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SUSTAINABLE HOUSING FOR SUSTAINABLE CITIES

A POLICY FRAMEWORK FOR DEVELOPING COUNTRIES

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SUSTAINABLE HOUSING FOR SUSTAINABLE CITIES:
A POLICY FRAMEWORK FOR DEVELOPING COUNTRIES

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A POLICY FRAMEWORK FOR DEVELOPING COUNTRIES

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Planned urban expansion in Morocco. **© Matthew French/UN-Habitat.**

EXECUTIVE SUMMARY

In a rapidly changing and urbanising world, the provision of adequate and affordable housing remains a key priority for all governments. However, the concept of housing requires a new understanding to effectively and synergistically address the pressing issues of slums prevention, the urban divide, economic and human development, and climate change. No longer regarded as simply a roof over one's head, housing today plays a crucial role in achieving sustainable development – as envisaged by the idea of sustainable housing.

Sustainable housing is, however, yet to gain its due prominence in developing countries. It is rare that the social, cultural, environmental and economic facets of housing are addressed there in an integrated policy. In many developing contexts, the so-called pro-poor housing programmes often provide accommodation of poor standards, in remote locations, with little consideration to the residents' lifestyle and livelihood strategies. In others, rapid housing developments create amplified carbon footprint and further negative impacts on the environment. Yet in most developing cities, decent and safe housing remains a dream for the majority of the population, while government considers affordable housing as merely a social burden.

Sustainable Housing for Sustainable Cities outlines key concepts and considerations underpinning the idea of sustainable housing and provides a comprehensive framework for designing sustainable housing policies and practical actions. Although sustainable housing is often considered from a predominantly "green" perspective (resource saving, greenhouse gas reduction), this report advocates a more holistic approach, which recognises the multiple functions of housing – as both a physical and social system – and which seeks to enhance and harmonise the environmental, social, cultural, and economic dimensions of housing sustainability. Thus, along with the solutions for the built environment (resource and energy efficiency, environmental, ecological and health safety, resilience to natural disasters), sustainable housing policies should deal with the affordability, social justice, cultural and economic impacts of housing, and contribute to making healthy residential neighbourhoods and sustainable cities.

It is only through sustainable solutions that the tensions between urban growth, climate change, poverty alleviation, affordable housing provision, and access to quality residential services, clean energy and environmental conditions can be mitigated, while the potential of housing for improved economic prosperity and social development can be further unlocked. Well-designed, inclusive and participatory housing policies and programmes have much to offer to this end.

Self-built housing using locally available materials in the Democratic Republic of Congo.
© Matthew French/UN-Habitat.

01 HOUSING AND SUSTAINABILITY

1.1. WHAT IS SUSTAINABLE HOUSING?

Housing is one of those basic social conditions that determine the quality of life and welfare of people and places. Where homes are located, how well designed and built, and how well they are weaved into the environmental, social, cultural and economic fabric of communities are factors that, in a very real way, influence the daily lives of people, their health, security and wellbeing, and which, given the long life of dwellings as physical structures, affect both the present and future generations. Housing is therefore central to *sustainable development* (Box 1).

Housing is also part of the relationships between society and the environment. On the one hand, housing construction and operation consume large amounts of natural resources (land, energy, water, building materials), while producing waste, air and water pollution. On the other hand, housing itself is exposed to a variety of environmental impacts and hazards, including those associated with natural disasters and *climate change* (see Box 2). These aspects are also significant considerations for sustainable development.

This complex web of inter-relationships between sustainability and housing is addressed by the policies for *sustainable housing*. These policies consider a spectrum of underlying conditions to achieve sustainability in housing development (along the four dimensions of sustainability – environmental, social, cultural and economic), such as: impacts on the environment and climate change; durability and resilience of homes; economic activities in housing and their links with the wider economy; cultural and social fabric of communities and impacts of housing on poverty alleviation, social development, and the quality of life.

Although sustainable housing is often associated with wealth and affluence, it does not need to be so – genuinely sustainable houses are those that are inclusive and affordable for all. Addressing the issue of affordability is, therefore, a necessary condition for transformation towards sustainable housing. And yet affordability is not enough, because the so-called affordable homes cannot be considered sustainable if they create negative impacts on the environment or social life. The marriage of affordability with other sustainability conditions is a must. In this Guide, the link between sustainability and affordability is discussed in the unified notion of sustainable housing.

Furthermore, while sustainable housing is often considered from a resource-saving (green) perspective, this Guide advocates a more comprehensive approach – viewing sustainable housing not simply as units or clusters of self-sufficient "green buildings", but as socially-enhancing and environmentally-friendly residential practices integrated into the wider urban/settlement systems. This approach is necessitated by the holistic perspective of sustainable development and by the very multi-faceted nature of housing. Sustainable affordable housing in this regard may be considered as extension of the adequate-shelter-for-all strategy of the Habitat Agenda (paragraph 60): Adequate shelter means

more than a roof overone's head. It also means adequate privacy; adequate space; physical accessibility; adequate security; security of tenure; structural stability and reliability; adequate lighting, heating and ventilation; adequate basic infrastructure, such as water-supply, sanitation and waste-management facilities; suitable environmental quality and health-related factors; and adequate and accessible location with regard to work and basic facilities: all of which should be available at an affordable cost.

Box 3 gives a glimpse on the attributes that sustainable homes may have, while Table 1 provides a more comprehensive framework for sustainable housing policies, which is organised along the four dimensions of sustainable development (environmental, social, cultural, and economic) and different spatial scales (from national to household).

What is the meaning of housing in this Guide?

The two interrelated functions of housing need to be acknowledged:

- Housing as physical structure – residential buildings/shelters, their design, material qualities, their arrangement in space, and their ecological interactions with the physical environment;
- Housing as social structure – residence-based activities, their character, social qualities, and their socio-economic interactions in space with the immediate communities and wider society.

Through both of these functions, housing represents a system of social and material relationships, which is simultaneously arranged at the different spatial scales (homes, surrounding neighbourhoods, settlements, regions, countries) and which, therefore, requires a corresponding hierarchy of policy interventions.

1.2. THE PURPOSE AND STRUCTURE OF THE GUIDE

It is the framework summarised in Table 1 that shapes the discussions of this Guide. The purpose is to provide a detailed introduction regarding the key aspects and concepts for designing and implementing sustainable housing. This Guile will hopefully build capacity and can serve as an advocacy tool for communicating the importance of housing as a system within the urban system and, consequently, the importance of sustainable housing for developing sustainable cities. The

BOX 1: SUSTAINABLE DEVELOPMENT

Sustainable development is a recognised principle for economic and social activities. Although it remains a "shifting concept" depending upon in which sustainability context it is applied and from which value position, a common ground understanding owes to the 1987 Brundtland report (WCED, 1987) and the 1992 Rio "Earth Summit", which defined it as "meeting the needs of the present generation without compromising the ability of future generations to meet their own needs". Sustainable development is seen as a multidimensional process that links environmental protection with economically, socially and culturally sound development. Those links are referred to as a four-dimensional approach to sustainable development, highlighting the need for a harmonious association between environmental, economic, social and cultural dimensions.

Guide should assist the national and local level decision makers, as well as other practitioners and professionals of the housing sector, architects, international and development co-operation agencies, NGOs and CBOs and other stakeholders in their efforts to support the provision of sustainable affordable housing.

This Guide is structured as follows. The rest of Chapter 1 will consider some main housing challenges of developing countries and will provide a further case for sustainable housing. The following chapters will highlight the key issues to consider for housing within the four-dimensional sustainability model – that is, environmental (Chapter 2), social and cultural (Chapter 3), and economic (Chapter 4) dimensions, as follows from the framework presented in Table 1. It is important to stress that the division into these "dimensions" is something artificial and should be understood as assistance with systematising and emphasising different aspects of policies, rather than as a division between policies themselves. Indeed, as sustainability emerges from the overlaps and synergies between the four dimensions, there will be much overlap between the materials covered under the different sustainability rubrics in the rest of this Guide. That will be further stressed in Chapter 5 that considers how to balance the sustainability dimensions in relation to housing policy and deliver holistic approaches. The concluding Chapter 6 highlights the key principles important for sustainable policy delivery.

1.3. HOUSING CHALLENGES IN DEVELOPING COUNTRIES

While the challenge to provide sustainable affordable housing is common for all countries, the need for decent affordable housing is particularly acute in developing regions. These are experiencing rapid and continuing urbanization, driven by population growth and migrations from rural to urban areas (Box 4). Urbanization increases the demand for affordable housing and urban infrastructure and services, which cities struggle to cope with. As a result, urban growth in Asia, Africa and Latin America is associated with slums and informal settlements; shelters are built with little to no basic infrastructure and sanitary provision, and with negligible regard of formal planning and building regulations.

Why are slums a challenge for sustainability?

Although slums and informal urban areas provide a crucial mechanism for the dwelling of many of the urban poor and disadvantaged, they pose a range of serious humanitarian and environmental problems for both present and future generations, including:

- Environmental deterioration and life-threatening problems related to sanitation and pollution (including air and water pollution from garbage and sewers);
- Exposure to environmental hazards (landslides, flooding, poor drainage);
- Further health risks, diseases and injuries related to poor construction, overcrowding, anti-social behaviour and crime;
- Uncontrolled and conflictual urban sprawls;
- Informal and extralegal economies;
- Illegal and harmful infrastructural connections.

These problems, although not limited to slum areas, further aggravate the vulnerabilities of the already deprived living conditions in the same cities and their surroundings. Moreover, slums, squatter settlements, and other low-income houses often occupy risk-prone areas that are vacant and available to establish makeshift residences. For example, if located in hilly and mountainous areas, many of

them are exposed to landslides, which occur suddenly and can kill hundreds of residents (like in Rio-de-Janeiro State in Brazil in 2010). In India and in many cities in Africa, such as Accra, Kampala, Lagos, Maputo, and Nairobi, slums are also commonly flood-prone (Satterthwaite, 2007). These conditions will only be exacerbated by the increasing climatic fluctuations.

There are also challenges related to the access of clean energy provision. Today, 1.3 billion people still do not have access to electricity – most of these live in sub-Saharan Africa and developing Asia. More than half of the population of the developing world depend on polluting solid fuels for cooking – traditional biomass (1.7 billion people) or coal (0.4 billion people) (IEA, 2011). Indoor air pollution from solid fuel use has been responsible for almost 2 million deaths each year worldwide and causing other chronic illnesses, making this risk factor the most dangerous killer after malnutrition, HIV/AIDS and lack of safe water and sanitation. This disproportionably affects the poorer families and especially children and women, who spend more time within the domestic environment (WHO, 2011).

Even where governments succeed in tackling the challenge of slums and energy access, there remain challenges of planetary importance emerging from the sheer volume of housing that has to be built or renovated to accommodate new population and address existing housing shortages and inadequacies. In China alone, as much new building floor space is expected to be built by the end of the next decade as the entire existing building stock of the US today (UN-Habitat, 2011d). If the new-built housing stock is not built with the utmost attention to sustainability and efficiency (in all senses of these words), it will quickly accumulate a considerable new burden for the environment and the climate, while also multiplying economic wastefulness and social deficiencies (cf. Box 14 later in this Guide for a Mexican case). Furthermore, every time a major renovation of a home is done without due considerations to sustainability principles, another chance is missed for many years to reduce its environment footprint. How many such chances are being missed on the everyday basis?

Given that many developing regions have been successful in slowing down the growth of slums over the last decade or so (Box 4) and that much knowledge and capacity have already been accumulated to this end, there is an increasing awareness that housing policies must shift towards bridging the affordable and sustainable agendas. Even in the regions where conditions and resources are more challenging for tackling the slums and up-scaling sustainable housing, like in Sub-Saharan Africa, there is a need to change the conception of housing to embrace all of the sustainability dimensions for designing more effective and sustainable housing responses.

It is only through sustainable solutions that the tensions between economic development, social welfare and equality, urban growth, housing provision, access to clean energy, good quality residential services, and environmental conditions can be alleviated.

1.4. WHY SUSTAINABLE HOUSING?

Sustainable housing offers a great spectrum of opportunities to promote economic development, environmental stewardship, quality of life and social equality, while mitigating the precarious convergences of the problems related to population growth, urbanisation, slums, poverty, climate change, lack of access to sustainable energy, and economic uncertainty.

It is seldom, especially in developing countries, that the social, cultural, environmental, and economic facets of housing are addressed in an integrated fashion. For example, affordable housing is commonly considered on a cost basis, while environmental and social issues (including people preferences, lifestyles, and cultural aspirations), as well as economic

impacts are thought to be addressed separately or totally ignored. However, ignoring one or another dimension of sustainability only leads to the accumulation of vulnerabilities and precarious housing situations.

There is, for example, a large gap between policies for "normal housing" and "affordable housing" – these often co-exist in parallel worlds. The so-called pro-poor, slum upgrading, and refugees housing programmes often provide accommodation of standards or in locations where people would live only because of despair and necessity. Standardised houses are built in large-quantity "matchbox" developments, cheaply, isolated from mainstream urban employment and services and do not cater for households' varied needs and values. Saving on construction costs often means substandard materials and techniques (rather than search for sustainable affordable alternatives) that render the dwellings short-lived and, furthermore, cause health problems (a sick house syndrome). Moreover, these initiatives do not provide a duly consideration to energy and water efficiency, leading to households being locked in wasteful practices and unaffordable running costs. Segregation of unemployment and poverty may only be reproduced in such locations rather than resolved (Figure 1).

Planned and built within an integrated sustainability framework, housing will not only be more accessible to low-income households, but will also respond to their diverse social and cultural needs and will have multiple positive outcomes for people's physical and mental health and safety, for economy, and for the built and natural environments. Besides, sustainable houses hold up for a longer time, making them a smart investment for government and other stakeholders (see Box 5).

The following chapters will highlight the key issues to consider for affordable housing within the four-dimensional sustainability model according to Table 1.

BOX 2: CLIMATE CHANGE, MITIGATION AND ADAPTATION

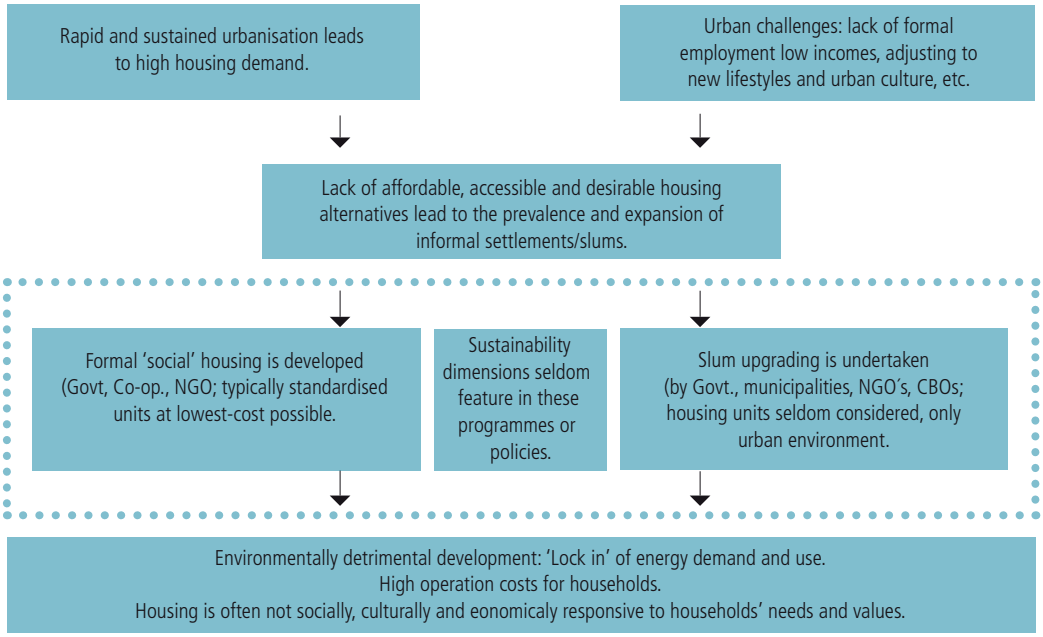
Climate change refers to the rise in the global average atmosphere temperatures, followed by an increased frequency of climatic abnormalities, intensified heat and cold waves, droughts, storms, floods, as well as rising ocean level. The accelerated climate change is believed to be a result of human activities that increase the concentration of greenhouse gases (GHG) in the atmosphere – to which carbon dioxide (CO_2) is the largest contributor. CO_2 is naturally stored on Earth in "carbon sinks" such as fossil fuels (oil, gas, coal, etc) and green biomass. Human activities release this CO_2 by the burning of fossil fuels for energy and the reduction of forests, grassland and peatland. Key mechanisms to limit GHG emissions (and thus to slowdown climate change) include switching to low-carbon energies, reducing energy demands and preventing deforestation; these measures are known as mitigation. However, adaptation measures to the already inevitable adverse impacts of climate change are also needed.

TABLE 1: A MULTI-SCALE FRAMEWORK FOR SUSTAINABLE HOUSING POLICIES.

	MACRO (NATIONAL)	MESO (REGION, CITY)	MICRO (NEIGHBORHOOD, HOUSEHOLD)
Environmental dimension	Housing to support climate mitigation and adaptation efforts. Mainstreaming green housing practices and innovations. Ensuring energy and resource efficiency in the building industry. Integrating national housing and energy systems.	Achieving good location and density for residental areas and access to infrastructure. Serviced land in environmentally safe locations and green areas. Protection of ecosystems and biodiversity. Promoting sustainable and low-corbon urban infrastructure, public transport and non-motorised mobility, energy systems. Waste management and recycling.	Ensuring energy efficiency, micro/ generation, water and resource efficiency. Green design, using sustainable local construction and materials. Sanitation, preventing hazardous and polluting materials. Affordable use of resources. Improving resilience and adaptation of homes.
Social dimension	Fulfilling the right to adequate housing and promoting the right to the city. Ensuring affordable, decent and suitable homes for all, including disadvantaged groups. Developing social housing provision. Promoting choice and security of tenure.	Promoting integrated comunities and ensuring trust in communities. Providing community facilities, preventing segregation and displacement. Regenerating and reintegrating 'neglected' areas into regional, urban fabric. Ensuring infrastructural integration of housing into wider areas. Upgrading inadequate housing and slum areas.	Empowering people and ensuring public participation. Ensuring health, safety, well-being in residences. Creating a sense of community, 'sense of place', and identity. Meeting secific needs and wants in housing (including those related to gender, age and health). Providing access to infrastructure and public spaces.
Cultural dimension	Promoting links between housing and knowledge-based and cultural economies. Promoting traditional, indigenous and local knowledge (including of relevance to sustainable resource use, energy efficiency and resilient building techniques). Protecting cultural heritage.	Promoting urban creativity, culture, aesthetics, diversity. Shaping values, tradition, norms and behaviours (eg. in relation to energy use, recycling, communal living and place maintenance). Protecting housing heritage and familiarity of city (eg. preventing unnecessary social replacement/ gentrification or complete redevelopment.	Culturally responsive settlements and house planning and design. Imrpoving aesthetics, diversity and cultural sophistication of the built environment and residence. Helping community creativity (i.e. via amenities; affordable sporting, cultural and entertainment facilities. Assisting people's transitionfrom rural and slums areas to decent housing or multifamily housing.
Economic dimension	Institutional capacities for sustainable housing markets and housing development. Articulating housing productivity within national economic systems. Improving housing supply and effective demand, stabilising housing markets. Improving housing finance options. Promoting innovations in housing. Stimulating necessary technological developments for sustainable housing.	Managing economic activities and hrowth by strengthening housing provision and housing markets. Provision of necessary infrastructure and basic services to housing. Providing serviced land for housing. Strengthening entrepreneurship of communities, local building industry and enterprise. Promoting local and traditional building materials and techniques. Promoting regional and urban regeneration.	Ensuring housing affordability for different social groups. Providing adequate residences to raise labour productivity; ensuring housing is integrated with employment. Supporting domestic economic activities and enterprise. Promoting petty landlordism and self-help housing. Housing management and maintenance. Strengthening resilience and future-proofing of homes.

Source: UN-Habitat 2011c.

FIGURE 1: SHORTCOMING OF THE PRESENT HOUSING POLICY RESPONSES.



Source: UN-Habitat, 2011c: 10.

BOX 3: SUSTAINABLE HOUSES

Sustainable houses are those that are designed, built and managed as:

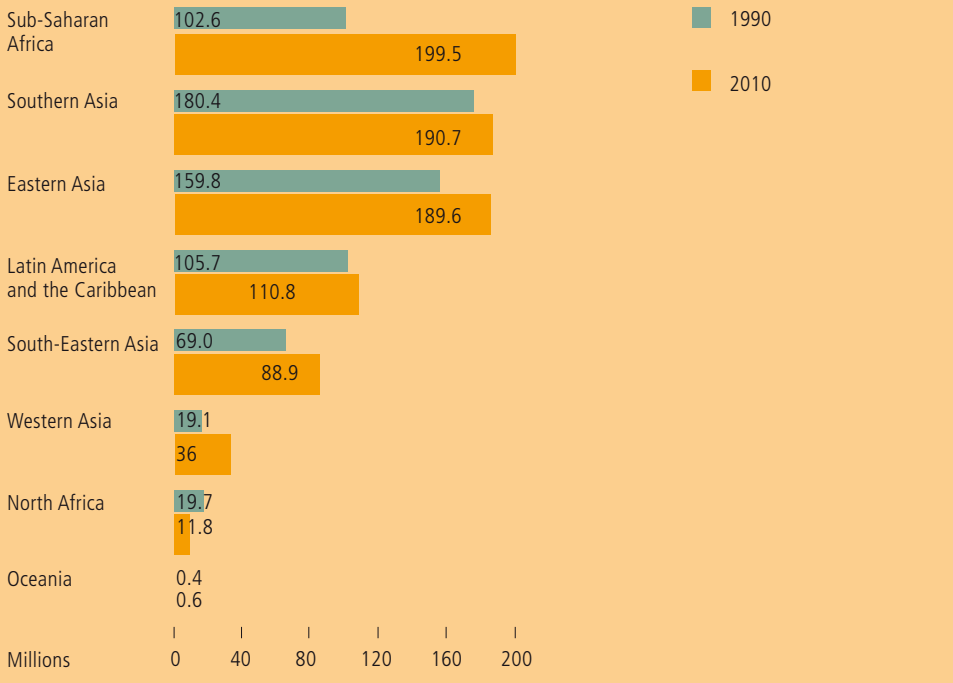
- Healthy, durable, safe and secure,
- Affordable for the whole spectrum of incomes,
- Using ecological low-energy and affordable building materials and technology,
- Resilient to sustain potential natural disasters and climatic impacts,
- Connected to decent, safe and affordable energy, water, sanitation and recycling facilities,
- Using energy and water most efficiently and equipped with certain on-site renewable energy generation and water recycling capabilities,
- Not polluting the environment and protected from external pollutions,
- Well connected to jobs, shops, health- and child-care, education and other services,
- Properly integrated into, and enhancing, the social, cultural and economic fabric of the local neighbourhood and the wider urban areas,
- Properly run and maintained, timely renovated and retrofitted.

BOX 4: INCREASING HOUSING DEMAND IN OUR URBAN FUTURE

The world's urban population is expected to grow from 3.5 billion in 2010 to 6.2 by 2050 or from about 52% to 67% of the world's total population. As much as 94% of this growth will be in developing regions (from 2.6 billion by 2010 to 5.1 billion by 2050) (UN, 2011). The capacity of cities to deal with the population growth is challenged by the structural problems of low development and poverty. The 'urbanization of poverty' sustains the rise of slums. It is estimated that 828 million people in developing regions were living in slums in 2010, which constitute a third of the total urban population in these regions (more than 70% in many countries in Sub-Saharan Africa). Although the relative share of slums in the total population is thought to be decreasing in most regions, the absolute number is still growing (see graph below) (UN-Habitat, 2010b).

Given a projected urban population increase by 1.43 billion between 2010 and 2030 and adding to this the existing slum population, the number of people in the most urgent need of housing within the next two decades can be estimated to be at least 2.25 billion. Assuming an average household size of 5 people, 450 million housing units have to be built worldwide to accommodate this population – that is, 22.5 million units annually or more than 60 thousand units each day, from this very moment. But even this is just a tip of the iceberg, as there is also the need to improve the inadequate housing conditions of non-slum residents and to replace existing housing stock that will come to the end of its life or will be destroyed due to natural disasters and social conflicts.

URBAN SLUM POPULATION IN DEVELOPING REGIONS IN 1990 AND 2010 (MILLION PEOPLE).



Source: UN-Habitat.

Informal "Palafita" housing in Salvador, Brazil extending over Todos os Santos Bay.
© Matthew French/UN-Habitat.

BOX 5: MULTIPLE BENEFITS OF SUSTAINABLE HOUSING

- Improved quality of life and dignity of residence,
- Affordable access to housing,
- Improved health and lower incidents of illness, fatalities and material losses, better labour productivity,
- Better conditions for human development, employment, creativity and economic growth,
- Durability and low maintenance cost,
- Protection against natural hazards,
- Improved efficiency and savings on the use of energy, water and other physical resources,
- Better environmental protection and sanitary conditions,
- Contribution towards climate adaptation and mitigation,
- More sustainable and socially inclusive urban growth,
- Social cohesion and political stability.

Solar water heating installed on social housing in Brazil. The units in the foreground are damaged, which highlights the importance of adequate maintenance. ***© Matthew French/UN-Habitat.***

02 ENVIRONMENTAL SUSTAINABILITY OF HOUSING

The environmental sustainability of housing is concerned with the impacts of housing on the environment and climate change, as well as the impacts of the environment on housing itself. More specifically, there are three types of the relationships between housing and the environment:

- House building and operation require various environmental resources, such as building materials, water, energy and land;
- Residential activities in human settlements have direct ecological impacts on local areas in terms of air and water pollution, waste and damage of natural ecosystems;
- Homes and their residents are also themselves exposed to varied environmental hazards, which may emerge due to human activities (e.g. air and water pollution, lack of sanitation), due to natural factors (e.g. landslides, vector-born diseases such as malaria), or due to the combination of natural and human-made factors (e.g. climate change).

Thus, housing provides an important means for addressing local and global environmental concerns in relation to public health, energy, water and material efficiency and CO2 emission, waste production and recycling, climate adaptation and environmental hazards mitigation measures. Corresponding strategies for improved environmental sustainability in housing include the following:

- Reduce environmental footprints from housing in terms of energy and associated GHG emissions, water, land and material use, as well as waste;
- Ensure healthy housing and surrounding living environments (including improved sanitation, public health impact and reduced pollution);
- Strengthen resilience and adaptation (robustness of design, hazards prevention, greening).

The rest of this chapter will review the following common principles and considerations in respect of environmental footprint and resilience of housing:

- The whole lifecycle of houses;
- Residential densities and urban mobility in neighbourhoods;
- Mitigating environmental hazards and improving green spaces;
- Energy and resource efficiencies;
- Sustainable affordable building material and practices;
- Integrating housing into low-carbon community infrastructure.

2.1. CONSIDER THE WHOLE LIFECYCLE OF RESIDENTIAL BUILDINGS

Contemporary housing sector consumes large amounts of scarce energy and other resources in its construction, maintenance and use. Therefore, housing activities potentially represent key mechanisms to better plan energy and resource consumption and to support climate change mitigation/adaptation efforts.

As far as the implementation of housing projects is concerned, it is important to consider the whole lifecycle of houses in question – "from cradle to grave" (Table 2). Thus, the planning stage may address the choice of the planned site and its impact on the local environment, links to the city; quality of the local built environment; density; public transport and infrastructure; environmental hazards. Design takes into consideration embodied energy and resource utilization and enables energy and water efficiency; district heating/cooling and micro-generation; waste management; robustness and resilience, future proofing; possibility of upgrade. Construction should integrate safety and environmental standards; the use of local sustainable materials. Refurbishment should consider the choice of refurbishment material; energy efficient design; disturbance of the environment; management of construction waste. At the final stage of life, a decision is taken whether demolish or reuse and recycle building components.

2.2. URBAN FORMS AND RESIDENTIAL DENSITIES

If deciding on a new housing project, especially of a larger scale, it may be appropriate to start not so much with the architecture and design, but with choosing the best location to maximise sustainability. This is to recognise that people live not simply in a house, but in a neighbourhood and a settlement or a city. Sustainable development is seriously compromised by organizing cities around "urban sprawl" and private car mobility. Transport is a main energy user and emitter of CO2, as well as other pollutants. More scattered residential environs require more land, resources, and infrastructure (water, gas, electricity, roads) and lead to a disintegration of the city space, including between socially segregated areas. Relatively *compact and mixed-use mixed-income areas*, which integrate housing, work, facilities and entertainment in close proximity, are believed to constitute an important strategy for reducing these negative footprints. A more compact city also allows easier, more affordable access by low-income residents to urban services and employment opportunities and a better sense of community integration and cohesion.

In large urban areas, an extension to the compact city approach – *polycentricity or decentralized concentration* can redirect development pressures to new urban centres. The strategy means that, if inevitable, peripheral development also proceeds in a compact town-size mixed-use way. For this, planners can envisage new housing developments to be of a substantial size and located within or near existing settlements, so that new car travel distances are minimized. Development should ideally be located near to a regional or metropolitan public transportation system, so that high levels of public transport accessibility can be provided. However, building free-flowing highway networks is likely to encourage the sprawl of development and a strung-out community (Banister and Anable, 2009).

However, it is not always that "densification" programmes are accepted or welcomed in a given social context. In already low-density areas such programmes can meet residents' protests and sabotage from powerful landowners. It is, therefore, important to prevent lock-in in low-density high-carbon lifestyles from the very beginning by using the instruments of urban planning and building control effectively for new-built areas.

How dense is a "compact" neighbourhood?

Good environmental practices suggest moderately-high densities for compact neighbourhoods. However, the actual density needs to be context-specific. There is a level beyond which density creates social, economic and environmental congestion and undermines sustainability. In some developing regions, many denser residential areas are associated with poverty and overcrowding. It is important in such cases to actually reduce densities and introduce new public, open and green spaces for recreation and leisure. Furthermore, multi-floor residential estates used for the resettlement of poor slum dwellers are not appropriate for many of them, as the poor use their home for their informal businesses that often need access at the ground level. More generally, however, good urban design creates attractive living environment by balancing variously dense developments with access to green space, adequate infrastructure and good transport. Many European towns and cities show that the best solution lies in a compact-green city fusion, where a relatively compact built environment includes a diversity of densities and designs and maintains a good coherence with the landscape and green environment (EU, 2004).

Related tasks include encouraging walking, cycling and public transport (from, to, and between residential areas). Public transport is a crucial means to curb emissions from travel. For example, Mumbai with a higher share of public bus transport and suburban rail has experienced a 60% reduction in energy and emissions compared to Delhi (Das and Parikh, 2004). There is an interesting trend of adopting "non-traditional" means of public

TABLE 2: GUIDING MATRIX FOR ASSESSMENT OF ENVIRONMENTAL SUSTAINABILITY.

STAGE OF HOUSE LIFECYCLE	EXAMPLES OF ENVIRONMENTAL SUSTAINABILITY CONSIDERATIONS
Planning stage	Impact of the planned site on the local environment; relationships with the city; quality of the local built environment; mixed-use and density; poly- centricity; infrastructure; public transport; green areas; environmental hazards.
Building design	Considering embodied energy and resource utilisation; enabling energy and water efficiency by design; integrating district heating asnd micro-generation; sustainable waste management; green roofs; robustness and resilience; future-proofing; possibility of upgrading; shaping of lifestyles.
Construction	Safe, environmentally-friendly, local affordable material; minimization of environmental impact from building activity.
Operation	Energy performance; air-conditioning, air quality; pollution by residents and impact of the local pollution on residents, water use and water management, water recovery; comfort and hygiene of homes; quality and energy efficiency of the local infrastructure and transportation; property maintenance and management; waste management and recycling; greening the area; natural hazards.
Refurbishment	Choice of refurbishment material; energy efficient design; disturbance of the environment; management of construction waste.
End of life	Demolishing or reusing; recycling of building components; management of construction waste.
Refurbishment	Choice of refurbishment material; energy efficient design; disturbance of the environment; management of construction waste.
End of life	Demolishing or reusing; recycling of building components; management of construction waste.

Source: UN-Habitat.

transport, such as aerial ropeways – which can also make remote residential areas more accessible. Examples include metrocables in Medellin, Colombia and Caracas, Venezuela, as well as Algeria's aerial ropeway serving the cities of Skikda and Tlecern (UN-Habitat, 2010a). Similar infrastructure is being built to provide urban access from some of the favelas in Rio de Janeiro, Brazil. Such means of transportation use less material and energy, relatively cost-effective to install and are non-polluting.

2.3. MITIGATE ENVIRONMENTAL HAZARDS AND IMPROVE GREEN SPACES

At the stage of planning and design of residential projects, it is important to give an in-depth attention to contextual environmental hazards (existing or potential), including those related to the natural environment, such as floods, landslides, earthquakes, etc. These considerations and related actions are a key ingredient of the housing resilient strategy.

One simple strategy to mitigate environmental hazards, while also protecting biodiversity and improving the health and quality of life of the residents, is to ensure a good network of green spaces in the neighbourhoods. A green network may include open spaces, waterways, gardens, woodlands, green corridors, wildlife habitats, and street trees. A green network not only supports the natural ecological processes, but is also an essential part of local climate management strategies – important for both climate adaptation and mitigation.

Why do green areas matter for natural hazard mitigation and climate management?

Urban forestry and habitat restoration are among the most cost-effective means for carbon sequestration, as well as for urban air quality and runoff management. Increasing the amount and size of vegetation helps to reduce the amount of pollutants in the low atmosphere; vegetation also removes carbon dioxide during photosynthesis and emits oxygen. Green areas have a cooling effect and mitigate heat waves (hotter-than-normal weather) and urban heat island (higher temperatures in urban areas than in the countryside) – both of which have negative impacts on human health and biodiversity. Furthermore, vegetation reduces surface water run-off, thus preventing soil erosion and reducing the need of piped drainage. All of these effects are important in the context of increased climate uncertainties and climate-related and other natural hazards.

Cities, even with a high density, have potential for increasing green and open areas by, for example, restoring brownfield sites as parks or redeveloping closed landfills as green areas (Box 6). Recycling of wasteland and derelict sites and buildings gives an opportunity to clean up contaminated sites, assist environment and social and economic regeneration. Some of the 'novel' approaches to greening the housing, although with a long tradition behind, include also the integration of vegetation into the design of individual buildings, such as greening roofs and walls, 'pocket parks', and the planting of trees in courtyards (Box 7).

2.4. ENVIRONMENTAL PERFORMANCE OF RESIDENTIAL BUILDINGS

Key concerns for the sustainable design of residential buildings lie with their environmental performance (energy efficiency and CO2 emissions; water efficiency; material efficiency; pollution; waste management; relationships with the immediate area), health impact (air quality, water quality, hygiene), human comfort (hydrothermal quality, acoustic quality, visual attractiveness, smells control), as well as with the provision of appropriate housing management. Some of the main elements of these issues are considered below.

Energy efficiency in housing

The generation of energy is the main contributor to CO2 emissions and climate change and it also results in many other forms of environmental pollution. Housing is responsible for as much as a quarter of the global operational energy demand (embodied energy used in construction notwithstanding). This energy is used for space and water heating and cooling, cooking, lighting, and operation of other energy-consuming activities within homes. The use of this energy is in fact a necessary condition to support life and social activities in houses (Table 3). Yet, as discussed above, millions do not even have access to clean energy or struggle to afford it in sufficient quantities because of the cost (leading to the phenomenon of "energy poverty"). Improving energy efficiency and using renewable energy is a way to address this complex knot of environmental and social problems.

It is widely acknowledged that the cost of investing in the hosing energy efficiency is commonly smaller than gains achieved over a medium-term period from resultant energy savings. Energy savings also mean avoided energy and CO2 generation. This also makes the residential sector one of the most cost-effective (in fact, profitable) mechanisms for the reduction of CO2 emissions.

To reduce energy demand and carbon footprint from residential buildings a range of solutions may be used (Golubchikov, 2009):

- Planning and optimising the orientation and interrelation of buildings in space, as well as optimising walls' and roof's albedo (by paint or greening), in order to use the opportunities offered by passive heating, lighting and active shading,
- Better insulating the structural elements of houses - walls, windows, doors, roofs - in combination with a better ventilation (allows keeping houses warmer in cold periods and colder in hot periods),
- Installing energy efficient appliances for heating, cooling, cooking and lighting and ventilation,
- Improving the efficiency of utilities supplying houses with electricity, gas, water, heating,
- Developing local low-carbon power plants servicing housing (e.g. district heating and cooling based on combined heat and power generation, renewable electricity generation),
- Equipping houses with renewable electricity or heat generating installations (microgeneration),

BOX 6: THE REHABILITATION OF AL-AZHAR PARK IN CAIRO, EGYPT

Cairo, located amidst desert environments, has a particularly high residential density, with very limited open space. By the mid-1990s, Cairo had only one square metre of open space per resident. A 30 million USD Al-Azhar Public Park Project, which was opened in 2005 by the Aga Khan Trust for Culture's Historic Cities Programme, was one solution to this problem. The park was built on a 30-hectare site used as a dump for many centuries. The project has also rehabilitated the historic districts of Islamic Cairo, which is one of the primary destinations for tourists, and has provided the residents with new opportunities for apprenticeships and employment.

- Reducing energy-intensive building materials and technologies used in homebuilding,

- Incentivising and disciplining households through energy metering and billing,

- Capacity building activities to raise awareness of the importance of energy savings and how it can be achieved.

These solutions are equally applicable to both cold and warm environments, although climatic considerations affect the use and priority of particular building techniques. For example, thermal insulation and solar gains need to be augmented in colder climates, while a greater role is given to passive cooling, shading and wind tunnelling in hotter climates. Increased thermal mass is used in climates where there are larger seasonal and day and night variations in temperatures such in arid and colder climates, while it is less appropriate in tropical climates with smaller variations in temperatures (for more details on planning and building energy-efficient houses with climatic considerations see a complementary guide *Going Green: A Handbook of Sustainable Housing Practices,* UN-Habitat, 2012).

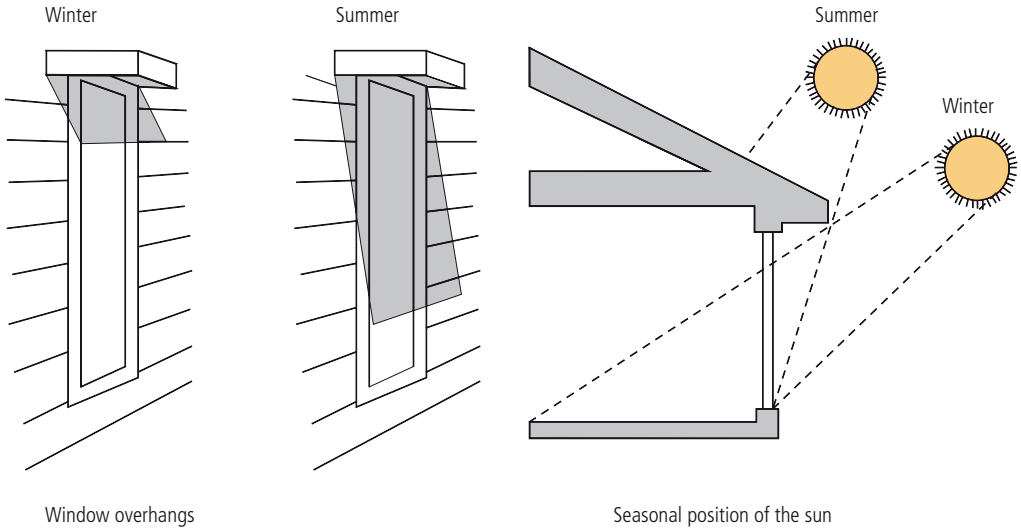
Many European countries, especially those located in the colder environments, are quite experienced with very low-energy buildings. Comfortable room temperature is achieved by means of highly efficient components, such as high levels of insulation of walls, roofs and windows, heat or cold recovery from recycled air, and the use of internal sources for heating (including existing household appliances and human heat). In order to minimise energy use, the design of buildings may be required to fit the specific characteristics of the location (in terms of climate, vegetation, topography and geology, as well as the existing built environment) and to use passive lighting, active shading, and energy-efficient appliances and lighting (Figure 2). Remaining energy demand for electricity, the cooling system or hot water can come from conventional sources (electricity, gas, district heating) or from autonomous sources (microgeneration – as will be discussed below).

In principle, exiting technological solutions already allow individual houses and even whole communities to be completely self-dependent for their energy needs – much like the areas that lack access to modern energy facilities, but, in contrast to them, with a fully modern quality of life. Zero-energy and zero-carbon cities are already a realistic future (Box 8). As will be shown below, European Union standards, for example, are increasingly strengthened in anticipation that all new buildings will be required to be built to zero-energy standards in the near future.

How about indoor air quality in energy efficient houses?

Modern highly energy-efficient houses are characterised by high levels of air tightness to stop warm or cold air losses. This requires extra measures to ventilate houses. Commonly used is mechanical ventilation with heat recovery. It operates by electricity and recovers heat or cold from the used air indoor and exchanges it with the fresh incoming air, thus providing good air quality and comfort. The installation of such systems is, however, unaffordable for the majority in developing countries. And yet, it is not even necessary to have so high levels of insulation. A knowledgeable use of traditional materials and thermal mass, combined with natural ventilation systems (e.g. wind-driven cross ventilation or stack ventilation), may be sufficient to protect the house from a cold or hot climate and to considerably reduce its energy demand, while still allowing the house to "breathe" naturally. In any case, it is the imperative that indoor air quality must prevail over energy consideration, as inadequate ventilation may damage the health much more than poor insulation – particularly if "dirty energy" or smoking is practiced indoor. Building codes, model designs, and related monitoring should include indoor air quality considerations alongside energy.

FIGURE 2: WINDOW OVERHANGS: USING PASSIVE LIGHTING AND ACTIVE SHADING.



Source: Hendler and Thompson-Smeddle, 2009:14.

BOX 7: GREEN ROOFS

Green or vegetated roofs reduce the over-heating of buildings in summer and provide a better thermal insulation in winter, thus improving the building's own energy performance in addition to the positive effects for the neighbourhood as a whole. This cooling effect is also beneficial for solar panels, as they currently work best at temperatures up to 25°C. Green roofs also intercept storm-water runoff and reduce the load on the building's drainage system, thereby extending its maintenance cycle. There are examples of mandatory green roofs as posited by recent policies in Toronto and Copenhagen; several cities in Austria, Switzerland, and Germany, following the original experiences of Basel and Linz, have introduced either a compulsory greening of all flat rooftops on new buildings or additional subsidies for such measures.

Embodied (embedded) energy

The amount of energy used in buildings during their full lifecycle is not only due to their direct energy consumption (energy-in-use), but also due to energy used during construction and demolition. Concrete and steel manufacturing, extraction of raw materials, and transportation of construction materials contribute to the energy use and carbon footprint of a building. It is often the case that buildings that are allegedly 'low-energy' are built without due consideration of these 'embodied' forms of energy consumption. Although they consume little operational energy, their embodied energy is such that over their lifecycle, their carbon footprint can still be larger than that of the buildings with a lower operational efficiency but built in a sustainable way and using local materials with low embodied energy. The choice of materials and their transportation is among major considerations for both construction and refurbishment.

An analysis of the relationship between embodied energy and energy-in-use helps ensure a better choice of building materials. There is, for example, a variety of energy modelling software tools that can assist architects and engineers in optimising the building design for reduced energy demand (with the caveat that all models have their own limitations and never fully predict real-life situations). A house designer needs to understand the environmental effect of all aspects of a house, including the delivery cost of building materials, and the possibility of disassembling building elements for refurbishment and recycling. An optimal way to save embodied energy (and to reduce the cost) is to ensure that residential buildings last longer – through, for example, integrating features from the outset to reduce the need for costly and wasteful repairs and retrofits over the medium term. One technique that has been experimented with is integrating local traditional sustainable and durable materials into prefabricated construction (Box 9).

Water efficiency

Water efficiency at construction sites, in the manufacturing of building materials and in completed houses is a crucial element in achieving sustainable housing, given both the depletion of fresh water resources globally and shortages of clean fresh water supply in many socially challenging environments. The residents of poor areas and slums in many developing cities, especially women, spend a lot of time of their life in collecting water from remote sources, while also often having to pay disproportionably high to the suppliers of potable water compared to their compatriots enjoying a centralised water supply.

As regards to residential buildings, water is typically used for the following purposes:

- Bath and shower
- Toilet
- Laundry
- Cooking
- Cleaning
- Gardening
- Water losses due to leaks.

The following sustainable practices are commonly implemented:

- Minimisation of water losses and leaks,
- Rainwater and snowmelt harvesting systems,
- Re-use of water,
- Water efficient installations in houses,
- Waterless and low-flow technologies,
- The installation of water metering systems (for incentivising water saving).

These systems may range from highly sophisticated and high-tech to low-cost that can be particularly appropriate to improve

TABLE 3: MINIMUM STANDARDS FOR HOUSEHOLD ENERGY SERVICES TO SUPPORT DECENT WELLBEING.

ENERGY SERVICES	MINIMUM STANDARDS
Lighting	300 lumes for a minimum of 4 hours per night at household level.
Cooking and water heating	1 kg woodfuel or 0.3 kg charcoal or 0.04 kg LPG or 0.2 litres of kerosene or biofuel per person per day, taking less than 30 minutes per household per day to obtain; Minimum efficiency of improved solid fuel stoves to be 40% greater than a three-stone fire in terms of fuel use; Annual mean concentrations of particulate matter (PM 2.5) < 10 µg/m3 in households, with interim goals of 15 µg/m3, 25 µg/m3 and 35 µg/m3;
Space heating	Minimum daytime indoor air temperature of 18°C;
Space cooling	Maximum apparent indoor air temperature of 30°C;
Refrigeration	Households can extend life of perishable products by a minimum of 50% over that allowed by ambient storage;
Information and communications	People can communicate electronic information from their household; People can access electronic media relevant to their lives and livelihood in their household.

Source: Adapted from Practical Action, 2012:42.

BOX 8: LOW CARBON CITIES

Some prominent examples of new low-energy low-carbon communities in developing countries include Masdar City, currently being built in Abu Dhabi as a zero-carbon, zero-waste, car-free municipality for 50,000 residents, which is thought to become the world's first climate-neutral city and Dongtan in China being planned as a low-carbon city to accommodate 0.5 million people. While there are encouraging examples, their overall sustainability is often disputed, as the projects may actually involve huge development cost (with associated energy and GHG impacts), be relatively isolated and exclude low-income people. It is important to act in existing urban districts, where there is a greater potential for paving a more sustainable future. An example here includes the Western Harbour (Västra Hamnen) district of Malmö, being turned from a brownfield area into an environmentally friendly town based on 100% renewable energy.

the quality of life and alleviate water problems of the poor, as well as to alleviate the load on existing freshwater provision systems. For example, even in very dense slum areas, guttering may be used to transport rainwater from the rooftops to the storage vessels to be used for multiple household purposes and, if properly collected, stored and treated, for cooking (e.g. Gould and Nissen-Petersen, 1999). Water used for "cleaner" purposes can be captured and then used for "dirtier" purposes, as well as for irrigation, thus allowing a reuse of water. For example, in both developed and developing countries large quantities of clean fresh water are used to flush toilets, whereas this function can be served by "used water" (so-called "greywater"), harvested rainwater and many other kinds of water that are uncontaminated and free of solid subsistence.

Regulations can be effective to improve water management and recycling. For example, more than 40,000 homes in Melbourne, Australia, are required to use Class A recycled water, metered and delivered separately in a distinctive purple pipe, rather than potable water for toilet flushing, washing cars and watering outdoor landscaping (OECD, 2010: 126).

Pollution of existing water systems by household sewage and waste is another persistent problem in many poor areas, which needs to be tackled seriously and prevented. Solutions here are closely interlinked with the measures for improving sanitation and waste management facilities (see *Household waste management and recycling* below).

Furthermore, both the quantity and quality of water may also be saved already at the stage of construction – in this regard, water conservation and saving measures need to be communicated to the construction workers to raise their awareness about an environmentally-conscious water usage.

Building codes for sustainable housing

The development of appropriate technology should be followed by strengthened minimum efficiency requirements for housing/building construction (incorporated into so-called "building codes") – for example, for energy, water, air quality, as well as the ecological safety of the used materials and technique. Building codes are mandatory in many developed countries. Indeed, mandatory building codes are found to be among the most effective mechanisms for ensuring improved performance of buildings, including for energy (Laustsen, 2008; Levine et al., 2007). Such codes may be of national or local jurisdiction and may be differentiated by types of development and geographical conditions.

For example, the European Union (EU) already prepares for moving towards "nearly-zero energy" requirement for all new and retrofitted buildings by 2020 and develops corresponding energy performance standards for buildings, or energy building codes (EU, 2010). The idea is that only buildings that use very little energy to operate will be permitted. New buildings will have to take this little energy from nearby renewable energy sources or will generate it themselves. With proper onsite generating capacities and permission for a dual-flow of electricity between the building and the common grid, some buildings will be able to send as much electricity back to the grid as they take from it or even generate a surplus (known, respectively, as net-zero energy and plus-energy buildings).

What are energy building codes?

These are building codes which regulate various energy-related elements of a new or renovated building, such as the building's thermal design (e.g. thermal capacity, insulation, passive heating, thermal bridges); indoor climatic conditions and air quality; the systems for heating, hot water, ventilation, cooling, lighting; and the design, positioning and orientation of the building. They usually

Retrofitting housing to improve environmental peformance in Czech Republic.
© Mathew French/UN-Habitat.

specify different parameters for different climatic zones.

In developing countries too, targets can be put in place to ensure an increasing penetration of passive, zero-energy, and zero-carbon buildings – with a caveat, however, of not introducing universally strict regulations too fast (Box 10). Stringent building codes may be unfeasible for smaller developers and individual self-builders, thus pushing such people into informal practices. Indeed, mandatory codes are still rare in developing countries, especially for residential buildings, and where they do exist are hardly followed.

In any case, building codes should be supported by other instruments, including subsidies, capacity building and leadership development. Voluntary building codes and certification systems are used to this end too (Box 11). One of the recommendations advocated by the UN-HABITAT for a few decades now has been that model (non-mandatory) self-building designs be developed for low income groups that can be easily understood and implemented. These may include a range of designs for different incomes and specific locations, all ensuring energy and water efficiency (UN-Habitat, 2011d). Specially appointed free or low-cost information centres may further support the local population on this matter.

2.5. SUSTAINABLE BUILDING MATERIAL AND PRACTICES

Sustainability of housing construction practices

The actual construction process may create massive environmental problems, including noise pollution, air and dust, and harmful contamination through toxic waste. The waste from construction and demolition activities

BOX 9: PREFABRICATED BUILDINGS

Prefabricated housing construction (also know as pre-manufactured, off-site, flat pack, modular or volumetric) was popular in the post-WWII Europe as a means for providing quick affordable housing in mass quantities. Houses were usually designed for a short life with little consideration to aesthetics or energy efficiency and have gained a poor reputation. Despite this, there has been a resurgence of interest to the pre-manufactured technique as potentially environmentally-sustainable yet cost-effective. The advantages of the off-site technology include a reduced embodied energy (because of less vehicle deliveries and the economy of scale), waste reduction, reduced site disturbance, and better control over the used material and methods in factory settings. The houses can be built to high environmental standards and can either follow a pre-designed template or be customised. A disadvantage is, however, that prefabricated houses have to be bought as ready-made products and, even if overall offering cost savings, can only be afforded by the more affluent or incorporated developers and government. Still, some prefabricated components can be standardised and subcontracted to poorer areas' workshops, thus also contributing to employment opportunities.

Furthermore, as one type of prefabricated houses, portable buildings provide a quick solution for accommodating refugees, victims of natural disaster or temporary labour – since they are portable, the embodied energy is preserved when buildings are relocated to another site. Care should be taken, however, because in many cases such 'temporary' houses can become permanent and this should also be considered in the design and planning stage.

is frequently dumped illegally in dams, river courses and any available hollows. The extraction of raw materials often happens in rural areas, causing the degradation of land and ecosystems. Deforestation can also be related to the building materials industry, as timber is often obtained unsustainably from indigenous forests, which, given minimal biomass and ecosystem replacement activities afterwards, leads to soil erosion, salinisation of watercourses, reduced precipitation and the related problems.

Defective and inefficient construction materials and techniques can put at risk both construction workers and the end-use residents. Sustainable house-building industry should prevent the use of harmful building materials and finishes of residential buildings, which constitute a large share of the global toxic load. Construction practices should also promote sound and safe activities on construction sites, especially with regard to reduction in topsoil and vegetation losses, dust and noise pollution, and safe storage of harmful chemicals.

Which building materials are unsafe for health?

A study by World Health Organisation re-emphasises that the following materials should be avoided in building construction, insulation and repair activities: asbestos, lead paint, pressed wood products manufactured with volatile organic compounds (e.g. formaldehyde), arsenic in timber, batt insulation materials containing formaldehydes, and foam boards containing carcinogens and endocrine disruptors (WHO, 2011).

Affordable building techniques and materials

There remains a huge potential for sustainable construction technologies and practices involving ecological, healthy and safe materials and environmentally friendly techniques – even if there have been a good progress in this regard (following, for example, the Agenda 21 Sustainable Construction in Developing Countries; see CIB and UNEP-IETC, 2002). The adaptation of traditional building technologies - which are in harmony with local conditions, affordable, durable, reliable and, importantly, functional for the modern life - is especially important.

Locally available traditional materials have much smaller environmental impact in contrast to materials such as bricks, concrete and iron – mainly because of the lower embodied energy. Some well-known affordable materials with low embodied energy include, for example: adobe or compressed earthen blocks, earthen and lime-based plasters, the use of ash as alternatives to Portland cement, straw-bale, local stone, locally harvested rough sawn lumber, as well as other local biomass products (bagasse, hemp, bamboo), which are used as raw material to manufacture durable building materials (CIB and UNEP-IETC, 2002; UN-Habitat, 2011d). There has been a worldwide resurgence of interest in earth building. However, most soils do not contain the mix of clay, silt and sand required for good brick making. Modern stabilization technology has broadened the range of natural soils suitable for making compressed stabilized earth blocks, and increased their strength and durability. An interesting type used in South Africa is also eathbag/sandbag constructions; sandbag walls cannot crack, are fire proof, good insulators and resist water penetration (Roux and Alexander, 2009).

Indigenous knowledge and techniques may be invaluable for improved adaptive capacity of houses by optimising constructions for natural hazards. However, there should be careful considerations of the durability, resilience and resistance of the buildings made with the use of low-cost indigenous materials, especially in the areas that are prone to natural disaster. Suitability of particular materials for particular climatic conditions and geographical hazards has to be assessed before advocating low-cost local methods.

Training should target safety in construction, as job-related accidents are common among poor construction workers in developing countries . ***© Oleg Golubchikov/UN-Habitat.***

BOX 10: SHOULD ZERO-ENERGY BE A TARGET FOR SUSTAINABLE HOUSING POLICY?

A transition towards zero-energy zero-carbon housing is a revolutionary change that will transform the housing sector of the future. Target-oriented instruments that require new levels of technological performance should, however, be reconciled with the housing policy's principles of affordability, accessibility and distributive justice. There is a risk of targets such as "zero-energy houses" being transferred, in isolation from other instruments and objectives, to countries or regions with a limited welfare state or undeveloped housing policy. This is not only because these regions may lack immediate expertise on building low-energy and yet healthy, resilient, safe and environmentally friendly houses, but also because prioritising such targets may detract policy attention from affordability or adaptation and result in unbalanced practices. It is necessary instead to design policy pathways to low-energy housing by nourishing certain policy development and cross-policies links seeking for an all-round sustainability. There are instruments that can guide countries towards such a more balanced progression, including the UNECE Action Plan for Energy Efficiency in Housing, which highlights a number of policy packages for moving progressively yet sustainably towards a low-energy housing sector.

Source: Golubchikov and Deda, 2012; UNECE, 2011

A combination of traditional and modern materials may be an optimal way to take the best of the two "worlds". The re-integration of indigenous practices and materials cannot simply replicate a model of a traditional house. Their use must adhere to the context of contemporary requirements and technology. Although these techniques have been deeply rooted in the culture of different regions, today there is not much confidence in the technical and economic feasibility of these techniques – partly due to many incorrect applications recently. Furthermore, the traditional methods of construction originated in the rural context and are largely neglected in cities as old-fashioned (Box 12). Having said that, the traditional technologies serve as a springboard for research and innovation into more sustainable technologies (CIB and UNEP-IETC, 2002).

Recycling in the construction industry

There is a need in a practice of producing buildings and materials with a longer life span, and which are recyclable and disposable at a minimal environmental cost. Recycling provides a number of environmental advantages, especially in terms of a reduced consumption of natural resources and deposition of landfill; saving energy in material production and hence reduced pollution; and the availability of more durable materials.

A significant contribution to energy savings and avoiding GHG emissions is made by means of incorporating into residential buildings re-used materials (e.g. from the demolition of previous buildings) and by devising new buildings to be suitable for recycling at the end of their life. Recycling may be possible for wood, metal, glass and limestone (although the health safety of the used materials is obviously important to investigate).

Buildings with a solid basic structure can be refurbished with less energy spent than in the construction of a brand new building, as the structure and envelope incorporate a very high proportion of the embodied energy – even if this strategy require certain compromises (e.g. function and location in comparison to the ideal new building).

2.6. INTEGRATE HOUSING INTO SUSTAINABLE COMMUNITY INFRASTRUCTURE

Cogeneration and district heating

Houses have to be linked to adequate and low-carbon urban infrastructure. District heating and cooling systems are increasingly seen today as the most energy efficient option to provide space and water heating in densely populated urban areas. These systems have great environmental and other advantages especially when renewable sources or combined heat and power are the energy providers.

Combined heat and power (CHP), or cogeneration, involves producing thermal heat and electricity in one integrated process, so that energy losses are minimised. Cogeneration is most advantageous if connected to district heating (also known as community heating) and deployed at a city- or neighbourhood-scale. CHP plants can also provide cooling, by chilled water – this is known as tri-generation or as combined cooling, heat and power. CHP plants become an essential element for advanced district heating and cooling (DHC) networks.

Distributed power and micro generation

Renewable energy generated by individuals and communities can meet their own energy needs, including through neighbourhood-scale power installations (so-called distributed generation) and even smaller building-scale microgeneration. In this way, energy generation is also brought closer to the users reducing losses in energy transportation and

improving community control over access to energy. Different sources of renewable energy can be used – geothermal; wind; solar; biomass; and waste-to-energy. The small power generators can be linked to the usual electricity grid or district heating (albeit raising issues of their compatibility) or, alternatively, supply electricity and/or heat directly to the consumer (such as stand-alone renewable power operating at distribution voltage level).

What are popular renewable microgeneration technologies?

Building-level microgeneration may include heat pumps, small CHP plants, solar panels (PV) and solar water systems (thermal collectors), wood pellet stoves, small wind turbines, and other renewable technologies. Although the efficiencies of all microgeneration systems are being improved over time, it is solar water systems that have been particularly popular due to their relative efficiency and simplicity. For example, such systems have been compulsory to install on certain types of new buildings in Israel, as well as in many cities around the world. In Barcelona, for example, "Solar thermal ordinance" requires all new buildings and major renovations to use solar thermal collectors to supply at least 60% of the energy used to heat water (OECD, 2010: 122). In many countries the installation of such systems is a requirement for being included in public financing programmes for housing – e.g. for certain types of constructions funded by the Housing Development Administration of Turkey (TOKI). German Agency for International Cooperation (GIZ, previously known as GTZ) has provided grants for installing solar water systems for low-income families in the framework of the programmes of the "1,000 Roofs" in Brazil and the "25,000 Solar Roofs for Mexico". As one type of solar water systems, self-made batch heaters have been common in the Caribbean, Asia and Africa.

Even if microgeneration offers savings on the running cost for energy, high upfront costs remain a serious barrier for its effective use at the household level. Providing grants and loans for the residents to invest in microgeneration, finding other financing incentives (e.g. feed-in-tariffs), or installing this in larger-scale social or affordable rental housing developments will not only improve access to clean energy, but will also help poorer residents to save on their living cost (Practical Action, 2012). A care must yet be taken about the reliability of the systems and the arrangement for their maintenance and repair, so that households do not actually lose money in case of technical faults.

And yet community-scale micro-grids (locally combined and centralised grids of electricity generation), especially in the context of developing countries and remote communities, help avoid high capital cost required for connecting to national networked power generation and distribution. At the local scale, green energy also enables participation of local industries in the development, deployment and maintenance, creating opportunities for the local workforce. Such community-based activities represent a good size for local companies or cooperatives to finance. Micro-grid may also include a mix of different energy sources for improved reliability, combining green energy with non-renewable fuels, such as diesel, in so-called hybrid micro-grids (ARE, 2011).

Household waste management and recycling

Integral to environmental sustainability is a well-designed waste management system. Waste management involves the collection, transportation, processing and recycling of waste materials.

Why does waste matter for sustainable housing strategies?

There are a number of reasons:

- Irresponsible or disorganised waste disposal creates various risks for both the health of the residents and the natural environment, including air and water pollution.
- Waste places a heavy load on urban infrastructure and involves land use change;
- The decomposition of waste in landfills is one of the most important contributors to the emissions of methane, and waste is also responsible for carbon emissions if burned;
- Waste is itself the end of the lifecycle of products, the continual production of which consumes valuable resources and energy;
- Waste can amplify negative local climate impacts - for example, dumping of solid waste can clog drainage channels and cause local flooding.

The provision of waste and recycling facilities near housing should also be accompanied with easy and efficient collection of waste and recyclable materials. These facilities are fundamental for creating a good quality neighbourhood and sustainable housing.

Waste prevention, recycling, composting, and energy recovery from household waste are also good environmental and climatic practices, helping to achieve sustainability. For example, in some environmentally-concerned countries like Sweden less than 20% of household waste is deposited as landfill.

Recycling of domestic waste involves the use of waste as a resource for other products. Many materials may be recycled including glass, paper, metal, plastic, textiles and electronics. Pre-sorted biodegradable waste (e.g. kitchen and garden waste; sewage sludge) may be used for composting. However, urban waste recycling and composting requires effective municipal infrastructure for the collection of these materials, their sorting and further processing.

BOX 11: ENVIRONMENTAL ASSESSMENT AND INTERNATIONAL RATING SYSTEMS FOR BUILDINGS

Voluntary building codes and environmental assessment systems have been effective in promoting green buildings. These may also be useful for the development of national building codes in developing countries. Examples of internationally-renowned rating systems include BREEAM (BRE Environmental Assessment Method) in the UK, LEED (Leadership in Energy and Environmental Design) in the US, Green Star in Australia, and HQE (Haute Qualité Environnementale) in France. In order to rate a building, they include considerations of the impacts of the assessed buildings on the environment, health and wellbeing. These certification systems have been also exported beyond their origin to now rate many buildings worldwide, including in developing countries. They may also affect government's decisions, including in choosing or prioritising projects for public subsidies. For example, BREEAM assessment methods for housing have been incorporated into national standards in the UK known as the Code for Sustainable Homes, certain levels of which become mandatory to achieve for various housing developments. Of interest are also standards that are developed for the assessment of building materials and design options by International Standards Organisation (ISO).

Lack of waste management infrastructure creates serious problems with sanitation and water pollution in Kibera slum in Nairobi, Kenya. ***© Oleg Golubchikov/UN-Habitat.***

BOX 12: A CULTURALLY-AWARE USE OF LOW-COST BUILDING TECHNIQUES

The effort of World Hands Project in Juarez, Mexico, highlights the importance of culturally-aware approaches to low-cost sustainable homes. The project was originally designed to use reclaimed and recycled materials including reinforced tire foundations, straw-bale walls, and recycled pallet wood. The new houses took advantage of a passive solar design, a high performance building envelope and low embodied energy building materials (including earthen plasters). However, this building model was found to be unpopular with the local population, because the straw bales were difficult to acquire and transport, and the look of the earthen plaster was considered low-status. The design was consequently modified to use recycled pallets for the walls, which is a common method of building in the area, stuffed with waste straw obtained for free from a local livestock yard and a lime plaster that the residents were fond of. The experience points out to the importance of understanding the preferences of the local stakeholders and allowing them a central role in the design and planning process.

Source: UN-Habitat, 2011d

Other non-recyclable organic waste can be used as a resource for energy generation, following the same technologies as for the production of biofuels from crops. A number of technologies are already commercially popular, such as: anaerobic digestion for biogas; incineration of waste; pyrolysis for syngas; biofuels; charcoal; and, extracting heat from wastewater. Biogas generation has particularly proven to be a relatively simple technology that can be used in a variety of context and scales to produce cheap and competitive energy (Box 13).

BOX 13: EXPERIENCES OF BIOGAS GENERATION FROM LANDFILLS AND HUMAN WASTE

There are examples of both city-scale and community-scale initiatives of using organic waste for biogas generation. At a city level, the city of Monterrey, Mexico used public and private funds to construct a seven-megawatt energy plant that captures and converts enough landfill gas into electricity to power the city's light-rail transit system and its streetlights. The city of Guangzhou in China has undertaken one of the largest landfill energy capture projects, which is expected to generate more than 50 GWh of electricity, sufficient for 30,000 households.

At a community level, examples include the initiatives of the Sulabh International Social Service Organisation that has been promoting dignity and sanitation of residential areas in India and built over 6,000 public toilets, of which above 170 are currently connected to biogas plants to provide clean energy. Effluents from the production of biogas are turned into a colourless, odourless and pathogen-free liquid manure. The biogas generated from this anaerobic digestion process is used for cooking, street lighting and electricity generation. A modified diesel engine can run on biogas by connecting the gas to its air filter. High-density settlements, slums, public markets and schools are ideal for toilet biogas plants.

Source: OECD, 2010: 125; Kitio, 2006:13.; http://www.sulabhinternational.org/

Peoples process in Myanmar. **© UN-Habitat.**

03 SOCIAL AND CULTURAL SUSTAINABILITY OF HOUSING

Housing is critical to meeting basic human needs in shelter, but it is also important for the social development of communities and societies. Housing social needs can be expressed as a certain hierarchy as in Figure 3. Although traditionally housing policy has focused on fundamental social needs fulfilment, such as affordable, decent and healthy homes, it also has to ensure that housing achieves intermediate social needs such as transport and facilities, as well as the ultimate needs of the development of human and social capital and capacity (education, skills, health, and values), cohesion and wellbeing in communities and society at large (good relationships, participation, inclusion and equity, security, sense of community). These challenges are considered within the social and cultural dimensions of housing sustainability.

What does social and cultural sustainability of housing mean?

Social sustainability in housing is about creating affordable, good-quality, inclusive and diverse (mixed-tenure and mixed-income), secure and healthy dwellings, residential areas and communities, which are well-integrated into the wider socio-spatial systems of which housing is part – urban and national. Cultural sustainability takes into consideration cultural worldviews and values, norms and traditions, as well as lifestyles and behaviours of occupants, communities and society, thus supporting the dignity of communal life.

Given the significance of housing for human needs and livelihoods, the social dimension of sustainability remains the key condition – even the focal point – against which the environmental, cultural and economic considerations must be assessed, counterbalanced and developed. However, every effort must be taken to ensure that the social dimension is integrated with the broader conditions for sustainable housing as expressed in the holistic four-dimensional approach (see Table 1).

The rest of this chapter will review these aspects:

- Affordability, dignity and resilience of housing;
- Social and spatial justice in sustainable housing provision;
- Empowerment, participation and inclusion;
- Social infrastructure and facilities;
- Housing as coping strategies for the poor;
- Adaptable housing for present and future needs.

3.1. AFFORDABILITY, DIGNITY AND RESILIENCE OF HOUSING

At the very core of any housing policy lies the provision of affordable and adequate shelter for all – irrespective of people's wealth and influence. In almost all developing countries, but also in more developed ones, unmet housing demand contributes to an unbalanced housing market, unaffordable housing and overcrowding.

BOX 14: MEXICO'S STRATEGY FOR SUSTAINABLE AFFORDABLE HOUSING

Meeting housing demand is one of the main policy priorities in Mexico, as the acute housing deficit in the country is estimated at 8.9 million homes – more than a third of the existing stock (Maes et al., 2011). To respond to this challenge, government launched an ambitious National Housing Programme (NHP) to facilitate the delivery of six million affordable homes during 2008-2012. However, the National Housing Commission (CONAVI) estimated that this new housing stock would accumulate considerable CO2 emissions (33 Mton above the baseline within a decade). A set of measures were consequently designed to mitigate this effect.

Apart from developing green regulations and standardization for new developments, CONAVI and the Institute of the National Housing Fund for Workers (INFONAVIT), the major mortgage provider in the country, launched the Hipoteca Verde (Green Mortgage) programme in 2007. The programme provides additional affordable mortgages and 20% subsidies to qualifying households to buy homes equipped with the so-called Basic Package of pre-approved eco-technologies (energy-efficient lighting, solar water heaters, thermal isolation and reflective paint and coating on roofs and walls, separated solid waste containers, energy efficient gas water heaters, as well as water-saving toilets and taps). The idea is that the eco-technologies will provide savings to the households who can therefore afford taking a larger loan, while the initiative also overcomes the barrier of the higher initial cost of the eco-technology. According to CONAVI, each home in question has saved 1-1.5 tons of CO2 emissions per year. CONAVI has also started providing additional 20% Basic Package subsidies within its Ésta es tu Casa (This is Your House) programme, which already includes 20-25% subsidies for families who earn less than 2.6 minimal wages and who do not normally qualify for a green mortgage (Maes et al., 2011).

14 national agencies joined efforts to promote the Integrated Sustainable Urban Developments certification (DUIS), which assists private projects in building new towns where employment, infrastructure, transportation, social services and utilities, and the environmental considerations are holistically addressed. The DUIS are planned in conjunction with large-scale projects for new employment centres; more than a million inhabitants are expected to occupy them in 20 years. Because of access to cheap finance and further government assistance, these projects achieve high economy of scale, while government-subsidised mortgages ensure stable demand for the new-built housing.

However, the sustainability of the new housing policy depends upon continuing political will in Mexico. Critics also argue that many new communities are planned far from the existing centres of growth and may eventually be left abandoned or otherwise encourage motorised commuting. Furthermore, the affordable housing programmes are yet to reach the majority of the needy. For example, those employed in the informal sector lack social security accounts or full-time employment contracts to qualify for affordable mortgages and subsidies; in contrast, many wealthier families use the publicly-assisted mortgages to buy second homes – this partly explains high vacancy rates in the respective housing projects. Developing sustainable social rental housing might be a way towards a more inclusive and balanced housing policy.

Source: Contribution by Sofía Viguri Gómez, Centro Mario Molina, Mexico; see also CONAVI, 2011

Among the many by-products are slums, lack of infrastructure, sanitation, clean energy and fresh water – leading to a great variety of negative social and health implications.

As stressed throughout this report, the affordability of housing is a particular issue on which the social, economic, environmental dimensions of sustainability most clearly converge. This convergence is used in some of the most advanced programmes, which attempt to simultaneously target the sustainability and affordability of housing, such as in Mexico, which is today one of the leaders in the developing world for comprehensive government-led programmes for sustainable affordable housing (Box 14).

Further aspects of affordability will be considered in the Economic sustainability chapter, as it is important to articulate that affordable housing is not simply a social welfare mechanism, and not at all "a burden" for the economy and government, but is rather a means for economic development and one of the most important vehicles for solving the structural problems of poverty. The economic aspects of affordable housing supply notwithstanding, affordable housing is also about a dignified shelter – providing people not only with affordable, but also healthy, safe, ecological and resilient place to live.

Both structural elements and design of dwellings and residential environments around them have a substantial impact on people's health, safety and quality of life. Houses are in fact the 'biological' extensions of people who use them; they are a 'third skin' – additional to the human skin and clothes and having the same functions of protection, insulation, breathing, regulation and communication. Just as health depends upon a healthy 'first skin', so does it depend upon a healthy home.

What particular aspects of health and safety need to be recognised?

It has been already discussed that the use of different construction materials makes big difference for the health of the residents. Further hazards related to housing quality can be gathered into a few groups:

- Physiological hazards (damp and mould, smoke, excess cold or excess heat, building-related pollutants such as asbestos and radiation);
- Psychological hazards (crowded space and lack of security, lack of light or excessive light and noise);
- Infection-related hazards (lack of hygiene, sanitation and drainage, water supply contamination, infectious diseases);
- Accident-related hazards (falls on and between the levels and on the stairs, electrical hazards, fires, burns, scalding, collisions, cuts and strains);
- Environmental hazards (landslides, earthquakes, tsunami, as well as air pollution).

High incidents of severe health problems and death are associated with substandard, unsafe housing, and related physical infrastructure and public services. Overcrowding reinforces diseases, as the infection is spread easily; poor sanitation due to poor infrastructure leads to severe infections (e.g. water- and food-borne diarrhoeal diseases). Housing with poor heating, dampness, poor air quality, overcrowding is also associated with a range of physical and mental illnesses, including tuberculosis, respiratory disease, cancer, stress, anxiety and depression.

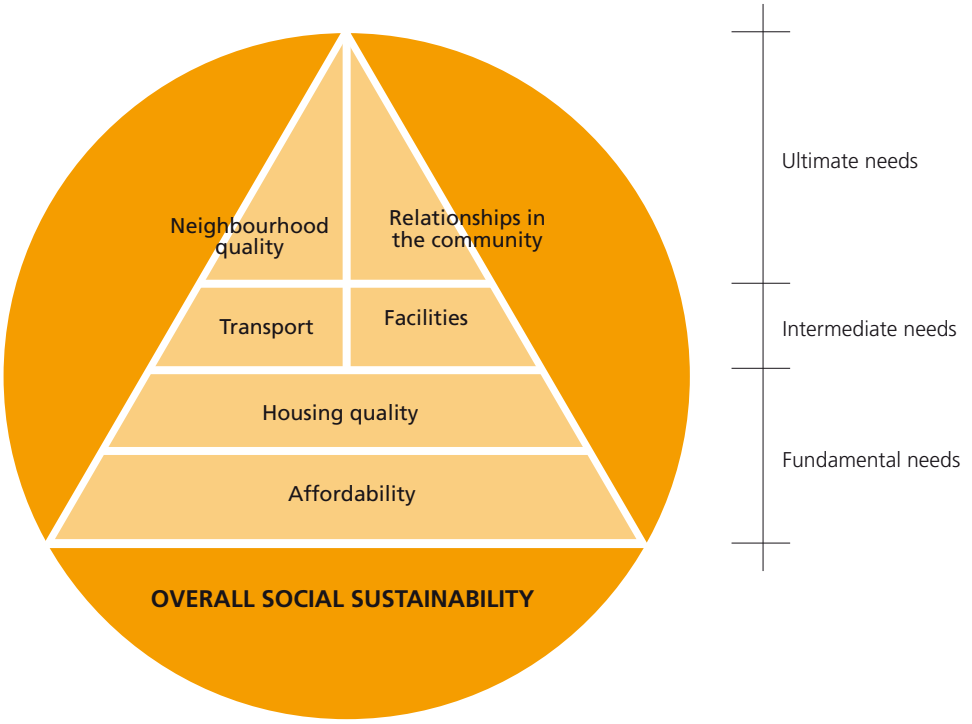
Furthermore, the quality of houses determines how well they will be able to withstand environmental shocks and disasters when these come and, consequently, how well they can protect the life and health of households and whole communities. These factors of sustainable housing are compromised by low-quality construction, violations of formal building codes in disaster-prone areas, and a lack of building control mechanisms or their enforcement.

Certainly, housing quality, improved sanitation and resilience are among the key priorities of housing policies around the world, also driving slum improvement programmes. As discussed above, the use of sustainable housing practices, ecological materials, and better climatic protection of residential buildings contributes to improved resilience and protection of houses against various hazards. It is crucial to involve community in disaster management processes and planning, so that people are well-informed about hazards in their areas and ways to minimise the risks for their lives.

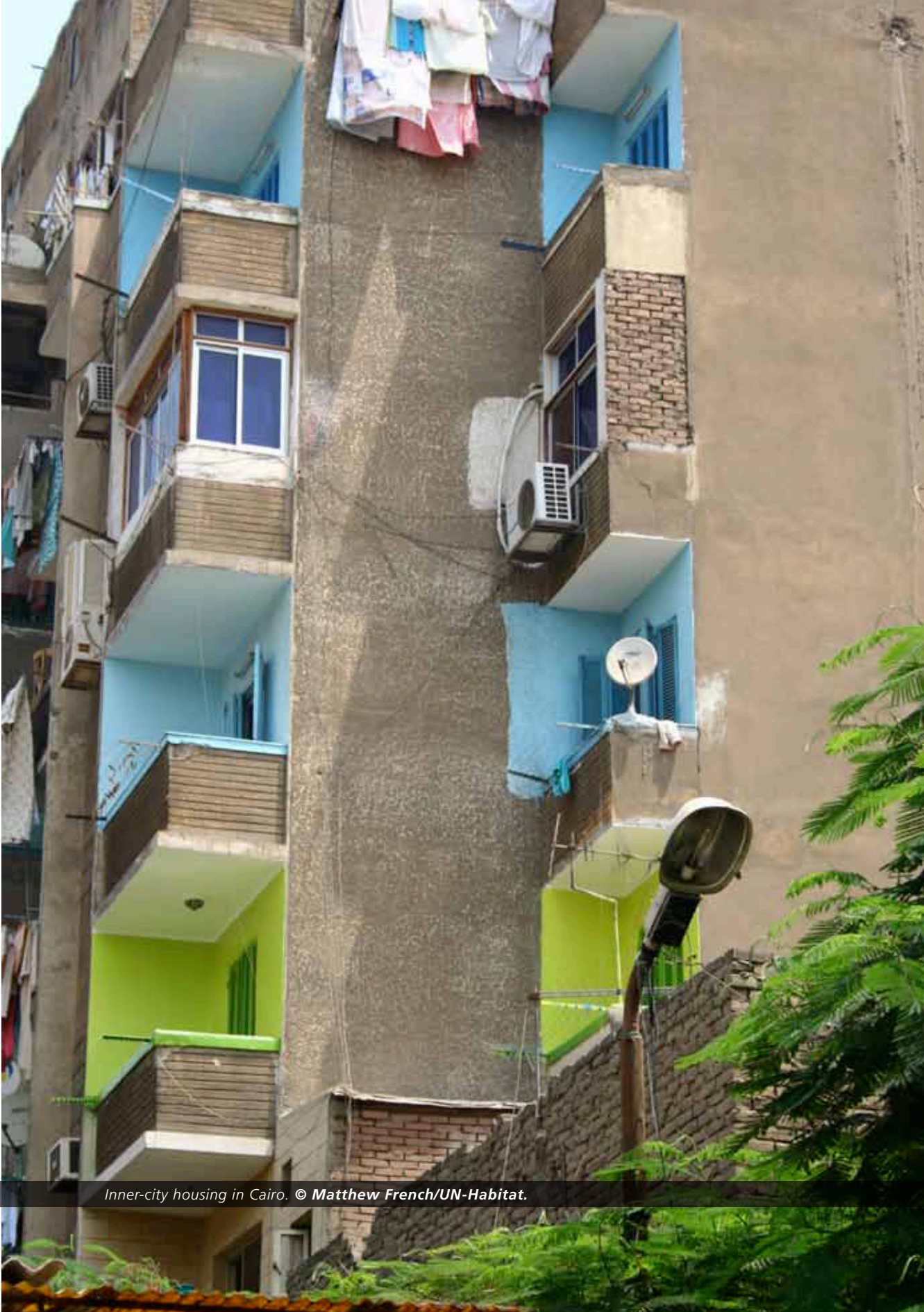
3.2. SOCIAL AND SPATIAL JUSTICE

The income divide between the wealthy and the poor poses a significant threat for sustainable development. While it is certainly a societal problem, it has various manifestations in space, as most vividly expressed in the contrast between the living conditions in slums and those in "golden ghettos" (which are often even located next to each other), but is also visible in the urban conditions of poverty, segregation, exclusion and marginalisation. Bridging this urban divide is one of the most serious challenges

FIGURE 3: A CONCEPTUAL REPRESENTATION OF THE SOCIAL SUSTAINABILITY OF HOUSING.



Source: Ancell and Thompson-Fawcett, 2008: 432.



Inner-city housing in Cairo. **© Matthew French/UN-Habitat.**

for this century. UN-Habitat (2010b) has been eloquent in advocating "the right to the city", as a platform for actions for achieving more inclusive, equitable and sustainable city.

Policies for sustainable affordable housing, which improve access to adequate, safe and ecological housing and which involve a degree of the redistribution of wealth and opportunities in favour of the disadvantaged groups, are certainly among important instruments for bridging the social divide and reinforcing *social justice*. By removing disproportionate environmental risks for the heath of the vulnerable social groups (e.g. inside and outside pollution and hazards), sustainable housing is also reinforces *environmental justice.*

Sustainable housing is also important to address the urban divide and reinforce the right to the city – effectively *spatial justice* (Harvey, 1973; Soja, 2010) – by providing enabling residential environments in which all residents, irrespective of their wealth, origin or gender, can access basic and public services, public spaces and all kind of benefits and opportunities created by cities for everyone. In this regard, the fulfilment of the basic human need in shelter must be supplemented by the provision of affordable and decent amenities, services and infrastructure to the poor (including, schooling, healthcare, and public transport)– and right in the place where they live – while preventing their forced evictions, gentrification and displacement.

The design and management of neighbourhoods are important too. It is often that affordable housing programmes have been seen as purely public housing development targeted at the poorest social groups and built in distinctive design and isolated locations; a social stigma has haunted these locations. It is crucial that affordable housing initiatives go beyond the

TABLE 4: SUPPORTING COMMUNITY SOCIALISATION.

BUILT ENVIRONMENT	COMMUNITY PRACTICES
Socially mixed housing areas	Joint community projects to encourage inter-generational and inter-group mixing
Community centres	Local community governance
People-friendly layouts (e.g. car-free areas, well-lit areas)	Voluntary security and neighbourhood watch
Distinctive architecture or landscaping to create sense of local identity	Community cultural events and celebrations
Religious facilities	Neighbourhood networks (e.g. women's groups, special interest clubs, babysitting circles)
Local libraries and museums	Local oral history collection and depositories
Public and congregational spaces (e.g. open spaces, parks, benches)	Community betterment events (e.g. fundraising litter picking, planting,)
Shopping and entertainment facilities (including markets, cafes, pubs)	Collective services (e.g. credit unions, childcare co-ops)
Affordable sporting facilities, playgrounds and play spaces, community gardening areas	Community sporting competitions and gardening activities

Source: Adapted from Young Foundation, 2011.

provision of simply more houses and towards the provision of better residential areas.

What also matters is that a balanced socio-spatial distribution and diversity of population and housing tenures is achieved and that segregation and polarization are avoided. A way towards this may be to remove design distinction and exclusionary zoning and start mixing different tenures, so that, for example, flats or houses may be mixed between socially rented or owner occupied. It should be noted in this respect that focusing exclusively on homeownership and the private housing market to cater for the housing needs provides only limited choices affordable for the high- and middle-income groups and discriminates against other tenure choices, leading to speculative prices. If there is a housing choice across different types of tenure, including government and non-profit rental housing, a more competitive environment between them is achieved (see the Economic sustainability chapter).

3.3. EMPOWERMENT, PARTICIPATION AND INCLUSION

Certainly, ensuring that social and spatial justice and the "right to the city" are achieved and social sustainability is comprehensively addressed necessitates a broadened participation in housing and urban development initiatives and social inclusion and interaction, centring on participation rights, opportunities and responsibilities. It is important to remember that social sustainability of housing is not just about producing better quality houses and environments, but also about fostering community capacity, building bonds and trust between responsible leadership and citizenship, and engaging people in the process of city building and realising their right to be involved and make decisions.

As, for example, noted in relation to housing the poor in developing countries: "Urban development is the result of decisions and actions made by a wide range of public and private actors. The best solutions to urban poverty and housing problems are those in which a variety of actors work in partnership, with the poor being the key actors. When governments acknowledge that they can't solve the problem alone, but only in partnership, that's when the really effective work begins. The most important thing governments can do to help resolve problems of urban migration and housing is to ensure that no group is excluded from participation in the process of deciding how to solve those problems, and to ensure nobody is excluded from the benefits of urban development and public resources invested in solving these problems" (UNESCAP and UN-Habitat, 2008a: 13).

The involvement of population in decision making processes should give the local community control over shaping its own living environment and sharing the ownership of new initiatives, thus ensuring their more successful implementation and higher wellbeing of their users. The representation of the full spectrum of the community's fractions, including that of minorities and marginalised groups, is vital to prevent social exclusion and also mitigate possible conflicts. Furthermore, women must be integrated at all stages of housing development activities to ensure gender-sensitive planning. It is often the case that empowering the community and its fractions needs to go side by side with capacity building for people to understand their rights, responsibilities, and possibilities.

3.4. SOCIAL INFRASTRUCTURE AND FACILITIES

Housing development is more than building buildings and providing a dignity of shelter. It is also about a decent infrastructure and dignity of communal life through opportunities for inclusive urban environment and decent and supportive social and cultural milieu.

Sustainability of residential areas relies on good infrastructure in place (public transport, water, energy sources and public spaces) and accessibility of essential community services (schools, shops, healthcare, but also facilities for families and children). Essential social facilities must be provided at an early stage in the life of new communities, so that residents do not have to commute to get access to them, and also develop bonds with the place they live in (Young Foundation, 2011).

Furthermore, public facilities must ensure that people do not have to rely on cars or otherwise be excluded, but have easy access to places where jobs and urban services are located. This is indeed a key requirement for the green credentials of neighbourhoods and cities. Within neighbourhoods, healthy and safe lifestyles can be encouraged by facilitating walking and cycling as means of transport, amenities for physical exercise and recreation, family activities, as well as conveniences for the disabled and elderly. If residents have opportunity to move around safely on foot or by bicycle, this improves the attractiveness and quality of life in the areas, while it is also beneficial for health, local cohesion, and the environment.

How to ensure that adequate infrastructure is provided?

It is best to plan the infrastructure and capacities from the very beginning of development. Many places, however, face challenges in securing timely provision of adequate infrastructure for new housing developments. On the one hand, there are common cases of new residential infills being built within an established neighbourhood overstretching its existing infrastructure and causing frequent breaks in water, power or gas supply. On the other, problems in new large-scale residential areas may involve significant delays in infrastructure provision, leading to 'isolated communities' with a lack of access to water, gas and other utilities, as well as public transport. Effective methods to ensure essential infrastructure is provided in due time include the development of infrastructure plans, setting up effective partnership and co-operation between public bodies and service providers. Providing better neighbourhood services is also facilitated by giving more power for local authorities to strategically plan and deliver better local services and by active local residents' involvement and participation in relevant decision-making.

A well designed residential neighbourhood represents a more attractive living environment that increases residents' satisfaction and sense of belonging, raises community spirit and encourages social interactions. Good social relationships have positive impacts on physical and metal health, but also on economic resilience and productivity – if people are better connected with each other, they share news, knowledge and skills and help each other to cope with various everyday challenges – from assisting in childcare to providing small loans and to creating joint ventures.

It is important to enhance the social and cultural life of local communities by improving aesthetics, diversity and cultural sophistication of the built environment, assisting community creativity (i.e. via amenities, community centres, training, affordable sporting, cultural and entertainment facilities), protecting housing heritage and familiarity of cities (e.g. preventing social displacement, gentrification or complete redevelopment) and by a number of other design and community practices, which (in addition to social and transport infrastructure) may include those as outlined in Table 4.

3.5. RESIDENCE AS COPING STRATEGIES

While all social groups have higher satisfaction in their life if they feel they are adequately integrated in community structures, social networks are even more important for the poorer, disadvantaged and marginalised

High density, mixed-use morphology of housing in Buenos Aires, Argentina.
© Matthew French/UN-Habitat.

groups who cannot always afford paid services, but who are willing to share with the communities their time, skills, experiences and material resources in order to withstand various challenges and pressures they face in their everyday life.

Slum residents in particular may be cash-poor, but they have remarkable resilience and resourcefulness embedded in the social settings of their local communities – including family "safety nets", solidarity, possibilities to learn skills from each other and share knowledge, and, importantly, informal employment. Furthermore, the very combination of social and physical structures of slums offers additional support mechanisms – for example, proximity to jobs and markets, flexibility to extend shelters using their own labour, possibilities to carry out ground-level home-based work activities (such as trade, services, or small agricultural activities).

Lack of attention to this "social milieu" is a reason why many larger slum re-settlement programmes fail to succeed and why residents are often discontent about them (as, for example, demonstrated in the multi-thousand protests against the rehabilitation of Dharavi in Mumbai, India, the largest slum in Asia). In particular, high-rise multifamily estates, which are often built to resettle slum dwellers, may be culturally, socially and economically challenging for the poor to adapt to – especially if also higher rents and utility bills are to be paid for. Many just sell their homes at very low prices or rent them out to wealthier people and move back to slums. Although this may help them financially, this situation is not sustainable. Therefore, social and cultural aspects need to be seriously negotiated with when attempting to improve slum dwellers' living conditions.

Beyond slums, in both developing and developed contexts, there is a need to rethink the previous urban redevelopment and renewal practices (which have lead to gentrification and the displacement of the original population and intensified discontent and class conflict) and change them towards more selective and sensitive interventions that would retain existing urban structure (which also often have a high heritage value) and avoid the disruption

BOX 15: CULTURAL DIMENSIONS IN AFFORDABLE HOUSING PROGRAMMES IN ETHIOPIA

Lack of attention to the cultural dimensions has been one of the challenges facing what has in many other respects been considered as highly successful large-scale low-cost housing development and slum resettlement programme – the Integrated Housing Development Programme in Ethiopia. It was launched in 2005 and by 2011 has already built 171,000 housing units, a significant achievement considering the limited capacity of the Ethiopian housing sector. However, cultural inexperience of people to live in vertical apartments rather than their detached houses has created a number of tensions and concerns. Adding to the need to adjust to the vertical living, the new housing units do not respond to customary activities such as the preparation of traditional injera bread and slaughtering of animals, which are crucial parts of Ethiopian culture. In response to post-occupancy issues, an awareness campaign was undertaken by the Addis Ababa city administration consisting of a technical manual outlining appropriate behaviours and responsibilities in condominiums. Nevertheless, there remains significant scope to improve the design of the built environment, both the units themselves and the overall master planning, to improve the responsiveness of the physical environment to occupants' needs, values, and lifestyles.

Source: UN-Habitat, 2011a

to the existing communities and their social capital, whilst still improving the conditions and quality of their life.

Further, a number of culture-related capacity-building strategies are important to design for assisting the transition towards sustainable housing and living:

- Supporting sustainable values, norms and behaviours (e.g. in relation to energy use, recycling, communal living and place maintenance, understanding the benefits of green technology);
- Assisting migrants' transition from rural and slums areas to formal urban housing and particularly to multifamily housing (see Box 16);
- Developing traditional, indigenous and local knowledge (including of relevance to sustainable resource use, energy efficiency and resilient building techniques).

3.6. ADAPTABLE HOUSING FOR PRESENT AND FUTURE NEEDS

Housing has also to be flexible and responsive to various and changing needs of residents, including those associated with elder groups, people with limited mobility, as well as with children and women. Today, for example, most houses and residential settings are not flexible enough to meet the need of the elderly group. A house design can ensure access by wheelchairs, so that people can stay in the same house as they age. Sometimes, targeted assistance is necessary to improve housing of these groups so that they do not need to change their homes because it becomes not flexible enough and challenging for them to live in (Box 16).

Housing planning and design must also be gender sensitive, recognising that in most cultures women take care of domestic life and families. For example, a lack of domestic facilities (e.g. water, toilet, showers) in slum areas and the need to walk through unsafe neighbourhoods to get access to these facilities (which may still lack dignity, privacy and security) as well as to other services and places of work makes women vulnerable and exposed to violence and rape. Providing gender-sensitive facilities closer to homes, improving the design and security of streets and providing public transport and road infrastructures can mitigate these problems. Improved access to water immediately release women's time for other activities and opportunities. Both women and communities at large should be involved at all stages of housing development activities to ensure that their needs are properly accommodated.

It is also important to allow flexibility in designing houses and neighbourhoods to accommodate future needs as much as the present needs. As, for example, stated by Young Foundation (2011: 43), "in order to allow new communities to flourish, planning authorities should avoid a rigid 'master-planning' approach that seeks to create a blueprint for the future. Rather, master plans need to allow for a degree of ambiguity, uncertainty and openness to change, recognising that a new community will develop best if it is allowed to be dynamic and to evolve in ways that the planners cannot entirely predict." Regenerating some vernacular designs and building techniques for dwellings can help achieve better flexibility of residence, as well as improved environmental performance (Box 17).

BOX 16: HOUSING ADAPTATION AND REPAIR SCHEME IN MALTA

In Malta, low-income families, elderly people and single parent families often live in areas from which out-migration is intensive and the quality of housing is poor. In order to stimulate the families to remain in their homes, the government offered these households grants for organising repairs of their dwellings. Direct grants were paid to the households upon receipt of the renovation bills, subject to allowed activities and amenities installed. The project helped more than 1,700 families within 5 years. This has prevented further deterioration of the housing stock, as well as alleviated demand for new housing with corresponding pressure on land and affordability. However, government has recognised that more effective measures are needed to reach the neediest households and provide tenants with information and training on how to access social housing funds.

Source: Novem, 2002: 31.

BOX 17: REMAKING TRADITIONAL BUILDING DESIGN FOR FLEXIBLE HOUSING

In Tajikistan with its many mountainous and seismic-prone areas, a traditional design of houses has included terraced adobe units built on slopes, where the roof of the lower lying house was used as a terrace for an upper lying house. This tradition is currently combined with modern design to provide affordable opportunities for growing rural families to extend their houses upslope as their demand in living space increases, while creating more energy efficient and earthquake-resilient shelters. Houses are placed in compact clusters, optimised for climate consideration, and are made of clay aired bricks, straw and wood. This reduces embodied energy, while heat losses can be lowered by up to 25% compared to a typical new building built in the same locations.

Source: Akbarov, 2009

"Micro-enterprises are often part of the housing environment and should be supported as they provide important livelihoods for households. **© Matthew French/UN-Habitat.**

04 ECONOMIC SUSTAINABILITY OF HOUSING

The economic dimension of housing sustainability emerges from a variety of economic functions and implications that the housing system has, such as:

- Housing and related infrastructure are among the most valuable and lasting human-made capital assets;
- Housing provides the basis for human welfare, labour productivity and mobility;
- Housing is an important part of household expenditures and public expenditure and if unaffordable creates numerous socio-economic problems;
- Housebuilding, housing services and real estate markets are among the key economic and employment activities;
- Housing is a platform for home-based activities and entrepreneurship;
- Housing is part of economic flows of natural resources and energy.

As shown in Box 18, affordable housing is a productive asset that has important contributions to national welfare and economic development. Moreover, decent affordable housing and related infrastructure are among the key factors that also make local places more attractive, inclusive and competitive and hence are the key to sustainable economic development at the local level too. Indeed, places with housing deprivation have little prospect to attract skilled workers and investments, while places with expensive housing often end up being surrounded by slums and create serious social tensions and stress and sub-optimal local economies.

Yet, all these economic implications of affordable housing remain largely unrecognised in national growth strategies in developing countries. Affordable housing is seen primarily as a social welfare instrument (for alleviating poverty, promoting fairness, and ensuring housing rights), not as a system to advance economic development (Tibaijuka, 2009). While the social welfare imperative is certainly overwhelming, there is still a strong need to articulate affordable housing along the economic sustainability lines as well.

The rest of this chapter will review the following important economic aspects that the policies for sustainable affordable housing in developing countries need to pay particularly attention to (see also Table 1):

- Affordability of housing supply;
- Ensuring balanced housing markets through affordable tenure choices;
- Recognising affordable housing building as a source of employment;
- Assisting home-based enterprises;
- Mobilising savings and domestic finance.

BOX 18: THE IMPORTANCE OF AFFORDABLE HOUSING ACTIVITIES FOR ECONOMIC DEVELOPMENT

Affordable housing contributes to economic development through its capacities to:

- Stimulate economic growth through housing markets and homebuilding activities;
- Stabilise and reduce volatility of housing markets;
- Improve health conditions and labour productivity through better living conditions;
- Add to the growth of capital assets of the gross capital stock;
- Support regional and urban regeneration, development and growth;
- Contribute revenues to local, regional and national governments (e.g. via taxes) and individual wealth (e.g. via housing markets);
- Generate employment and income through residential and building activities and their multiplier effects in other sectors;
- Strengthen local building industry and enterprise and promote local and traditional building materials and techniques;
- Provide domestic financial mobilization through housing finance institutions;
- Generate additional income by raising collateral for business start-ups and small firm growth as well as through home-based enterprises and renting.

Housing is more than just a place to sleep; It should also be connected with economic activities as these present an important livelihood strategy for many households in developing countries.
© Matthew French/UN-Habitat.

4.1. AFFORDABILITY OF HOUSING SUPPLY

A policy to increase affordable housing supply will need to set clear targets and strategies based on a sound assessment of needs and trends and the capacities of existing housing resources. Although there are no universal solutions, common strategies to improve the affordability of housing supply involve:

- Regulations and incentives for the construction and real estate markets;
- Provision of subsidies and other types of housing assistance;
- The development of affordable mortgage market and alternative financial systems;
- Provision of public land and infrastructure for housing projects;
- Building public housing and incentives to community-based, cooperative, non-profit and rental housing programmes;
- Regulating and stimulating self-built housing and housing improvements;
- Modifying building codes, regulations and procedures to reduce housing compliance costs
- Partnerships between local and central government, private companies and other stakeholders to realise housing projects in local communities;
- Strengthening house-building industry and affordable building material markets.

It is important that in the context of sustainable housing, the traditional measures for improving affordable housing supply are now complemented by the potentials offered by the energy and water efficiency, micro generation, and using ecological local materials and labour (as discussed in the Environmental sustainability and Social and cultural sustainability chapters). For example, improving thermal insulation in Europe and North America has proven to be an effective way of not only regenerating houses, but also decreasing the "energy poverty" of the many poor who face the life-threatening dilemma between "eating and heating" (Golubchikov, 2009; Boardman, 2010). Certain elements of green housing are used in the ambitious pro-poor housing programmes in Latin America, including in both homeownership and social rental housing (Box 19).

4.2. BALANCED HOUSING MARKETS AND THE CHOICE OF AFFORDABLE TENURE

While the housing market is an important driver for the wider economy, unbalanced housing supply and demand and limited affordability create unhealthy housing markets that generate 'ripple effects' through the economy and financial system (Berry, 2006) and result in what is known as 'boom-and-bust' economies. It is especially in this context that pursuing housing affordability will improve the overall health of the economy.

Why does homeownership create problems for the economy?

There are particular problems with macroeconomic policies excessively favouring private housing markets and homeownership. Too much focus on homeownership contributes to market volatilities. Under the conditions of economic growth, there is a rapid expansion in mortgage activities that may result in the 'credit binge' and a surge in property prices. Under the economic downturn, housing prices drop and many are left with "negative equity" (their property value drops below the amount of their remaining mortgage). As many low-income people also find themselves unable to pay back their credit obligations during this period, their home is repossessed and they lose

their already accumulated capital in property investment. All this reinforces social inequality, while also leading to homelessness. Moreover, when the majority's incomes are locked in paying back mortgages, household disposable incomes available for other goods and services shrink, with negative consequences on the aggregate demand in the economy, further reinforcing general economic problems.

Developed economies with lower rates of homeownership (e.g. Switzerland, France, Germany, Austria and Sweden) have not experienced the same housing price volatility as countries with much higher rates of ownership. For example, between 1971 and 2001, UK experienced a 2.5% annual increase in house prices, which was above a European average of 1.1%; in France the rate was 0.8%, in Germany it was zero, and in Sweden it even declined by 1% (Maclennan and O'Sullivan, 2011).

Today, the dominant private sector supply, backed by high homeownership rates, caters mostly for the high-end of the housing market thus worsening the housing, economic and poverty situations in many countries. Rental housing, on the contrary, remains a neglected option for policies in developing countries – even though this is where most urban residents live today and will live in the future. Table 5 demonstrates that the proportion of population in rental housing tends to be much higher in large (and growing) cities than in their corresponding countries. This points at the need of concerted efforts to improve public and private non-profit options for affordable rental housing (for further details see: UN-Habitat, 2003; UNESCAP and UN-Habitat, 2008c; UN-Habitat, 2011b).

In short, the supply of affordable housing options is needed across all tenures – not only homeownership – to ease the 'housing stress' for households with varying needs and to ensure a proper and competitive tenure choice and flexibility. Figure 4, for example, demonstrates housing provision along the continuum of affordable housing options used in Australia.

4.3. SUSTAINABLE AFFORDABLE HOUSE-BUILDING AS A SOURCE OF EMPLOYMENT

One of the most important economic functions of housing is its links with employment. For example, residential construction makes up between 7 and 10% of the total labour force in developing economies (Tibaijuka, 2009). It is particularly less-expensive housing that has considerable linkages with employment creation, especially in the context of poorer areas, where low-cost housing production provides employment for unskilled and skilled labour. Table 6 demonstrates, for example, that less expensive housing is much more labour-intensive than luxury housing. Affordable housing also stimulates the development of small enterprises - subcontractors, which in the context of developing countries are more likely to employ the local poor and informal labour.

However, sustainability principles need to find an appropriate balance between low and high technology, which will likely to be specific to the socio-economic context of particular areas. While low technology activities involve locally available low-cost resources, it is also usually characterised by inefficient use of labour and materials and low-quality outputs. Yet, high technology involves a large capital investment and high import components, limited impact on local employment, expensive outputs, as well as high transportation cost and related embodied energy. For example, across African countries, as much as 60% of building materials are imported (Tibaijuka, 2009). It is intermediate low-cost technologies that seem to be particularly effective in terms of sustainability and impact on employment in most developing counties. These are as low-cost, small scale, easily used; local resources and building materials are utilised (Tibaijuka, 2009; UN-Habitat, 2002). Intermediate technologies also require certain expertise and this opens additional room for training and skills development – which can be externally

BOX 19: BRAZIL'S AFFORDABLE HOUSING PROGRAMME - MY HOUSE, MY LIFE

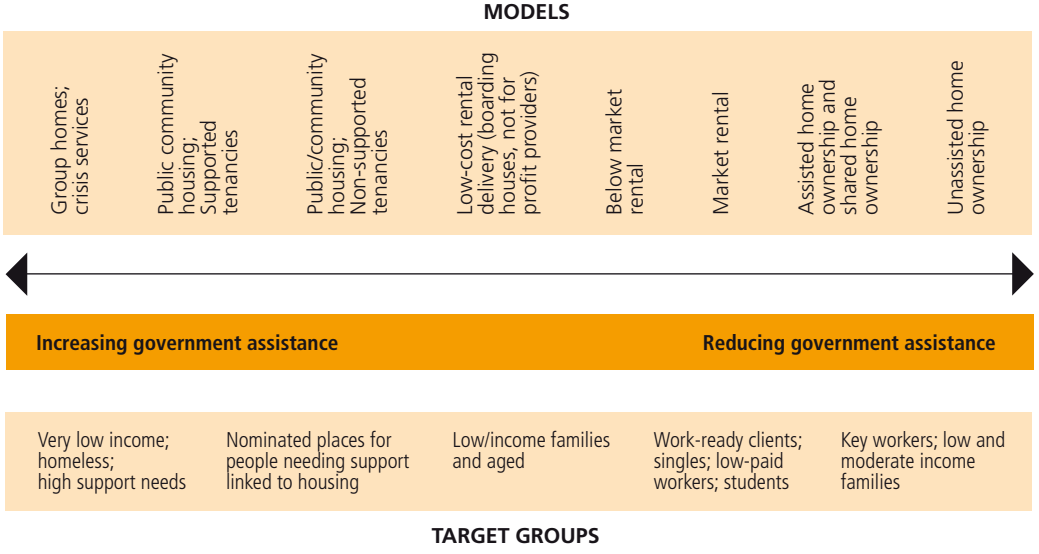
Despite a remarkable reversal of inequality in Brazil since the adoption of socially-progressive redistributive policies in the 2000s (Cornia, 2012), the country of more than 200 million population has a large proportion of the population living in substandard shelters. To address this, the Brazilian Government has launched the Minha Casa Minha Vida ("My House, My Life") housing programme (MCMV) in 2009, as one of the packages of Brazil's Growth Acceleration Programme. It aims to build 3 million homes for low-income families in just five years. The programme is administered by the public Caixa Economica Federal Bank. The second phase of the programme, staring in 2011, has been allocated BRL140 billion and as in 2012 it was protected from budget austerity cuts.

MCMV provides incentives for housing developers, provided they will offer new homes at a government-approved cap price. Currently, low-income households are eligible to receive an allowance to buy these homes (e.g. up to 90% of the house price if earning less than three times the minimum wages (i.e. less than about USD1,000), as well as a low-interest mortgage to cover the rest. Before MCMV, mortgages in Brazil were only available for the wealthiest families – only 10% of Brazil's real estate were mortgaged. Real estate loans represented less than 4% of the country's GDP. As demand for new homes is ensured by the public subsidies, MCMV marshals great interest of investors and developers across the world.

MCMV also attempts to incorporate green concerns - e.g. in the second phase of MCMV, single-family houses have to be equipped with solar water heaters, although there are also shortcomings arising from a lack of consistent sustainability requirements. It is very often that new homes, especially in larger cities such as Rio, are built far from the centres of commerce and lack public transportation and community facilities – thus undermining their overall sustainability.

Barrio Carioca is being developed as a part of the Brazilian 'My House My Life' housing programme to scale up housing production and have a positive impact on the national economy and job creation.
© Matthew French/UN-Habitat.

FIGURE 4: PROVISION OF AFFORDABLE HOUSING OPTIONS FROM THE POLICY PERSPECTIVE.



Source: CAH, 2012.

TABLE 5: HOUSING TENURE STRUCTURE IN SELECTED COUNTRIES AND CITIES.

HOUSING TENURE IN COUNTRIES, %				HOUSING TENURE IN CITIES, %			
	Owners	Renters	Other		Owners	Renters	Other
Germany	40	60	-	Berlin	11	89	-
Netherlands	53	47	-	Rotterdam	26	49	25
Bolivia	60	18	22	Santa Cruz	48	27	25
Canada	62	33	5	Toronto	58	42	-
USA	66	34	-	New York	45	55	-
UK	69	31	-	London	58	41	-
Egypt	69	31	-	Cairo	37	63	-
Brazil	74	25	1	Sao Paolo	70	20	10
South Africa	77	22	2	Johannesburg	55	42	3
Thailand	87	13	-	Bangkok	54	41	5

Note: *Estimates are based on data from the period 1996-2001 and include both formal and informal housing.*

Source: UN-Habitat, 2003: 9-11.

A woman trader in an informal market in Kibera, Nairobi. ***© Oleg Golubchikov/UN-Habitat.***

provided, as well as shared between the local communities.

There are particular economic, employment and training opportunities related to the use of locally-produced sustainable/green building materials and technologies. Sustainable technology can be a platform to employ and train workers and unite communities. Even if for the many poor it is self-building that remains the only option (beyond renting), self-help methods ("sweat equity") offer a means of empowerment to the local community – especially when local methods can be supported and further optimized with input from experienced sustainable design professionals (UN-Habitat, 2011d).

The development of local sustainable building materials and technologies may also boost the associated retail and consulting industries. This implies that direct and indirect impacts may stretch far beyond the construction industry, having a genuine multiplication effect. Furthermore, rehabilitation, upgrading and retrofitting, which are necessary to improve the environmental performances of houses in many areas also rely on labour-intensive, locally-implemented projects and can stimulate employment (Golubchikov, 2009).

4.4. RECOGNISE HOME BASED ENTERPRISES

Many low- and middle-income urban households in developing countries are using their dwellings as workplaces – to produce things, carry out trade and provide other services. This phenomenon of home-based enterprises (HBEs) is very important for generating their income and providing employment (Box 20). Small-scale home-based enterprises use labour-intensive methods and work within local neighbourhoods to self-employ their owners and to provide further jobs to the local labour (Tipple, 1993; UN-Habitat, 2006).

Although home-based activities often find themselves in the informal sector and are often treated with hostilities in government policies, it is more effective to acknowledge them and support their gradual formalisation rather than ignore or, even worse, harm them. That will particularly affect the life of women, who constitute the majority of workers in the UNESCAP and UN-Habitat, 2008a).

In the context of slum upgrading or redevelopment, it is important to take into account those self-employing needs of the low-income people and their use of dwellings not only as residence, but also as a workplace. This should be reflected in designing appropriate internal housing space, number of floors, and street layouts.

HBEs may also be linked more directly with the green economy. With proper financial, training and technical assistance, the potential of HBEs may be involved in the production of sustainable building materials or low-cost green technologies, such as, for instance, rainwater harvesting systems or prefabricated building components of standardised designs

(e.g. pre-cast beams, columns, piles, roof tiles, ceiling panels, door frames). Moreover, if HBEs and local entrepreneurs can be involved in the production of the whole pre-manufactured sustainable housing, this will make particularly beneficial and lasting impact for sustainable house building industry. The industry of prefabricated construction has already a long tradition, especially in wood-rich areas. For example, Bali in Indonesia has been known for reaching certain successes in exporting prefabricated houses, although this industry has targeted rather affluent groups and been vulnerable to the changes in the global economy.

4.5. MOBILIZE SAVINGS AND DOMESTIC FINANCE

Given that developing countries have limited financial resources for housing and related infrastructure, it is critical for sustainable housing to define finance solutions (UN-Habitat, 2005). Housing finance sources may include conventional mortgage finance, subsidies, microfinance, migrant remittances, and informal finance (Tibaijuka, 2009). Much evidence points at traditional formal finance (e.g. mortgage finance) being largely inappropriate (unaffordable and inaccessible) for the poor, while high levels of subsidization to achieve affordability (i.e. supply side subsidies) being unsustainable (UNESCAP and UN-

BOX 20: EMPLOYMENT IN HOME-BASED ENTERPRISES IN SELECTED COUNTRIES

- Argentina: 8% of workers in the manufacturing sector in Buenos Aires are home-workers;
- Philippines: 13.7% of workers in the informal sector are home-workers;
- Botswana: 77% of enterprises are home-based;
- Kenya: 32% of all enterprises are home-based;
- Lesotho: 60% of all enterprises and 88% of women's manufacturing enterprices are home-based;
- Malawi: 54% of enterprises are home-based;
- Venezuela: 45% of all clothing industry workers are home-based;
- Zimbabwe: 77% of enterprises are home-based;
- Tanzania: 64% of female households in Dar es Salaam use their homes for economic activity.

Source: Tibaijuka, 2009: 96

Habitat, 2008b). In this situation, some countries have been exploring different ways for alterative housing finance schemes (Box 21).

For instance, housing microfinance (HMF) is widely considered to fit into the incremental building process adopted by many poor households – when home is considered as a slow continual process of building and improvement rather than a finished product. HMF is also based upon a more nuanced understanding of the financial needs of low-income households (Tibaijuka, 2009: 164).

However, when HMF model draws on purely informal finance practices, they may be over-exploitative and even criminal – charging high interests and being brutal for non-payers. One good practice is combining informal and formal practices though, for example, community-based loan arrangements as discussed in Box 22. By managing their own financial base, the community organisation not only knows their members' needs better, but provide people a simple, regular mechanism for building collective management skills, cooperation and mutual assistance.

It is also necessary to develop a sound financial infrastructure for environmental/green housing technology, and for new green technology to establish its market niche. This would include a transparent system of subsidies, grants, loans, public investment programmes and leasing, as well as self-sustainable funding sources (e.g. revolving funds). Such instruments should be targeted at appropriate stakeholders, including owners, tenants, builders, technology producers and retailers. Information about such financial instruments has to be systematized and easily accessible (Golubchikov, 2009).

One specific industry that is developing to help with financing energy efficiency improvements and deploying relevant technology includes energy service companies (ESCOs). These help finance and coordinate energy efficiency measures and receive profit from the savings of their clients. This model is usually used in the industrial sector, but may also be of interest for financing the improvements of energy performance of the housing stock that is managed by larger housing management companies.

TABLE 6: EMPLOYMENT GENERATED BY DIFFERENT CONSTRUCTION TYPES IN SRI LANKA

HOUSE TYPE	AREA	COST	EMPLOYMENT
	(m^2)	(rupees/m^2)	generated per million rupees of expenditure (people)
Luxury	181	475	280
Conventional	50	190	510
Traditional	37	76	500

Source: Tibaijuka, 2009: 96.

BOX 21: ALTERNATIVE HOUSING FINANCE SCHEMES

The Housing Provident Fund (HPF) was established in Shanghai in 1991 to mobilize private resources to secure long-term funds for meeting housing needs without state subsidy. Modelled on Singapore's HPF, the Chinese HPF scheme involves a compulsory monthly contribution by all employees and employers of a share of workers' salaries to the Fund. While HPF has been shown some limitations, it is an effective housing finance model that support housing finance in China.

In Mexico, organisations such as FONHAPO (the National Peoples Housing Trust) and SEDESOL (the Secretariat for Social Development) provide mortgages to those without credit histories, to seasonal or temporary workers and those participating in Mexico's large informal economy. (Maes et al., 2011).

Sources: Chi-Wai Yeung and Howes, 2006 and Maes et al., 2011

BOX 22: COMMUNITY-BASED HOUSING LOANS

A fast-growing strategy for channelling housing finance is getting group loans by the community organization (e.g. against collective land as a credit security), which then on-lends to its members, and takes responsibility for managing the repayment process and making a single group repayment each month to the lender. In these group loan strategies, the whole community is collectively responsible for repaying the loan, and developing internal systems for ensuring the repayments are made in full each month, even if some members might have repayment problems. Although savings groups may have no legal power to penalize late-payers, there are a number of techniques they can work into their loan management systems to accommodate the inevitable repayment problems and to help their neighbours who have problems making repayments. These systems are positive, supportive, realistic and highly social. When communities design and manage them, they will ensure good repayment. One way communities do this is by charging their members an extra margin on top of the lender's interest rate, or making some extra monthly saving compulsory during the repayment period. Both techniques allow a community to build up a reserve to act as a buffer against repayment problems.

Source: UNESCAP and UN-Habitat, 2008b: 24

Traditional housing area in China. ***© Emma-Liisa Hannula/UN-Habitat.***

The community-managed loan repayment in Kenya. ***© Oleg Golubchikov/UN-Habitat.***

Construction work by community members in an informal area of Lusaka, Zambia.
© Matthew French/UN-Habitat.

05 DELIVERING HOLISTIC APPROACHES

5.1. FIND A BALANCE ACROSS THE SUSTAINABILITY DIMENSIONS

Certainly, there are positive cross-linkages between improving different dimensions of sustainability in housing, so that sometimes it is even not possible to easily divide measures into the environmental, social, cultural or economic categories. Let's consider, for instance, some examples of the multi-win across environmental and economic dimensions:

- Transforming housing stock towards environmental sustainability is simultaneously an opportunity to raise the economic sustainability – energy, water and material savings offered by green housing imply economic savings for residents and society in large;

- Physical and functional durability and the enhancement of the lifetime of houses is another major concern for sustainable construction. Sustainable housing design takes a long-term perspective and considers the use of more durable materials and components, which will lead to reduced maintenance costs and service charges in the future;

- Positive side-effects from energy retrofitting projects can include the improved aesthetics of buildings; better noise isolation; better indoor thermal and moisture conditions, leading to higher levels of comfort of living and health (and hence labour productivity), as well as lower rates of wear and tear and longer cycles of refurbishment and repair. Reduced exposure to the fluctuation of outdoor conditions prevents dampness, rusting and mould formation. Such factors, taken together, have also beneficial impacts on property values.

Although such examples are encouraging and while policy-related reports never stop stressing that sustainability is a multi-win solution, it is important to maintain a realistic perspective. Getting to the objective of sustainability is not without serous hurdles, because rather than multi-win scenarios it often involves conflict and controversy, issues of power and the redistribution of wealth (Marcuse, 1998: 111).

Environmental sustainability and social justice, for instance, may work in the opposite directions and involve a very real conflict of interest between different stakeholders. As discussed above, tough energy performance standards may undermine affordability or indoor air quality and health; cost-oriented housing projects may be harmful for the environment, health and social cohesion; healthy houses may not necessarily be friendly to social mix or climate. Besides, projects that are designed to ensure all-round sustainability may involve political problems with getting access to land or key infrastructure or ensuring local residents' consent.

Although it is imperative to focus on a multi-win balance across the sustainability dimensions, it is important not to discard the necessities of tradeoffs. Solutions will always be specific to particular initiatives, socio-cultural contexts, and political landscapes.

As a general point while designing or assessing a project, programme or another initiative for sustainable affordable housing, it may be useful to start right from the affordability and social justice perspectives. Some questions to ask in relation to this may, for example, be:

- Who will benefit from the project? Is the project pro-poor? Will it reach the very poor?
- Does the project ensure social justice and prevent socio-spatial inequality?
- Does it prioritise collective consumption (e.g. public services, public space, public skills) or focus on elitist consumption (e.g. car-based mobility, gated communities, real estate speculations)?
- What would be the project's wider social implications?

If the housing project satisfies necessary affordability requirements, it further needs to be considered across the spectrum of the other sustainability constraints, as discussed in this Guide. As an illustration, Table 7 provides an example of what kind of questions might be considered in relation to hypothetical projects that seek to integrate affordable housing with different aspects of sustainability. Of course, these questions are not exhaustive and are given here simply for illustration. As a rule of thumb, building on a broader participation of stakeholders and voices will lead to securing a broader and more lasting consensus.

5.2. USE THE INSTRUMENT OF SPATIAL PLANNING MORE EFFECTIVELY

Spatial planning is relevant for all sectors of the urban economy and is principal for the organisation and integration of different sectors and urban systems into a consolidated spatial strategy. Cities with a long tradition of strong land use planning, public transport and green space strategies are among the healthiest

TABLE 7: EXAMPLES OF CROSS-DIMENSIONAL SUSTAINABILITY CONSIDERATIONS.

Projects considerations	Environmental considerations	Social considerations	Cultural considerations	Economic considerations
Energy efficiency	Will it be safe for health and local environment?	Does it provide for the varied needs of different social groups?	Are energy efficiency features easy to operate?	Does it include local materials and technique?
Rental housing development	Does it incorporate green spaces?	Does it allow for social mix?	Does it consider cultural habits and expectations of the residents?	Are public transport and access to jobs considered?
Heritage restoration	Is it water- and energy-efficient?	Does it help or harm community cohesion?	Does it protect current residents from displacement?	Is it financially viable?
Slum upgrading	Will it improve resilience to climate change?	Does it include social services (education, healthcare)?	Does it include opportunities for cultural development?	Does it cater for the needs of local entrepreneurs?
New 'social' housing	Does it negatively affect the local ecosystem?	Is it integrated as part of the city and its services?	Does it support local cultural norms, traditions, and ways of life?	Will the housing be affordable for the intended beneficiaries?

Source: UN-Habitat.

and safest in the world, including Portland in the US, Vancouver in Canada, Copenhagen in Denmark, Munich in Germany and Melbourne in Australia (UNEP, 2011).

Housing and planning were once well connected to promote effective housing programmes in urban and rural areas, but over the last few decades, this relationship has been weakened. Housing has become reliant on the market rather than being plan-led, with a number of negative effects manifest in land shortages for housing, urban sprawl, imbalanced housing market (housing shortages in growing urban centres and abandoned housing in declining areas), rigid housing differentiation, shrinking green spaces, etc.

But spatial planning remains a key tool to strengthen the all-round sustainability of housing, by providing a sense of strategies for the development, redevelopment and further improvements of areas of different scale (from regions to neighbourhoods), including slum upgrading. It can improve social cohesion, the environmental performance and energy efficiency of housing projects while also assisting in climate mitigation and adaptation efforts (Box 23). For example, in many places in Western and Northern Europe the potential of urban planning is realised by building new "eco-neighbourhoods", such Hammarby Sjöstad in Stockholm, Sweden; Viiki in Helsinki, Finland; Vauban and Rieselfeld in Freiburg and Kronsberg in Hanover, Germany; Vesterbro in Copenhagen, Denmark; Leidsche Rijn in Utrecht, the Netherlands, and BedZED in Beddington, United Kingdom (OECD, 2010).

What is important is that decisions on land-use and urban layout have impacts lasting for decades and even centuries. Particular land use and infrastructural patterns create a long footprint for the future, as future investments

Community-based planning for slumupgrading. ***© Matthew French/UN-Habitat.***

BOX 23: CONTRIBUTION OF PLANNING TO SUSTAINABLE AFFORDABLE HOUSING

- Limit urban sprawl and car-dependency by ensuring appropriate levels of building density and mixed-use developments, organizing transport flows, public transport and non-motorized transportation options;
- Deliver comprehensive programmes for rehabilitation and regeneration of slums and other problematic areas (e.g. derelict, former industrial) and ensure better living and environmental standards in the built environment;
- Bring together disparate residential developments of the city to ensure integrated residential patterns (e.g. re-designing and upgrading slums as the city's neighbourhoods);
- Ensure social inclusion and socio-spatial integration, by preventing social segregation and mitigating social imbalances between neighbourhoods;
- Transform existing low-density areas towards mixed-use development, based on a strategy of stimulating polycentricity;
- Ensure the provision of social infrastructure and amenities and accommodating the particular needs of various social groups through appropriate spatial organisation, densities and design;
- Preserve and expand an integrated system of green spaces and other natural infrastructure;
- Protect cultural and architectural heritage of urban areas and integrate them into the urban tissue;
- Increase recycling infrastructure in the city, install waste-to-energy technologies; promote sustainable material cycles via design control;
- Develop integrated infrastructure for renewable sources of energy, district heat-cooling-electricity systems and waste-to-energy.

Housing is more than houses. It should be connected to the urban environment, including public spaces, where people meet and socialize, such as this example from Kenya. ***© Matthew French/UN-Habitat.***

are predetermined by existing infrastructure, which may lock economies into unsustainable lifestyles and patterns. Spatial planning is important to prevent being locked into high-carbon or hazard-prone conditions that would be expensive or impossible to alter later (World Bank, 2010).

5.3. IN-BUILD RESILIENCE IN HOUSING DEVELOPMENT

Improving climate adaptation and resilience is also among important measures to improve the sustainability of housing. Indeed, due to climate change, depending on their location, communities are increasingly exposed to intensified heat waves; droughts; wildfires; storms surges and floods; as well as to rising sea levels (in coastal areas); and other climate-induced geomorphological hazards. These

manifestations may involve significant cost to human health, to physical capital and natural habitats, further leading to public and private costs associated with aid, rehabilitation, resettlement, or conflict resolution.

Large housing development should be subject to a climate robustness test and incorporate future-proof design. Previous solutions designed for the climate of the past may no longer be relevant under new uncertainties. To overcome the inherent uncertainties of climate change, major new investment solutions and general capacity building efforts should advocate flexibility, diversification, and redundancy. The *2010 World Development Report* (World Bank, 2010) highlights a number of important principles for such strategies:

- 'No-regrets' actions that would provide benefits irrespective of climate change (such as improving energy and water efficiency in housing);
- Reversible and flexible options to keep the possibility of wrong decisions as low as possible (e.g. restrictive planning for coastal areas can be relaxed, whereas forced retreats from such areas due to flooding or increased protection can be very costly);
- Safety margins or redundancy (e.g. paying the marginal additional costs of building a more robust house, or extending safety nets to vulnerable groups);
- Long-term planning based on scenario analysis and an assessment of alternative urban development strategies under a range of possible future scenarios;
- Participatory design and implementation based on local knowledge about existing vulnerability, and fostering ownership of the strategy by its beneficiaries.

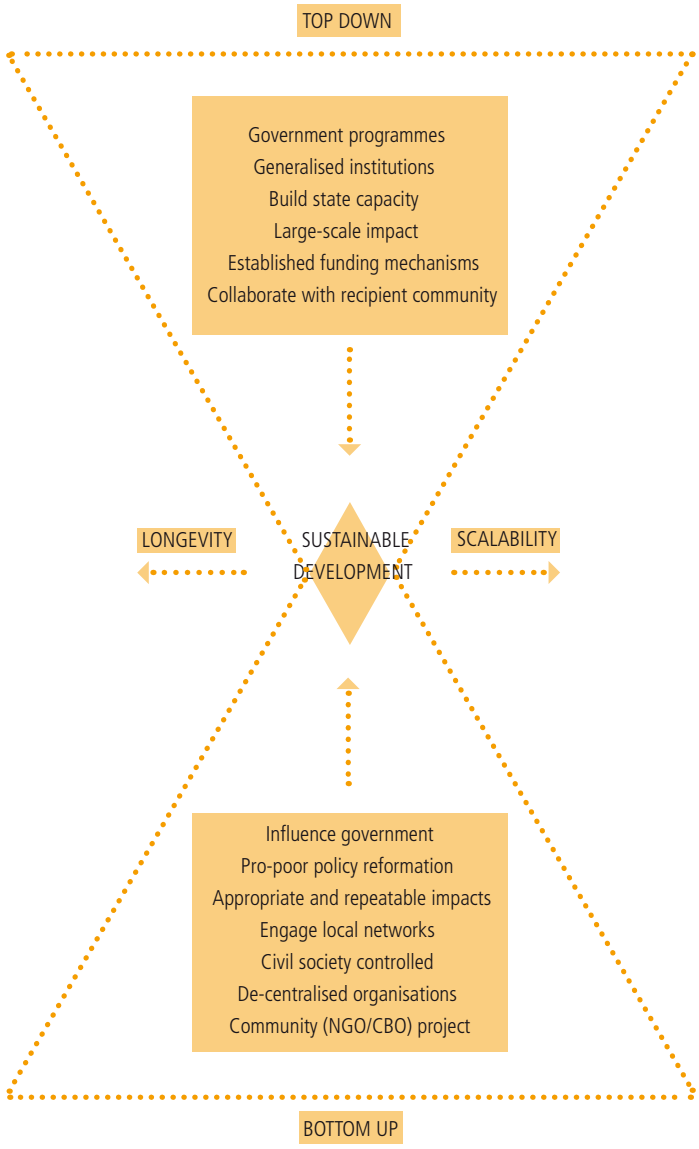
Whilst the anticipation of the external shocks is vital for prioritizing certain fields or directions, communities' overall vulnerability is ultimately determined by a number of structure factors that are not possible to change overnight. A dilapidated and inefficient capital stock; buildings built in the absence or in violation of construction regulations; poorly maintained urban engineering systems; underdeveloped public services; social inequality; polarization and deprivation; are all factors which leave communities badly exposed. Resilience in this sense needs to be incrementally and yet purposefully and progressively 'accumulated' by improving the quality of both social wellbeing and housing stock (Golubchikov, 2011).

5.4. MAINSTREAM BEST PRACTICES

Worldwide and nationally there are usually many good examples that achieve interesting results for sustainable affordable housing, even though they often focus on some aspects of sustainability or are very limited in outreach. The real challenge lies in how to combine the best aspects of these practices and mainstreamed them.

Generally, two approaches to sustainable housing may be identified. One is a "top-down" (centralised) approach, which relies on government initiatives and polices and multilateral partnerships. The other is "bottom up" (decentralised) approach which relies on the efforts of small and dispersed initiatives by individuals and groups (including NGOs, communities, companies). Both are important for sustainable housing practices, although both have important practical limitations – limited scale and scope in case of the bottom-up projects and, typically, limited understanding of final users' needs in case of the top-down approach. Figure 5 shows schematically how both of these approaches may be engaged to form a focus on sustainable development. In both scenarios, longetivity, replicability and scalability are key considerations.

FIGURE 5: TOP-DOWN AND BOTTOM-UP ROUTES TO SUSTAINABLE DEVELOPMENT.



Source: Cronin and Guthrie, 2011: 131.

People´s process in Myanmar. **© UN-Habitat.**

06 KEY PRINCIPLES FOR SUSTAINABLE POLICY DELIVERY

The general approach for the realisation of the sustainable affordable housing policy is represented in Figure 6. Housing practices must be adjusted to achieve multiple benefits across the four sustainability dimensions – to simultaneously improve people's livelihoods, contribute to the economy, and enhance the environment. A crucial aspect is sustainable policy delivery. The latter relies on a strategic vision and supportive institutions, multi-stakeholder cooperation, and sustainable sources of funding – all underpinned by appropriate regulation and capacity building.

The following principles are relevant at all scales of sustainable affordable housing projects and programmes – from the national to community level.

Leadership and commitment:

It is the imperative that sustainable housing initiatives are backed by a clear and strong leadership and political will. When critical changes are to be set in motion, it is especially important that strategic thinking and strong leadership are present. Within government special organizational units should be charged with the responsibility of coordinating sustainable affordable housing initiatives, which will have a sufficient mandate as far as these policies are concerned. It is also important to establish coordination between various relevant authorities.

Institutionalising sustainable housing:

For sustainable housing to really become a long-term and sustainable policy, it needs to be fully institutionalised in the relevant government and non-government structures and practices and become independent from changes in government. Sustainable housing ideas should become part of political and policy discourses and the operation of government, non-governmental and private sectors, as well as academia. For this to gradually happen, a national housing strategy (see Box 24) and a strong legislative basis need to be introduced, governance structures reformed, and strategic investment, research and training programmes launched.

Multilateral collaboration:

Good governance should be underpinned by a clear vision, strategies and action plans, which need to be formulated and implemented by collaboration with multiple stakeholders, including between different levels of government and government departments, private sector, non-government organisations and local community. Wide and open consultations are critical to the development of the sustainable housing strategies and projects. Participation and cooperation can also bring-in missing technical expertise.

Community participation:

Local and end-user participation is essential for understanding community needs and preferences, as well as to learning about the local community's knowledge about climate challenges. Sharing ownership of the project with the local community and end-users better guarantees its viability. Projects should also respect local culture and traditions.

Context-specific approaches:

The challenge of integrating potential competing social, cultural, economic, and environmental considerations in sustainable housing requires cooperation and integration across sectoral and administrative boundaries. This is best achieved by a holistic spatially-focused approaches (rather than sectoral), which will seek locally-nuanced solutions, based on specific social and physical contexts. Problems vary from one location to another and so should be responses.

Capacity building:

This involves educating various publics about the multiple benefits of sustainable housing and green building; developing educational programmes for various groups and job markets to acquire necessary skills; accumulating and sharing data bank of best practices; promotion of exemplary projects and case studies.

Financial mobilisation:

It is important to mobilize financial resources for the implementation of the sustainable housing policies and projects, including by engaging with public-private partnerships, the private sector, and advocacy with the government organisations.

Indigenous low-cost materials and techniques:

Particular effort needs to identify and, if necessary, restore low-cost sustainable methods for homebuilding, which should be further combined with modern methods to deliver affordable and resilient homes. The development of new materials and technologies should include a strong pro-poor element.

FIGURE 6: SUSTAINABLE HOUSING POLICY.

SUSTAINABLE HOUSING		
Environment Housing in natural and local environment	**People** Housing as arena for socio-spatial justice and culture	**Prosperity** Housing as a driver of economic growth
Housing system to protect natural environments, use natural resources prudently, mitigate and adapt to climate change	Housing system to ensure everyone has access to a decent affordable shelter in a place which is desirable to live in	Housing system to support a strong, responsive and competitive economy at local, regional and national levels
Social footprint assessment, economic footprint assessment, environmental footprint assessment		
• Appropriate institutional, legal and regulatory setting • Multi-level and multi-stakeholder governance and cross-sectoral cooperation • Housing as part of National Development Srategies, Sustainable Development Strategies, Poverty Reduction Strategies • Tools: housing strategies, building regulations, spatial planning, land provision, funding, capacity building • Monitoring, implementation or policies and projects		

Source: UN-Habitat, 2012.

White building by Vann Mollyvann in Phnom Penh, Cambodia is informally occupied by numerous residents.
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BOX 24: NATIONAL HOUSING STRATEGY FOR SUSTAINABLE HOUSING

The purpose of a national sustainable housing strategy should be a creation of an integrated policy framework to guide the country in the development of a sustainable housing sector, while also assisting with the wider ambitions for poverty reduction, socio-economic development, and dealing with climate change. The strategy needs to integrate housing programmes that already exist in the country with a broader framework aimed at creating a more sustainable and affordable housing sector. The national sustainable housing strategy should: (1) set out a clear housing vision for the country over a 10-20 year timeframe and key strategic objectives; (2) be based on a sound evidence base; (3) set out policies and a detailed action plan to implement the vision and objectives, giving details such as when, how, where and by whom actions will be delivered; (4) set out the outcomes expected from the delivery of the actions and the indicators that will be used to monitor progress towards them, including quantified targets; and (5) be reasonably concise and accessible to the general public.

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