Chapter 6:

Building Climate Resilient Housing

Quick facts

1. Buildings account for 34 per cent of global energy demand and 37 percent of CO_2 emissions, with housing alone responsible for between 17 and 21 per cent of total emissions worldwide.

2. In 2024, 45.8 million people were displaced by weather-related events, including storms (25.2 million), floods (19.1 million), wildfires (425,000) and droughts (387,000), among other weather-related risks. While not all these events can be attributed directly to climate change, their frequency and severity are increasing as a result of its effects.

3. Progress on reducing housing-related emissions is significantly off-track. Between 2015 and 2023, CO_2 emissions from building operations rose 5.4 per cent– in contrast to what should have been a 28.1 per cent reduction in that period to meet the targets of the Paris Agreement.

4. Current estimates suggest that 60 per cent of the buildings that will exist in 2050 have yet to be built, meaning the next 25 years present a unique opportunity to decarbonize future construction and reduce other emissions indirectly associated with housing.

5. While investments in energy efficiency for buildings have generally been on the rise, amounting to around US$270 billion spent in 2023, the Global Alliance for Buildings and Construction has called for this to be doubled to US$540 billion by 2030.

Policy points

1. Housing stock is a key entry point for delivering climate resilience at scale, and housing policy should be integral to climate policy as a core sector for climate change mitigation, adaptation and just transitions.

2. Multilevel governance is an essential component for delivering climate-resilient housing, as no single level of government or market actor controls all action levers.

3. Climate impacts and actions generate unequal distributions of benefits and burdens, especially in cities. Resilience strategies must prioritize the needs of vulnerable groups and ensure that any action protects the right to adequate housing for all.

4. Addressing housing emissions requires a whole-system transformation, decarbonizing every stage of housing production from design and construction to in-use operations and end-of-life demolition.

5. Community-led housing is a proven resilience strategy that delivers sustainable, appropriate housing at lower costs, while generating a range of local benefits.

In the period leading up to the adoption of the Paris Agreement on Climate Action in 2015, there was growing awareness – albeit not always explicitly stated – that sustainable housing could contribute to building climate resilience. Since then, with the passage of successive international agendas and agreements (Box 6.1), there has been increasing political and economic momentum from governments, agencies and other actors to deliver climate resilient housing.

Housing plays a dual role. On the one hand, measures can be taken to make it more climate-resilient; on the other, well-designed, well-planned housing supports the resilience of individuals and communities

Figure 6.1: The dual role of climate-resilient housing

Illustrated by Vanesa Castán Broto

This chapter discusses how to build climate resilient housing to deliver climate justice by activating diverse and dynamic efforts across different scales – individuals, communities, neighbourhoods, cities and nation-level systems. In terms of what constitutes resilience, it is adapted from the IPCC's definition of resilience[1] for an urban context as: "The ability of urban systems, communities, households and individuals to resist, absorb, adapt and recover from shocks and stresses, while maintaining essential functions, structures and identity, and transforming in ways that support long-term sustainability."[2]

In this regard, housing plays a dual role. On the one hand, measures can be taken to make it more climate-resilient; on the other, well-designed, well-planned housing supports the resilience of individuals and communities (Figure 6.1). This underscores the position of housing not just as a site of climate risk, but also as a powerful lever to cut emissions, protect the vulnerable and catalyse just, resilient urban futures. Every factor shaping housing, from land tenure to financing, has been shown to enhance resilience. Indeed, the right to adequate housing is closely related to the capacity to build resilience across all scales (individual, community, neighbourhood, city, nation-state).[3]

Housing is a powerful lever to cut emissions, protect the vulnerable and catalyse just, resilient urban futures

A mud house in the rural landscape of São Bento, Paraiba, Brazil © Shutterstock

The 2015 Paris Agreement provided an important framework for the development of subsequent global agreements on sustainable housing

Building on the emphasis in the World Cities Report 2024 on social and climate justice as central for effective urban climate action, this chapter focuses on the most vulnerable populations by examining the intersection of climate change, housing and social equity in urban environments. It therefore seeks to present an evidence-based perspective on climate-resilient housing by addressing three questions:

i. *Balancing the need for adaptation and mitigation:* In the context of the housing crisis, what does it mean to deliver housing that helps reduce greenhouse gas emissions while being resilient to climate shocks?

ii. *Translating aspirations into inclusive action:* How can climate-resilient housing solutions be effectively implemented, particularly for vulnerable populations such as those living in slums and informal settlements who face disproportionate climate risks and have limited adaptive capacity?

iii. *Ensuring the right governance framework is in place:* How can collaborative, multi-stakeholder governance systems that incorporate Indigenous and local knowledge systems, together with community-based participatory approaches be effectively integrated across diverse urban contexts to advance climate-resilient housing?

The chapter is structured into the following sections:

- An overview of the housing sector's contribution to carbon emissions, as well as the available responses emerging from half a century of sustainable housing experience (Section 6.1)
- An examination of the impacts of climate change on housing and how these can be addressed at different scales, especially for vulnerable populations (Section 6.2)
- An analysis of the challenges posed by current governance systems in delivering climate resilience, in line with the right to adequate housing for all and the role of multiple knowledge systems in developing solutions (Section 6.3)
- A conclusion with recommendations and ways forward (Section 6.4)

Social and climate justice are central for effective urban climate action

Box 6.1: Housing and climate resilience on the development agenda

The 2015 Paris Agreement was a milestone moment for climate action. Though housing was not directly mentioned, the emphasis on resilience building through sustainable energy use and emission reductions provided an important framework for the development of subsequent global agreements on sustainable housing. This included the Sendai Framework for Disaster Risk Reduction (2015–2030), which frames housing as a critical dimension in inclusion and social protection. This was further reinforced by Sustainable Development Goal (SDG) 11 "Make cities and human settlements inclusive, safe, resilient and sustainable", where climate change is identified as a key threat, and the New Urban Agenda (NUA), with its provision on "strengthening and retrofitting all risky housing stock, including in slums and informal settlements, to make it resilient to disasters".

In subsequent years, a number of landmark conferences and international commitments have afforded housing an increasingly central role in building resilience. For instance, the Buildings Breakthrough collaboration launched at the 2023 United Nations Climate Change Conference (COP28) offered a bold roadmap for countries to progress towards "near-zero emission and resilient buildings as the new normal by 2030". This was followed in 2024 by the Declaration de Chaillot, which explicitly acknowledged the exposure of housing to climate risk as well as its role as a key driver of emissions. The outcomes of the 4th Ministerial Meeting on Urbanization and Climate Change during COP30 in 2025, while encompassing a wide range of issues, identified housing as one of its key priorities for achieving a resilient urban future, including "equity and inclusion for the urban poor and residents of informal settlements". Together, these developments signal a heightened global commitment to transforming the housing sector.

Source : UNFCCC, 2016; United Nations, 2015; United Nations, 2017; Global ABC, 2024; GlobalABC, n.d.; UN-Habitat, 2025; UN-Habitat, n.d.

Findhorn is a world-renowned destination for mindfulness and is also a centre for ecological and sustainable living ©Shutterstock

6.1 Reducing Greenhouse Gas Emissions in Housing

The buildings and construction sector is considered the largest emitter of greenhouse gases worldwide, accounting for 34 per cent of global energy demand and 37 per cent of energy and process-related carbon dioxide (CO_2) emissions in 2023.[4] Housing alone is estimated to account for between 17 and 21 per cent of global emissions.[5] Evidently, then, the housing sector is a key entry point for decarbonizing and delivering climate resilience at scale, particularly given the growing demand for housing.[6] Progress, however, falls far from existing emission reduction commitments. Between 2015 and 2023, CO_2 emissions from building operations rose 5.4 per cent – in contrast to what should have been a 28.1 per cent reduction in that period to meet the targets of the Paris Agreement.[7] This represents a significant missed opportunity to tackle emissions in a sector with clear mitigation potential.[8]

Emissions from buildings vary widely across countries, reflecting differences in income levels, climate, energy mixes, and building stock characteristics. Diverse countries like Russia, India and Iran, all highly dependent on fossil fuels, dominate the list of the highest emitters in the buildings sector (Figure 6.2).[9] However, efforts to reduce emissions are also evident, with countries as diverse as Japan, Trinidad and Tobago, and Brunei achieving consistent year on year annual reductions of 0.1 – 8.8 per cent in their building emissions. The EU 27 has managed to facilitate reductions across all its members, with Italy and France leading at over 3 per cent annually. At the same time, China has shifted from being a contributor of emissions to achieving the greatest reductions of any country in the 2015–2023 period. This contrasts with the US, which has moved from a modest role in reducing emissions in the building sector to accelerating emissions since 2015. These figures suggest that countries that have not decarbonized their economies tend to use more fossil fuels in the buildings sector. In contrast, countries with strong decarbonization policies, such as the EU 27 and more recently China, seem to be reversing the trend.

Between 2015 and 2023, CO_2 emissions from building operations rose 5.4 per cent – in contrast to what should have been a 28.1 per cent reduction in that period to meet the targets of the Paris Agreement

Figure 6.2: Top 10 countries by increase and by reduction in GHG emissions in the building sectors 2015-2023 and 2005-2023

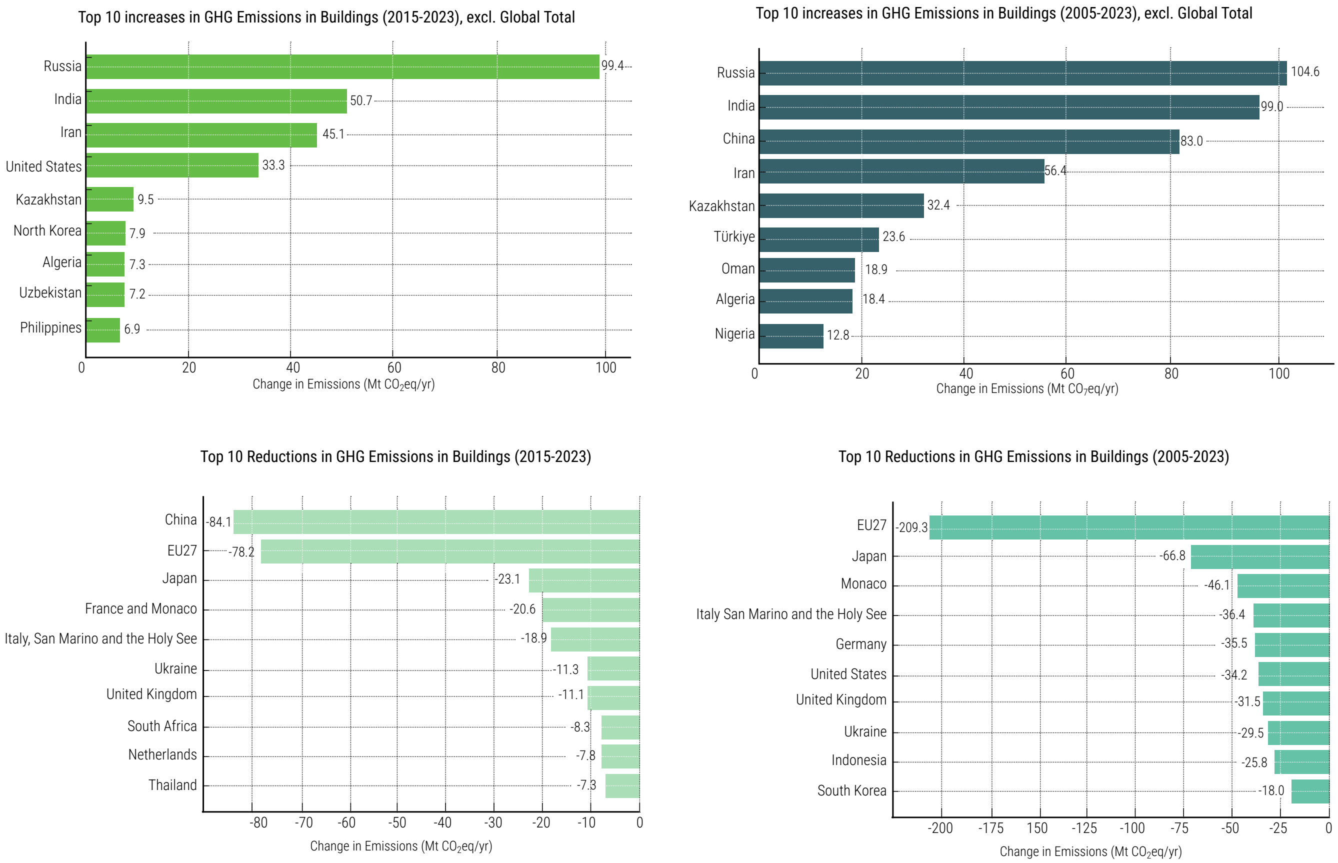
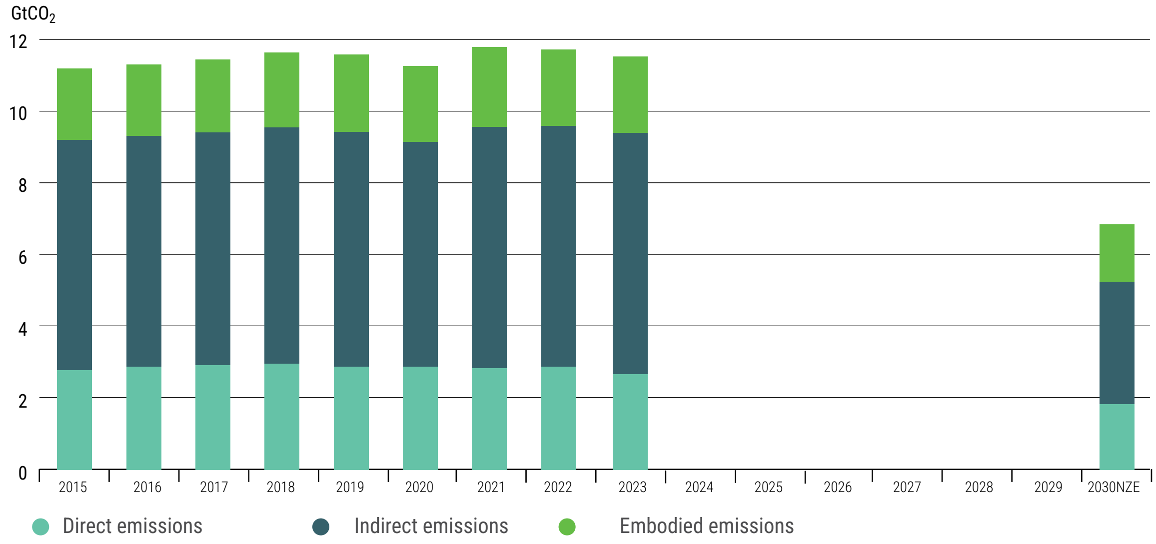


Figure 6.3: Distribution of emissions as direct, indirect and embodied emissions



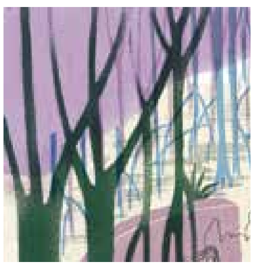
Source: IEA, 2024, p136.

Often overlooked in discussions about the climate impact of buildings are the different pathways whereby emissions are generated, not only during their construction but also in relation to how they are inhabited and how the infrastructure around them is used. An essential aspect for understanding greenhouse gas emissions in the buildings sector is to differentiate between direct, indirect and embodied emissions (Figure 6.3):[10]

- *Direct emissions* are those released on-site from activities related to use and occupation: for example, emissions from the combustion of fuel for thermal comfort or to deliver hot water. Direct emissions are shaped by the practices of inhabitation, which are themselves shaped by cultural practices, income levels and other factors shaping life at home.[11]

- *Indirect emissions* are produced off-site to sustain the building or provide a service, such as electricity generation or water supply and treatment.

- *Embodied emissions* relate to the building's life cycle, including the extraction, transport and assembly of construction materials. These include end-of-life practices, such as demolition, waste processing or recycling.[12] Given current construction practices, the bulk of embodied emissions relates to the steel and concrete sectors.



While housing occupants can influence direct emissions, reducing indirect and embodied emissions—which account for over two thirds of total emissions— requires a whole systems approach

While housing occupants can influence direct emissions, reducing indirect and embodied emissions—which account for over two thirds of total emissions— requires a whole systems approach. Current projections suggest that 60 per cent of the buildings that will exist in 2050 have yet to be built,[13] presenting a unique opportunity to tackle indirect and embodied emissions in the building sector. At the same time, retrofitting existing stock can also tackle both direct and indirect emissions, but its current pace is far too slow to meet the scale of the challenge.[14] In any case, reducing emissions requires a place-based perspective that is better advanced through the involvement of communities.[15]

60 per cent of the buildings that will exist in 2050 have yet to be built, presenting a unique opportunity to tackle indirect and embodied emissions in the building sector

6.1.1. Direct emissions

Direct emissions from buildings – arising from on site combustion for heating, cooking and hot water – account for approximately 5–8 per cent of global greenhouse gas emissions.[16]

While global direct emissions from buildings declined slightly (by about 1 per cent) between 1990 and 2019, there are significant regional variations, with marked declines of around 14 per cent in the Europe region, contrasted with a nearly 200 per cent increase in the Middle East region. These contrasts highlight both the mitigation potential in residential buildings and the importance of context specific interventions.[17]

Table 6.1 provides examples of measurable actions to reduce emissions in the housing stock that are already having an impact on direct emissions within the sector in different locations around the world. However, while low-carbon designs and technologies exist, the question remains about how to align these investments with the objective of providing housing for all.

Modern brick suburban houses in the United Kingdom with rooftop solar panel systems producing renewable electricity for residential homes during winter season © Shutterstock

Table 6.1: Examples of building and construction measures to reduce direct emissions in buildings

Building and construction measures	What do they consist of?	What resources are needed?	What is their impact on reducing emissions?
Energy efficiency retrofits	Deep renovation of existing buildings (insulation, windows, efficient lighting/appliances)	Finance, building materials, skilled workforce, incentives	Up to 60 per cent lower energy intensity in buildings[18]
Stronger building energy codes	Mandatory standards for new builds and renovations (insulation, glazing, HVAC, lighting)	Legislation, enforcement capacity, and training for builders	Up to 50 per cent reduction in a building's energy consumption[19]
Heat pump installation	Replacing fossil fuel heating/ cooling with electric heat pumps	Subsidies, grid upgrades, manufacturing scale-up, and advice to consumers	Around 500 million tonnes of CO_2, or nearly 40 per cent global reduction of total direct and indirect emissions in space and water heating[20]
Onsite renewables (solar, thermal, PV)	Installing solar PV and solar hot water to displace direct fossil fuel use	Capital investment, rooftop access, storage systems, know-how	Rooftop photovoltaics could reduce global average temperatures by 0.05–0.13 °C before 2050[21]
Minimum Energy Performance Standards (MEPS) for appliances	Standards for boilers, stoves, air conditioning, etc.	Regulatory frameworks, testing labs, enforcement, and enrolment of the private sector	In South Africa, energy efficient electric appliances can deliver energy savings of between 9 and 76 per cent[22]
Sufficiency measures integrating behaviour and design	Lower energy demand via passive design, smaller floor area, smart controls and behaviour change	Awareness, design guidelines, digitalization, public mobilization	A new Passivhaus home built in England, in the United Kingdom (UK), will result in 86 per cent fewer lifetime emissions than an equivalent house equipped with a gas boiler[23]
Green building certification and labelling	Incentivizing low-carbon design via rating systems (LEED, EDGE, etc.)	Certification schemes, monitoring systems, incentives	In Manila, the Philippines, Green Building Certification had multiple benefits, including encouraging the adoption of sustainable technologies[24]
Public procurement and zero-carbon targets	Actions taken in public buildings to be net-zero carbon may serve to establish benchmarks or establish sustainable supply chains	Political will, budget allocation, procurement frameworks	Indirect impact by driving markets and creating demand for sustainable technologies[25]

To date, 88 countries have adopted mandatory Building Energy Codes (BECs) in at least one city, and as many as 54 countries have implemented standards

The majority of these measures require upfront capital from homeowners or developers, typically increasing the cost per housing unit and so reducing affordability. There has long been an argument that energy-efficient improvements pay for themselves by reducing utility bills, but examples of well-developed markets like Germany suggest that this is not always the case.[26] While costs continue to fall as technologies and designs develop, there is still a need for public policy support beyond building regulations to facilitate the democratization of low-carbon housing standards.

The IPCC considers building energy codes the primary regulatory instrument for reducing emissions from both new and existing buildings.[27] Building codes represent a success story in developing a global standard for reducing greenhouse gas emissions in housing and buildings more generally, as dynamic policy tools that can be adapted effectively to local conditions.[28] To date, 88 countries have adopted mandatory Building Energy Codes (BECs) in at least one city, and as many as 54 countries have implemented standards but lack a comprehensive BEC. However, as shown in Figure 6.4, recent data for many countries is not available, meaning the picture on progress remains incomplete.[29]

BECs should, however, be understood and integrated within the broader framework of adequate housing for all. In some cases, for example, the need to meet building code requirements may prove insurmountable for families relying on self-help housing and add a further layer of stigmatization for low-income and informal settlements households particularly when building codes are embedded in long-term histories of oppression[30] (discussed further in Chapter 5).

Moreover, there is a need to be cautious about their presentation as a panacea. Instead, building codes should be considered alongside a diverse suite of interventions, involving a range of actors across the whole housing sector. This could encompass traditional methods of environmental policymaking through regulation and incentives, alongside more dynamic approaches such as provision, self-management, activism, awareness-raising and training (Figure 6.5).

Building codes should be considered alongside a diverse suite of interventions, involving a range of actors across the whole housing sector

Figure 6.4: Prevalence of building energy codes (BEC) and standards

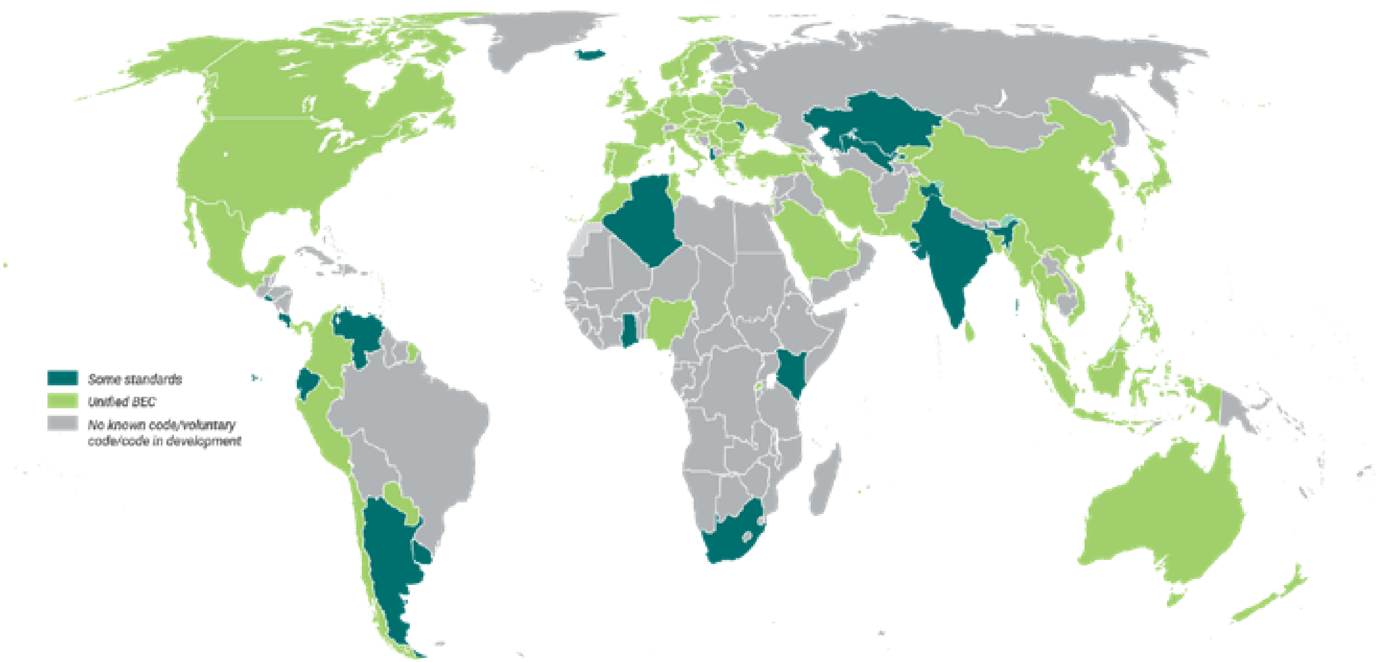
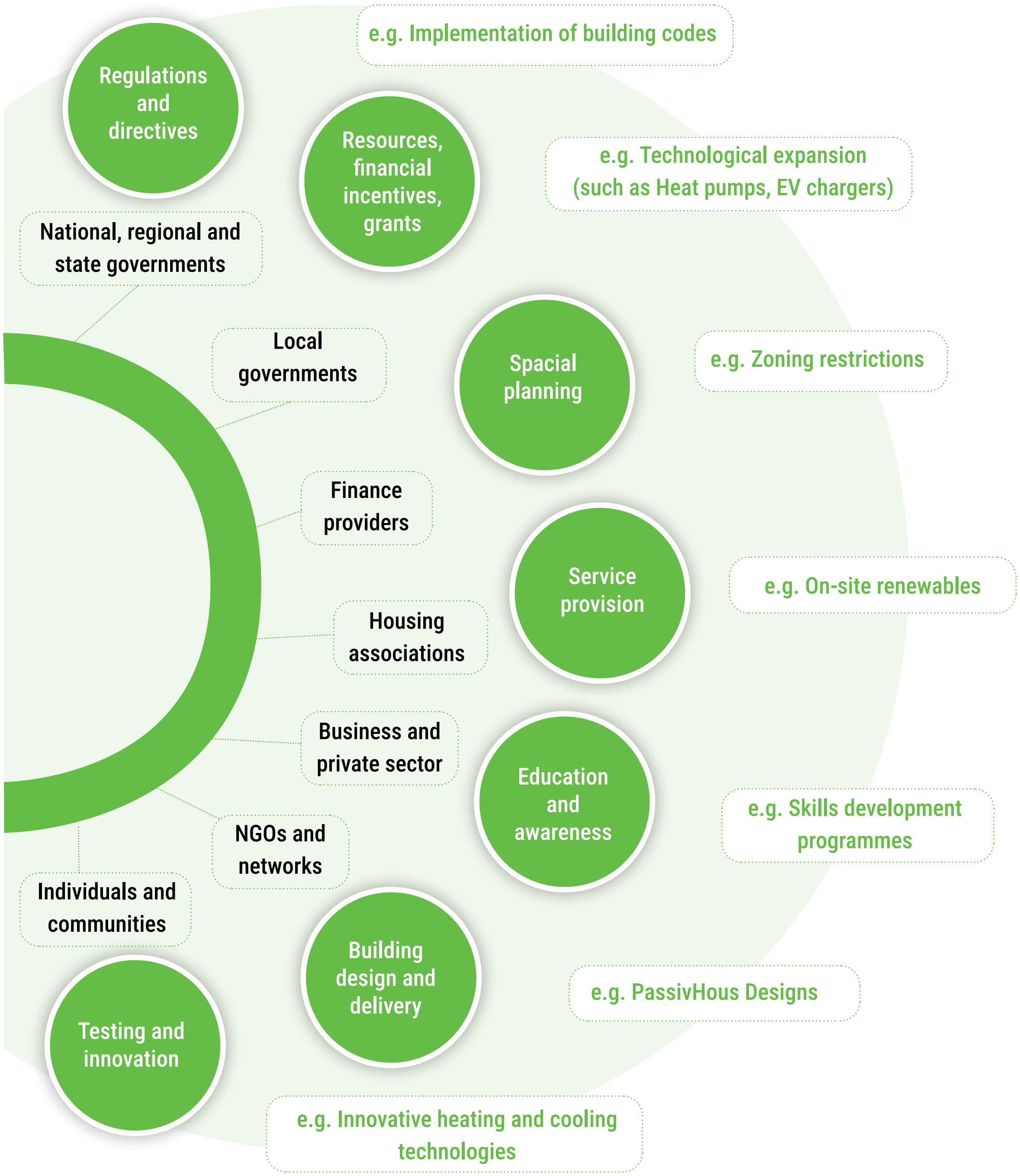


Figure 6.5: Actors, policy strategies and examples of action



Illustrated by Vanesa Castán Broto

There is also an urgent need to research how established actions to reduce direct emissions must account for dynamic changes driven by global spatial trends, particularly climate change impacts, biodiversity loss and urbanization.[31] For example, around 80 per cent of the increase in global CO_2 emissions between 2023 and 2024 was attributed to record-breaking temperatures, driving up the use of cooling, with two-thirds of the temperature-associated emissions attributable to China and India.[32]

Actions to reduce direct emissions need to integrate local knowledge to identify and manage place-based uncertainties

This points to the growing difficulty of using building templates or standard designs to address dynamic environmental impacts. To be effective, actions to reduce direct emissions need to integrate local knowledge to identify and manage these place-based uncertainties.

6.1.2 Indirect emissions

Indirect emissions are generated off-site to meet building and housing demands. Common examples of indirect emissions include those generated by the production of electricity off-site and the provision of services such as water, waste disposal or district heating, as well as the outputs associated with the various objects that make the house habitable, from furniture to appliances. The integration of buildings into the overall service provision system, including networked infrastructure and waste management, can potentially have considerable environmental benefits through efficiencies of scale. For example, urban electrification has great potential to reduce emissions because electricity can be converted to renewable energy more efficiently through a larger network. National-level initiatives to support electrification can translate into significantly reduced emissions among urban households, as in Tanzania (Box 6.2).

Supporting a reliable supply of electricity can be an effective way to reduce greenhouse gas emissions in the housing sector, while ensuring affordability

Box 6.2: eCooking in Tanzania

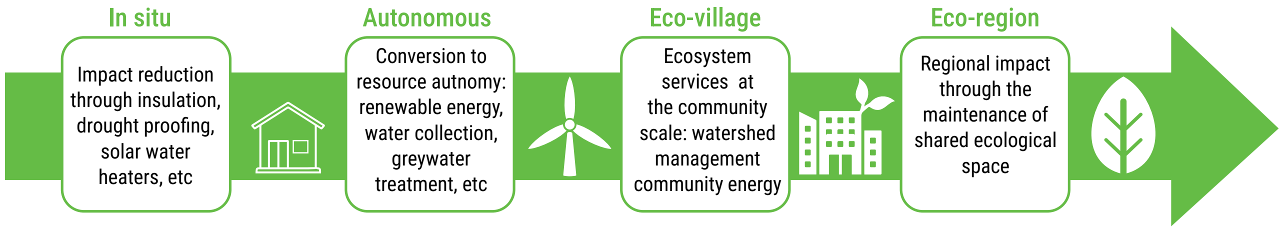
For local and regional governments, supporting a reliable supply of electricity can be an effective way to reduce greenhouse gas emissions in the housing sector, while ensuring affordability and facilitating large-scale technological transitions towards more sustainable practices. In Tanzania, for instance, a process of rapid electrification across the country has seen access among the population more than double from 15 per cent in 2020 to 40 per cent in 2020. This has provided a vital alternative to high-polluting energy sources such as charcoal, paving the way for more sustainable practices such as eCooking. Estimates suggest that, were 40 per cent of the urban population currently using charcoal to instead use electric appliances such as pressure cookers, rice cookers and induction stoves, an annual reduction in emissions of 1.3M tonnes/yr CO_2eq could be achieved. In addition, eCooking has a range of other benefits, including improved health, significant time savings and lower energy costs.

A number of different stakeholders have been involved in driving this transition forward through various economic, behavioural and policy interventions. The Tanzania Electric Supply Company Limited developed a programme to give consumers access to eCooking appliances through sustainable finance. To address the challenges of changing practices and cultures of cooking that were previously reliant on charcoal, the Tanzania Traditional Energy Development and Environment Organisation (TATEDO) developed a recipe book specifically tailored to eCooking. The government has also engaged the private sector and NGOs to facilitate skills development for repair and maintenance, as well as support the establishment of a reliable supply chain. These efforts culminated in the government's adoption of a National Clean Cooking Strategy in 2024 to facilitate the move away from high-polluting energy sources to eCooking.

Source: Clemens, 2022; TATEDO, 2022

Cooking in steel pot on the electric stove © Shutterstock

Figure 6.6: Rethinking housing sustainability at different scales



Source: Elaborated by Vanesa Castán Broto from Birkeland, 2012.

Delivering reductions in indirect emissions requires careful consideration not only about the house itself, but also its surrounding neighbourhood and regional context. As Figure 6.6 shows, in situ measures alone are generally insufficient. To achieve more meaningful impacts, housing should be viewed holistically within its broader environment, with a focus on large-scale, integrated approaches that promote the development of entire "eco-villages" or even "eco-regions".

Inspiring practical, ongoing experiments on sustainable housing have emerged from self-organized and intentional eco-communities, often involving fewer than 400 people.[33] They usually encompass not only infrastructure but also food supplies and sustainable living practices such as shared habitation, co-housing or collaborative housing (Box 6.3). There are hundreds of ecovillages, mainly in Europe. Examples also exist in other locations, including the US, Canada, India, Thailand and Australia, with many integrated into international networks such as the Global Ecovillage Network.[34] It is true that eco-communities are rarely scalable initiatives and have not fundamentally changed housing paradigms. They do, however, offer opportunities for knowledge and innovation that can support the realization of more sustainable housing and emissions reductions.[35]

Box 6.3: Sustainable living at the Dancing Rabbit Ecovillage in Missouri, US

The Dancing Rabbit Ecovillage in northeast Missouri in the US describes itself as "a thriving sustainability demonstration project" that hosts annual visitor programs to showcase low impact living. Its residents commit to ecological covenants that prohibit personal motorized vehicles on Dancing Rabbit property and the use of fossil fuels for purposes such as warming or cooling the home. Residents are also required to conform to organic standards in all land-based activities, ensure electricity is from sustainable sources, and to prioritize waste reclamation. Interviews with Dancing Rabbit members show that their way of life has a reduced impact on ecosystems and that many of their practices improve their quality of life. Yet, they also express frustration with the perceived restrictions on their personal freedom that living in such a context entails.

Source: Pickerill, 2025; Ecovillage, n.d.

Local governments and housing associations can play an essential role in reducing indirect emissions: for example, either directly through the provision of social housing or indirectly by providing incentives for other actors to change existing practices. However, they often face difficulties ensuring that actions to reduce emissions do not exacerbate existing drivers of exclusion.[36]

Financial grants, subsidies and low-interest loans can play a role in mitigating the need for up-front investments from households, while potentially reducing long-term user costs. For instance, Cornwall Council in the UK retrofitted 83 council owned social homes as part of its Whole House Retrofit Innovation project, funded in part by the UK Department for Business, Energy and Industrial Strategy (BEIS). The upgrades – including loft, wall and under-floor insulation, solar panels, single room ventilation and ground source heating – significantly cut both direct and indirect emissions by reducing household energy demand and lowering reliance on carbon intensive electricity.[37]

Regulatory authority and community organization can also be leveraged to unlock economies of scale and accelerate shifts towards green energy. In the US, Community Choice Aggregation (CCA) regulations allow local governments to procure electricity on behalf of residents and businesses, using aggregated demand to negotiate cleaner power options. In 2022, about 5.7 million customers using 14.6 billion kWh of electricity benefited from CCA in California, Illinois, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Ohio, Rhode Island, and Virginia.[38] By aggregating their electricity demand, communities are able to negotiate better rates for their energy supply and accelerate the shift towards green energy.

Inspiring practical, ongoing experiments on sustainable housing have emerged from self-organized and intentional eco-communities, often involving fewer than 400 people

Bakklandet Wooden House Village in Trondheim, Norway © Shutterstock

6.1.3 Embodied emissions

Embodied emissions are forecast to increase, particularly as housing demand grows. As emissions are generated throughout a building's lifecycle, achieving net-zero embodied carbon requires emissions to be minimized at every stage.[39] This "whole-life" approach[40] means considering if the building is needed, whether there are already existing assets that could be used in its place, how to construct it most efficiently and the best way to dispose of it without generating further emissions.

There are already encouraging examples of innovations in reducing embodied emissions through repurposing existing assets. A Scottish cleantech building materials company, Kenoteq – a spinout from Heriot-Watt University – develops bricks made from construction and demolition waste and reuse materials that would otherwise go to landfills. The bricks, which do not need kiln firing, produce 95 per cent less carbon emissions compared with the traditional clay versions.[41] In Kenya, a community-focused enterprise, Gjenge, has responded to the mounting problem of non-recyclable waste by repurposing it into a range of alternative building materials. Besides preventing the burning or burial of discarded plastic, Gjenge's innovation also avoids the energy-intensive process of manufacturing cement, so contributing to the reduction of embodied carbon.[42]

Looking at the construction process as a whole, the Life Cycle Assessment (LCA) is a design method that supports material accounting of the full impact of buildings from raw material extraction through manufacturing, transport, construction, use, maintenance and demolition. By analysing emissions at every stage of the building's lifetime from "cradle to grave", LCA identifies opportunities for lower carbon design choices and helps guide policy action.[43] Through multiple national level regulations, Nordic countries have already taken bold steps to tackle embodied carbon by applying LCA principles to capture emissions throughout the different stages of a building's life cycle – upfront production, in use and end of life. These regulatory shifts create the conditions for material innovation at scale. For example, in Växjö (Sweden) and Trondheim (Norway), the widespread adoption of timber-based construction has significantly cut embodied emissions, replacing steel and concrete with materials that not only use far less energy, but also process and store carbon. The Nordic countries are now working towards a harmonized legal framework, further expanding the scale for controlling embodied carbon in the building sector across the region.[44]

By analysing emissions at every stage of the building's lifetime from "cradle to grave", Life Cycle Assessment (LCA) method identifies opportunities for lower carbon design choices and helps guide policy action

While the LCA is a valuable tool for architects, designers, engineers, and planners involved in the development of housing projects, whether they are newly built or retrofits, it does have some limitations. In particular, its general focus is on conventional housing projects rather than a more holistic perspective that incorporates the broader neighbourhood in its assessment.[45] Thus, an alternative has been to use the LCA in a wider context as an urban planning tool to evaluate "circular" strategies to reduce emissions by reimagining building practices and infrastructure use.[46] These approaches retain the value of existing buildings, extend their life and aim to reduce overall consumption by activating existing assets through incentives or regulations. Cities as varied as Mataró (Spain) and Amsterdam (the Netherlands) already use circular strategies, such as imposing restrictions on vacant housing, although they face barriers to implementation (Table 6.2).[47]

Table 6.2: Circular strategies for reducing life cycle emissions from buildings

Circular strategy for reducing life cycle emissions from buildings	Key elements	Benefits	Examples from European countries	Barriers to implementation
Sharing of space	Using the same physical space for multiple users or functions (e.g., co-working)	Reduces demand for new construction, lowers embodied emissions	Co-working hubs, rural shared workspaces, co-housing	Cultural resistance, legal/contractual issues and management of complex social relations
Temporary use of vacant space	Re-purposing unoccupied buildings or land temporarily instead of building new ones	Saves embodied energy, materials, and supports urban regeneration	Pop-up shops or clubs, cultural projects in vacant buildings	Short tenure security, lack of incentives and zoning restrictions
Virtualization / digital solutions	Replacing or reducing physical space with digital tools and remote work	Cuts demand for office buildings, reduces travel and energy use	Hybrid work, virtual meetings, working from home	Digital divide, employer resistance, cybersecurity concerns
Adaptive reuse	Extending a building's life by converting it to a new use	Saves embodied energy and materials, avoids greenfield construction	Converting offices or industrial buildings into housing	High retrofit costs, regulatory barriers and heritage restrictions
Vertical extensions	Adding floors to existing buildings rather than constructing new ones elsewhere	Mitigates land pressure, saves embodied carbon and densifies cities	Rooftop or garden extensions	Structural limitations, safety codes, community opposition and over-densification
Relocatable / modular buildings	Constructing buildings or modules designed to be moved and reused	Preserves embodied materials, reduces demolition waste, and may facilitate retaining population	Modular schools, relocatable offices and housing	High initial investment, limited design flexibility, logistics challenges and planning regulations
Building relocation	Moving an existing building to a new site instead of demolishing it	Retains embodied carbon, avoids new material use	There are several relocation projects in Nordic countries	Technical complexity, high cost, limited applicability
Refurbishment and renovation	Upgrading and maintaining existing buildings for more prolonged use	Reduces demolition waste, lowers operational energy demand	Social housing projects to retrofit zero-carbon appliances and designs	Financing gaps, disruption to occupants, split incentives between owners/tenants
Design for disassembly	Designing buildings for easy deconstruction and material recovery	Enables reuse of components, high-quality recycling	Circular design principles in EU building codes, and the approach has become popular in the construction industry[48]	Lack of standards, higher upfront costs, and a limited market for reused materials
Material substitution	Replacing carbon-intensive materials with low-carbon alternatives	Reduces embodied emissions significantly	Using timber instead of steel/concrete, architectural designs with mudbricks	Supply chain limitations, fire safety and durability concerns, and conservative building codes

Source: Lundgren et al, 2025.

Reducing embodied emissions, however, requires coordinated action at different scales from the design of buildings and neighbourhoods to the national level. The latter is especially important with regards to normalizing different directives and practices related to housing. This is particularly relevant for tackling complex challenges, such as the growing use of carbon-intensive materials, such as cement and steel, in buildings (Box 6.4). Tackling these emissions may require nuanced negotiations with industry, mediated by national governments, showing the limits of sustainability action by local governments alone.

Box 6.4: Tracking the flows of cement and steel in housing

Embodied carbon accounts for about 18 per cent of global greenhouse gas emissions, with the majority attributable to cement and steel.[49] Progress towards achieving emission reductions in this area since 2015 has, however, been uneven.[50] In the case of steel, while there have been various positive measures including the adoption of the WTO Steel Standards Principles by key organizations,[51] a lack of commitment from national governments has undermined any meaningful steps towards decarbonization. In the case of cement and concrete, there is limited agreement on what net-zero carbon means in the sector. Again, substantive commitments are few, despite the development of standard accounting methodologies by organizations such as the Global Cement and Concrete Association (GCCA). Cement and steel also consume large amounts of water, further multiplying the negative environmental impacts.

IEA envisions a critical pathway for the decarbonization of both sectors. For steel, increased recycling and strong electrification are key levers to facilitate decarbonization.[52] In the case of steel, a key issue is developing dialogue with communities affected by the sector's decline to ensure a more just transition, alongside the decisive implementation of regulations and business strategies by the public and private sectors. In the case of cement, the primary initial step is to prepare a comprehensive policy framework to facilitate the implementation of more ambitious policies and regulations.

Source: IEA, 2024

Wet concrete being poured onto steel reinforcement bars at a construction site
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6.2 Reducing the Vulnerability of Housing to Climate Impacts

When climate change impacts housing and homes, the consequences are felt across society, as adverse climate outcomes change the lives of individuals, communities, cities and wider regions. However, the way those impacts are experienced vary widely across a city. People living in informal settlements are disproportionately affected by climate hazards and have limited adaptive capacity.[53]

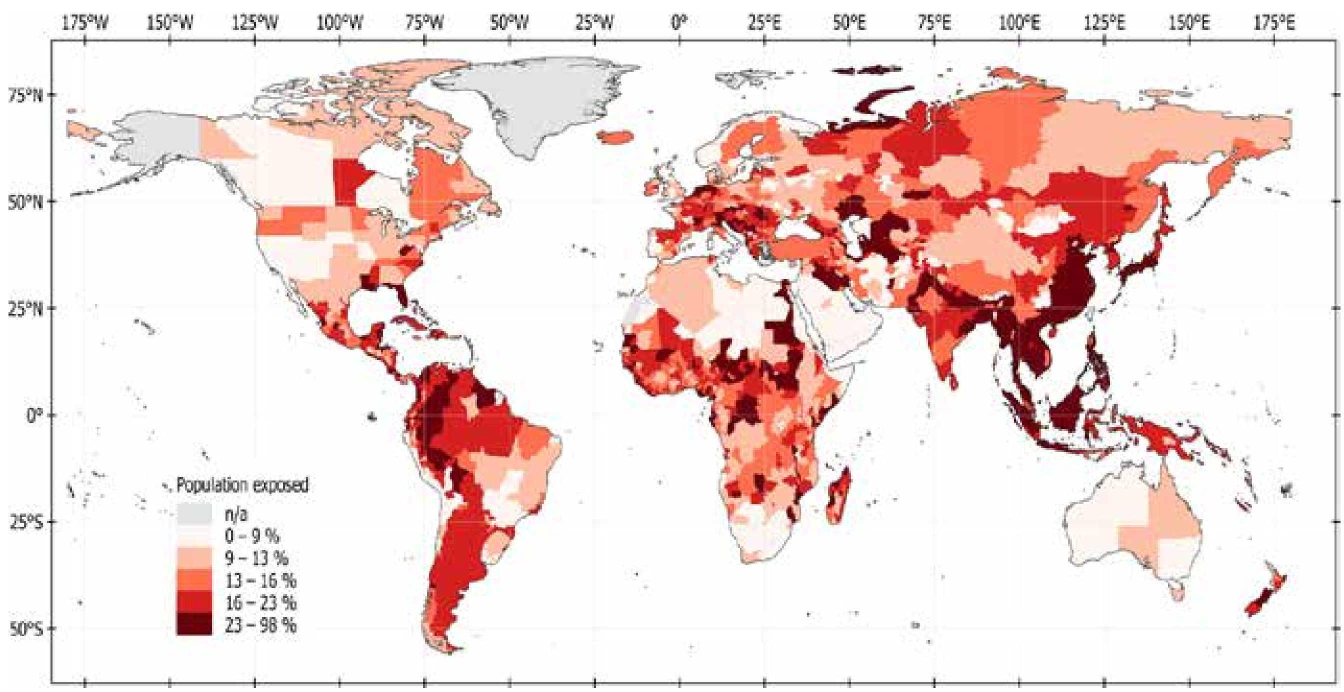
The adverse impacts of climate change are already keenly felt. In 2024, 45.8 million people were internally displaced by weather-related events, including storms (25.2 million), floods (19.1 million), wildfires (425,000) and droughts (387,000), among other weather-related risks.[54] While not all these weather events can be attributed directly to climate change, their frequency and severity are increasing as a result of its impacts. Displacements create new demand for housing, sometimes on a temporary basis but often for protracted periods, with associated needs for access to services and livelihoods (a point discussed further in Chapter 4). Housing is also a major determinant of health vulnerability to climate change.[55]

Addressing climate hazards requires not only evaluating the current state of the hazard, but also its future evolution. Hazards do not occur in isolation but often interact with other concurrent risks. On the one hand, there is the possibility of a "cascade event" that creates multiple interactions between the hazard and the infrastructure sustaining housing. For example, the impacts of flooding on electricity and communication networks may complicate the emergency response, as happened when Hurricane Idai hit Beira (Mozambique) in 2019. On the other hand, the development of slow-onset events may add to the progressive deterioration of the housing stock, making it less resilient to further events.

The destruction of housing stock due to climate risks not only directly affects people's lives but also makes it more difficult to access housing in the future

From the perspective of housing as a human right, the destruction of housing stock due to climate risks not only directly affects people's lives but also makes it more difficult to access housing in the future.[56] Moreover, climate risks add to insurance costs, further reducing the means to manage urban risks even for those not already excluded from formal financial instruments.[57] Housing, again, becomes a key means through which resilience can be attained. Urban resilience demands a citywide perspective that prioritizes those most at risk: a city that works for the most vulnerable is a city that works for all.

Figure 6.7: Percentage of population exposed to flood risk at the subnational level



Source: Rentschler, Salhab et al., 2022.

6.2.1 Specific climate-related risks to housing

Housing is acutely exposed to the effects of climate change. Both acute and slow-onset events, from sea storms to gradual temperature increases, impact on housing and how it is inhabited. Risks to consider when developing climate-resilient housing include sea-level rise, inland flooding, extreme storms such as typhoons, cyclones and hurricanes, wildfires, heatwaves, water stress and subsidence. If effective reconstruction measures are not taken, these risks may become chronic over time.[58]

Over 850 million people live in coastal zones with low elevation and will thus be exposed to increasing risks of sea level rise,[59] including flooding, erosion, sea intrusion and pollution, leading to increased maintenance costs.[60] In addition, many others are at risk from fluvial overflow from rivers or surface water flooding. For instance, a recent assessment of flooding risks in 188 countries estimated that as many as 1.81 billion people (23 per cent of the world population) were situated in locations exposed to “a significant level of flood risk”.[61] Compaction and soil sealing, common in highly populated areas, exacerbate the risk of flooding. Countries in Southeast Asia are heavily affected, but risks are widespread in all world regions, as illustrated in Figure 6.7.

As many as 1.81 billion people (23 per cent of the world population) are situated in locations exposed to “a significant level of flood risk”

In the wake of devastating wildfires across Europe during 2025, experts have warned of a “new normal” of extreme weather in the continent

Flooding is often driven by extreme events, such as extreme storms. Table 6.3 demonstrates the impact of these events on housing and associated infrastructure. The storms cause direct destruction through high winds (tearing roofs, collapsing walls), storm surges (which cause inundation and erosion of foundations) and heavy rainfall, potentially triggering landslides and flash floods that may wash away entire communities. Additional impacts on materials and land availability, as well as the loss of livelihoods and displacement, also hinder reconstruction efforts.[62]

Concern about the impacts of wildfires on housing has also risen, as recent events in locations such as California (US), Spain and Australia have led to population displacement, destruction of homes and increased air pollution.[72] In the wake of devastating wildfires across Europe during 2025, experts have warned of a “new normal” of extreme weather in the continent.[73] The impacts of wildfire are long-lasting, as the loss of vegetation and subsequent erosion can further exacerbate the loss of water resources and the risk of flooding.

Increased average temperatures and heatwaves are also a concern, as poorly designed housing can exacerbate the effects of heat, leading to heat exhaustion, dehydration and cardiovascular strain among residents. Heatwaves, often described as “a silent killer”, are responsible for

Table 6.3: Examples of housing impacts of extreme storms recorded in recent years

Name	Location (country/territory)	Year	Estimated cost	Estimated destruction
Super Typhoon Hagibis	Japan (Honshu)	2019	~ 2.9 trillion yen (~US$21.3 billion)	3,273 totally destroyed, and over 90,000 partially damaged or inundated[63]
Typhoon Co-may (Lekima)	China (Zhejiang / Shandong)	2019	~CNY72 billion (US$10 billion)	~149,000 damaged[64]
Hurricane Dorian	Bahamas	2019	~US$3.4 billion	~3,000 homes damaged or destroyed[65]
Cyclone Idai	Mozambique / Malawi / Zimbabwe	2019	~US$2.9 billion	~240,000 homes damaged or destroyed in Mozambique alone[66]
Super Typhoon Rai (Odette)	Philippines	2021	~US$0.95 billion (₱47.6 billion)[67]	>1 million homes damaged[68]
Hurricane Ida	US (Gulf of Mexico)	2021	~US$95 billion	Up to 75 per cent of buildings damaged in some hard-hit areas such as Lafourche Parish[69]
Hurricane Ian	US (Florida & SE)	2022	~US$112.9 billion	~5,000 homes destroyed and 30,000 damaged in Florida alone[70]
Typhoon Yagi	Vietnam (North/Northeast)	2024	~US$1.66 billion	~314,000 homes damaged or destroyed[71]

Source: compiled by author.

millions of unrecognized deaths.[74] These impacts may be higher for certain population groups susceptible to heat, such as the elderly, children, people with disabilities or low-income individuals who may not have alternatives to minimize exposure (Figure 6.8).[75] Rising temperatures are often alleviated with individual air conditioning units that increase the home's overall energy consumption, therefore increasing emissions and further reducing resilience.

Heatwaves, often described as "a silent killer", are responsible for millions of unrecognized deaths

6.2.2 Addressing the impact of climate change on housing

While climate-related events affect everyone, the impacts are strongly determined by location, income and other factors, with poor and marginalized homes and neighbourhoods typically most exposed to risks. Housing inequality compounds climate-related vulnerabilities.[76] At the same time, housing can be a key lever for improving health and resilience among vulnerable populations, and providing climate-resilient housing responses is also an effective way to build communities.[77] In particular, climate resilience can be developed through interventions in building design and construction, neighbourhood planning, city-wide planning

Figure 6.8: Vulnerabilities that exacerbate the individual impacts of heat and inadequate thermal comfort

PHYSIOLOGICAL FACTORS	EXPOSURE FACTORS
Older and people with disabilities	Outdoor and manual workers
People with certain medical conditions or taking certain medications or drugs	People living in sub-par housing conditions or who lack access to cooling
Pregnant people	People who are poor, displaced or experiencing homelessness
Infants and children	Athletes and attendees of outdoor events

Adapted from: WHO, 2024

A firefighter fights intense flames consuming a house during a wildfire outbreak in Stillwater, Oklahoma, US. © Shutterstock

and broader interventions at the regional and national levels. Three areas of action open: People and community capital; Housing stock (new and retrofit); and Integrated planning of neighbourhoods and cities.

People and community capital

Community is key in strengthening resilience: it is not built solely by individuals, but through their relationships with others and the environment, underscoring the importance of a collective, shared approach to any form of action.[78] Local actions led by community organizations aiming to improve neighbourhoods are almost always beneficial for building resilience, particularly for more disadvantaged households, and especially when local community representatives are facilitating resilience-building efforts themselves.[79] Across the world, there are numerous examples of community-based housing programmes that have successfully support resilience building, in many cases either in preparation for or in the wake of natural disasters (Table 6.4).

Community capital in its different forms can also be effectively leveraged to bolster resilience through informal practices (discussed in more detail in Chapter 5):[86] it encompasses social capital (the degree of interconnectedness among community members through relationships of reciprocity and trust), economic capital (including sustainable livelihoods, markets, community savings and access to credit), human capital (the specific abilities of the community including skills, diverse forms of knowledge, experience and opportunities for action), physical capital (the available infrastructure and facilities, together with the institutions and practices that maintain them) and natural capital (relating to the ability of the community to access natural resources sustainably)[87] (Figure 6.9).

Housing inequality compounds climate-related vulnerabilities

Table 6.4: Examples of different forms of community capital building climate-resilient housing

Location	Case study
Cambodia and the Philippines	Community-led housing in Cambodia and the Philippines through the People's Process and Asian Coalition for Housing Rights (ACHR), where residents collectively plan and construct homes.[80]
Denmark and the UK	Co-housing schemes that foster cooperation and shared resource management across generations.[81]
Zimbabwe and Tanzania	Third sector organizations such as Dialogue on Shelter Trust (Zimbabwe) and the Centre for Community Initiatives (Tanzania), both affiliated to Slum Dwellers International (SDI), support diversification and local development to access housing.[82]
Mexico	Incremental housing finance through the INFONAVIT programme, enabling low-income earners to upgrade homes progressively.[83]
US and Nepal	Habitat for Humanity's Build Back Better programmes includes skills training on disaster-resistant building methods further building the human capital.[84]
Nepal	Post-earthquake Nepal reconstruction projects trained local masons in earthquake-resistant design, creating new forms of community-led disaster reconstruction.[85]

Relatively small measures, such as those that improve ventilation and thermal comfort or use local materials, can make a big difference to the habitability of the home

In addition, there are multiple opportunities for multilateral, regional and local agencies to engage communities constructively in processes that develop local forms of capital and contribute to climate-resilient housing. The example of the People's Process approach deployed in Tboung Khmum, Cambodia, is a good example of the transformative impacts that donors can achieve by engaging communities at multiple scales (Box 6.5).

Community-led housing (CLH) is an effective strategy to deliver community resilience. While varied in their approaches, CLH initiatives share a number of common principles that are in line with strategies to build community capital:[88]

- Residents are in the driving seat, ensuring their central involvement in the housing project.
- Action follows principles of solidarity and cooperation, mobilizing resources through community savings.
- The focus is on ensuring long-term affordability and guarding against gentrification.
- There is collective stewardship, often through communal management of infrastructure, land sharing or institutional development.
- The overarching focus is always on advancing the right to housing.

Community-led housing is an effective strategy to deliver community resilience

Over the years, climate resilience and attention to housing environments have become increasingly central to CLH efforts because it is often conducted in ways that help build resilience.[89] Examples demonstrate that CLH builds multiple elements of community capital and can deliver housing for just a fraction of market costs, with a substantially smaller carbon footprint. This is illustrated by the case of Uruguay's FUCVAM, where the use of local materials reduced construction costs by 30–40 per cent while also lowering emissions.[90] Arguably, the most substantial impact of CLH is its ability to deliver social and human capital through networking, collaboration and the potential for peer-to-peer learning. In Argentina's San Martín de los Andes, for instance, the active participation of Mapuche communities enabled the implementation of traditional techniques that minimize deforestation and soil degradation.[91] This

Box 6.5: Applying the People's Process to disaster-resilient upgrading in Tboung Khmum, Cambodia

Cambodia faces severe vulnerability to floods, storms and strong winds, especially in low-lying provinces along the Mekong River. In 2018, Tropical Storm Son-Tinh and the collapse of the Sepa-Nam Noi dam displaced over 5,000 families across five provinces. The worst-affected district was Tboung Khmum, with 2,148 households evacuated and no immediate reconstruction assistance available.

In response, the "Project for Improving Living Environment and Disaster Prevention Capacity in Cambodia", implemented by UN-Habitat with support from the Government of Japan and Cambodian authorities, applied the principles of the People's Process approach to rebuild 202 disaster resilient houses and install 216 latrines, benefitting nearly 10,000 people in the district. Communities mapped risks, identified safe construction sites and formed Community Development Committees to oversee construction and preparedness activities. The project also strengthened local skills by training 172 builders and 70 officials, while enhancing women's participation, social cohesion and governance capacity. Although internationally financed, the community leadership shaped planning, decision making, monitoring and conflict resolution throughout the project.

Source: UN-HABITAT, 2020

Figure 6.9: The different dimension of community capital

Source: Adapted from Vallecha et al. 2025 also enables political mobilization and pressure at the local, regional and national levels. For example, the Philippines Alliance, in support of the Homeless People's Federation of the Philippines, has established strong partnerships with municipal actors through CLH projects.[92]

Building community resilience is dependent on timing, scale and the development of a common understanding on how to approach it. Humanitarian responses have focused on "building back better" after disasters, but as explained above, community resilience depends particularly on the ability to build different forms of capital over time. Planning helps anticipate disruptions and address pre-existing vulnerabilities that may become critical in the context of emergency responses and recovery.[93] Resilience is also consolidated at different scales, reflecting the interconnected nature of systems at the neighbourhood and wider regions where housing is located.

Community-led housing can deliver housing for just a fraction of market costs, with a substantially smaller carbon footprint

Housing stock: new and retrofit

Climate resilience can be delivered through interventions in the housing stock, prioritizing affordability and the needs of low-income dwellers in particular (Figure 6.10). The first step to building climate-resilient housing is to evaluate the conditions of the existing stock. Relatively small measures, such as those that improve ventilation and thermal comfort or use local materials, can make a big difference to the habitability of the home. Many such measures may emerge from the deployment of traditional knowledge or an informed understanding of the current climate and how it will impact future projections. Awareness, education, peer-to-peer learning and demonstration projects can also significantly enhance housing resilience.

There is also much to gain by investing in efforts to reduce housing emissions, both direct and indirect, as discussed in Sections 6.1.1 and 6.1.2. Mitigation actions often have co-benefits for adaptation. For example, retrofitting old and inefficient housing with energy efficiency measures such as insulation or upgraded heating, ventilation and air conditioning (HVAC) systems is an effective way to improve its performance and liveability. Similarly, applying green building standards in the construction, design and operation of housing reduces emissions, improves environmental quality and facilitates long-term savings.

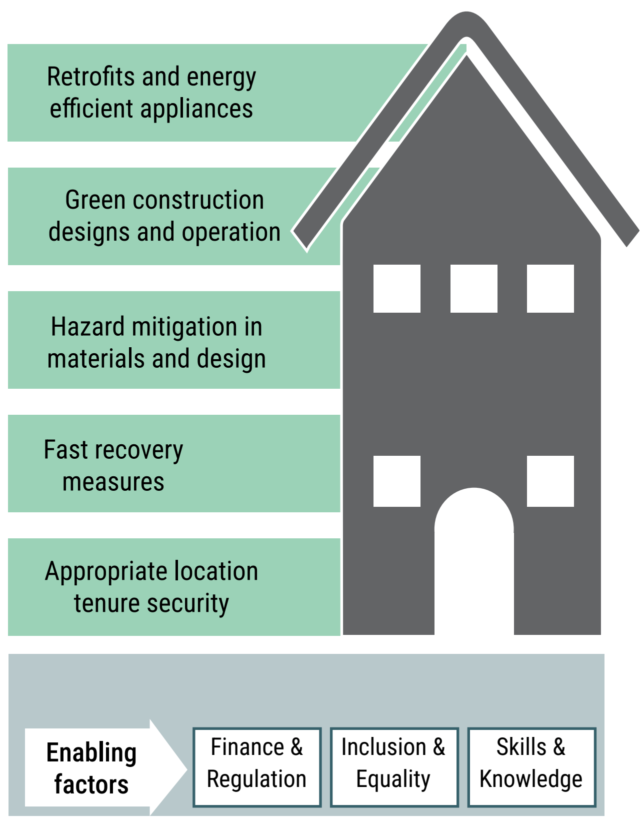
There is, however, a need to apply such standards carefully, as they may curtail access to housing and create additional vulnerabilities, particularly when they do not fit neatly with local conditions and traditions. Trade-offs can also manifest in different ways: for example, the implementation of flood zoning policies help reduce flooding risks at the city level, but may impact negatively on housing access and affordability by

Negotiating resilience with communities helps reduce unintended impacts, particularly in the context of informality where communities play a central role in the production of space

reducing the availability of developable land.[94] Negotiating resilience with communities helps reduce unintended impacts, particularly in the context of informality where communities play a central role in the production of space.[95] A key challenge is considering the multiple decisions and points of intervention to advance climate-resilient housing through a negotiated approach across the different stages of housing delivery.

On the other hand, climate resilience is also achieved through adaptation to the increasing frequency and severity of weather-related shocks. Strategies for hazard mitigation can be incorporated into the design and construction of housing, such as elevating structures in flood-prone areas, using flood-resistant materials and house elements, retrofitting foundations to withstand storms or earthquakes, and improving site drainage. These can be complemented with measures to facilitate rapid recovery, such as collective planning, reduced interconnections in physical infrastructure, and modular infrastructure and housing.

Figure 6.10: Areas of intervention to build resilience in existing and new housing stock



Elaborated by Vanesa Castán Broto

Often, adaptation can be addressed through mobilizing traditional and alternative knowledge. For example, the construction of elevated housing has a long history in many parts of the world and continues to be practiced to this day (Figure 6.10). The stilt village of Ganvié on Lake Nokoué in Benin was founded in the 17th century by communities seeking to hide from slave traders. Today, the community works on the ongoing rebuilding and maintenance of timber houses on piles over the shallow lake and a system of elevated platforms connected by canoe transport.[96] Such examples have been emulated in contemporary urban settings elsewhere, such as the modern amphibious housing designs in Gelderland (the Netherlands), demonstrating the potential for learning about traditional technologies.[97]

Indigenous knowledge around building methods has also long been used to build resilience, often developing techniques closely aligned with the characteristics of a particular place. This is reflected in the varied architecture evident in many Small Island Developing States (SIDS).[98] In Samoa, the traditional housing called Samoan fale features a high thatched roof over an open structure with no walls, thus protecting inhabitants from the sun and rain while allowing natural breeze to cool the structure. In New Caledonia, the traditional Kanak case has thick walls and no windows, so that the structure retains the warmth from an indoor fireplace (and the smoke helps keep mosquitoes away). In Fiji, the traditional bure withstands strong winds and tropical cyclones with the use of hardwood posts deeply buried in the ground to provide stability. The steep, four-sided rooms and strong bindings secure the whole structure. In the Solomon Islands, particularly on Tikopia Island, Indigenous communities use natural landscape features as protection, taking shelter beneath overhanging rocks during severe storms. A similar ingenuity is reflected in the vernacular architecture deployed by communities in Indonesia, drawing on locally sourced materials and designed to withstand a range of natural disasters such as flooding, heavy rain and earthquakes (Figure 6.11). The diverse solutions evident in traditional architecture offer important learning opportunities for the development of context-appropriate housing today.

Often, adaptation can be addressed through mobilizing traditional and alternative knowledge

The diverse solutions evident in traditional architecture offer important learning opportunities for the development of context-appropriate housing today

Figure 6.11: Diversity of traditional and adaptable architectural styles in Indonesia

Source: Illustrated by Sepeda Ilmu.

Neighbourhood scale is crucial for effective disaster risk management and reconstruction

Integrated planning of neighbourhoods and cities

Housing resilience extends far beyond the individual structures: it both shapes and is shaped by the community it is situated in. In this regard, the neighbourhood scale is crucial for effective disaster risk management and reconstruction, linking housing with the surrounding infrastructure and environment.[99] Sustainable neighbourhood design begins with the recognition that each neighbourhood is different, as much as every city: rather than importing ready-made solutions, an assessment of the specific needs and opportunities of the particular location should be undertaken.[100] This paves the way for context-specific solutions that put people at the centre of action while enriching existing urban landscapes. For example, low-income residents in the informal settlement of Kibera, Kenya, actively participated in flood modelling, helping improve its accuracy and local relevance.[101]

Neighbourhoods thrive within a connected city. City-wide interventions, drawing on resources such as UNDRR's Disaster Resilience Score for Cities (Box 6.6), can make a huge difference in how a neighbourhood develops and feels. The knowledge and resource demands of sustainable planning, however, are often high and may exceed the resources available in each city or neighbourhood. Despite widespread evidence about the potentially transformative role of communities in urban development projects, the pressure authorities may face to deliver at speed influences the extent to which self-governance and participation are meaningful or even possible in many cases.[104]

Rehab City, New Cairo, Egypt © Shutterstock

Planning for density can help build resilience across the city by improving the use of space and aligning it with community use

Where city governments are unable to deliver effective planning responses, local communities may step in to develop locally adapted plans. These examples show the considerable benefits that can accrue when local planners recognize and facilitate locally-led incremental resilience-building. Old Fadama in Accra, Ghana, for instance, is one of the city's most deprived settlements, its residents exposed to both the risks of eviction due to insecure tenure and flooding caused by climate change. All too often in contexts like these, local populations in vulnerable settings are simply displaced in the name of climate adaptation to make space for greening programmes, without considering the loss of resilience this entails due to the erosion of social and human capital.[105] However, with the support of international NGOs such as the Centre for Public Interest Law (CEPIL), Shack/Slum Dwellers International (SDI) and People's Dialogue on Human Settlements (PDS), local leaders in Old Fadama led a community upgrading initiative to improve accessibility, identifying flooding as a critical challenge and negotiating relocation with the most affected residents.[106]

Urban density is often seen as a problem, but planning for density can help build resilience across the city by improving the use of space and aligning it with community use, in line with some of the densification strategies suggested by circular thinking (see Section 6.1.2). Among the different approaches to integrating neighbourhoods into wider urban systems, the three-value (3V) approach proposes focusing on the various forms of value created by the structure of urban space, namely:[107]

- Node value emphasizes the centrality, accessibility and mobility of space, and how it facilitates movement across the city.
- Place value emphasizes the urban quality of different places, the development of vibrant neighbourhoods that ensure the well-being of populations and ecosystems.
- Potential market value emphasizes a place's economic attractiveness.

This emphasis on connectivity across the city supports arguments for transit-oriented development (TOD) to facilitate compact housing growth around public transport intersections.[108] Their mixed use, high-density design, typically connected to major transport links, can deliver significant emission reductions both in the construction of housing and the subsequent lifestyles of its inhabitants, who are in close proximity to a range of amenities and have easy access to public transport. However, while TODs often have significant impacts on housing availability, affordability remains a challenge.[109] A comparative study of 107 TODs in 24 rail-served regions in the US found that housing affordability rates varied widely but, in most cases, lower-income groups are priced out.[110]

Box 6.6: Taking action to reduce rising urban temperatures: examples from the Making Cities Resilient Campaign

UNDRR's Disaster Resilience Scorecard for Cities aim to facilitate a collaborative planning process, in line with its "Ten Essentials for Making Cities Resilient", which operationalize the principles of the Sendai Framework at the local level.[102] The Resilience Scorecard is a tool that facilitates the assessment of the city's resilience against a list of 47 indicators in the preliminary assessment and 117 in the detailed assessment.[103] The Scorecard is broad and system-wide, and rather than focusing purely on housing, it emphasizes the language of property and infrastructure. Nevertheless, different indicators such as property risk, building codes, land use and displaced persons enable local governments to address climate-resilient housing.

Various cities have piloted the Scorecard as part of the Making Cities Resilient campaign, including Manchester (UK), Makati (Philippines) and Suroydarya (Nepal). In particular, its work has helped demonstrate different approaches to addressing urban heat challenges through housing and urban infrastructure interventions, including:

- Amadora (Portugal), a densely populated city of 200,000 inhabitants, has addressed heat through retrofitting of dense housing areas and an ambitious tree planting programme to increase green space by 50 per cent in five years. Designated cooled emergency shelters address the needs of vulnerable residents, such as the elderly and the homeless.
- Incheon (Republic of Korea) integrates planning, data and housing upgrades for heat management. Cooling measures include the use of cool roofs and walls in public and residential buildings, shading infrastructure, and tree planting in cool, dense residential areas. They have also targeted low-income houses for upgrades, including wall insulation and window films.
- Quito (Ecuador) incorporates nature into housing designs through green roofs, vertical gardens, and permeable gardens, as well as the expansion of parks and community gardens (especially in dense districts).
- Cape Town (South Africa) integrates the revision of planning and urban design policies to incorporate heat risk management to guide private developers and shape public spaces. Tools include heat risk maps and a map of the city's network of green spaces. As of 2025, the city had installed six spray park cooling centres in lower-income neighbourhoods.
- Nairobi (Kenya) has addressed higher temperatures through cooling and nature-based housing solutions, with the core concern of addressing affordability. Green roofs are a key element of the city's strategy to address heat, with over 200 buildings having benefited.

Source: UNDRR, 2025b

Amadora, Portugal, May 9, 2025, Modern architecture of municipal market of amadora water mine © Shutterstock

In the UK, Coal Drops Yard, in the area near King's Cross station – hailed as the most successful regeneration project in London, with a strong emphasis on climate resilience and carbon neutrality[111] – implemented a TOD concept to align multiple stakeholders for the development.[112] Nevertheless, it has come at the expense of the needs of different communities, especially low-income residents who have seen skyrocketing prices in housing and sex workers whose space needs have been overlooked.[113]

In the context of informal settlements, TODs may expose communities to insecure land tenure, displacement and housing unaffordability. Moreover, TODs may conflict with existing informal transport systems and create unfamiliar transport options, reducing the overall mobility of poorer populations and further compromising housing needs.[114] Thus, increasing resilience requires approaching development projects such as TODs with caution and through the perspectives of the disadvantaged communities that they impact.

Green projects can generate unintended consequences that undermine both climate resilience and the right to adequate housing

Overall, the planning and implementation of green projects can generate unintended consequences that undermine both climate resilience and the right to adequate housing. For instance, the negative impacts associated with "green gentrification" or "green grabbing" (Box 6.7) underscore the need for adequate safeguard measures to prevent negative social impacts.

Box 6.7: The impacts of green grabbing and green gentrification on the right to adequate housing

The UN Human Rights Council has highlighted how green gentrification and green grabbing can undermine climate resilience by challenging the right to adequate housing. Green gentrification occurs when environmental improvements – such as energy-efficient retrofits, green building standards or urban greening – raise property values and living costs, pushing out low-income residents. Green grabbing refers to the appropriation of land, housing or resources under the pretext of environmental protection or climate action: for example, the creation of green zones or carbon offset projects that displace residents.

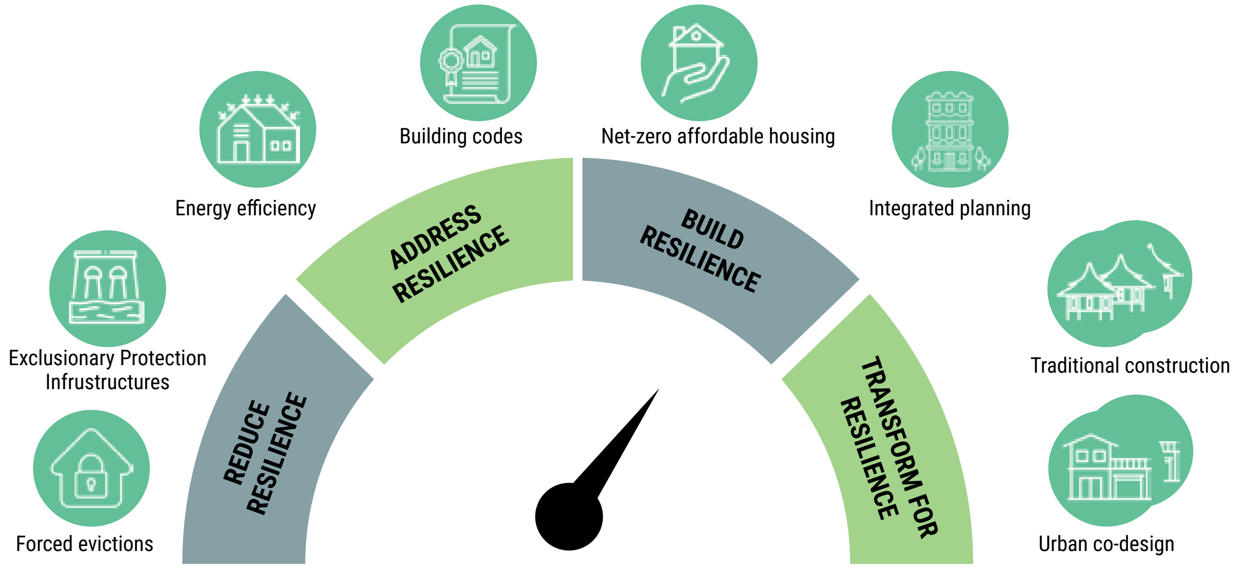
In both cases, any gains in efficiency, adaptability and sustainability are primarily captured by wealthier residents or large landowners, displacing low-income tenants, Indigenous communities or others living in informal conditions. As residents are evicted, long-established networks weaken, social cohesion erodes and people are pushed to hazard-prone, underserved areas, heightening their vulnerability. Concentrating land and benefits in the hands of a few wealthier actors further reduces access to adequate housing, thus undermining trust and participation.

Different measures can reduce the impact of these processes. Measures to deal with green gentrification include tenant and housing affordability protections such as rent controls, legislating equitable green grants, and support for cooperative and community-led housing. Addressing green grabs demands strong human rights safeguards through due diligence in climate projects and strengthened land tenure rights, including diverse forms of customary and collective tenure. Benefit sharing mechanisms and the avoidance of forced evictions are also important mechanisms for preventing green grabbing

Source: Rajagopal, 2022.

First march against gentrification held in the Condesa neighborhood of Mexico City © Shutterstock

Figure 6.12: The climate resilience dial: reduce, address, build and transform



Illustrated by Vanesa Castán Broto

6.3 Enabling Conditions for Climate – Resilient Housing

Current thinking on pathways to climate resilience highlights the need to put vulnerable populations at the centre of resilience efforts.[115] Of particular concern, from a climate justice perspective, is the distribution of benefits and burdens arising from climate action. Access to housing is no exception to this, particularly in urban environments. The technical side of delivering climate-resilient housing, while important, is only part of the story: ultimately, its success requires a political and social transformation that redefines how housing is produced, inhabited and governed.

Furthermore, as elaborated in previous sections of this chapter, evaluating resilience is not always straightforward. Actions implemented under the banner of climate resilience are not always intrinsically good:

Any planning for climate-resilient housing must take into account the unequal distribution of impacts

while encompassing transformative strategies that place communities at the heart of the process, they can also involve exclusionary measures that treat them as part of the problem, such as forced evictions (Figure 6.12). Any planning for climate-resilient housing must take into account the unequal distribution of impacts. With this in mind, the following section discusses two key enabling factors that enable just pathways towards climate-resilient housing: multilevel governance and sustainable housing finance.

Climate-resilient housing must start with partnerships, because no single level of government or market actor controls all the levers

6.3.1 Multilevel Governance

Climate resilient housing must start with partnerships, because no single level of government or market actor controls all the levers. Multilevel governance refers to the system of shared authority and coordination among different levels of government (international, national, regional and local) alongside non-state actors such as civil society, the private sector and communities.[116] In the context of climate resilience, it implies both vertical alignment (coherence between global, national and local agendas) and horizontal collaboration (across sectors and actors). Multilevel governance in housing resonates with the idea of negotiated resilience, which acknowledges multiple definitions across different actors.[117]

At the national level, countries are increasingly recognizing buildings and housing in their climate agendas. For example, the number of countries with Nationally Determined Contributions (NDCs) that reference buildings rose from 135 in 2021 to 161 in 2024.[118] Government institutions at the national level can develop broader policy frameworks that embed decarbonization, risk reduction and disaster management at different levels of decision-making, as in the Philippines (Box 6.8). For example, the government of Kenya has established requirements for affordable housing to meet green standards.

National governments can play a crucial role in protecting the right to adequate housing and establishing assurances for protecting vulnerable populations. At the same time, they can also support market development and provide security to investors and other actors through various tools such as building codes, green procurement, fiscal incentives and support for housing associations.

At the local level, action becomes real. Local governments can enact land use ordinances, planning permissions, infrastructure provision and, often, social housing portfolios. Local governments can also play a key mediator role, convening action between businesses, civil society organizations and other relevant institutions. This puts them in a unique position to support both community-led housing and incremental neighbourhood improvements that can make a difference to local resilience. Communities, for their part, mobilize populations and make room for voices that are often excluded but whose experiences are essential to build resilience, whether this is people with disabilities, imigrants, Indigenous communities or the elderly.

National governments can play a crucial role in protecting the right to adequate housing and establishing assurances for protecting vulnerable populations

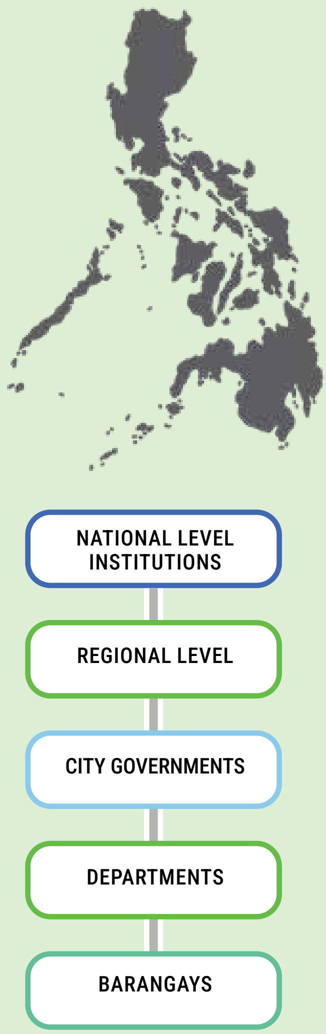
Box 6.8: An innovative multilevel governance framework for climate action in the Philippines

The Philippines is often cited as one of the countries most at risk from climate change. In response, in 2009 the government approved the Republic Act (RA) 9729 and the Climate Change Act (CCA). This offers a standout case where housing resilience is integrated and mainstreamed at multiple levels of governance through ambitious legislation.

The Act created the Climate Change Commission (CCC), a policy-making government body that coordinates, monitors and evaluates climate adaptation and mitigation efforts across government. The CCC also leads implementation of the National Framework Strategy on Climate Change and the National Climate Change Action Plan (NCCAP, 2011–2028), which align climate priorities with national development planning cycles. The CCC also administers the People's Survival Fund (PSF), replenished annually, to finance local and community level adaptation proposals, making the Philippines a pioneer in institutionalizing adaptation finance.

At the local level, the Act positions Local Government Units (LGUs) – comprising some 138 cities, 1,496 municipalities and more than 42,000 barangays – as frontline actors responsible for preparing Local Climate Change Action Plans (LCCAPs) and integrating them into local development and land-use plans. Barangays play a crucial role as first responders and as information channels between communities and municipalities. Iloilo City, for example, has leveraged multilevel governance in negotiating relocations, water conservation and nature restoration, which have addressed deepening inequality and vulnerability among the most disadvantaged groups.

Despite its strengths, the system faces challenges including overlapping institutional mandates, limited enforcement mechanisms and uneven local capacity, particularly in translating community needs – such as land and housing – into formal adaptation strategies.



Source: See and Wilmsen, 2020. Figure of multilevel governance structure in the Philippines elaborated by Vanesa Castán Broto


Barbados Island © Shutterstock

Private actors have considerable influence in shaping land markets and housing quality. Developers, construction firms and architects can make low-carbon, climate-responsive design the default, while investors collaborate with local plans to prevent overdevelopment in high-risk areas. Landlords and building owners have day-to-day responsibility for keeping homes safe, efficient and affordable. Professional bodies of planners, engineers, and housing federations can codify best practices, as seen in the UK's Healthy Homes programme, which the Town and Country Planning Association supported in developing the principles and reviewing the standards.[119]

6.3.2 Climate-resilient housing finance

Finance for climate resilient housing continues to fall short of global needs. Tracking such investment is difficult because programmes fall into two categories: climate resilient initiatives that may include housing elements, and housing programmes (such as upgrading or reconstruction) that do not always incorporate explicit resilience components. Consequently, there is no consistent dataset of investments in climate-resilient housing. In 2022, global investment in energy efficiency for buildings reached US$285 billion,[120] driven largely by heightened energy security concerns in Europe, before falling slightly to US$270 billion in 2023 – a figure that the Global Alliance for Buildings and Construction (GlobalABC) has said should be doubled to US$540 billion by 2030.[121]

Multiple forms of innovative finance for climate-resilient housing are emerging, including green bonds, blended finance, carbon markets and debt-for-nature swaps

However, beyond energy efficiency, identifying resilience specific housing investments is difficult, yet the number of national and multilateral initiatives with resilience elements –including energy efficiency, resettlement, social housing and flood-resilient design – has grown. Several country examples illustrate emerging practice. In the Philippines, the PSF, capitalized at PHP 1.42 billion (around US$17 million), has supported 24 locally led adaptation projects.[122] Indonesia's KOTAKU National Slum Upgrading Programme, a US$1.4 billion initiative supported by the World Bank, includes infrastructure and services that reduce climate related risks in informal settlements.[123] Kenya's Green Affordable Housing Fund, backed by €21.5 million (US$23 million) from the European Investment Bank,[124] promotes climate resilient construction. France's €5 billion (US$5.4 billion) MaPrimeRénov' programme supports energy efficient retrofits of ageing housing.[125]

Finance for climate-resilient housing continues to fall short of global needs

Multiple forms of innovative finance for climate-resilient housing are emerging, including green bonds, blended finance, carbon markets and debt-for-nature swaps. However, to be viable and deliver for vulnerable groups, these approaches often need to be complemented by instruments that mitigate financing risk and enhance affordability such as grants, guarantees, and concessional finance. An encouraging example is the Barbados Roofs to Reefs programme that integrates resilience efforts from retrofitting roofs for energy efficiency and storm-water management, to improving critical infrastructure like sewer and water systems, and preserving coastal and marine ecosystems. The program is partly financed through the world's first US$125 million debt-for-climate-resilience swap, backed by guarantees from the Inter American Development Bank and European Investment Bank, and supported by upfront grants from the Green Climate Fund.[126]

Collectively, these initiatives show progress, yet investment remains insufficient, fragmented and poorly tracked. An important gap persists in developing and scaling locally anchored, inclusive and affordable financing mechanisms for climate-resilient housing. In this regard, much can be learnt from housing cooperatives and community savings groups, which have become increasingly prevalent around the world.[127]

6.4 Concluding Remarks

Climate justice begins at home, it is often said, to emphasize everyone's potential to contribute to one of the global challenges of our time. Climate justice also begins at home because the home is the site of climate action, both to reduce emissions and improve resilience.[128] Bearing that in mind, this chapter has argued that:

- *Far from being a trade-off, reduced housing emissions go hand in hand with improvements in quality of life.* Measures that promote energy efficiency, a shift to non-polluting fuel sources or circular construction simultaneously enhance comfort, safety and affordability. Furthermore, addressing climate risks in housing can also deliver improvements in habitability, as measures that increase resilience – such as insulation, shading and elevated design – also enhance comfort and liveability while at the same time lowering energy use and emissions.

- *Climate resilient housing depends as much on social as physical and technical innovation.* A key insight is that most sustainable forms of housing are those grounded in the knowledge, networks and agency of communities themselves. There are now decades of experience in community-led approaches to housing development that demonstrate its potential in different contexts. The People's Process – that is, a locally-led, community-driven approach in which residents plan, build and manage housing – is central to achieving this.

- *In the context of strengthening climate resilience, eviction and displacement should only be deployed as a last resort.* Instead, it is crucial to reflect on local environmental conditions and the opportunities they present for in situ improvements. There are low-cost, locally implementable options for incremental improvements, whether in the existing housing stock or in the surrounding infrastructure. From the design stage through to use of the built environment, there are ample opportunities to deliver integrated approaches to climate resilience in existing and new housing as alternatives to relocation.

- *Climate resilient housing ultimately demands a political and social transformation that redefines how housing is produced, inhabited, and governed.* In particular, it requires multilevel governance arrangements that enable coordination not only between national and local government but also with neighbourhoods and communities, combining vertical alignment and horizontal collaboration across sectors and actors. This resonates with the idea of negotiated resilience, shaped through multiple decisions and points of intervention – an approach that helps reduce unintended impacts and promote climate justice.

- *For climate-resilient housing to be widely accessible, the current financing landscape needs to be fundamentally transformed.* Financing and regulatory frameworks should evolve accordingly to empower community approaches, rather than bypass them, and safeguard against exclusionary dynamics such as green gentrification and green grabbing. Some finance is already available for innovative programmes that focus on affordable resilience, but must be significantly scaled up to meet growing demand. The challenges and opportunities for expanding such approaches – and the limitations of conventional housing finance – are discussed further in Chapter 8.

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