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COMMENTARY

Shelters in the Storm: Transnational Perspectives on Housing, Climate Adaptation, and Finance

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ABSTRACT: The physical and financial effects of climate change on housing are simultaneously reshaping financial markets and urban policy and practice. In this roundtable discussion, Savannah Cox interviews five experts working on housing, climate adaptation, and finance in a wide range of urban contexts: Zac Taylor, Isabelle Anguelovski, Alex Fella, Zachary Lamb, and Linda Shi. Participants illuminate how these domains collide in multiple and complex ways in the frontline communities where they do research and capacity-building. Physical climate risks like flooding or heat stress, housing characteristics like tenure, property and land regimes, as well as public and market-led planning and finance approaches collectively shape local housing and adaptation trajectories. This complexity calls for more than simply scaling up the volumes of capital to address housing adaptation finance "gaps" in citie—as commonly advocated for by urban climate policymakers. Even well intentioned and proactive investment approaches can lead to unequal outcomes like climate gentrification. Urban policymakers, financial institutions, civic groups, and other stakeholders must build local capacity to understand and address these dynamics. Climate risk assessment tools, technical support, ownership structures, and other interventions offer potential routes to foster agency and mobilize resources to balance housing and climate goals in cities.

KEYWORDS: climate adaptation; climate finance; climate risk; housing; urban resilience

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SUMMARY FOR POLICYMAKERS

- The physical and financial risks that climate change poses to housing are reshaping financial markets and urban policy, with crucial implications for frontline residents and communities.
- Policymakers, planners, civic groups, and urban stakeholders more broadly must understand how public and private climate adaptation finance and investment shape housing accessibility and affordability.
- Urban stakeholders can start by assessing housing and neighbourhood characteristics, like housing affordability and climate risk exposure. These results can be used to understand local adaptation investment needs and capacities.
- Public and private financial institutions can take proactive steps to mobilizing capital for housing and climate goals by building shared understandings with urban policymakers and other stakeholders.
- Policymakers and financial institutions must recognize that adaptation investments may unintentionally increase housing affordability and accessibility strains on the most vulnerable. It is important to proactively identify ways to address challenges like climate gentrification.
- Tools and instruments for gauging housing climate risks have a significant influence on whether adaptation investments are made and if they are equitable and affordable for residents. Mapping and co-creation processes can help to build resident agency to prioritize and address key climate risks while balancing other housing and community priorities.
- Housing and adaptation investments are more likely to be effective and equitable if horizontal organizational capacity is in place to realize housing and climate adaptation investments. This can take several forms, such as dedicated support for local technical assistance for financing adaptation.

Introduction

Growing concerns about the physical and financial effects of climate change on housing are simultaneously reshaping financial markets and urban policy and practice. Rising losses and damages from climate change are already being experienced in several cities and within frontline communities. Realized losses—and anxieties about future losses—increasingly drive financial activities in housing markets, including where, whether, and how institutional investors buy assets; how residential mortgages are underwritten; and whether home (re)insurance is provided (see, e.g., Knuth et al., 2025; Taylor & Aalbers, 2022). At the same time, large-scale public and private investments are being made to address these and many other risks that climate change brings to the fore, including major European funds for climate risk reduction in cities (see Venner et al., this issue), or discussions about ways to link

home retrofits and other investments in physical climate risk reduction to (re)insurance market reforms (see Meissner et al. and Stein et al., both this issue).

These climate-related financial market transformations impact housing in complex and varying ways. Housing is not (just) a site of concentrated financial risk to be managed from a distance but also where the socio-economic realities of climate change come into view and where new resources—including finance—are needed to support several simultaneous transitions in the built environment, be it decarbonization or climate risk reduction. This results in a challenging and urgent coordination and resourcing challenge for housing policymakers, practitioners, and residents. In many places, public and private actors are working to tackle these challenges, often expressly motivated by housing vulnerability and justice concerns. But even the most well-intentioned of measures to take climate measures in frontline communities have resulted in climate gentrification, or the displacement of lower-income residents by higher-income residents moving into areas that are less vulnerable to climate change. Climate gentrification may be amplified by uneven forms of financial institution intervention and (dis)investment in frontline communities (see, e.g., Shokry et al., 2022; Taylor & Aalbers, 2022). Cities must therefore mobilize climate finance at scale but in ways that are attuned to social and material complexities of housing and property regimes, unequal power dynamics between financial institutions and cities and their stakeholders, and the very real threat of creating new or worsened urban injustices and inequities triggered by (dis)investment.

Too often, crucial questions of housing access, affordability, and justice are disconnected from discussions on urban climate finance. This is despite the centrality of housing in forging resilient urban futures—and, in many cases, contemporary financialized capitalism. With this interview, we aim to bring housing in its many complexities—in terms of tenure, physical form, social meaning, political centrality, and financial value—into a generative discussion about urban climate adaptation and its financing.

Climate finance and urban resilience scholar Savannah Cox interviews five researchers working at the intersections of housing, urban climate adaptation and finance: Zac Taylor, Isabelle Anguelovski, Alex Fella, Zachary Lamb, and Linda Shi. Drawing on examples from a variety of place-based engagements of interview participants, this piece advances three overarching contributions to understanding this crucial domain.

First, the interviewees unpack how and to what effect housing, urban climate adaptation efforts, and finance interact in frontline communities. Interviewees demonstrate how diverse combinations of physical climate risks (like flooding and heat stress), housing characteristics like tenure, property and land regimes, and public and market-led planning and finance approaches shape local contexts and trajectories for housing and adaptation. Drawing on work on the home (re) insurance crisis in South Florida, Zac Taylor argues that changing patterns of climate finance, as in the case of (un)insurability, always need to be traced back to their effects on housing affordability and vulnerability in frontline communities (see Taylor & Aalbers, 2022).

Participants also underscore that even those public-sector led adaptation measures that explicitly aim to address social vulnerabilities to climate change in the housing

sector can worsen them. Isabelle Anguelovski illustrates how hard-fought greening practices in Barcelona have delivered benefits for some vulnerable residents, but many of these gains may be fleeting due to climate gentrification pressures sparked by speculative property investment and housing price increases in the very same areas (see Anguelovski et al., 2018). In examples drawn from Barcelona, Norfolk, and Taipei, several interviewees draw critical attention to how public and private real estate and land finance practices are entangled with, and often steer, the accrual and distribution of costs and benefits of public adaptation investment. These perspectives offer empirically informed ways to understand how this complexity unfolds in cities and frontline communities—and where new points of collaboration and intervention might be found.

Second, the interviewees emphasize the importance of understanding how tools used to gauge climate risk enable varying—and often unequal—forms of agency over housing futures by shaping how, if, and where finance flows to adaptation projects. Growing financial market concerns about climate change have spawned the rapid development of a for-profit and privatized climate risk-rating industry (Colven et al., this issue), one increasingly focused on defining urban vulnerability and housing (dis) investment trajectories for a variety of financial institutions. Here, Linda Shi contrasts the growing use of these big data– and artificial intelligence (AI)–powered risk models and analytical tools with the climate adaptation information sharing and decision-making practices of residents, local government and other stakeholders in the communities she works in.

For Shi and other participants, imbalances in both access to information and the pace of deliberation and coordination pose new challenges for participatory planning and community organizing around housing and climate adaptation in an AI era. Despite the novel challenges AI poses for the housing sector under climate change, interviewees note that many core challenges are longstanding. Zachary Lamb discusses how well established tools for making public investment decisions, like cost–benefit analysis, can limit the flow of resources to housing with less financial value, as in the case of mobile home housing in California. The question of who gets to value risks, and what is seen to be at risk, is closely connected with specific forms of housing tenure and ownership—and therefore requires a rethink of how changes in the latter can build more resident agency over adaptation (see Lamb et al., 2023). Here, climate risk identification is closely tied to questions of epistemic justice and whose knowledge is being made visible and mobilized in decision-making.

Third, all participants share an acute awareness of the need to advance the scale and pace of investment in climate adaptation in housing, especially for the most vulnerable in cities. But how should that happen, and what can happen next? Here, each interviewee reflects on ways to learn from housing movements, invest in individuals and initiatives that "hold space" for stakeholders to find each other, and create the conditions where residents have not just information but also the resources needed to act.

Alex Fella draws a helpful contrast between top-down financial value–driven versus bottom-up community-led risk identification and adaptation planning in Norfolk. In the latter, a tight-knit collaboration between students and housing residents suggests an alternative "tool" for producing knowledge and consensus about potential housing and climate adaptation futures.

But meeting the scale of this challenge will also require urban policymakers, civic groups, and other stakeholders concerned with housing and climate to build new bridges with the public and private finance. In other words, if we want to understand how housing affordability crises emerge locally—and why it is that they pop up so regularly, despite official investments in adaptation—we need to get out of the city and into the board rooms of finance. We hope, then, that this interview invites new perspectives and prompts creative interventions at the housing, climate, and finance nexus.

Savannah Cox: Climate change intersects with housing in many ways, shaping where and how we build, where and how we live, and who can live where. To start us off, to Alex and Isabelle: How do measures to address climate change, chiefly through urban adaptation measures, create new or deepen existing housing needs and vulnerabilities?

Alex Fella: I can only answer this question from the region that I know well enough, which is coastal Virginia, and particularly from Norfolk, a mid-sized city of 250,000. Norfolk is the fastest sinking city on the east coast due to our rising seas and our abnormally high land subsidence rates like Miami. Norfolk's adaptation plans reflect an adversarial relationship to the water and a very complex relationship to finance when it comes to housing. There are many adaptation plans, but all of them are anchored by Vision 2100. The plan has a map of Norfolk with different neighbourhoods each assigned one of four colour codes.

In my work I focus on the red and yellow zones. Red zones are neighbourhoods that Vision 2100 explicitly names as "being economically rich in assets" and thus warranting, according to the plan, flood mitigation interventions through a mix of gray and green infrastructure, flood walls, pumping stations, and wetland restorations. The important thing to know about red zones is that they have the highest rents in the city, and multifamily investors own at least half of all multifamily units in these zones. On the other hand, there are yellow zones, and these are neighbourhoods that are deemed less economically rich. The city has signalled that they will not invest in flood mitigation in those yellow zones, and instead, residents will have to "take the lead themselves"—a particularly pernicious form of neoliberal climate governance. Roughly half of all the city's renters live in census tracts that are fully or partially intersected by these yellow zones. These are important rental housing dynamics to lay out to understand Vision 2100 as a utopian vision of what Norfolk calls the "coastal community of the future," one they see as "no longer on the water, but of the water."

When it comes to housing, that utopian future envisioned by the city is far from settled. Developers are increasingly directing capital flows to these de-risked red zones, by purchasing or building new multifamily housing, which reflects a kind of risk-rent dynamic that Zac and Manuel Aalbers have pointed to in Miami. To be sure, red zones were already centres of real estate capital, long before the word *adaptation* was ever raised in Norfolk. But at the same time, perhaps unexpectedly, investors are still investing in yellow zones. They believe that they can capture profit in the next 5 to 7 years in these yellow zones—as one investor told me, "I'm just looking for a deal, if the money is investing somewhere, I'm assuming that it's going to be protected by somebody."

But more interesting to me, investors continue to flock to these yellow-managed retreat zones because they believe that if enough capital concentrates in an area, the city will have to save it. The deeper point that I see here, when it comes to housing, is this contest [between] city adaptation planning and a future that is actively being shaped by real estate investment around multifamily housing. This opens all sorts of new risks, not just for the demos to govern in times of climate crisis but specifically for renters who find themselves stuck between rising seas and rising rents.

Isabelle Anguelovski: I focus on two different types of climate impacts. Let's start with understanding the scope and urgency of climate impacts that I've seen around me in Spain, and how this has affected housing, and especially the housing of vulnerable residents. The first is one of the most visible yet still in some ways slower onset impacts of climate change, which is extreme and prolonged heat. The summer of 2022 was one of the worst in Barcelona's history. Neighbourhoods like Raval, an area with very dense older housing from the 19th century and much earlier, and with many migrants from Pakistan and Latin America, suffered from more than 120 tropical nights, that is when minimal temperatures reach or are above 20°C. You could see this extreme vulnerability relating to how and where people live in poorly insulated apartments, without access to natural ventilation, air conditioning, or nearby green public spaces. This type of neighbourhood has slowly through the years become more exposed to heat stress, with nights being identified as the most sensitive time of the day for health impacts.

One of the general responses to urban heat islands by the municipality under the prior government of Ada Colau (2015–2023) has been a policy called Superblocks (Superilles in Catalan), which was complemented by another more recent programme called the Green Axes (Eixos Verds). Both programmes convert streets into pedestrian avenues or 3 × 3 blocks, build new green spaces along streets and at intersections, and provide new public space equipment and playgrounds. The idea was to build them in neighbourhoods that were both highly impacted by contamination and urban heat island effects.

As soon as we've seen these new islands of green space and pacified traffic, we've seen different types of investors move in and residents reporting that benefits from green initiatives are thus limited and short-lived. You've had middle-class or upper-class digital nomads as well as corporate real estate investors from international markets—North America, Canada, Russia, the Middle East—moving to or investing in or next to many of those Superblocks, especially in areas like Poblenou and Sant Antoni. You've also seen new hotels and upper market residences being built for wealthy residents, and a lot more evictions and rental abuses, as reported by the Sindicat de Llogateres, the Tenants Unions in Barcelona. As residents we surveyed reported, "We're happy to have those green resources, but we know that we are going to be kicked out by these different types of green improvements." Similar challenges are also confronting us regarding energy retrofits, many of which receiving EU funding through the NextGeneration funding scheme and being supported by the City of Barcelona and neighbouring municipalities. How do we deliver these improvements without triggering climate gentrification?

Then, second, you have the extreme flooding event that we've just seen recently, the DANA [High Altitude Isolated Depression] storm and flooding

in October 2024. I would say this is the first time that an event was very visibly associated with climate impacts in Spain. The DANA affected municipalities near Valencia, a metropolitan region of 1.5 million residents: 300 people died, 77,000 homes were either fully or partly destroyed, and 30% of them had been built in flood zones.

Now the questions are, Who has the right to rebuild? Where? Who will be given the funds to rebuild? Where are people who cannot rebuild go and with what support? In Spain, we're now seeing what we saw two decades ago in New Orleans, which are disaster profiteers and disaster capitalism, with rebuilding contracts going to construction companies where current employees of the Valencia government were working in prior years, with different paybacks to private entrepreneurs that are linked to local governments. There is this sense that this is not going to be a fair reconstruction, and people who will have the right to come back will be those of higher economic status. Working-class residents who were very affected by the DANA do not necessarily have the means. In response and to counter the poor management of the DANA crisis by the Valencia regional government, the central government in Madrid has opened new budget lines to support these socially vulnerable groups, especially to small store owners, given how many small ground-level shops were affected. Close to 85,000 cars were also lost, many of whom from those store owners, plumbers, electricians, carpenters, and others with essential jobs that have lost not only their homes, but their means of work transportation.

For us in Spain this is the first case of "Wow! It's really reaching us." Homes are impacted, along with entire neighbourhoods and the infrastructure around them. How can we avoid climate gentrification caused by these disaster profiteers? And how can cities manage displaced residents?

Savannah Cox: So, on one hand, we see how housing investment is chasing public adaptation measures. But on the other, in Alex's case, we see how investment is prefiguring adaptation—investors are putting capital in places to demand public investment in adaptation. In both cases, the benefits for those who need decent, affordable housing, seem to be short-lived.

There is then the question of how to marshal resources toward adaptation. But it's not always clear how these resources, be it government funding or private finance, articulate with housing. In part this depends on the complexities of housing. Are we discussing owner-occupied or rental housing? Is it real property or manufactured housing? These questions shape how, where, and whether climate finance actually reaches homes and the people who live in them. Zach, can you reflect on this in the context of your work on manufactured housing?

Zachary Lamb: Manufactured home parks (which are also sometimes called "mobile home parks" or "trailer parks") are largely a North American phenomenon, although they exist in some forms elsewhere. The reason I've found them to be an interesting place to grapple with questions of adaptation, agency, and finance is because there are some very particular forms of tenure and land governance in mobile home parks that can shape who has power and resources to deal with climate threats.

Residents of manufactured home parks face elevated climate vulnerabilities for a number of reasons. These are communities that are disproportionately located in hazardous zones with a wide range of climate risks, like fire, heat, and flood. Vulnerabilities are also rooted in the form of both the housing units and the form and infrastructure at the neighbourhood scale. This housing is uniquely vulnerable to certain risks in part because houses built before 1976, when national standards were put in place, can have serious problems with their structural integrity, energy efficiency, and safety. Most mobile home parks were built between 1950 and 1980, so many are facing problems with crumbling infrastructure that is now especially prone to problems from climate change and other hazards.

These problems with climate vulnerability are compounded by displacement risks faced by residents. Many parks were built on what was then the urbanizing fringe of U.S. and Canadian cities. As they've become engulfed in suburban fabrics, residents are facing increasingly serious displacement risk and development pressure. Cities often view these neighbourhoods as locally unwanted land uses. They're often stigmatized and looked down upon. In many cases, there is a desire to change mobile home parks into other land uses that are seen as more desirable. Climate risk can serve as a pretext for moving people out of mobile home parks, either preemptively or in some cases after a major disruptive event, and we see that in several cases.

In our recent research, we find that the vast majority of mobile home parks in California are privately owned for-profit enterprises. Most started out as "mom-and-pop operations," as rural landowners converted some of their land to yield more revenue. There's increasingly a consolidation of park ownership from these small operators to various forms of corporate ownership.

These communities often exist as semi-independent infrastructural islands. The roads, the drainage, the water and wastewater systems, the electrical transmission, all of that, are often to varying degrees owned and controlled by private, for-profit companies. Homeowners themselves typically only own the house that sits on a lot. The house gets trucked to the lot, and then they pay lot rent to the park owner for the access to infrastructure and for the right to be on that land.

For many homeowners, the home is their largest financial asset. And yet these homeowners have very little agency to shape their own climate vulnerability because they don't control the infrastructure, because there are many rules that govern what they can and can't do with their homes in terms of elevation, planting trees, installing air conditioning, and everything else. This split tenure arrangement dramatically impacts who has agency to protect their homes, to make sure that they're safe in the event of climate disturbances.

One of the other major issues emerges when philanthropic or public resources are allocated to mobile home parks for adaptation purposes. There can be a justifiable resistance to allocating public funds or philanthropic funds to private landlords that are often seen as slumlords. Unfortunately, the people who are harmed by that lack of investment are the residents. This is one of the dynamics where adaptation finance questions come into play.

For instance, in California, there was a recent programme to dedicate several million dollars across the state to upgrade mobile home parks, including for hazard mitigation. But these funds were only available for parks that were either

nonprofit-owned, resident-owned, tribal-owned or privately owned by entities that own less than three parks. Yet many, many corporate entities own dozens of parks each. While there are justifiable reasons to not give public funds to corporate landlords, residents are really at the mercy of these kinds of policy decisions.

I'll just briefly mention the cooperative side of things. Mobile home co-ops, resident-owned co-ops and similar types of communities show a lot of promise in terms of addressing these split incentive and split agency problems. Co-op ownership can help give residents agency to take action to deal with climate change and other vulnerabilities. But these kinds of alternative ownership mechanisms can sometimes make it very difficult for resident parks and co-ops to access finance for capital improvement upgrades, for instance. In many cases, we've heard that banks don't know how to deal with co-ops and other non-traditional forms of ownership.

Savannah Cox: Turning to Zac and Linda, can you share more about how adaptation finance and housing come to together in the communities where you work?

Zac Taylor: Much of my research in this field has focused on questions of insurability in cities. In the news today we see regular discussion about the crisis of insurability, particularly in the United States, Australia, and, increasingly, Europe. For me this conversation started with fieldwork in Florida 10 years [ago], beginning with research on climate adaptation and real estate markets in coastal communities.

I started out by asking local property developers, city policymakers, and adaptation experts about what was driving the adaptation conversation in these communities. I remember this early conversation with an executive working for a multinational design and construction services firm—the type of company that, in the United States, is responsible for doing a lot of adaptation work on behalf of cities. He said something like, "You know, we can have all the resilience plans we want in Florida, but at the end of the day this is all about insurers and reinsurers and when they come to the table to take decisions about what's insurable or not." This led me down a rabbit hole, seeking to understand how insurance markets work from an urban planning and adaptation perspective. This proves difficult because it's hard to get access to data on insurance markets and to understand the underlying geographies of the market.

When we talk about the insurance crisis in the United States, we are also talking about an urban geography, and in particular a housing geography that usually looks like single-family homes or condominiums that are mortgaged. That's because property owners with a mortgage typically must maintain insurance as a condition of their loan. This is crucial—we aren't usually talking about renters, or high-net-worth individuals who can self-insure. There's also an underlying geography of uninsurability we're beginning to grapple with.

So where does this geography land? What do we know about how rising insurance costs are intersecting with housing costs and related forms of vulnerability? In places like South Florida, we've recently seen 30%–40% year-over-year increases in premiums (see Birss et al., 2024). In many communities, middle-income families are paying the equivalent of two or three monthly mortgage payments on basic property insurance premiums—before we talk about the extra costs of flood insurance. We're also seeing reports of declines in the quality

of coverage they have, as that price increases. There's a real crisis of housing affordability here, especially for those who are locked into maintaining insurance as a condition of their mortgage.

Step one, I think, is to understand where this geography of insurance crisis is and what types of communities are impacted. And step two is to think about that urban geography from a broader urban financial and fiscal risk perspective. This links to Linda Shi's work on the financial capacity of communities to grapple with adaptation, as in the case of the vulnerability of city property tax bases to climate change (see Shi & Varuzzo, 2020). I'm worried about communities where these insurance-driven housing affordability pressures intersect with limited municipal capacity to address adaptation. This links to mortgage markets, to bond markets, to the fiscal foundations of housing markets, public-sector finance, and collective wealth generation in the United States. Where might we see housing displacement pressures link to abandonment and forced migration, to foreclosure and local fiscal crisis? Will this threat be picked up by bond markets or sophisticated institutional investors in cities and real estate? Savannah's work closely considers this possibility (see Cox, 2022).

The last piece of the puzzle is to think about what can be done to address these challenges for frontline communities. In my work, I try to think about these needs and opportunities relationally—across scales, time horizons, housing tenure, physical risk drivers, and types of finance. We see many different public and private players coming to the table and negotiating this risk puzzle today. But we don't yet see an integrated view of how we can organize and finance responses to these challenges, thinking across municipal fiscal reform or insurance market reform, for example. As one answer to this, colleagues and I recently proposed linking insurance market reforms to the creation of housing resilience agencies in frontline states (see Birss et al., 2024). These institutions would like risk transfer (insurance) with risk reduction (retrofits). For now, we're talking about a very fragmented housing, climate, and finance picture. That fragmentation is beginning to pull communities apart—look no further to places like Miami, which is a frontline for climate gentrification.

Linda Shi: The cases that I can add fit well with this question about how finance reaches people on the ground. It's important to distinguish between single and multifamily housing, and especially multifamily housing that is not owned by an institution, whether it's a public housing agency or a landlord of some kind, which means that there are many different owners inside.

In the United States, for instance, the Stafford Disaster Relief and Emergency Assistance Act of 1988 does not mention condos and co-ops in their definition of housing. The Federal Emergency Management Agency has chosen to interpret them as being a business rather than a form of housing, for example, in terms of access to flood insurance and post-disaster assistance. There are separate programmes specifically for condos. For co-ops, there's no support for the entire building. You could get flood insurance for the unit. But when you think about a unit in an apartment or a multifamily building, that's for your bedroom and some personal things, but all the things that you consider to be the guts of your house, like the foundation, the walls, the elevator, the parking, the utilities—all of that is not part of your unit. Co-op buildings cannot get insurance on those fundamental pieces, nor can they get disaster aid as they're treated like a business.

Co-op residents can access a small business loan, but they cannot access actual aid. Co-ops face a lot of difficulties after a disaster, as in New York City.

I think that this story is also very prevalent in terms of buyouts or other disaster aid for multifamily housing. Most of the disaster aid programmes are for multifamily housing with up to four units within a building. If you have more than four units, which is the case for a lot of multifamily housing in any city, you're going to have a hard time doing any kind of renovation, much less a buyout, which disproportionately impacts lower income people who live in multifamily housing.

Part of the challenge relates to the technical ability to get agreements across several actors. In Taiwan, for instance, most people live in multifamily housing. It's a very dense place. The country is in a very high-risk earthquake zone. Taiwan tried to retrofit many buildings for earthquakes, but there were many buildings where individuals did not agree even on the comparatively small sum of money for the retrofit for an earthquake, relative to say, moving a building or lifting a building. Either you have people who then move into new construction housing, which is more expensive, or you have buildings with a management company where everyone chips in and make the retrofit. Who doesn't retrofit? It's the lower income people living in the lower quality housing.

These older buildings are often targeted for demolition, including for large-scale flood-resilient redevelopment. How do they finance them? In Taiwan, they use a unique form of what you could call eminent domain. In the United States, when you "take" a property—you must compensate for the full market value of the property. But for big projects in Taiwan, local governments can't afford to pay everybody market value. Instead, they use "zonal expropriation" where they take a very large area—hundreds or thousands of hectares of land—without full compensation. Instead, they obligate each landowner to give up to 60% of the property as a public donation to provide for public amenities and infrastructure. The government sells part of these lands to developers, which then provides the revenues to build roads, parks, and schools. The future price value increase of the remaining 40% that a resident gets to keep is the compensation. This is how Taiwan has financed a lot of riparian infrastructure and land use development, and often it's lower income and rural people are paying for it through mandatory land donations.

In this way, everybody becomes enrolled in the expectation that property values must increase, and subsequently, because there's very low property tax here, there is no way to recoup the financial speculative gains that actually take place. Today, I was meeting with community members of Shezidao, in Taipei, a in unique, historic community that for the last 50 years has been prohibited from making any upgrades to their homes. So, they live in this unregulated, uninvested, and now increasingly industrially polluted place, facing serious environmental justice issues. Now these properties are going to be totally taken and demolished for a massive zonal expropriation redevelopment project. Residents have to donate their land, and smallholders who won't have enough land afterwards to afford a replacement new housing unit post redevelopment will be displaced. Incredibly, a government project that is putatively for the benefit of a community that does not have sufficient levee infrastructure is going to build the levees but for a totally different set of people who can afford the new development. Residents are fully aware of this situation, and many oppose it but have little

recourse. In this way, we can see how low-income groups—whether in multifamily housing or more dispersed peri-urban individual housing— are deprioritized for climate resilience funding and deprioritized for climate-resilient development.

Isabelle Anguelovski: Perhaps I can give a little nuance to what Linda was saying in terms of public versus private finance. The challenge is that when you have money that's publicly available, you still have to deal with the huge technical and administrative burdens that come with managing public funds for housing retrofits. I'm again returning to the case of Barcelona, which is part of a broader metropolitan area governed by an agency called the Metropolitan Area of Barcelona, where you have a total of 36 municipalities working together to implement large-scale energy retrofits, climate resilience related to flooding and heat, and out of the approximately 600,000 buildings that exist in the region, more than half need a form of rehabilitation. Since 2022 we've had approximately 100 million euros of support from the European Union, through Next Generation Funds. Yet, some early observers estimated that more than half of Barcelona's funding might have to go back to the European Union because projects cannot be approved and implemented easily enough. Hopefully this figure will be much lower in the end, but the deadline for using these dedicated funds is coming soon: December 2026.

That's because we have so many multi-housing buildings—the ones that are in greatest need of rehab and energy retrofits are these giant towers built during the Franco dictatorship or during the transition to democracy, say between 1960 and 1990—where it is extremely complex for residents to undertake retrofits. Many [residents] are now over 65, many are women living alone. With changing migration and ownership patterns, you've also had a huge loss of social capital over time—to get together with your neighbour, to make decisions collectively about what to do with your building, figure out how you can apply for funds, or find the right contractors. Even though you have all these funds—and for the neighbourhoods that are considered vulnerable, 100% of the budget of energy retrofits and resilience is financed by Next Generation Funds—only approximately 5,000–6,000 buildings have been able to benefit from this help up until 2024. Imagine 600,000 buildings in need of some retrofit. If you multiply the current approved projects by two or three, by the end of 2026, maybe you'll reach 15,000–20,000, but that's nowhere close to what you need.

What I mean to say is that even when the funds are there, the technical complexity and lack of social capital makes the challenge of equitable retrofits even more complicated. We see solutions to address this is when there's something called a community development plan in place. For example, in a municipality called Cornellà de Llobregat, you have a huge investment in technicians and in architects paid through Next Generation Funds to accompany the community building process, to get access to these funds. What we see here in Spain, and, in other cases, like in the United States relating to the Inflation Reduction Act, is a question of how to get available public money to flow directly to renters and working-class homeowners and nonprofits around them. Investment in technicians within public agencies, that can accompany communities and that have these capabilities to apply to funds, to put dossiers and applications together, and help residents so that they don't have to front the costs, are hugely important.

Savannah Cox: As we know, there are any number of tools, instruments, or processes that people in finance, people in local government, people who care about their homes, can use to assess climate risk, and to determine how to address this risk through adaptation investments. What sorts of tools and processes are being used here to gauge and create agency to address these risks?

Linda Shi: Lately, we've seen the entry of big data, much of it going into risk modelling, in the urban adaptation domain. There's an unevenness of the pace at which data can be mobilized and whose data and what kinds of data can be used. Certain kinds of data lend themselves to AI, to being able to move very quickly. But then you look at a co-op, and the pace at which the data move among residents or between city government and residents is much slower. You have to be able to mobilize people to agree on how to take action, but we haven't improved our tools of speeding up that kind of communication at all. Meanwhile, data about house prices and insurance costs are being compiled quickly. At the Managed Retreat Conference at Columbia University in 2023, there was a presentation by one of these firms and it was just shocking. They've compiled 1,500 databases and use AI to put them together. And now they can provide a service: find which county will give me the highest return on investment over the next 5 years with the least risk. Show me ten other places that look just like this, so I can go and invest there. Or help me disinvest from the ten most disaster-prone counties. I think there's a real imbalance here.

Alex Fella: I'd like to compare two housing and adaptation cases in Norfolk to address your question about who gauges climate risk and how, Savannah.

I'm thinking about a project in Norfolk that was recently completed called the Tidewater Gardens Redevelopment Project, which connects to the way that tools like catastrophe risk modelling are used in relation to housing. Early resilience plans drafted with the city in 2011, before Vision 2100 came about, were informed by the Rockefeller Foundation's 100 Resilient Cities initiative, and a programme called Re.invest, which paired a consultancy firm called Wall Street without Walls with city planners to produce a map of where neighbourhoods were most at climate risk. They weren't simply modelling risk but also looking at ways to capture multiple revenue streams from flood protection measures. Tidewater Gardens was one neighbourhood they identified—a 618-unit public housing complex home to about 1,300 residents. Here the city demolished all public housing, in part to build mixed-income buildings in their place and in part to create what they called the Blue Green Way, which daylighted a buried creek, which would serve as a reservoir for when the city floods.

Tidewater Gardens was formerly an all-Black, redlined community, economically and socially isolated from the rest of the city. It's entrenched in this history of racial and economic segregation. It was majority slum housing until the 1950s. The Norfolk Redevelopment and Housing Authority demolished that housing, bulldozing it into the Newton Creek, and then built Tidewater Gardens on top, only to demolish it again to daylight the creek. The creek bed, for the psychoanalyst in me, represents the return of the repressed and the abject here—what's buried always comes back in distorted form. The demolition of Tidewater Gardens was funded by the U.S. Department of Housing and Urban Development

(HUD), in part because of the planned daylighting of the of the creek. The project received enormous pushback from the residents of Tidewater Gardens, from residents of surrounding public housing neighbourhoods, and other residents in the city. It's hard to overstate how fierce the battle was over the Tidewater redevelopment project. That said, the project went through anyway. Mixed-income housing was built on top of it, yet the creek was never daylighted. Adaptation planning was used very sort of knowingly as a way to secure HUD funding and investor buy-in from organizations that were consulting on these projects long before 2011, 2012. Tidewater Gardens shows us that you don't need adaptation plans to physically materialize for renters to feel their effects. A plan alone is enough to send out the eviction notices.

I want to contrast that project with another that happened nearby, called the Chesterfield Heights project. I think these two examples clash with each other in a very important way, which highlights the importance of tools. If in Tidewater Gardens we see a neighbourhood whose real estate value can be captured through the roll-out of flood mitigation technologies, Chesterfield Heights sort of poses the exact opposite case. Chesterfield Heights is also a predominantly Black, historically redlined neighbourhood, with a mix of middle- to low-income residents with sizable flooding challenges being addressed through a collaboration with Wetlands Watch, a nonprofit organization where I'm now on the board. The City of Norfolk and various universities aimed to protect 450 owned homes and 300 public housing units from flooding through remodelled storm drain systems, artificial estuaries, wetlands restoration, and a floodgate. The Chesterfield Heights project was started by [a] student-led collaboration between Hampton University (which is historically a Black university) and Old Dominion University. When I think about tools, I'm stuck by those used by the students who came up with the Chesterfield Heights project. It is not an exaggeration to say that they knocked on every single door in Chesterfield Heights. They did hundreds of hours of community surveys to know what residents there wanted most. They sought to understand the culture and social capital in the neighbourhood, to elevate the residents' authority to shape the future of their community. That initial student design was met with resounding success. Now, the knock-on effects of climate gentrification are too early to tell. I don't want to plant the flag in it and say it's a win. In terms of what Zach was saying earlier about agency, I find these two neighbourhoods similar to each other, although very different in terms of the means through which risk and climate vulnerability were modelled. Maybe this opens up a way for us to think about how different tools can be used in defining housing and climate risks.

Savannah Cox: Zach, do you want to further reflect on this question of agency drawing on examples from your work?

Zachary Lamb: We tend to think about the resident-owned cooperative as one model for giving low- and middle-income people agency to make choices about how they adapt. One of the things we saw when looking more closely at that model was that, as promising as it is, at the higher level, it's tied into the same networks of capital and risk modelling used in the conventional ownership and real estate finance sector. ROC USA is a national organization that has been instrumental in facilitating the growth of the resident-owned manufactured

home park model. They also act as lenders for resident groups hoping to become owners of their communities. When ROC USA is deciding which communities they will finance to become resident-owned cooperatives, they do some of the same kinds of risk modelling that any other lender would do, and so they often won't lend to a community that has substantial flood exposure, for instance. That makes perfect sense from the perspective of protecting the integrity of their overall portfolio. But it also means that the communities that are facing the greatest climate risk are not able to access this powerful tool for gaining adaptation agency.

Another issue is on the benefit–cost analysis side. I was just recently in conversation with planning and elected officials in a community in Santa Cruz Mountains in California, talking about a flood-vulnerable mobile home park there. The community is on a steep riverbank in a flash flood territory, and the officials would like to be able to invest in creek bank stabilization, because there were homes literally hanging off the edge. There's imminent risk, but one of the officials said that, in any kind of benefit–cost analysis, it is going to be very hard for investments to protect mobile home parks to "pencil," to justify the investment, because the homes just don't have a high enough value, especially if they're older homes. Using conventional analyses, they can't justify making these public investments in risk mitigation—the value of the homes is just too low. That's a story that we know from many different settings. I think it's particularly acute in stigmatized, "naturally occurring affordable housing" types of settings like mobile home parks.

The last thing I'll mention is the tradeoff that you see in the co-op model. For folks who are living in mobile home parks, this is often the only affordable option for them, and they're often deeply invested in this place because they own their home. The most imminent risk to them in many cases is the risk that their home will no longer be affordable. So in co-ops you have this tradeoff: Communities can make collective investments to become safer, whether that's through vegetation management in a high fire risk zone or through upgrading drainage systems to reduce flood risk. But those types of measures can be expensive. When people are making decisions collectively about how to invest their resources, they're often making trade-offs between risk reduction and maintaining affordability, keeping their cost of living as low as possible, because many of these people are living on fixed incomes. They don't have extra capacity to raise their own lot rents considerably to pay for upgrades that are going to make them safer. There's a real challenge in terms of coming to consensus that it's worthwhile to invest in upgrading their shared facilities to make themselves safer. When we think about risk modelling, it's worth thinking about who is doing those risk calculations and what are the various forms of risk that they're taking into account that don't have any immediate link to climate change.

Savannah Cox: As we look to conclude, I want to pose what may be the hardest question to answer. Why and how it is that people with good intentions with respect to climate adaptation and housing issues can still contribute to these negative and very familiar outcomes? Be it related to gentrification and displacement, or moral hazard and levee effects, or exclusionary decision-making processes. What would you recommend be done to advance equity in this very challenging, complex context?

Zac Taylor: As an academic enmeshed in practice networks, especially in the Netherlands, I often ask: What does it mean for practitioners, be it academics or planners or others, to hold these "in-between" spaces? Who takes leadership here? Who can coordinate this? In my work on urban climate retrofit finance and governance in the City of Rotterdam, I notice how municipal workers simultaneously thread together different conversations about adaptation, weaving together a broad coalition of stakeholders, interests, tensions. One day the discussion is with technicians, who may see climate retrofitting a fundamentally technical challenge with clear solutions. Another day it is with residents, who may see this as a housing justice issue, deeply entwined with multiple questions of identity, belonging, inclusion. And the next day, it's with financial institutions, who perhaps focus on this as a mortgage finance or social housing finance problem—but not as a collective public and private, individual and institutional, resource coordination problem. Who holds this complexity in cities, moving forward?

In some ways Isabelle talked about this in relation to the need for technicians to coordinate local housing adaptation initiatives. Alex also touched upon this in the context of student work in Norfolk. I think see these as instances of planning, of coordinating the relationships between knowledge and action. I think we need "planners" who are able to hold and mediate the discomfort and complexity that comes with trying to connect domains and stakeholders and to forge a new common sense around problems. Crucially, I think, is doing this in ways that are attuned to the real enduring and emerging injustices that haunt the housing, climate, and finance domain. I think we need to talk about the ethics and practices of doing this work. We need investment in people who do this work. We need institutions to make room for it. We need resources to train people to think and learn. Much of this work happens in the in-between, and I think cultivating this practice is really important. The question of what this looks like is a common one across the cases we discussed today. How do we name, celebrate, and resource this work?

Linda Shi: Zac, you're totally right that any change will come from people talking to each other, and no amount of AI is going to get around that. So being able to create the spaces and the people who have the mediation skills to foster difficult conversations is key. If housing justice people don't like what's happening in the world of private housing finance, at some point there has to be a conversation and a set of strategies at scale beyond opposition. I think it's a real challenge for us, realistically speaking, because everywhere we look, the kind of polarization and the rise of far-right extremism creates fewer and fewer spaces where people can actually come across and talk to each other in this way. I don't know that I'm very optimistic at any large scale, which is what we're talking about. I think these things do happen inspirationally in smaller communities, one by one, like in the Norfolk case that Alex has been talking about today. Zach Lamb's new book focuses on how we can lift up these inspirational examples, because we can all point to things that don't work (see Lamb & Vale, 2024). At the end of the day there are a lot of people who are doing good work, and we want those stories to come through.

The more that I do climate work, the more that I feel like it's not climate work that we really need to be paying attention to. Whether it's as deep as colonialism or racism or capitalism, or mechanisms like insurance or market lending rates or property rights. These are the more fundamental things that are causing

the kinds of climate and housing injustices. Well meaning people, no matter what they think, are operating within an unequal sausage maker. The sausage is going to come out the way that sausages look. It's not suddenly going to be pasta. Climate thinkers need to join forces and put our weight behind the people who have been pushing for housing justice all this time rather than asking the housing justice people to get on our bandwagon and think about climate. As a climate researcher, it's hard and uncomfortable to be like "I really don't actually understand housing, housing finance, and this world that you are all talking about." To be in that space, to humble ourselves and learn other peoples' priorities, is perhaps actionable enough for readers.

Zachary Lamb: I really appreciate those insights from both of y'all. I came to the resident community stuff because I had been working on infrastructural adaptation questions. The systemic nature of many of those problems drove me to seek out smaller scale communities that were able to take climate adaptation actions that fit their values and needs. I find a lot of inspiration in my conversations with folks in mobile home parks, and I see mobile home parks as a potentially powerful form of adaptive urbanism. We need to push housing models that give people more agency and reduce their vulnerability and precarity in the face of profit-seeking, extractive landlords. But to do that, we need to link these models for alternative ownership and agency to climate adaptation. We need to make sure that people have the resources to adapt at the same time that they're gaining agency over their communities. Giving people agency over a super vulnerable place without ensuring that they have the resources to adapt is not doing them much good. Linking neighbourhood preservation and community development finance tools to adaptation resources is key.

Second, we haven't talked much about the dire need to increase housing production in places like California, to address the housing affordability crisis. How do we make sure that in the drive to increase housing production, we're also prioritizing modes of housing and alternative tenures that give people more control over their communities. Some of these models may be a little bit harder to finance from a public finance perspective, but we know that they have other benefits in terms of giving people ownership and a stake in their communities. Linking the housing production conversations to the adaptation conversations is essential. We need to ensure that as that housing production conversation heats up and hopefully takes root in more places, that it is not treated as purely a matter of increasing production numbers and shovelling money toward the people who can produce units as fast as possible. These efforts should also include support for various forms of tenure and production, whether it's social housing and public housing or mobile home parks and resident housing cooperatives.

Alex Fella: Most of my daily work is with data—GIS data, census data, property data. I work to make that public-facing. Within the organization that I run, our aim is to democratize data for communities so that they can advocate for things that matter most to them. In working with the local health department on issues of housing and climate, I notice they're starting to take seriously that the conditions of financialization make equitable outcomes difficult to plan for, let alone to measure.

To give an example of that, to briefly go back to Tidewater Gardens, I did a small report recently on where everyone ended up after the demolition. The data that the Norfolk Redevelopment and Housing Authority gave me was from October 2022. That was their most recent data set—from at least 2 years ago. The residents were scattered. Most relocated to other majority African American, majority low-income communities. If we're thinking about measuring long-term health outcomes, for example, about what aging in place does when you have a strong social community, when those individuals are displaced into other census tracts, they're "lost" in the data. Measuring anything close to equity becomes impossible. Thinking from a data and analytics lens, how do you make these issues public-facing for mayors, for council members, for planning commissioners?

I think about the data democratization piece, because it may be one way to bolster just adaptation—by putting research on these issues back into the hands of communities. Most people that I talk to daily don't know if they're in a flood zone, let alone if they're in a managed retreat zone. So much of this work is geared toward academics, but if we predicate the notion of just adaptation on participatory processes, on the right to the city, unfortunately it too often comes down to questions of who has the most information about their city. I'm heartened to see a new movement of collaboration between academics and the people who work in offices of planning and climate resilience.

Isabelle Anguelovski: Maybe it's because I've spent too many years in Europe, but I feel that the more I work on climate adaptation, the more I end up dealing with the core issue of the right to housing and housing vulnerability. How do you rehabilitate social housing, public housing, and private market-price housing for different layers of the working class and lower middle class? How do you finance this work? How do you avoid pushing residents out through new gentrification processes? Through taxation of the urban grabbers, of those who make a profit on land and cities, is really key. What I'm seeing in Barcelona, for example, is that we've made such a step forward so quickly in a decade in terms of improving environmental quality, green space, restored waterfronts, nature-based initiatives, the cleanup of rivers. We've just plowed forward, and we've made it happen not necessarily with enough community engagement but with quite some effectiveness. I'm taking a step back and thinking about all this community engagement in the United States that takes so much time and effort, and it seems the rate of displacement is faster than the rate of people being able to have a just and resilient neighbourhood. So how much was the engagement worth? What do we need to do here? I'm trying to rehab the word *taxation* in public discourse, directed toward those who grab cities through tourism—the tourists, developers, cruise ships, airports, ports, industries—and who grab the land and its value.

Barcelona will double the tourism tax in 2026, which will directly be used to finance new social housing with resilient features. So that's really something key. You have places like Nantes in France, where the metropolitan agency for housing is working together in public–private partnership, to build different types of permanent social housing. Nantes is a city where 56% of any new units of housing are protected by regulation—in a city of 325,000 residents (Baró & Anguelovski, 2021). That's not a 10% or 15% inclusionary zoning measure that serves no purpose like you have in so many U.S. cities. That's the majority of newly

built housing that is going to be protected. That's what you need. You need the types of political coalitions that are making these types of measures pass in city council and metropolitan agencies.

Conclusion

Increasing scrutiny over the physical and financial risks that climate change poses to housing is transforming financial markets but also urban policy and practice. Drawing on transnational insights from North America, Europe, and Asia, this interview sheds light on what these transformations mean for frontline residents and communities. The interview aims to help urban stakeholders frame and focus this complex and dynamic housing, climate adaptation, and finance puzzle. To conclude this dialogue, two takeaways and related points of potential action for urban practitioners are proposed.

First, urban policymakers and related stakeholders must understand how public and private climate adaptation finance and investment shape housing accessibility and affordability locally. Place-specific combinations of physical climate risks (like flooding and heat stress), housing characteristics like tenure, legacies of housing provision and (in)equity, land and property regimes, and public and market-led planning and investment approaches influence important trajectories for housing and adaptation. Existing and new forms of housing and climate adaptation finance mingle with these complexities, creating new opportunities or limits for rolling out measures in equitable, scalable ways. Urban policymakers and allied stakeholders can map out how these financing and investment patterns intersect with housing characteristics and climate vulnerabilities as a baseline to understand where to focus needs and priorities. It is crucial to recognize that capacities to address these needs are likely to be differentiated along multiple axes, ranging from resident income and housing tenure, to building characteristics and neighbourhood-level attributes. Stakeholders should also understand that even the most well intentioned adaptation investments may inadvertently worsen long-term housing affordability and accessibility for residents, leading to challenges like climate gentrification and other types of new housing inequalities. It is important to proactively identify these potential pain points and breakdowns and identify ways to mitigate them, such as anti-displacement measures.

Second, urban stakeholders—including policymakers, private financial actors, and residents and community organizations—must address unequal access to tools and instruments to gauge and address housing and climate risks. Assessment tools have a significant influence on whether adaptation investments are realized and if they are equitable or affordable for residents. Tools and instruments for building awareness and supporting deliberation and decision-making, like mapping and co-creation processes, have the potential to help build resident agency and knowledge to prioritize, and ultimately act on, climate risks in line with their priorities and values. Housing and adaptation investments are more likely to be effective and equitable if individuals and initiatives are in place to support green jobs and training related to housing and public space infrastructure, help communities

access financial resources, and provide increased technical and social support needed to implement measures for climate adaptation. Interviewees point to several ways this might take shape, like investment in local technicians to support communities undertaking housing retrofits, or university–community partnerships for awareness-raising and participatory planning.

The search for just and effective solutions for financing housing and climate ultimately requires a focus on relationships. Urban practitioners must continue to invest in skill sets and work profiles that emphasize bridge-building. This may include capacity to frame and translate between subject domains (e.g., between housing and finance or climate and finance), or in relation to cross-cutting questions, like "who pays the bill" (see Mehvar et al., this issue). Here, too, the financial sector must play a role in better understanding—and directly engaging with—frontline communities where housing and climate issues are most acute. This hard work begins with building shared understandings through exchange and deliberation and, with time, may lead to novel interventions that ensure financial resources meet those most in need. The reflections and propositions offered here, we hope, can enrich our collective capacity to understand and navigate the complexities of housing, climate adaptation, and finance in cities worldwide.

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