COMMENTARY

To Insure or Not to Insure, That Is the Question: Why Property Insurance Matters for Urban Climate Resilience, and Why Some Urban Areas Are Becoming "Uninsurable" Just When We Need Insurance Protection Most

Kate Stein, *Carrier Management, Willis, London, United Kingdom*
Wallis Greenslade, *Institute for Innovation & Public Purpose, University College London, London, United Kingdom*
Ed Day, *International and North American Property Broking, Willis, London, United Kingdom*

ABSTRACT: Property insurance is increasingly recognized as an enabler of not only post-disaster recovery, but also affordable housing, financial resilience, and the wider climate adaptation agenda for individuals and communities. In many cities and communities, however, climate change and other factors such as inflation and overdevelopment are increasing the risk of loss and damage from extreme weather hazards. In response, insurers are raising the premiums they charge for property insurance, or in some cases, withdrawing from vulnerable geographies completely—just at a time when insurance is becoming more important to cities as a tool in their climate adaptation toolkits. Through a conversation among three insurance experts from academia and industry, this article unpacks drivers of uninsurability and explores potential shifts in how responsibility for property risk is shared across an "ecosystem" of public institutions and private sector companies. It offers a practitioner's look at the role of property insurance in urban climate adaptation and insight into how property insurance may evolve in an uncertain climate future.

KEYWORDS: climate change; property insurance; resilience; physical risk; protection gap; risk-based pricing; responsibility; uncertainty; uninsurable risk

Correspondence should be addressed to Wallis Greenslade at University College London, Institute for Innovation & Public Purpose, 11 Montague St., London WC1B 5BP United Kingdom. Email: wallis.greenslade.23@ucl.ac.uk

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SUMMARY FOR POLICYMAKERS

- For individuals, communities, and policymakers, property insurance is a critical enabler of not only post-disaster recovery but also affordable housing, financial resilience, economic development, and climate adaptation in cities.
- In many urban contexts, climate change and other factors, such as inflation and overdevelopment in areas vulnerable to natural hazards, are increasing the risk of loss and damage from extreme weather hazards. In response, property insurers are raising premiums or even withdrawing entirely from vulnerable geographies. This is becoming an increasingly important issue for city policymakers.
- Making properties and communities more insurable requires (a) reducing the underlying risk of loss and damage and (b) increasing the insurance capacity available. Responsibility for these actions is dynamic over time and shared between the insurance industry and government at the local, regional, and national levels.
- At a city government level, risk reduction interventions might include incentivizing or mandating measures to adapt to climate risks, for example, by creating grant programmes to fund preparing buildings for extreme weather or imposing stricter building codes or climate-smart zoning.
- Measures to increase available insurance capacity could include city governments expanding their use of existing "alternative" insurance tools (e.g., parametric insurance and captives) as well as collaborating with the insurance industry to develop and pilot new insurance approaches.
- Cities also can engage in dialogue with regional and national governments on how to expand available capacity, helping mitigate risk, enhance insurability, and promote a better understanding of risk and reward sharing between public and private institutions.
- An effective response to insurance affordability challenges requires collaborative and coordinated action in multiple sectors and jurisdictions; it will not be sufficient to pursue any one of the measures above in isolation. To enable this kind of coordinated action, and to ensure disproportionate losses are not imposed on any one stakeholder group, all actors in the urban climate adaptation "ecosystem" must strive to develop greater awareness of their interdependencies, unique challenges, and collective opportunities.
- Cities are uniquely positioned to convene action-oriented, multisector conversations on insurance affordability issues, and to act as "living laboratories" for piloting many of the measures described earlier.

Introduction

Property insurance is a largely invisible technology that shapes communities, economies and politics. Whether or not a homeowner or business has property

insurance impacts their ability to recover from disasters, affecting not only their financial stability but also that of their local and regional economies (Elliott, 2021; Kousky, 2022). A lack of affordable insurance can lead to greater government spending on recovery in the aftermath of disasters; it can also affect whether investors decide to invest and lenders decide to lend, and on what terms. Property insurance is thus entwined not only with disaster preparedness and recovery but also with housing affordability and economic development on local, regional and national levels. Increasingly, it is a political issue (Chen, 2024), as property insurers in the United States, Canada, the United Kingdom, Australia, Aotearoa New Zealand, and elsewhere respond to more frequent and severe extreme weather events by increasing the costs of property insurance—or by withdrawing from vulnerable geographies entirely. At the heart of these debates is a question of responsibility: As climate change intensifies extreme weather hazards, who will bear the risk?[1]

This article presents a conversation among three insurance experts about the drivers of these insurability and risk challenges and the roles the insurance industry and government play in addressing these. It takes two interrelated concepts as its starting point:

- First, *risk-based pricing* is the idea that the price insurers charge for providing insurance reflects the risk they are taking on. With a risk-based pricing approach, as risk increases, insurers raise premiums to try to remain profitable, or at least solvent, in the event they have to pay out to cover loss or damage. If risks in certain geographies or industries become "too risky," to the point where they threaten profitability—or even jeopardize insurers' ability to remain in business—insurers may stop underwriting in these areas altogether.
- Second, *property insurers define, quantify and price "risk" as a product of three factors: hazard, exposure, and vulnerability.*[2] The *hazard* is the event that could cause a financial loss at a property, such as a hurricane or a wildfire. *Exposure* is the economic value contained at the property—for instance, its insured value or its productive capacity.[3] *Vulnerability* is the property's susceptibility to damage from a given hazard. Changes to any of these three variables impact the property's "insurable risk," and over time, insurers adjust premiums accordingly.

Breaking down risk into the key components of hazard, exposure, and vulnerability helps untangle the myriad interacting variables that go into pricing, many of which sit outside the realm of the insurance industry. For instance, one key driver of rising property insurance premiums is inflation: As inflation pushes up property values (i.e., as it increases exposure), insurers have to provide more coverage for the same property and pay out more in the event of a loss. To keep pace, they charge higher premiums. Another factor impacting insurance pricing is investment (or lack thereof) in preparing a property against extreme weather. Additionally, real estate development and re-development is ongoing in many areas prone to wildfires, floods and hurricanes; this increases the possibility of property damage and loss (i.e., it increases exposure), and this also causes insurers to charge higher premiums.

Of course, significant and unpredictable changes to property risk stem from changes to patterns of extreme weather hazards. As increasing physical climate risk increases the severity and, in some cases, the frequency of extreme weather events, the property insurance industry is on the hook to pay out for more frequent and intense losses. It is difficult for risk modellers to forecast the magnitude, location, and frequency of losses; this makes it hard for insurers to know how to adapt their pricing and reserving.[4] Simultaneously, reinsurers, which provide insurance to insurers, are also facing greater losses; consequently, they are charging insurers more, and insurers are passing these costs on to consumers.[5]

As insurers raise premium prices or withdraw completely from vulnerable geographies, there are a large number of property owners left unable to access or afford the insurance they need to maintain their mortgages. This also creates a growing number of property owners and businesses who, lacking adequate insurance, would have to bear all the costs of post-disaster repairs or relocation themselves. Furthermore, there are macroeconomic impacts of uninsurability—as most lenders require property insurance as a prerequisite for a home loan, there is a critical link between mortgageability, banking institutions and property insurance. It is little surprise, then, that a growing number of governments are setting up or expanding public "insurers of last resort" that provide (re)insurance funded by taxpayers or financed by government bonds. These entities complement or replace private-sector insurance for large-scale and/or difficult-to-quantify risks.[6]

Property insurance has always been the product of a complex and interdependent economic, financial, and political system. For the most part, the insurance industry has been able to make a profit from this system by providing a social good: the funds homeowners and businesses need to recover, rebuild, or relocate after disasters. Extreme weather, continued development in areas vulnerable to natural hazards, and insufficient investment in climate adaptation and risk reduction are making it more difficult for property insurers to profit in some geographies; in response, governments are stepping in to take on more risk. As climate change continues to intensify and increase the uncertainty around natural hazards, there is no doubt responsibility for property risks will continue to shift among the insurance industry, local, regional, and national governments and individuals, businesses, and communities. To ensure disproportionate losses are not imposed on any one stakeholder group, all actors in the urban climate adaptation ecosystem must strive to build their awareness of their interdependencies, unique challenges, and collective opportunities.[7]

The conversation

Ed Day is a property insurance broker at the global insurance brokerage Willis, a WTW company. As the head of international and North American property broking in Willis's London office, he and his team are critical intermediaries between large organizations—mainly companies, although also some government entities—that need property insurance and the insurance companies that can provide it. In his work, Ed routinely encounters the models, industry and government decisions, and extreme weather impacts that are causing insurers to raise

prices. His role is to navigate these in a way that provides the best outcome for his clients and generates revenue for his company.

A colleague of Ed's at Willis, Kate Stein works in Willis's Great Britain Carrier Management team. Her clients are insurers in the London market; her role is to help them strategically engage and pursue potential business development opportunities with broking leaders like Ed, who represent clients with risks the insurers may want to underwrite. Kate is also a co-founder of the Climate-Resilient Insurance Strategy Project (CRISP), which facilitates collaboration among communities, governments, and the insurance industry to promote risk mitigation and insurance affordability.

Finally, Wallis Greenslade is a policy researcher working on climate and environmental risks and how they transmit into the economy. She is an alumna of University College London's Institute for Innovation and Public Purpose, where her research explored the roles and responsibilities of institutions that govern property insurance as an adaptation technology within the London ecosystem. Wallis is particularly interested in understanding how risk is shared between market and state, and what this means for governing uncertainty in the Anthropocene.

The conversation among Ed, Kate and Wallis took place in June 2024.

Introduction to Insurance-land: Why insurance matters

Kate Stein: Ed, can you start by giving an overview of the work you do? What does it mean to be an "international property broker"?

Ed Day: Our world, international property, is insuring the bricks and mortar of buildings, plus any profit attributed to those buildings.

In London, where we sit, we've got the benefit of both the Lloyds market,[8], but we've also got a number of "company markets."[9]

Kate Stein: So essentially what you're doing is advocating for clients, helping them get the best property insurance possible?

Ed Day: Yeah, as you say, advocate for the insured to get the best coverage. That could be price, that could be capacity, that could be terms and conditions.[10]

The aim is to give the best to our "insureds" or our clients around the world for their property risks.

Kate Stein: Could you say a bit more about why insurance matters—not only for individual clients but also the broader role insurance plays in economies as an enabler of risk-taking?

Ed Day: I think that when economies are going the wrong way (and I use *economies* in the broadest possible sense), people need insurance more. Where there is a bigger downside or we're worried about the future, we're worried about uncertainty, or we're worried about volatility, then insurance becomes more and more enabling.

Kate Stein: Could you give an example of how insurance—specifically property insurance—enables economic growth and development?

Ed Day: So in 2020–2021, the big Texas freeze, you got a lot of big semiconductor sites.

And unfortunately, because of the cold weather, there were a number of losses in those semiconductor sites.

They had to turn off the power for the big manufacturing sites, including semiconductors, and move it to the hospitals to ensure that hospitals continuously had electricity.

If you pull the plug on a semiconductor factory, everything's ruined.

Hundreds of millions, if not billions, of pounds' worth of damage were done.

And then you look at what happened to car prices because the auto manufacturers couldn't get their chips to build cars. The price of cars went through the roof.

Insurance gives the business owners confidence that they can put themselves back into the position where they were before.

Without insurance, I suppose the knock-on effect of this freeze would be that people can't afford cars. That choice and availability wouldn't be there. It also would affect jobs in that local area. Because if your factory goes down and they don't rebuild it in that country or in that state or county, there's going to be more issues around employment.

So insurance benefits both the workers on the property side but also what is manufactured for the wider world.

Climate change and insurance: The world is becoming harder to insure right when we need protection the most

Kate Stein: Moving on to put this in the context of climate change, Wallis, can you speak a little bit about why insurance matters?

Wallis Greenslade: So, insurance is interesting because we've talked about it being an economic enabler.

And of course, insurance companies are both institutional investors and underwriters of risk, which is important in the climate discussion.

Now, in terms of underwriting risks in the context of increasing physical climate risk. In many countries, for example, the U.S. and the U.K., if you don't have insurance, then you can't get a mortgage.

If you can't get a mortgage, it obviously has individual household effects, but it also has effects across the housing market and across commercial lending. Banks, in many cases, won't lend if there's no insurance available. So you can see how, if a geography is hard to insure due to increasing physical risk, its real estate market could be severely impacted. So uninsurability has all of these macroeconomic and systemic and infrastructure effects too.

Kate Stein: Or, it *seems likely* to have these effects. Our understanding of the extent to which they're happening today is limited, but the future seems a bit more bleak.

Wallis Greenslade: Right. We know that physical climate risk is increasing dramatically, and we know that physical climate risk introduces a great deal of uncertainty and complexity to the insurance industry.

So, there's a real question for me in how that uncertainty affects the decisions that we're making in the insurance industry and what that means on the different time scales—of say a one-year-insurance policy renewal cycle in the context of climate trends that play out over the long term, as well as short-term time horizons.

Kate Stein: Ed, I'd be interested to hear about the time horizons that you find yourself working within and whether or not you've come across any tensions or imbalances within the system for these.

Ed Day: So I think the easy answer to that is yes, we see a lot of imbalances around time frames.

A lot of insurance, if not all insurance, is an annual basis. So you go through your annual renewal to re-evaluate how much your insurance costs.

There are long-term agreements coming back into the market slowly, but there are very few long-term deals, multi-year deals. Probably less than a percent of all deals are in a multi-year deal. Everything else is very short term, 12 months.

And I don't think that's the most helpful to buyers, especially the more sophisticated buyers because, their 5-year plans, their financial plans are a lot longer than a 1-year annual cycle.

We then look at what they can do especially around climate to improve their physical protections. And generally, they need to work that payback of investing in a new seawall or raising all their machines over a multi-year period.

They're not going to save £80 million in year one if they've refitted everything to deal with earthquake shocks or however that may be.

So I think there is a disconnect between the insurance world and the climate world, including in the way that I think models then work.

Kate Stein: On the modelling point, we use models in insurance, we use them in climate, but they're very different models.

Ed Day: Catastrophe risk models used by property insurers look at historic data, and that's been great in the past.

But then if you look forward, they're not fit for purpose.[11]

Kate Stein: There's work underway to start accounting for climate change in risk models. But we are not really at the point yet where those models give a good picture of the present impacts of climate change, or what the future might look like. So it makes it very hard for insurers and reinsurers to accurately estimate what the future risk is and then also to figure out what to charge in premium.

Ed Day: For example, in the Middle East, no one's developed a flood model for the Middle East because there's never been floods that have caused major insured losses there, until this year.

So I suppose it then also favors those more developed nations that are bigger insurance buyers. If you look back, the models that are good are U.S. windstorm, Californian earthquake—where there's a lot of insured property.

So especially when we look at where it's going, if insurers don't know how to price a risk, there's two options.

They over-price it, which hinders the client. Or they just pull out, which hinders the client.

So that's when we need a viable mutual or something that is not-for-profit, that is for the benefit of that region.[12]

Kate Stein: To the point about insurers having to make a profit, brokers as well, having to make a profit, many organizations in the industry having to make a profit. It's because they're private or publicly traded companies with investors who expect a return on their investment.

So insurance is a social good—it is something that helps promote financial stability and development like we were talking about before.

But on the kind of delivery side, it's not just about the social good.

There is this fact that we are required to be making money.

So I think that's important to acknowledge.

And then the second thing too, just about the pricing dimension of things. Insurance pricing has to reflect the risk. And so if the risk goes up—whether that's because the hazard becomes more severe or the property gets older and is more vulnerable to the hazard, or maybe if there's just more uncertainty around any of it—the price is going to go up.

And I think that's really important to just say in the context of climate change, as we're experiencing more extreme weather events, more severity and frequency, it's logical that as the risk is getting higher, premiums will most likely follow.

Wallis Greenslade: I would just add to that that a lot of scholars are no longer describing this as risk in the way that we have traditionally understood risk, but it has entered this new era of being true uncertainty.[13] This shifts how we think about pricing risk and how we understand nonlinear future dynamics.

Looking toward the future: How insurance might evolve

Kate Stein: So, Ed, how do you think different scenarios for property insurance might evolve over time? Are there a few different examples you can give of what property insurance might look like in 20 years?

Ed Day: I can give some views.

We probably need to write them down, seal them in an envelope and then come back in 20 years and see how off I am.

I think that the bigger global firms will probably weather, for want of a better phrase, the change twofold.

One, I think they'll be able to put more into their risk management and their physical protections.[14]

And then two, I think what we'll see maybe is a lot more around captives.[15] So these big global [insurance clients] having their own insurance companies that they can fund and they're able to offset their "good" risk in Canada to their "less good" risk in Florida—for argument's sake.

And again, it's that internal diversification that they're able to provide and their pricing and they, they can control it. Maybe if they've got a site in one country that is subpar, they can charge a bit more internally to that site.

Whereas I think the smaller, the smaller less global firms are not going to be able to benefit from that. They are still going to be price takers from the market.

So I suppose we are going to see even less insurers potentially, but then more companies taking these captives on and deciding and actively taking more control in their own risk and pricing because yet they are in control of their own destiny on that side.

I think we'll see a lot more financial instruments, whether that's a parametric[16] or something along those lines come in.

We can also get better products that are more tailored. So if you're an SME (small and medium-sized enterprise) buyer in the U.K., let's say you're a carpenter. You've got your workshop. Your risk is completely different to that risk of a scaffolder, for instance. Most of their risk will probably be stock in those metal poles.

And yeah, they're not going to burn.

Whereas a carpenter's shop is probably going to burn because it's wood.

So can we get better, more specific insurance programmes for these businesses?

Wallis Greenslade: Continuing this fortune-telling exercise about the future of property insurance, I would like to temporarily occupy the voice of doomsday, and remind us that in 20 years, we are living in a radically different climate.
I'd love you to talk a little bit more about who might be the "price makers" in this scenario.

And the second character I'd like to introduce is the role of reinsurance, and I'd like you to talk a little bit about where reinsurance might sit in this scenario.

Ed Day: So I can link the two together so we're only asking one question. Among "price-makers, price-takers," I think the price-makers are the reinsurers.

Kate Stein: Reinsurance is insurance for insurance companies. So if you're an insurance company, you're providing insurance in Florida and there are stronger hurricanes hitting Florida because of climate change, that means as the insurer, you're potentially on the hook to pay out more often or just more.

You are also getting your insurance from a reinsurer.

You're paying that reinsurer. And if you're experiencing more losses, then they are potentially experiencing more losses as well. So they will raise prices because price follows risk, which means you'll raise your prices and your clients will also potentially have to pay more.

Reinsurers tend to work globally. So if there is a hurricane in Florida and the reinsurer raises their prices there, they might also raise prices globally, which means a lot of insurers will have to pay more.

Ed Day: Ultimately, yeah, in the last couple of years, that's why I've been having to tell a U.K. water company their insurance policy has gone up. Because the wind has blown in Florida and the insurance has a treaty[17] increase.

My guy that lives in East Anglia just can't get his head around that.

It goes back to the ultimate capacity provider, which is the reinsurer.

Kate Stein: And I think to your earlier point too, there may be other capacity providers stepping in going forward.

So, yes, reinsurers, but then also insurance-linked securities investors,[18] which we see a lot of in Florida, which are again, investors taking on risk, paying out under slightly different circumstances.

Something else you alluded to in your future view is that the insurance industry is maybe increasingly interested in risk mitigation.

Could you say a little bit about what role you think the insurance industry could or should play in climate adaptation? Could or should insurers and reinsurers be making investments in resilience—in, you know, helping clients prepare their properties against climate impacts?

Ed Day: Yeah, I definitely think they should.

And I think to various degrees they are. I suppose it can be from the most basic – they give a premium reduction, a rebate, however you want to call it, to the client, but stipulate that they must improve their buildings or improve their climate resilience.

That is certainly happening. It happens more for the bigger clients than it does for the smaller clients.

Do we need to do more of it? I think the insurance industry probably does. But then I suppose how much of it then really needs to be pushed back to government, mandated in building codes?

One example that always interests me is Cockermouth in the north of the U.K. It had a flood and it damaged a factory in the bottom of the valley.

They had to work with the UK Environment Agency to build a flood wall around the property.

But it couldn't be too big because it would deflect too much water into the town, which was downstream.

So they didn't want to save the factory to hurt the town.

Well, anyway, they got to where they needed to, they spent millions doing it.

And then, yeah, the farmer plows his field to the other way up at the top of the hill.

Instead of going across, he decided to go up and down the hill, which just pretty much created gullies.

And the rain hit and the water just shot down.

They've got this brand-new flood wall. And the water all just went straight over it.

And then the client's like, well, I've spent so much money building this flood wall and I now can't get flood insurance because I've had two 50 million-plus losses in four years. And it's like, what more can I do?[19]

Kate Stein: That's a really interesting example of how a lot of insurance depends on what happens, for lack of a better way of putting it, in the real world.

Insurers don't necessarily have a lot of control over which way a farmer plows his fields or, you know, what the zoning code is that allows a welder to be built next to a carpenter.

That is very much in the remit of government, and to some extent the individual property owner. Everyone has a little responsibility for making the risk what it is. And each different actor can play a part in dealing with the risk—for example, a government could say plowing vertically up and down the hill isn't allowed. Or your client could say that to his neighbour, the farmer. That would help mitigate some of the risk before it even gets to the insurer.

Wallis Greenslade: Yes, to me, this speaks to the fact that insurance is not a single tool that operates in isolation.

It's something that really sits within a wider set of tools within the toolkit to adapt to a changing climate.

Ed Day: I've always seen insurance as a commercial vehicle with social good just attached to it.

But an insurer's not writing for the social good.

They're writing for their profit.

And the social good is just the way that they can do that.

Conclusion

This interview provides a view "from the inside" of why property insurance matters for climate resilience, some of the emerging challenges climate change poses to property insurability, and how this can shift responsibility for risk across actors in the property insurance "ecosystem." For local, regional, and national government staff working on resilience issues, as well as for property insurers, reinsurers, modellers, and brokers, three insights stand out:

First, climate change is amplifying natural hazards such as hurricanes, wildfires and floods, but it is layered atop other drivers of insurability challenges. Property risk and property insurance premiums are the products of complex interactions among diverse actors with responsibilities throughout the insurance "ecosystem"; climate change is adding another layer of complexity to these interdependencies. To take just a few examples relevant to cities: local government decisions about building codes, zoning and development patterns affect where and how properties to be insured are built, including whether they are built in flood-, wildfire- or hurricane-vulnerable areas. Reinsurers' exposure to loss and damage can result in higher rates, as they pass along the costs to insurers. At a property and a neighbourhood level, the investments policyholders and communities make to build resilience—and whether industry models account for these investments in premia—also affect both risk and rates.

Second, insurance is a key tool in the toolkit for climate adaptation, but it should not stand on its own. Reducing physical risk through investment in community- and property-level resilience will help ensure the availability and affordability of property insurance. Insurance is a key to unlocking these investments: incentives such as premium discounts and bursaries[20] can encourage property owners to assess their risk and provide upfront capital for them to invest in mitigation measures that reduce the risk of loss and damage for both them and their insurer. Key to all of this are ongoing improvements to models, enhanced property-level data collection, and further research that quantifies the value of various types of risk reduction investments so that their value can be quantified and priced into premiums.

Third, to make progress on risk and insurability challenges that are systemic in origin, there is a growing need for collaboration and direction-setting among

all levels of government, the insurance industry, policyholders, and academics. Cities sit at a unique nexus—they have regulatory control over the built environment but relatively little control over insurance regulation or industry appetite. To gain leverage, they can implement climate-smart zoning and building codes, and work with the insurance industry on pilot projects that link adaptation investment with premium reductions or that test new approaches to risk financing and insurance. Cities also can play critical roles as convenors for multisector dialogues on risk mitigation and insurability, bringing together the insurance industry, state/regional, and national government, academics and community representatives to identify interdependencies and pursue collective opportunities to respond to intensifying physical climate risks (see Bloom et al., 2024).

Author Information

Kate Stein manages relationships with insurance companies for the global insurance brokerage Willis, a WTW company. She is also a co-founder of the Climate-Resilient Insurance Strategy Project (CRISP), which facilitates collaboration among communities, governments, non-profits, and the insurance industry to promote risk mitigation and insurance affordability.

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Ed Day is head of international and North American property insurance broking in London for the global insurance brokerage Willis, a WTW company.

Contributors

Conceptualization: K Stein
Formal analysis: K Stein and W Greenslade
Project administration: K Stein and W Greenslade
Resources: K Stein and E Day
Writing – original draft: K Stein and W Greenslade
Writing – review & editing: K Stein, W Greenslade, and E Day

Notes

1. For more on why insurance's role is being seen as increasingly central in constructing climate change as a public problem that requires *collective* decision-making, see Collier and Cox (2021).
2. The formula that underlies many industry catastrophe models is Insurable risk = Hazard × Exposure × Vulnerability. See Cardona et al. (2012).

3. The term *exposure* is often colloquially understood to include people and productive capacity that may be at risk from a hazard—not only the financial value of physical assets at risk. However, typical catastrophe risk models used by the insurance industry capture only the financial value at risk. Other, non-financial forms of value (e.g., cultural value, social value, environmental value) are typically excluded from value-at-risk calculations.

4. Reserving: Insurers retain capital on their balance sheets to pay claims that are not yet settled. This affects the premiums they charge as well as the capital they hold to ensure their organization remains solvent, that is, that it is able to meet its financial obligations. See Hindley (2017).

5. A notable exception had long been the state of California, in which insurers have been prohibited by law from passing reinsurance costs onto consumers. In December 2024, as part of a broader suite of reforms intended to enhance the availability of property insurance in the state, California's insurance department passed legislation allowing insurers to incorporate reinsurance costs into premium pricing. See California Department of Insurance (2024).

6. For a comprehensive and accessible discussion of insurers of last resort and other "protection gap entities," the authors highly recommend Jarzabkowski et al. (2023).

7. Discussion of the insurance industry's past and ongoing role in contributing to the extraction, processing and burning of fossil fuels that cause climate change is beyond the scope of this article. However, it is important to note that by continuing to underwrite fossil fuel infrastructure and operations, and by investing in fossil fuel companies, insurers are playing a role in heating the planet and exacerbating the extreme weather hazards to which their property insurance portfolios are subject. For an example of a multisector effort to develop strategies for promoting a community's insurability in the face of climate change and extreme weather, see the post-event report (Bloom et al., 2024) from the July 2024 Insurance Strategy Forum held in Miami-Dade County.

8. Lloyd's of London (the "Lloyd's market") is a marketplace in which specialist insurance and reinsurance underwriting organizations, known as "syndicates," can join together to underwrite risks. Being able to bring together capacity from multiple different insurers enables the Lloyd's market to take on particularly large and complex risks. Furthermore, policies written in the Lloyd's market are backed by not only member insurers' capital but also a central fund of assets belonging to Lloyd's. See Lloyd (2023).

   For additional discussion of how increasing physical climate risk presents challenges to London-based institutions with a role in governing property insurance, and how these are adapting, see Greenslade (2025).

9. A "company market" is an insurance company operating outside of the Lloyd's of London marketplace. Some insurers operate as company markets and have Lloyd's syndicates.

10. "Capacity" is essentially the maximum amount of risk an insurer is willing to take on, based on its financial resources and the capital it has access to. Insurers with more capacity can, in theory, take on more risk—meaning either they can write more policies or they can write riskier policies. Terms and conditions and pricing follow from an insurer's capacity. For a very large risk, an insurer might expand its capacity by

raising prices to offset the amount of risk it's taking on, which is what has been happening in states such as Florida and California. Or the insurer might look to avoid taking on some of the risk by imposing more onerous terms and conditions. For example, in the United States, property insurers exclude flood risk from homeowners' insurance policies because widespread flooding that impacts a large portion of an insurer's portfolio can jeopardize their financial stability. Adding a policy condition that excludes flood damage enables the insurer to avoid taking on the risk of flood damage while still insuring the property against other risks.

11. As climate events become increasingly frequent and unpredictable, the models that insurers use to assess are becoming less accurate, with lower predictive power. For more on the actuarial approach to climate risk, see Trust et al's (2024) Climate Scorpion paper.

12. Jarzabkowski et al.'s (2023) work explores this idea by discussing protection gap entities (PGEs). PGEs respond to the increasing global insurance protection gap, by providing a public, or public-private (re)insurance scheme that aims to promote insurability. For example, Flood Re in the United Kingdom for residential flood risk.

13. The economist Frank Knight catalyzed a body of economic literature by distinguishing between "risk," in which the probability of different unknown outcomes can be calculated, and "uncertainty," in which it is not possible to calculate probabilities because the unknown outcomes are, or appear to be, random. The insurance industry deals well with situations of risk but struggles with uncertainty (Beckert, 1996; Knight, 1921).

14. Enterprise risk management frameworks and engineering solutions like the ones Ed references are among the tools that can be used alongside insurance to help an organization or community manage its risks, including climate-related risks. A key concept here is that for systemic, highly uncertain risks like climate change, no tool is a panacea. What's required instead is to effectively and equitably deploy the various tools in combination with each other—for example, combining climate-smart policymaking (e.g., resilient building and zoning codes) with grant programmes for preparing homes for extreme weather and ensuring that insurance policies written for these properties account for investments made in risk mitigation. The insurance industry can also contribute, for example, by providing bursaries (funding for risk management initiatives) to their insureds, thereby reducing risk for both the insured and the insurer. An example of an urban risk reduction initiative is the Property Assessed Clean Energy scheme led by U.S. local governments, which has been expanded from energy retrofits to include climate-proofing and risk reduction initiatives like hurricane wind risk in Florida. For a critique of this initiative, see Taylor and Knuth (2023).

15. A captive is a subsidiary that insures its parent company or companies, effectively a form of self-insurance in which the insurer firm is wholly owned by the party that is insured.

16. Parametric insurance differs from traditional indemnity insurance in that it pays out not based on the amount of damage to a property but based on whether an event (e.g., a hurricane) surpasses a predetermined threshold of intensity (a "parameter," such as maximum windspeed). Because the threshold for triggering a payout, and the payout amount, is established in advance, parametric insurance has the advantage of being able to pay out more quickly than "traditional" (indemnity) insurance. However, it is also often more expensive than indemnity insurance and tends to have more "basis risk" (risk that the payout will not be sufficient to cover the damage or loss).

17. A type of reinsurance.
18. An insurance-linked security is a financial instrument whose value is determined by insured loss events. For example, a catastrophe bond is a common type of insurance-linked security, which pays out when a predetermined catastrophic event (e.g. a magnitude 7.0 earthquake) occurs. Insurers and reinsurers pay their investors interest on the bond, and if the event takes place, the investors' capital goes to the (re)insurer to help them cover their losses.
19. For more on this particular flooding event and its impact on SMEs, see Wedawatta et al. (2013).
20. A risk bursary is a form of funding the insurer provides to the insured for risk management initiatives.

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