] at the risk of each transaction and looking across our current portfolios.” The following are key trends identified about investors’ climate-risk practices:

- All agreed that **valuation is currently lagging behind recognition of climate risk** and anticipate this changing in the near future. “We are at the point of the turn of the tide, where from now on [there’s going to be] so much awareness, but that has not yet started to feed through to valuation,” said one global investment manager. Some interviewees could point to limited examples in their own appraisals of decreased valuation due to climate risk, and others pointed to examples of increased valuation due to resilient design at the asset level. Valuation does not incorporate climate risks because it is “backward-looking,” said one European investment manager, and changes are masked by insurance and subsidies. Interviewees also emphasized that “there is a knowledge gap and a tool gap to give [underwriters and appraisers] the ability to assess the value of the risk and somehow bring that into valuations.”
- Investors and investment managers that have fully committed to assessing climate risk acknowledge that it is **difficult at this stage to predict an effect on returns**. If interviewees’ firms had begun to factor climate risk into pricing, most emphasized that they were ahead of the wider real estate industry for doing so and did not see this approach from market peers. Without the rest of the industry collectively acknowledging climate risk, first movers cannot shift the market. “Returns in the global real estate market are set by the highest bidder. So long as there are still parties across the world that are not focusing on [climate risk], it will not be reflected in the pricing,” said one European institutional investor. “Big picture, we haven’t seen as much impact on valuation of these risks as you would probably expect,” noted another global investment manager.
- **All investors interviewed had conducted at least one, if not multiple, physical climate vulnerability assessments for their portfolios**, whether in house, via a third-party consultant, or via multiple third-party consultants. With the acquisition of leading climate analytics firm 427 by Moody’s in 2019, vulnerability assessments became significantly more mainstream and are

increasingly being integrated into due diligence. One interviewee stressed how data providers can also offer investors clear prioritization for potential acquisitions based on materiality, noting that “we don’t want to spend a lot of time assessing climate risk when we don’t see a lot of climate exposure.” These analyses often consider both climate data and potential financial impacts; storms and floods are the main physical risks considered, and investors are beginning to focus on heat and wildfires, too. “For physical risks, what we’re trying to do (although it is a challenge) is to be able to set out in our underwriting process how those physical risks might impact liquidity, rental growth, and insurability and insurance costs,” explained one global fund manager.

Some investors also expressed confusion about the available data and range of available climate analytics products. Interviewees discussed the complexity of finding the best approach with a proliferation of climate analytics firms and approaches that yield variable data given the granularity of the models.

“For physical risks, what we’re trying to do (although it is a challenge) is to be able to set out in our underwriting process how those physical risks might impact liquidity, rental growth, and insurability and insurance costs.”
—Global fund manager

- **Pricing climate risk and resilience into an investment analysis is more difficult than pricing energy efficiency and carbon reductions**. Managers can quantify the return on investment of improving energy performance and climate mitigation, assuming a future price on carbon. Investors are starting to integrate climate risks associated with asset value into a similar framework as they use for energy management and climate mitigation, using frameworks and tools like the Task Force on Climate Related Financial Disclosures for physical and transition risks, and the new Carbon Risk Real Estate Monitor (CRREM) tool for transition risks.



- Most investors also spoke about the formal **integration of climate-risk considerations into due diligence and tools such as ESG scorecards**. Multiple interviewees noted that climate risk factors have been integrated into asset ESG scorecards and expressed interest in seeing climate risk more prominently incorporated into the market assessments and rankings used by their firms.
- Most investors could speak to **potential acquisitions that had not advanced through the due diligence process due to climate risk**, typically related to specific concerns about the site. These concerns are likely to have been uncovered through a physical risk assessment and screened before a potential acquisition reached Investment Committee. One U.S.-based investment manager noted that due diligence now covers “key risk factors, predominantly flooding and wind.”
- Most interviewees also expressed a commitment to **better understanding future insurance prices and the likely market impacts of shifting insurance policy**. This annual insurance pricing structure can underpredict risk for longer hold periods, as well as for the underpinning infrastructure. The approach also assumes the long-term availability of underwriting capabilities, in terms of the affordability and availability of products. If sites are unable to obtain insurance, they will not be eligible for loans, leading to major potential valuation consequences.
- Interviewees emphasized that **climate-risk analyses frequently influence property design**. Several discussed efforts to design risk mitigation strategies for vulnerable assets and price these costs into deals. Some also spoke about resilient design as presenting opportunities to differentiate assets and enhance value. For example, one interviewee said they were exploring opportunities to create a “resilience zone” under the assumption that some tenants would be willing to pay a premium for this level of protection. The resilience zone could offer widespread use of backup generators and be close to access routes at higher elevation. “I think the insurers and some of the Fortune 500s might have a keener interest in driving that kind of discussion and see additional value,” the interviewee noted.
- Almost all interviewees reported using **climate-risk analyses in property management and business continuity strategies**. Many were working with their property managers to ensure on-the-ground staff have a thorough appreciation of climate risk and preparedness plans for peak events and chronic risks at the asset level. One investor was putting together an infrastructure guide for each of its facilities, owned and leased, providing guidance for facility preparedness and protecting people and property. Most interviewees also emphasized a robust business continuity/ risk management program for their firm’s own operations and real estate assets.

3. Assessing Climate Risk at the Market Scale

For global investors, a core part of their business involves assessing risks and opportunities—and knowing which markets are likely to present the best immediate and long-term return on investment. Understanding climate risk at the market scale is a challenge for investors because of the complexity with which climate-related risks affect markets, the time frame in which effects materialize, and the difficulty of measuring the effects of city resilience efforts.

A growing number of investors, with help from climate modelers, economists, engineers, actuaries, and public finance experts, are looking to develop indicators to assess climate risk at the market scale and understand how physical risks drive near-term financial impacts and longer-term transition impacts that influence a market’s future sustainability. Interviewees also indicated that they are beginning to assess market-scale resilience strategies (including existing and planned infrastructure, insurance availability and affordability, policy, governance, and other factors), which have the potential to meaningfully mitigate the human harm, property damage, and business interruption caused by climate impacts.

In response to their assessments of physical and transition risk as well as of municipal resilience efforts, investors are changing their behaviors in some markets. They are also collecting new information and developing key indicators to inform decision-making and to identify markets that are responding to climate risk through investments in infrastructure and policy.

Reconciling Vulnerability and Adaptation

Many of the most economically powerful coastal cities face significant climate risk. However, these cities offer some of the most attractive investment environments, meaning that the risk is worth the return. “We have a dilemma that some of the most attractive markets are also markets that are affected more by weather-related risks,” noted one real estate investment manager. “On one extreme, if you wanted to divest from all climate risk, you end up introducing other types of risk in the portfolio. . . . If I divested from all these coastal markets, our returns would suffer.”

“We have a dilemma that some of the most attractive markets are also markets that are affected more by weather-related risks.”
—Real estate investment manager

A few interviewees elaborated further, noting that some of the most promising markets continue to present significant climate risk but also currently offer the most returns. Investing in these markets therefore represents a calculated risk, of which investors are increasingly aware. “The more the uncertainty plays into it, the higher the return threshold needs to be for folks to make rational decisions to stay in these markets,” said a U.S.-based real estate investment adviser.

Many of these high-risk cities are proactively enacting robust climate adaptation policies, building climate resilient infrastructure, and adding incentives or new regulations to encourage building-level resilient design. These initiatives represent progress from a decade ago and have the potential to significantly mitigate risk. However, some climate-aware investors question whether the programs sufficiently respond to the extent of risk faced and ultimately what the overall impact will be on real estate. One investor noted that he was seeking information to understand and compare markets “not necessarily for the biggest risk, but . . . the biggest risk relative to what city governments are already paying to absorb that risk.”

Quantitatively comparing physical risk and climate change readiness is a challenge for investors and policymakers. “There is no way to measure the city’s adaptation response at scale and with data right now,” explained an interviewee from a climate analytics firm. “Over time we will see more standardized reporting of how the city is addressing these issues, but right now it does not exist.” Some investors lamented this problem in interviews, noting the anecdotal nature of information. If a city “is spending a ton of time and resources [to address climate risk], is that sufficient to solve the problem?,” asked one investor.

Investors focused on climate risk generally believe that the value of resilient infrastructure is under-recognized and that the correlation between a market’s ability to be prepared for climate events and real estate investment performance will be greater in the future. “If a city was addressing [the impacts of climate change], you would think that would be a strong mitigator that addressed risk in that market, [creating opportunities to] drive value and add investment,” noted one investment manager. Some cities have begun to undertake broader economic impact studies for resilient infrastructure projects, determining the business case for investment by considering job creation and retention and preservation of the tax base as well as avoided losses.



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When Climate Risk Affects Investors' Market Decisions

Although most investors interviewed spoke freely about individual properties that had not advanced through due diligence because of climate risk, they did not have strong examples to share regarding similar scenarios at the market level.

Some interviewees emphasized that they are not currently reducing activity in any market because of climate risk and reiterated their continued interest in and enthusiasm for investing in historically profitable markets facing significant physical risk, such as New York City, Boston, South Florida, Tokyo, and Amsterdam. But several of these investors noted that they are increasingly focusing on ensuring individual assets are prepared for the effects of climate change and assessing the costs of that preparedness. One sustainability lead at a major fund noted that climate-risk considerations “are made on an asset by asset basis. We didn’t want guidelines that would restrict our investment universe. Each acquisition is unique; each asset is unique.”

“The more the uncertainty plays into it, the higher the return threshold needs to be for folks to make rational decisions to stay in these markets.” —Investment adviser

However, a few investors indicated that they are beginning to suspend acquisitions or take steps to reduce their real estate footprint in city markets where they harbor climate-risk concerns. Examples of divesting from entire markets because of climate risk remain limited but do exist. In most cases where an

investor divested from an entire market, they harbored general concerns about that market, and climate risks represented one problem too many. Some investors shared examples about markets where their behavior had recently changed because of perceived climate risk, primarily providing commentary on U.S. markets, including the following:

- One investment manager described an exit from Houston after Hurricane Harvey (2017), where “the climate risk factor added a material lever to the overall conversation.” The process of exiting took several years, given the need to make improvements to damaged properties. “We had to wait a couple of years . . . to restore the buildings’ reputations,” noted the investment manager. “We have been trying to determine an internal case study of what happened there and what does it mean to have your property impacted by a climate event.”
- Another investor described a decision to significantly reduce investment in Boston because of concerns about sea-level rise and the high proportion of the city developed on fill.
- One European investment manager noted that market decisions related to city-level physical risk can also happen in cities where climate risk is not commonly perceived as a major issue. The investment manager shared Edinburgh as an example, where a concern about future sea-level rise for a potential acquisition prompted an investigation of the municipality’s infrastructure plans for the surrounding area. “If flood risk comes out as something unfixable, then that will be an exclusion,” said the investment manager.
- Some interviewees noted overall speculation about prospects in South Florida, discussing concerns about flood risk while recognizing the resilience work underway at the city and regional levels. “I do think there is an observed discount for properties in South Florida,” noted one U.S.-based investment



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manager. Another investor described a process by which its fund reduced its exposure to a region after completing a local flood-risk study that shed light on the region's compounded risk via its geological foundation of porous, erosion-prone limestone. While the firm did not report a formal policy on investment in the region, the flood-risk study led to greater focus on properties with fewer vulnerabilities at the asset level.

- One interviewee described the potentially prohibitive required climate mitigation costs in California compounded by the uncertainty of whether appropriate infrastructure would be completed on schedule or at all. He stated, "The process of future-proofing development from the perspective of the California Coastal Commission is a very important part of the planning and design process, and it's adding a layer of risk."

The preceding examples reflect interviewees' recent decision-making on market activity and were shared on an anecdotal basis. Interviewees also alluded to markets that would merit further consideration because of future physical risk, remarking on wildfire risk in Australia, typhoon risk in Japan, and flooding risk in London and Copenhagen, among other examples.

For most investors interviewed, decisions to shift strategy in an established market often aligned with other concerns. Those concerns could relate to a city's general emergency response ability as measured by low-quality infrastructure, historical slow disaster response, or poor government accountability. In other cases, concerns aligned with broader questions beyond climate, such as local job market, fiscal challenges, rising insurance costs, or changing cost of living. Some investors also noted that they were using climate risk as a consideration to not enter a new market, or to "press pause" on new investments in certain markets. In essence, climate risk has become a "tiebreaker" for investment activity in certain cities.

In a small number of conversations, some managers noted making market-based decisions on limited or even anecdotal information. "There are so many markets to choose from," noted one manager, explaining that anecdotal concern was enough for him to avoid markets that could be vulnerable. Decisions like this were informed by a range of types of sources, from popular media articles to think tank studies focused on topics outside of real estate and land use. This approach to investment decision-making could prove detrimental to cities vulnerable to climate impacts and whose extensive resilience policies and infrastructure investments may require greater industry recognition.

Rankings, Data, and Metrics for Market-Scale Risk and Resilience

Although many city rankings and frameworks considering ESG topics exist, leading investors do not agree on how to quantitatively assess markets for climate risk, incorporating both vulnerability and resilience investments. One investment manager said, "We have never found any [tools of frameworks] that cut to the chase and say, first, is this city impacted by climate change? And second, is the city's reaction appropriate and sufficient given the risk?"

A climate analytics provider concurred, noting the complexity of measuring "what a city is doing in terms of adaptation and infrastructure investment and how that maps in terms of actual exposure to climate and . . . trajectory for growth. . . . [There is no] consensus methodology, so it's very much a qualitative difference, and that what makes it difficult to compare." To compensate, investors have reviewed articles and open-data sources on citywide risk, researched public officials' responses to climate risk, and compared their findings to rankings related to aligned topics, such as sustainability.

"We have never found [any tools of frameworks] that cut to the chase and say, first, is this city impacted by climate change? And second, is the city's reaction appropriate and sufficient given the risk?"—Investment manager

Ratings agencies are also beginning to pay more attention to and better contextualize these issues, although analysis continues to occur on an annual basis. One ratings agency noted that it supplemented studies of physical risk "by looking at other data sources like hazard mitigation plans that are maintained by local governments, or climate sustainability plans" as well as the agency's "interviews and discussions during the rating process with local leaders on how they're incorporating all of those things into their overall response."

Climate Risk at the Market Scale: Key Factors

This feature refers to the menu of practices, policies, and milestones to consider when evaluating how a market has acted to reduce potential harm from, or exposure to, physical climate risks. Topics are compiled from and inspired by the indicators that interviewees who contributed to this report are using in their own work or would like to in the future.



Physical Risk Faced

Market-scale climate risk assessment should first screen markets for types of physical risk faced. Physical exposure may be considered through a variety of metrics, such as total or percentage of population at risk, total or percentage of geographic area of a city at risk, total or percentage of real estate value at risk, potential for a peak event to disrupt the core business area, existence of core business and residential areas with reduced vulnerability, and other metrics.



Drought and Water Stress



Extreme Heat



Extreme Precipitation



Hurricane, Typhoon, or Storm Risk



Rising Water Levels



Wildfire Risk



Plus:
Other Environmental Risks

City Capacity and Strategies for Responding to Climate Risk



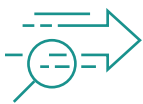
Accountability and Financial Position of Government

Issues to consider include fiscal solvency, borrowing power, bond rating, near-term revenue sources, and local ability to enforce policy changes.



Building and Development Resilience

Practices and milestones to evaluate include planning and zoning measures incentivizing development in areas facing reduced physical risk, best-in-class building codes, and the existence of funded buyout programs.



Business Continuity

Issues to consider include grid reliability, supply chain availability, the quality of transportation infrastructure, access to housing (including affordable housing) for key workers, and resilient telecommunications.



Emergency Preparedness

Policies and practices to consider include emergency communications and evacuation plans, community engagement programs, and community resilience hubs, which are facilities supporting residents before, during, and after a climate event.



Infrastructure Investment

Metrics to consider include current/planned geographic coverage, construction timelines and speed of implementation, types of storm or climate events addressed, committed funding, and maintenance plans.



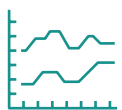
Insurance

Issues to consider include availability and affordability of private insurance and reinsurance for insurers in the market, and capacity of government mechanisms to support real estate owners.



Mitigation and Energy Efficiency

Policies and practices to evaluate include climate action planning, climate mitigation commitments such as greenhouse gas emissions reduction targets, progress meeting goals, and current emissions baseline.



Resilience Governance

Practices and milestones to evaluate include existence of a chief resilience officer—and capacity, permanence, and reporting line of the role—use of science-based decision-making in policy, budget for planned resilience investments, and engagement of citizens and the business community.

Climate Risk and City Fiscal Indicators

In high-performing markets, climate risk does not necessarily contribute to municipal fiscal problems as measured by traditional indicators like gross domestic product. In fact, “peak events” can lead to an influx of speculative property purchases during the recovery period and to international and national recovery funding and insurance payouts that can be applied to infrastructure investment and repair. *(See research by Arup, profiled on pages 30–31).*

Speaking about recent extreme climate events in the United States, one interviewee said, “In each [case], you saw the same ultimate resolution, which was very little impact. One, two, three years down the road, storms were not detrimental to market performance. Essentially, it’s the assumption that the cost to insure against these disasters will never change.” Others noted the differing market dynamics occurring after events; for example, Hurricane Sandy did not lead to long-term economic impact for New York City, whereas Hurricane Katrina led to reduced population in New Orleans.

Others chose to speculate about the long-term viability of a model in which national funding is widely available after a disaster, particularly in a U.S. context. The phases after a big disaster, according to one interviewee, were to see the market buoyed up by subsidies and insurance, followed by rebuilding and speculative demand. During the cleanup and reestablishment of the market, the costs of future event preparation were viewed by most to remain constant despite contrary climate change evidence.

This short-term “sugar high” of disaster support, insurance claims, and opportunistic investment likely masks underlying negative and fiscal impacts that could be exacerbated by future climate-related events (or other shocks). Between the growing awareness of underlying vulnerabilities, increased impacts of climate change, and the future economic landscape, given stretched government resources in the era of COVID-19, many investors have asserted that this post-shock cycle is likely to change with a more sophisticated understanding of the true costs of climate-related events.

In the United States, one interviewee noted, “There are two big mechanisms through which costs are likely to increase going forward: one is insurance, [and] the second area is . . . tax rates.” Another added cost is the increased fees from lenders for debt, as there have been instances where lenders charge higher rates to cover increased market risk.

“There are two big mechanisms through which costs are likely to increase going forward: one is insurance, [and] the second area is . . . tax rates.”—Real estate investment adviser

Considerations for Climate-Risk Market Analysis

While many investors interviewed noted their interest in a framework for market assessment and comparison, none had identified one to meet their needs. Even those who have begun changing practices in some markets because of climate risk have not followed a consistent methodology to arrive at those decisions.

In advance of more sophisticated methods, most investors expressed interest in better understanding a range of attributes related to climate-vulnerable markets at the city scale, such as the following:

- **Physical risk:** Physical risk is a core consideration for investors, one now better understood at the asset level because of the increasing availability of climate data. One consultant interviewed noted the “increasing capability of having very quickly, very large amounts of data available,” as well as the increased level of interest from clients. However, investors are more likely to have completed physical risk assessments for properties rather than markets. Some investors are also seeking open source information on market risk. While some publicly available studies of physical risk exist at market scale, they have not been completed in a centralized, transparent manner that allows for easy comparison between major markets and accounts for policy, tax, and other key differences.

“What experts worry about is the lack of continued investment to upkeep the system. A city is safe today, but it will fail one day without more operations and maintenance funding and planning.”—ESG lead at a real estate investment management firm

- **City governance capacity:** Metrics addressing accountability, transparency, and lack of corruption have long been a focus in due diligence, particularly for those investing in emerging markets. One investor noted that the firm “excludes markets for governance issues that would impact our ability to manage or control a property the way that we need to.” Interviewees described the political environment as an important piece of governance capacity to implement climate-resilient infrastructure and relevant policies. “I don’t think the cost is a big factor. It’s the will,” noted one investment manager. “As the Netherlands and many cities have shown, [infrastructure investment] is technically possible and financially feasible, but is there the will and political strength to do it?” Governance capacity as relevant to climate resilience is a relatively new area of focus. Moreover, the topic is a politically complex one: investments in infrastructure and changes in building policy usually take years to show results, and spending can be difficult to justify politically before a disaster occurs. Other key governance issues include a city’s ability to raise funds by imposing new taxes or raising capital through bonds, as well as city enforcement abilities vis-à-vis building codes and zoning. Importantly, the initiatives implemented by one municipal administration may not be continued or may be dismantled under new city leadership.
- **City resilience governance:** Investors discussed the emergence of dedicated resilience governance, including the chief resilience officer (CRO) role, as a positive development. “It’s all about risk mitigation,” noted one investment manager. “You can have risk, but if a city has the resources to plan ahead . . . we feel a lot better investing there . . . [When cities are] putting the resources and the governance structures behind a [CRO] and that office, you can know they are taking this seriously.” This position initially gained popularity through the 100 Resilient Cities (100RC) initiative, which was pioneered by the Rockefeller Foundation. This program concluded in July 2019, but many 100RC cities continue to support a CRO and have inspired others outside the original 100RC network to appoint resilience leads. Cities have structured this relatively new position differently and allocated widely varying levels of authority, budget, and influence, meaning investors can find determining the impact of the role difficult. Accordingly, numerous investors noted their interest in better understanding the scope of a CRO or resilience team, and benchmarking the role’s ability for impact, whether through budget, staff, implemented policies, line of reporting, or influence across key city departments.

“We’ve gone through the best-in-class efforts planning and preparedness and then scaling down for what smaller communities can realistically achieve. It’s not fair to hold a smaller community to the same standard as New York City.”—Investment adviser

- **Extent, quality, and implementation of resilience planning:** Alongside the increased interest in governance capacity for resilience, some investors described a specific interest in resilience and climate adaptation planning. For major global cities, chief resilience officers often lead this work, but sustainability, planning, public works, or infrastructure departments may also provide resilience planning leadership. Resilience planning is a relatively new undertaking for cities, so some investors describe the existence of a completed resilience plan as a best practice. Beyond the existence of resilience plans, select investors are also seeking strategies to assess the quality of plans, implementation progress, speed of implementation, and level of ambition in comparison to the risk faced. “We’ve gone through the best-in-class efforts planning and preparedness and then scaling down for what smaller communities can realistically achieve,” noted one investment adviser. “It’s not fair to hold a smaller community to the same standard as New York City.”
- **Building and land use codes:** Integration of resilience considerations is an emerging best practice for building, land use, and zoning codes. Interviewees noted that even finding this information can be time-consuming, onerous, and often unsuccessful, especially for smaller markets. “We are starting to look for land use approaches and land use policies incorporating resilience and . . . if that information is available in an easily digestible way,” said one adviser who also stated that year of building code update is a proxy they use when other information is not available.

Assessing Market-Level Climate Risk at Heitman

Mapping asset-level physical risk has advanced Heitman's ability to integrate consideration of climate-related risks into the firm's investment process. Heitman has expanded the scope of its assessment to include analysis of climate-related risks at the market level. This expansion reflects recognition that properties are not priced in isolation from their market setting. Properties are not islands; how they perform is directly related to how many jobs a city/market creates or to how many people want to live in a specific location. Tenant demand, in turn, is affected by such factors as relative tax rates and the quality of city services. Therefore, how cities are responding to the challenges caused by climate change can affect occupancy and rents, property operations, and investor sentiment. These factors flow through into property values and investment performance.

For the past few years, Heitman has engaged the firm 427 to screen and score current and forecast physical risks related to climate change for all of its assets and prospective acquisitions. This analysis has two goals. First, the screening flags any assets breaching pre-set parameters—for example, an unacceptably high risk of flooding—setting in motion additional due diligence. Second, it shows how inclusion of an investment into a portfolio would change its risk profile.

Heitman is not alone in its recognition that market-level risk caused by climate change is an increasingly important consideration for investors. Market risk will become even more relevant as climate change progresses. "We account for additional risk in various ways, depending on the type of investment and the expected hold period. If an investment premium to offset risk is not available, we focus on market-risk mitigation efforts and consider the weight a specific investment would have in a portfolio. Sometimes, we'll walk away from a prospective investment; in other instances, we'll proceed," said Laura Craft, head of global ESG strategy at Heitman.

"A property could have high flood risk in a market that doesn't have much flood risk. Conversely, a property could have no flood risk in a market with high flood risk. Either high market flood risk or high property flood risk alone could impact pricing."

In reviewing risk at the market level, Heitman is finding the landscape similar to the era before firms like 427 emerged to provide asset-level risk profiling. Given this vacuum, Heitman has developed its own market-risk assessment approach, drawing on publicly available data and local experts to do the following:

- Understand the physical risks the market is subject to, recognizing that these may differ from what an individual asset is exposed to.
- Conduct a review of relevant infrastructure (like flood walls, levees, and stormwater retention systems), including an

assessment of their quality and effectiveness. In this analysis, Heitman looks at planned infrastructure investments and their status (timing, funding source, and funding status). To date, few comprehensive data sources exist regarding infrastructure, with data quality and availability varying by market.

- Assess a market's climate risk history and future exposure. Have climate events occurred recently, or is climate risk as high a probability in the near to mid-term? If so, has the damage or expected risk resulted in corporate move-outs, population loss, or insurance premium increases?

For markets determined to be high risk, Heitman reviews the local government's approach to climate change. Does the city have a comprehensive plan in which its climate-related risks are assessed and mitigation proposed? What tactical infrastructure and resilience-building investments are proposed or already exist? For example, is there a plan to elevate key roadways in locations prone to storm surge or coastal flooding? How is the city preparing for more-intense rainfall? What mitigation strategies have been developed to contend with drought and wildfire risk?

The likely strain on infrastructure and city or regional budgets due to climate change is a key concern, and one Heitman anticipates could lead to a future devaluation of assets. Conversely, markets and regions prepared to withstand future weather events may represent more-promising locations for long-term investments.

"Last year, we wrote about how we were applying asset-level data gleaned from risk analyses to our portfolio construction and investment decision-making processes. We are continuing to refine our approach to make sure we are fulfilling our responsibility to our clients to underwrite all relevant risks," said Mary Ludgin, Heitman's head of global research and a member of the firm's Investment Committee.

"Market-level and/or asset-level risk alone will not preclude us from making an investment in an asset or a geography. However, we want to make sure pricing reflects an asset's risk and opportunity and that risk mitigants are in place. Our decision-making set is also impacted by the time horizon of the investment and where our investor's money resides in the capital stack."

Recently, Heitman undertook an analysis of a property on high ground where climate modeling showed low asset-level risk to sea-level rise, due to elevation and relative position in comparison to its surroundings. However, the nearby properties and the market at large faced a higher sea-level-rise risk profile. Models indicated that the neighborhood would increasingly experience inundation over the next two decades, and the asset itself would be isolated in three to four decades as sea level rises. Although the individual property was not at risk, the market had limited mitigation measures in place to offset sea-level-rise risk. In this situation, Heitman would not be inclined to pursue such an investment. The firm takes a similar

approach to assets already under management and would seek an exit. Furthermore, lenders have begun to adopt similar views and have increased loan rates to cover market-level climate risk.

“We have created a system that allows us to assess and account for market-level risk in investment decision-making by understanding the type of climate market risk faced, the market risk mitigants and resilience, the investment time horizon and structure, and the portfolio exposure tolerances.”—Laura Craft, head of global ESG strategy, Heitman

From the macro perspective, the World Economic Forum country analysis provides a snapshot of the overall quality of infrastructure at a country level. Regional and local databases, many of which are freely and publicly available, provide micro-level detail about local climate-risk mitigation preparedness. For example, with U.S. infrastructure aging, the reports from the American Society of Civil Engineers and the U.S. Army Corps of Engineers provide an understanding about the upkeep of levees, dams, storm-water retention facilities and other water-related infrastructure in place to protect a market from climate risks. The National Oceanic and Atmospheric Administration’s Sea Level Rise Viewer shows how sea level might rise to affect U.S. markets.

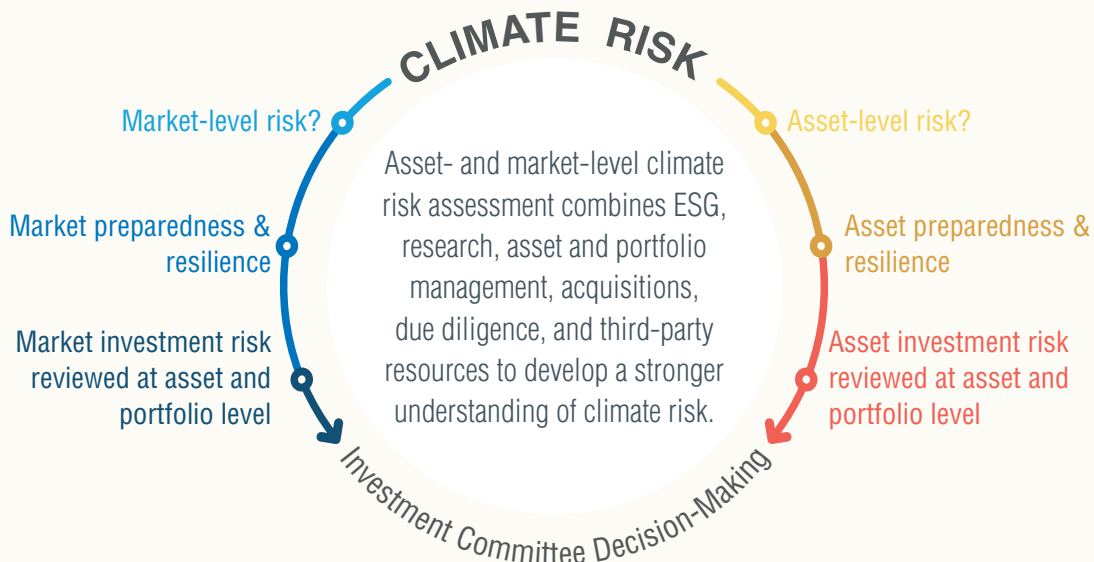
From Heitman’s perspective, a deep dive into market-level climate risk and resilience is necessary to understand the time horizon of the climate risk, how climate risk might translate into fiscal risk,

and the degree to which a market is resilient to this broader set of risks. Heitman’s expectation is that investments in markets facing imminent risk that have not been mitigated will see the largest decrease in valuation and the largest increase in required investment return to offset the additional risk exposure.

In addition to its multilayered review of infrastructure quality and preparedness, Heitman applies internal resources to vet other aspects of market- and asset-level climate risk and resilience. Heitman’s ESG team works with the firm’s due-diligence teams and third-party experts to develop a comprehensive view of the climate-related market- and asset-level risks a potential investment and its locale may face.

“We have created a system that allows us to assess and account for market-level risk in investment decision-making by understanding the type of climate market risk faced, the market-risk mitigants and resilience, the investment time horizon, and structure and the portfolio exposure tolerances,” said Craft.

“Market-level and/or asset-level risk alone will not preclude us from making an investment in an asset or a geography. However, we want to make sure pricing reflects an asset’s risk and opportunity and that risk mitigants are in place.”—Mary Ludgin, head of global research, Heitman





Financial Impacts of City Strategies

Some investors are concerned that the costs of city-required resilience investment may outweigh the benefit. Investors raised questions about how city resilience investments would affect the local investment environment, the longevity of current funding sources, and the ultimate effect on real estate taxes. Addressing these concerns will first require the ability to understand the baseline risk and anticipated future changes to this risk in a city market—an extremely difficult task.

In a best-case scenario, mitigation pays for itself: investment in preparedness infrastructure should reduce costs for recovery. An often-cited report by the National Institute of Building Sciences estimates that every \$1 spent on hazard mitigation by select federal government sources can save \$6 in recovery costs.²⁸ Accordingly, climate-ready infrastructure is theoretically a sound investment for a city, assuming an increased frequency and intensity of events caused by the effects of climate change. Generalized statistics like this can be harder to find for real estate, especially given the wide variety of market conditions and assumptions relevant to different real estate product types.

Interviewees said their interest in understanding climate risk at the city scale stems from an interest in protecting property and an anticipation of likely long-term costs. “Our view is that there are more costs coming for all of these resilience risks—hardening costs, insurance costs, property taxes costs,” noted one U.S.-based investment manager. “I’m not sure when these costs will hit, but they will.”

“Our view is that there are more costs coming for all of these resilience risks—hardening costs, insurance costs, property taxes. I’m not sure when these costs will hit, but they will.”
—U.S.-based investment manager

Another investor summed up the issue: “To pursue any of these strategies [for climate adaptation] costs money, and that will increase taxes.” These taxes and fees incurred could range from transaction costs to stormwater fees, permitting costs, zoning variance costs, or many other models. Efforts to enhance resilience, such as strengthened building codes and design guidelines, are also likely to present additional costs in the short term, even if they lead to avoided losses over the long term. An interviewee from a ratings agency agreed, noting that “there’s a balance certainly to be struck between the implementation of projects and the cost at which they’re being implemented.”

Investors should “evaluate what types of financial instruments are being deployed to generate capital to build [and] strengthen infrastructure.”—Ratings agency interviewee

Investors also commented that climate costs are sometimes not as significant as other costs faced by cities, such as pension payments or the recent surge in expenses related to fighting COVID-19. “In the short and medium terms, the bigger concern is a city’s ability to fund pension liabilities, which are current and enormous and seemingly dwarf environmental costs,” said one U.S.-based investor. “We take that into account when we decide what cities to invest in. We have not done that with climate.”

Another focus is understanding the range of options for infrastructure investment available to cities. One interviewee noted an interest in better understanding “the number of tools that [a city] can use to preserve credit quality in the event of a sudden climate shock like a hurricane, or again, the long-term implications of sea-level rise. Because when you look at it from that perspective, of course, it [leaves you] to evaluate what types of financial instruments are being deployed to generate capital to build [and] strengthen infrastructure.” Also, funding tools vary widely internationally.

Another interviewee from a ratings agency observed, “We see a growing capacity of municipalities to be able to respond to a sudden climate event and varying degrees of capacity to come up with plans to deal with longer-term sustainability challenges. . . . With respect to the cost, a lot of this drills back to the question of not just what are you doing to protect your physical infrastructure but are you able to do it in a way that doesn’t upset your balance sheet or allows you to maintain your overall credit quality.”

We see a growing capacity of municipalities to be able to respond to a sudden climate event and varying degrees of capacity to come up with plans to deal with longer-term sustainability challenges.”—Ratings agency interviewee

Yet, although costs could be significant, the investment in infrastructure is likely to be critical to ensuring that markets in physically vulnerable areas continue to function. “For real estate, once clients understand what their exposure looks like, they quickly come to the realization that they are only able to control a limited portion of that risk,” noted one consultant. “Generally speaking, if you’re covered for flood or sea-level rise, that’s good, but what if no one can get to your building; city services like the ambulance are not available?”



4. Markets Respond to Climate Risk through Infrastructure and Policy

For city governments and regional entities climate risk is an urgent issue. Accordingly, the concept of urban resilience—and a city’s adaptive capacity in response to both major disruptions and chronic stresses—is fundamental to city governance. The term has also evolved to mean more than “building back better” after extreme events, and is also now relevant to cities’ efforts to attract and maintain talent and economic development opportunities.

Globally, most major economic hubs are in coastal, river delta, or other high-risk areas.²⁹ These locations present many advantages, relating to connectivity, trade, quality of life and placemaking. These cities house more than half the global population, with much higher percentages of residents in some regions. About 80 percent of U.S. residents live in cities, for example,³⁰ and 39 percent of the European Union population lives in metro areas with 1 million or more inhabitants.³¹

Unlike businesses, which can relocate headquarters or have employees work remotely, cities are anchored in place. A limited number of major city relocations, or plans for relocation, in part owing to effects of climate change, are underway in 2020, notably for Cairo and Jakarta. However, aside from these rare scenarios, cities must address the potential impact of climate events to their often-vulnerable locations and minimize potential harm and disruption to residents and businesses. Investors are beginning to more systematically follow how markets are making these infrastructure, policy, and investment decisions to contribute to their forecasts for the future economic health, vitality, and attractiveness of real estate investment in these markets.

Climate Migration: Moving Cities

In response to changing environmental conditions, a small number of communities are taking the drastic step of relocating, partially or entirely, to safer locations. Climate change has been a factor in these relocations, as well as other environmental issues such as air quality. This phenomenon, which requires significant funding, planning, and land availability, is an extreme form of climate migration—that is, when individuals or communities relocate because of the physical danger as well as economic and health impacts of changing climate conditions.

The largest climate-driven city relocation underway is that of Indonesia’s capital, Jakarta. Indonesia announced in 2019 that it would move administrative and governance functions and some of its 1.5 million civil service staff to a new site on the Indonesian portion of the island of Borneo. The land beneath Jakarta is sinking rapidly, with 40 percent already below sea level, making the city especially vulnerable to sea-level rise and storms.³² Plans are also underway to relocate all administrative functions and build new housing and associated development for a new Egyptian capital city to shift activity from Cairo, in part because of pollution and environmental degradation.³³

Many Polynesian island nations are also experiencing climate-driven population decline, with some islands reporting up to 15 percent of residents have already relocated,³⁴ and the possibility that some islands will be completely inundated. Choiseul, the provincial capital of Taro Island in the Solomon Islands, will be moving its entire population—about 1,000 residents—to a new town on adjacent mainland, given sea-level rise, storm surge, and tsunami risks.³⁵

The Isle de Jean Charles in Louisiana, a coastal island home to members of the Biloxi-Chitimacha-Choctaw and the United Houma Nation tribes, has lost 98 percent of its land since 1955. The community successfully applied to the Department of Housing and Urban Development in 2014 and received US\$48 million to relocate all residents.³⁶ Similarly, Newtok, a native Yupik community in western Alaska, is also in the midst of a long-term relocation project caused by sea-level rise and land erosion.

With climate change risks intensifying, and costs of insuring, protecting, or rebuilding property rising, relocating communities may become more common. While government support has enabled the limited number of full-scale relocations that already exist, future scenarios may see more significant involvement from the private sector.



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Market Infrastructure Needs

Critical infrastructure keeps markets running, protecting communities and connecting people, goods, and services throughout buildings, districts, and regions. City residents and economies are highly dependent on transit, roads, parks, water supply, waste processing, and the energy grid. However, in many cases, this infrastructure is aging, not designed to withstand future hazards, or suffers from a lack of maintenance. As one U.S.-based financial adviser remarked, “Infrastructure is getting to the point where it’s [extremely] broken.”

A 2019 Global Infrastructure Outlook analysis by the World Bank estimates that “global infrastructure investment needs to reach [US]\$94 trillion by 2040 to keep pace with profound economic and demographic changes.”³⁷ The same report concludes that Asia has the highest infrastructure investment need, while the United States has the widest gap between investment needs and current spending. Also important to note is that Asia’s infrastructure boom is recent and ongoing, whereas the infrastructure boom in the United States was well over a half-century ago.

Sector-by-sector analysis of U.S. infrastructure found significant need for physical improvements to mitigate increasingly frequent and intense storms. For example, in 2020 the U.S. Environmental Protection Agency (EPA) determined that the United States requires more than US\$67 billion to address stormwater management infrastructure alone over the next 20 years, a level comparable to the investment the U.S. federal government made to initiate the U.S. interstate system.³⁸

Although some industry leaders have identified the need to design infrastructure to meet the likely hazards of the future, this approach is a best practice, not the norm. Most engineering standards do not incorporate future climate scenarios, despite structures’ 50- to 100-year lifespans. Climate Ready Boston, which

is among the most ambitious recent climate planning initiatives in the United States, assumes 40 inches of sea-level rise by 2070 and includes public works design guidelines for infrastructure and public rights-of-way.³⁹ In Barcelona, the city partnered with the Water Technology Center to incorporate climate projections and insurance data into the Barcelona Climate Plan. Conversely, lawmakers in North Carolina enacted legislation that required use of historical data, because sea-level-rise projections paint a bleak picture for future coastal development.⁴⁰

Infrastructure failures linked to climate-related factors and natural disasters are already having significant and often cascading effects. An Arizona heat wave in 2011, for example, contributed to power transmission issues that eventually led to widespread electricity outages, the shutdown of a nuclear power plant in Southern California, and the release of untreated sewage requiring boil-water advisories in both California and northern Mexico.⁴¹ Further, according to the Intergovernmental Panel on Climate Change (IPCC), “essential urban infrastructure will be increasingly compromised by interrelated climate change impacts,” thus exacerbating the consequences of infrastructure failures.⁴²

COVID-19 has prompted fears that funding earmarked for infrastructure projects will be diverted to cover pandemic-related expenses. At least in the short term, some U.S. cities and states are using this tactic to balance budgets. For example, citing COVID-19 expenses and reduced tax revenues, Washington state governor Jay Inslee cut US\$455 million from the state’s operating budget in April 2020, including reductions to climate change programs.⁴³ Similarly, California Governor Gavin Newsom’s May 2020 budget proposal removed a US\$1 billion climate action catalyst fund and US\$4.75 billion for local adaptation projects.⁴⁴



Protecting Waterfront Cities

The approaches waterfront cities take to protect vulnerable districts can include district- or market-scale protections such as seawalls, flood levees, and ecosystem restoration. Other tactics may include stormwater management and green infrastructure enhancements, street elevation, beach nourishment, water storage, and pumps. Cities must implement protective infrastructure carefully, so local solutions do not push floodwaters downstream.

Changes in building and zoning codes can also make new buildings more prepared for flooding and direct real estate development away from or reduce development in risky areas. Building retrofit incentives are an emerging area of interest for city governments seeking to advance resilience.

Investments in stormwater management and coastal protection can also have quality-of-life benefits. In Rotterdam, Netherlands, the municipality has developed a number of sunken water plazas. These are public squares, used for sports such as volleyball and basketball, but double as drainage infrastructure during periods of high rainfall. In American cities, waterfront parks are also increasingly seen as an opportunity to both protect against flood inundation and create vibrant public spaces.

Some cities are also exploring value-capture strategies, where future high-value waterfront development would contribute funding to protective infrastructure nearby. For example, Miami is exploring how value capture could contribute to a proposed US\$35 million seawall, park, and stormwater management project in Brickell, which would protect existing and new development including two proposed new towers that will be the tallest on the East Coast outside of New York City.⁴⁵



Bentheimplein Water Square in Rotterdam acts as a multipurpose rainwater collection basin during floods as well as a recreational space.

Cathrotterdam, Wikimedia Commons

Building for Higher Seas: Resilient Infrastructure in Singapore

As an island nation, Singapore faces severe risks from long-term sea-level rise and coastal storms. However, the national government has marshalled a significant response: in early 2020, Prime Minister Lee Hsien Loong announced a commitment of S\$100 billion (US\$73 billion) over 100 years to prepare the nation for flood risks.⁴⁶

Singapore already has an array of coastal protection features, including seawalls, revetments, and geo-textile sandbags. However, the government is planning for a future in which global warming potentially far exceeds the Paris Agreement's 2 degrees Celsius limit, where worst-case flood levels could hit four meters (13 ft). This level of risk would require significantly expanded protective measures, as roughly a third of the country lies less than five meters above sea level. To that end, much of the S\$100 billion will likely fund the construction of enhanced coastal infrastructure. Solutions could include traditional engineering approaches, like seawalls, polders, or dykes, or green infrastructure, like restored mangrove forests.⁴⁷



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Equitable Infrastructure Investments

City governments implementing resilience plans are increasingly striving to make future investments in resilience in an equitable manner to ensure that all people benefit from climate solutions and to avoid further exacerbating patterns of discrimination.⁴⁸

Many of the greatest infrastructure needs are in historically marginalized communities, including for low-income residents or people of color. In many South and East Asian countries, for example, infrastructure access closely correlates to income.⁴⁹ In the United States, low-income communities are frequently located in flood-vulnerable parts of cities,⁵⁰ and about 8 to 9 percent of government-subsidized housing is in flood-prone areas.⁵¹ In the United Kingdom, nongovernmental organization Climate Just notes that low-income households are less likely to live in flood-resilient homes and have home contents insurance, and are more likely to be displaced by flooding.⁵²

In some locations, flood risk and race also correlate; in Chicago, for example, “Thirteen zip codes represent nearly three-fourths of flood damage claims paid between 2007 and 2016. In these areas, 93 percent of residents are people of color.”⁵³ Previously redlined neighborhoods also face significantly more risk from extreme heat; a 2019 study found consistently higher temperatures in formerly redlined neighborhoods in 94 percent of the cities surveyed. With a frequent lack of parks, tree canopy, and cooling infrastructure, low-income neighborhoods can be as much as 13°F/–10.56°C hotter than affluent areas in the same cities.⁵⁴

To correct these dynamics, cities are rethinking how they allocate and prioritize infrastructure investments. For example, Houston flood control projects from a 2018 US\$2.5 billion bond were prioritized based on a U.S. Centers for Disease Control and Prevention social vulnerability index to ascertain how difficult it may be for a specific community to recover from a flood event.⁵⁵ The approach is counter to Houston's previous “worst-first” approach, which focused on flood vulnerability without considering socioeconomic context. The new approach “means elevating some of the communities that had gone overlooked,” Lina Hidalgo, Harris County judge, explained to the *New York Times*.⁵⁶



William Murphy, Flickr

Funding Structures for Resilience

Building the infrastructure to prepare cities for climate change requires significant financial investment. Historically, infrastructure investments were made based on complex assumptions about growth and economic development trajectories. They rarely accounted for future climate impacts. Recognizing these challenges, pioneering cities are exploring a range of methods to fund climate resilience. These approaches will affect real estate development and the cost of doing business in various ways in different cities.

“Although some cities have substantial local wealth—from household income and property value—none that we recently studied could absorb the cost of their resilience plans in their existing budgets.”—Climate experts⁵⁷

Typically, national and regional funding sources contribute to the building of resilience infrastructure, as can international institutions such as development banks and the European Union (EU). In the U.S. context, federal, regional, or state governments

often provide funding support to major infrastructure projects, including in the postdisaster context, such as the Community Development Block Grant Disaster Recovery (CDBG-DR) program. However, some city administrations are increasingly operating on the assumption that resilience initiatives will need to be financed at a local level, given the potential for reduced federal funding availability, especially postdisaster. In the U.S. context, federal funding can change cities’ approaches for enhancing resilience because of requirements aligned with pre-determined postdisaster recovery frameworks.

In the United States, municipal bonds have traditionally offered a relatively conservative means of financing infrastructure projects, including resilience projects. However, climate vulnerability and adaptation increasingly affect cities’ creditworthiness and overall ability to bond. As noted previously, ratings agencies including Moody’s have begun assessing climate vulnerabilities, as well as cities’ resilience and climate adaptation plans, to inform credit ratings. Worsened bond ratings can lead to an erosion of tax base, affecting the ability to fund climate projects as well as other municipal needs.

The Pew Charitable Trusts notes that physical climate risk is far from the only climate risk that could affect ability to repay bonds. “Just because a city is likely to be struck by sea level rise or

wildfire doesn't necessarily mean it will default on its bonds," noted Alex Brown of Pew's daily reporting service *Stateline*. "Further effects like crop yields and population shifts—and their impact on a tax base—could prove even harder to project."⁵⁸

Many recent high-profile climate infrastructure projects have been funded by new taxes or fees; for example, Miami Beach tripled its stormwater fee, measured per equivalent residential unit, to fund US\$650 million investment in elevated roads and new pump stations. Recent analysis by the U.S. EPA has noted that stormwater taxes will be an important opportunity to advance much-needed infrastructure across the United States, because less than 25 percent of permitted stormwater entities in the country had generated dedicated revenue through fees or taxes.⁵⁹

Taxation concerns exist as markets grapple with funding resilient infrastructure. City governments must balance fears of creating "unfriendly" business environments with fears of long-term climate-driven failure if investors and residents perceive risks could be too high. Various taxation methods also present risk; regressive taxes, such as sales taxes, perpetuate inequality, while taxes on existing vs. new construction will affect the real estate market and may contribute to lack of affordability.

Some cities are exploring innovative partnership approaches to deliver infrastructure and fund resilience initiatives with the private sector, whether through financial contribution, tax increment financing (TIF)-style funding districts, transfer of development rights, partnership in delivery of district-scale infrastructure, or requiring resilience measures for new construction through new codes. HafenCity, a waterfront redevelopment in Hamburg, Germany, was developed through a public/private partnership, whose funding derived from private land acquisition supported the development of new coastal infrastructure.⁶⁰

Some city government leaders interviewed spoke about both the range of funding approaches and the need to regulate and partner with developers to meet long-term resilience goals. "We have to work together more with . . . housing corporations and real estate," stated one European city official, "because 60 percent of the city area is not public. And we can't as a local government take an interest only in the public space. We also need that 60 percent to become adapted."

"We have to work together more with . . . housing corporations and real estate because 60 percent of the city area is not public. And we can't as a local government take an interest only in the public space. We also need that 60 percent to become adapted."—European city official

In short, funding resilient infrastructure will require city staff to think creatively. The financial feasibility of such infrastructure relies on a healthy tax base and sufficient future economic opportunity to justify the initial investment.

Conversely, a lack of investment in much-needed infrastructure may not only put people and businesses in harm's way, but also undermine a city's ability to fund infrastructure because of cascading municipal finance impacts. For example, if flood risk is not mitigated, and increased flooding leads to widespread devaluation of real estate, a city will receive reduced property taxes, and home and business owners will experience financial losses that affect their ability to contribute to the economy. In 2020, McKinsey Global Institute explored Florida real estate as a theoretical example of this phenomenon, determining that if investments in flood preparedness are not made and flooding losses continue, homes could be devalued by US\$30 billion to US\$80 billion, thereby leading to reductions in property tax revenue from 15 to 30 percent.⁶¹ Beyond these immediate budgetary impacts, private investment could redistribute if areas are no longer perceived as safe and desirable places to live, operate, and invest.

Resilience Financing Tools

Cities are leveraging an array of financing tools to raise the capital they need for large-scale resilience projects. These methods have a variety of short-, medium-, and long-term impacts on the real estate investment environment. These tactics include the following:

Bonds

- **General obligation (GO) bonds:** These bonds are a common municipal financing source for capital projects in the United States, backed by municipal credit and taxing power. San Francisco, for example, used a US\$425 million GO bond to pay for “Phase I of a \$5 billion plan to prepare its seawall for climate change and seismic risks.”⁶²
- **Green or climate bonds:** They are similar to GO bonds, but the capital must be put toward projects with environmental benefits. These bonds require verification of the environmental benefits, and—if certified by a third party—annual progress reporting.⁶³ Green bonds are usually issued with tax incentives to attract investment.⁶⁴ The EU announced in early 2020 that it will consult on establishing an EU Green Bond Standard in a bid to provide transparency, comparability, and credibility “to spur the take-up of sustainable finance in Europe.”⁶⁵
- **Collaborative revenue bonds (CRBs):** Revenue bonds are those where the debt is directly accounted for by a specific revenue source, with the advantage that there is no change in net revenue for the U.S. municipalities that issue these types of bonds. CRBs are the same except they are issued jointly by multiple public agencies. For example, in 2018, a multiagency group including an electric utility and a water authority announced a US\$4.6 million CRB to pay for wildfire mitigation projects in Tahoe National Forest, which will also have the co-benefit of improving water quality.⁶⁶

Taxes

- **Impact development fees:** These one-time fees are required of new developments to provide capital for new or expanded public facilities. Most impact fees are calculated into land value and often provide the capital for water infrastructure to reduce flooding.⁶⁷ Critics say these fees perpetuate inequalities in a number of ways, including by potentially increasing housing costs (developers pass on impact fee costs to the end user) and by eroding the responsibility of governments to ensure public services are available for all people.
- **Special assessments:** These taxes generate funds in the United States by assigning a higher rate to utility fees and tolls or property taxes (many buildings are exempt from property taxes and property taxes can be politically challenging to increase, so this method may not be preferable in some markets).⁶⁸

- **Local infrastructure sales surtax:** These are extra sales taxes (usually less than or up to 1 percent) to fund infrastructure projects in the United States. Collier County, Florida, leveraged this financing tool after Hurricane Irma (2017) knocked out power to 6.8 million people.⁶⁹ The county established a 1 percent sales tax that provides capital for an emergency backup system at 32 critical pump stations to reduce flooding and manage wastewater at critical sites, such as hospitals and shelters.⁷⁰

Public/private partnerships (P3s)

- **Public/private partnerships:** P3s shift some proportion of risk to private-sector entities, which broadens the pool of available funding and can sometimes eliminate the need for governments to provide upfront capital. Partnerships can take on a range of structures; for example, private entities may fund infrastructure as part of an agreed development opportunity; public-sector entities may raise private capital by selling land and using the funds from private acquisition to fund infrastructure. P3 projects typically need a revenue stream to attract private financing, and they require significant staff expertise to administer.
- **Tax increment finance:** TIFs, a tool frequently administered in the United States, can support district-scale infrastructure, although the financing method is not welcome in all regulatory contexts. TIF is a strategy to finance a project in a specific geographic area through expected increase in property tax from new development. Municipalities can use TIFs to capture resilience value on new developments and to finance replacement or renewal of existing infrastructure, for example by using TIF returns to pay the debt service on large bonds. Chicago has established more than 120 TIF districts, attracting over US\$6 billion in private investment and funding programs like the city’s stormwater management Green Roof Improvement Fund.
- **Transfer of development rights (TDR):** Typically established and implemented by zoning ordinances at county or local level, TDR is a market tool that can be used to achieve land preservation by allowing a landowner to sever unused development rights in exchange for compensation from another landowner who wants additional developments rights for another parcel.⁷¹
- **Mitigation banking:** This is a system of credits and debits where ecological loss resulting from development is compensated by the preservation and restoration of wetlands, natural habitats, and streams in other areas.⁷² The mitigation banker who completes the habitat restoration and maintenance can “sell” mitigation credits to a commercial developer or energy or transportation company to compensate for damage caused by a project in a similar environmentally sensitive area. Effective at large scales but complicated to implement, there were 1,900 mitigation banks in the United States as of May 2020.⁷³

Why Don't Municipal Fiscal Indicators Reflect Climate Risk Yet?: A U.S. Case Study

Extreme weather events have the potential to affect city revenue streams and expenses, disrupt businesses, interfere with critical services, and lead to a temporary or permanent relocation of segments of the population. Investors may infer that this would also cause a marked and recognizable change in the traditional indicators used to assess the fiscal health of cities. Likewise, as these extreme weather events become more frequent, increase in intensity, and affect larger geographic areas and more real estate, one would expect that the effects on municipal budgets would become even more pronounced and potentially affect real estate and other economic activity.

However, despite well-researched predictions, climate change-related events have yet to result in municipal budget failures for several large U.S. cities, a factor that is likely contributing to the lack of recognition of climate risk in valuation. A recent analysis led by Arup of the 100 largest cities in the United States failed to reveal a significant correlation between severe climate events (as recorded in the National Oceanic and Atmospheric Administration's Extreme Weather database) and economic or financial disruption at the city level. A deep dive into the study findings helps in understanding the discrepancy between what is expected, what the data show, and how measurements of city fiscal health could be improved. The study's conclusions may also lead investors and city officials to put city fiscal health metrics into broader perspective and perhaps reduce or shift use of this metric.

Measuring City Fiscal Health

Arup, in collaboration with North Carolina State University and the University of Nebraska Omaha, examined 20 years of budget data, from 1996 to 2016, for the 100 most populous U.S. cities to determine how climate-related shocks (specifically, hurricanes, flooding, tornados, wildfires, and blizzards) affect municipal fiscal health. Publicly available data on fiscal health indicators were used and included:

- Cash solvency—an organization's ability to generate sufficient financial resources to pay its current liabilities, which is related to liquidity and cash management;⁷⁴
- Budgetary solvency—an organization's ability to generate sufficient revenues to fund its current or desired service levels;⁷⁵
- Long-term solvency—the impact of existing long-term obligations on future resources; and

- Service-level solvency—an organization's ability to provide and sustain a service level that citizens require and desire.⁷⁶

The extreme events each have different effects on these fiscal health indicators and, in some cases, even lead to a positive increase in select situations. The research found a number of misleading correlations, such as flooding having a positive impact on cash solvency and fiscal health, and hurricanes increasing budget solvency. This is because municipalities often receive an infusion of funding from external sources, which can look like an overall financial gain when, in fact, it is really more an artifact of accounting practices.

External funding sources, such as U.S. CDBG-DR funding and FEMA emergency response grants, as well as insurance claims, bring additional revenues to city budgets that are available only because of a recent disaster. The assistance municipalities receive from the state or federal government could either fill gaps in revenue or take over certain services to reduce expenditures. The good news is that sufficient "backstops" have been in place to help cities pay for those unanticipated losses. This has resulted in an effective financial buffer when it comes to extreme weather events. In other words, a weather-related event has not yet adequately "shocked" the system of contingencies as to break it.

However, the COVID-19 crisis may prove to be the ultimate shock to the system that breaks it. What happens when that "extreme event" is no longer a geographically or temporally discrete event? How do those "rainy day" contingencies function when the entire system is equally shocked at the same time? The COVID-19 crisis has revealed those vulnerabilities in stark ways—many of which are similar to vulnerabilities that would result from climate change. It therefore provides the opportunity to build a more informed and resilient financial model moving forward.

Comparing City Budgets Pre-and Postdisaster

Traditional fiscal health metrics were not designed to measure the longer term, cumulative infrastructure and economic degradation caused by climate change. Although they do consider forward-looking projections, at around five years, the planning horizons are still quite short and assume a future based primarily on indicators from the past.

Indicators of resilience would require a more transparent assessment of actual losses that are incurred during these events and before external aid is received, as well as capturing the longer-term cumulative and cascading effects, such as decreased life expectancies within infrastructure systems and economic



Jorge Salcedo

impacts associated with disruptions in business continuity, as well as out-migration of people and commerce.

The costs associated with the immediate losses become more apparent when looking one layer below the fiscal health indicators. Examining the difference between city spending pre- and postdisaster provides insight into the incurred costs. In several instances, the Arup study found obvious breaks in what cities had budgeted for before the event and what their actual spends were following those events.

In one example, a city incurred significant unbudgeted expenses following a major hurricane, totaling nearly a billion dollars. However, the municipality received adequate external funding, allowing that overage to be covered. As a result, the actual cost associated with the weather event essentially “disappeared” from the record and, along with it, the opportunity to create a business case for resilience.

Fiscal Indicators for Climate Risk

In summary, the analysis demonstrates that the current tracking mechanisms of fiscal health are too coarse and sluggish to allow for actual transparency into the true costs of these events. However, the current model of contingencies will not be sustainable with the expected increase in the frequency and intensity of climate change impacts, as well as slow-moving stresses such as sea-level rise, which further exaggerate the effect of peak events.

The creation of transparent and relevant economic and fiscal indicators linked to climate resilience could resolve the paradox of plausible market impacts and lack of corresponding action. Resilience-informed indicators would also provide critical information to investors for determining how climate risk may affect their assets as well as enabling cities to create a more robust business case for major resilience measures.

It is likely that government resources to address the aftermaths of these events may dwindle, especially in the era of the COVID-19 response, and underwriting and rating practices will change to adapt to a different risk profile. Traditional public fiscal health indicators will not be the metrics that will capture this shift. Instead, there must be a more transparent and standardized way in which those losses—both short and long term—are recorded and shared publicly. By knowing the cost of these impacts, cities, investors, and others can better understand the value of resilience. This shift will present a critical step toward incorporating climate risk in valuation and enabling market-driven large-scale investment in resilient infrastructure.

Lisa Churchill, former associate principal, Arup, with contributions from Bruce McDonald, North Carolina State University, and Craig Maher, University of Nebraska Omaha

5. Measuring Real Estate Risk: An Actuarial Perspective

Climate-focused investors anticipate that shifting insurance practices will lead to more widespread valuation of climate risk and use of market assessment tools measuring climate risk and resilience. However, when will those changes happen? And why have today's models not taken climate change into account already?

Physical hazard risks to property have been systematically transferred through insurance for over 300 years. Within the past 30 years, computer-based catastrophe simulation models (often referred to as “cat models”) have emerged and evolved, allowing insurers and real estate investors to make increasingly sophisticated measurements of property risk.

However, the perspective of an insurer that revisits pricing annually is typically different from that of a real estate investor, whose economic decisions may be locked in over a much longer time period and exposed to a different array of risks and uncertainties. Because catastrophe modeling is primarily designed for insurance risk assessment rather than real estate, the current models and the way they are commonly used do not fully address the needs of real estate investors, especially with respect to the long-term risks associated with climate change.

To address the needs of real estate investors, catastrophe risk measurement must evolve to address the following:

- **Time horizons:** Physical risk models must be adapted to make projections over longer time horizons with consideration of future climate scenarios.
- **Understanding models:** Model use must improve, through better understanding of metrics and articulation of model results.
- **Modeling expansion:** Methodologies must emerge to evaluate the broader economic implications of the physical risk estimates that the models produce.

Until these changes take root, investors in areas exposed to climate change will find that today's catastrophe modeling framework falls short of what they need to understand and address cost uncertainties and more accurately price climate risk. Risk managers and investors can expedite these changes by discussing their assessment needs with partner firms and, in the meantime, can leverage a thorough understanding of catastrophe modeling to better prepare their assets and portfolios.

Opportunity 1: Extending Model Time Horizons

Most insurance policies transfer risk over a fairly short term, often one year. Thus, insurers have the ability to reprice, non-renew, or adjust the terms on policies frequently. Models are not designed

to accumulate loss estimates over a longer time horizon or to consider how annual loss expectations may change as climate shifts the probability and/or intensity of future losses. These tools are currently inadequate to reflect the future climate reality.

For catastrophe models to provide what is needed by real estate investors, two main modifications are needed:

- **Long-term focus:** In lay terms, catastrophe models simulate “thousands of versions of next year,” not “thousands of successive years.” Models must allow their users to specify “holding periods” for risk and accumulate estimated losses over that period, while maintaining a sound statistical framework for the simulations. A real estate investor may want to see the probability of total losses of at least \$X over the next ten years, not just the distribution of next year's potential losses.
- **Dynamic view of the future:** If underlying climate conditions such as temperatures or sea levels are materially changing, the current loss profile must be modified to depict the future hazards. Models typically do not allow a user to modify future climate conditions, and there are no established best practices to apply insights from climate science to catastrophic hazard risk modeling. Models must help users derive the accumulated damage over multiple years in scenarios where the probability or intensity of catastrophes is also changing, using credible adjustments based on the latest climate science.

To be more useful to long-term investors, these models must be retooled to match the time periods and sources of uncertainty relevant to a real estate investor. It would also be useful for insurers to use these models to become more confident about multiyear insurance products, and work with clients to make resilience investments to reduce premiums or enhance access to coverage.

Opportunity 2: Looking beyond Simple Metrics

Oversimplification of model results can lead to unintended consequences that undermine the risk management principles that the metrics were intended to support. There are many instances in which a single, simplified metric is distilled from the complex profile of a catastrophe model, and then used as the basis for decisions such as prescribing insurance requirements, assessing threats to individual properties, or allocating loss mitigation funding.

Under a changing climate, using a single-point estimate or metric that summarizes model results could be disastrous, as uncertainties compound over time. Instead of only considering if an asset is in a 100-year floodplain, for example, a best practice for investors and risk managers is to consider additional metrics

such as probable flood depth and the frequency of flood events over the lifetime of the asset.

Real estate investors can also better understand the simulation scenarios embedded in catastrophe models. Catastrophe models use simulation techniques that produce outputs to depict a range of possible outcomes rather than a single “average loss” estimate or “worst-case scenario” estimate. For example, a property with a near-certain expected loss of \$500 per year would be totally different than one with the same \$500 expected loss, but facing a 1 percent annual chance of a \$50,000 loss.

Risk managers and investors who embrace these richer, probabilistic measurements will gain a more nuanced and complete view of the underlying risk and the range of possibilities that could occur. Better policies and decision-making to manage climate-related risk cannot be achieved through better models alone but must correspond with improved understanding and use of metrics.

Opportunity 3: Modeling Expansion

Insurers fulfill their duty to indemnify the insured by restoring the property to its pre-loss condition but not necessarily to more modern sustainable, resilient, or healthy standards. Claims cover anticipated repairs to the structure on a site, not diminution in value of the site itself, which could depend on local development regulations, future insurance availability, and the impact of the catastrophe on the real estate market.

For investors, interest in a property extends beyond physical condition to market value, which can shift due to a range of factors relevant to both the viability of the site and the broader dynamics at play in a city market. As a result, the questions that risk managers and real estate investors should ask include the following:

- Even if a property were not damaged in an event, how could it be affected if an event occurred in its broader municipality?
- What are the tax or other consequences of the property’s regional exposure? Even if past events have not led to municipal budget insolvencies, could future events do so if there is no longer an influx of postdisaster federal funding?
- How could the risk of loss to a property be reduced through community mitigation efforts, such as stormwater improvements or better local building code enforcement?

- Would market-level mitigation efforts be led by the city, the state, or a federal entity such as the Army Corps of Engineers? Are plans in place, is there sufficient political will, and would mitigation measures be cost-effective?
- What could happen to an area’s economy after a disaster? Which sectors are particularly vulnerable to business disruption from climate events, how would that affect the asset in question, and how quickly could the region’s workforce return to work?

Catastrophe models were created to fill a market gap in the insurance industry; hopefully, when the right questions are asked by enough real estate stakeholders, modelers will rise to the challenge and invest in improvements that expand the value that their models provide to real estate investors.

Future Improvements

With improved catastrophe models and frameworks, savvy investors or policymakers could begin to make decisions based on metrics that reflect current and future climate risks. Policymakers could advance these efforts by aligning incentives with better projections. For example, a host of incentives tied to the best-in-class insurance modeling frameworks could discourage development in areas with limited exposure to flooding today, but that are likely to be exposed to sea-level rise and increased storm rainfall in the climate-adjusted future.

Looking beyond the progress made by the insurance industry in developing sophisticated catastrophe modeling techniques, many changes could improve the value of these models to real estate investors. With longer modeled time horizons, better metrics and vocabulary, and broader applications, investors could make more informed decisions to protect themselves against climate uncertainty. Without these changes, distorted investment decisions based on imperfect assumptions about climate risk could persist. Continued innovation today will ensure that today’s shortcomings in physical risk measurement do not result in fatal flaws for tomorrow’s investment portfolios.

Nancy Watkins, John Rollins, and Cody Webb, principals and actuarial consultants at Milliman

6. Conclusion

The real estate industry's knowledge and prioritization of climate risk has increased significantly in recent years, and is likely to accelerate further with a focus on market-level climate risk and resilience.

As real estate investors have become more sophisticated in tracking and evaluating climate risks, leading firms have already begun to broaden their scope of analysis to the city or market-context. This has increased investors' interest in data about how cities respond to extreme weather events as well as data on the financial implications of long-term city planning decisions and infrastructure investments.

Evaluating climate risk at a market level will require the development of new assessment methodologies. Few metrics are available to quantify market-scale risk and resilience, which can make it difficult for leaders in the field to test and build support for innovative ideas to enhance city resilience.

As investors find solutions and build these types of metrics into their investment decision-making, climate risk will become a more significant factor. Next steps for the industry to help it improve awareness and understanding of climate risk and resilience at a market level include the following:

- Developing strategies to measure market resilience in relation to climate change, considering both extent of physical risk and strategies for enhancing resilience including infrastructure and policy. Traditional public fiscal health indicators will not be the metrics that capture this shift. Instead, more transparent and standardized ways are needed to record and share both short- and long-term climate-related impacts to communities, property, and city budgets.
- Creating strategies to better link physical risk assessments at the asset level with assessments at the market scale. Real estate investors' physical risk assessment work at the asset level has advanced considerably in recent years but does not yet merge with the limited existing analyses at the market level.
- Exploring the role of the real estate industry in supporting funding mechanisms for future infrastructure and resilience investments alongside municipalities. What role can innovative public/private partnerships play through mechanisms such as tax increment finance and developer-funded infrastructure? Investment in resilient infrastructure is in the best interests of public sector leadership and the real estate industry, which seeks to build from and enhance value.
- Facilitating more collaboration between city policymakers, including chief resilience officers, and real estate investors and investment managers. This could be done by working with the strong networks already established by CROs around the globe. Most interviewees from the public and private sectors stated that they had little to no ongoing dialogue with the other side, but many said they would welcome the opportunity.
- Working with the insurance industry and actuaries to refine current tools so they more usefully reflect current and future climate risks as well as implementing emerging solutions like parametric insurance. Collaboration to more effectively apply catastrophe models to real estate investment is a critical first step as is ensuring that the conditions of real estate are more accurately represented in cat models.
- Working with the valuation industry to look at how climate change risks can be built into appraisals to more accurately price risks and reflect efforts to maintain or increase value through resilient design.

Appendixes

Key Terms

Adaptive capacity—The ability of institutions, humans, and other living organisms to adjust, adapt, and respond to challenging circumstances.

Chief resilience officer (CRO)—A city officer who oversees and implements citywide resilience projects.

Climate adaptation—Strategies that anticipate and adjust human and natural systems to moderate the projected or actual impacts of climate change.

Climate mitigation—Strategies that focus on preventing the causes of climate change, specifically reducing or capturing anthropogenic emissions of greenhouse gases.

Climate risk—The exposure or potential for negative consequences caused by hazards related to climate change.

ESG—Environmental, social, and corporate governance considers three main factors in measuring an organization's environmental and societal impact.

IPCC—The Intergovernmental Panel on Climate Change is an intergovernmental body of the United Nations dedicated to providing the world with objective, scientific information relevant to understanding the scientific basis of climate change.⁷⁷

KPI—Key Performance Indicators help measure the performance or success of an organization, project, or investment.

MSA—Metropolitan statistical areas are used by the U.S. government to classify specific urban areas.

Physical risk—Physical hazards that can directly affect the value of assets, related to climate change, such as sea-level rise, hurricanes, extreme heat, etc.

Resilience—The ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events.

TCFD—The Task Force on Climate-related Financial Disclosures develops and discloses climate-related financial risk disclosures that are used by investors, lenders, insurers, and other stakeholders.

Transitional risk—Potential changes in policy landscape, technology, and other market forces, in response to climate change that affect the real estate and land use industry.

100-year floodplain—Land in a particular region that “has a 1 in 100 chance or 1% probability” of annual flood.⁷⁸

Interviewees

- 427
- APG
- Arcadis
- BlackRock
- Breckinridge Capital Advisors
- Canada Pension Plan Investment Board
- CBRE Global Investors
- Cbus
- CityLab/Clever Real Estate
- City of Rotterdam
- Clever Real Estate
- The Concord Group
- Credit Suisse
- Delta Terra
- Goldman Sachs
- The Insurance Innovator
- JBG Smith
- LaSalle
- MetLife
- Moody's
- Morgan Stanley
- Nuveen
- PGGM
- PGIM Real Estate
- Principal Real Estate Investors
- QuadReal
- ReTech Advisors
- Risq

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CLIMATE RISK AND REAL ESTATE

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