



**Project\_Scoping**  
**URBAN PATHWAYS**  
**2019**

# **NAIROBI**

# **PROJECT**

# **SCOPING**

**Sustainable living unit "Tiny house"**



**Wuppertal  
Institut**

**UN HABITAT**  
FOR A BETTER URBAN FUTURE

**UN**  
environment

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# URBAN

URBAN PATHWAYS

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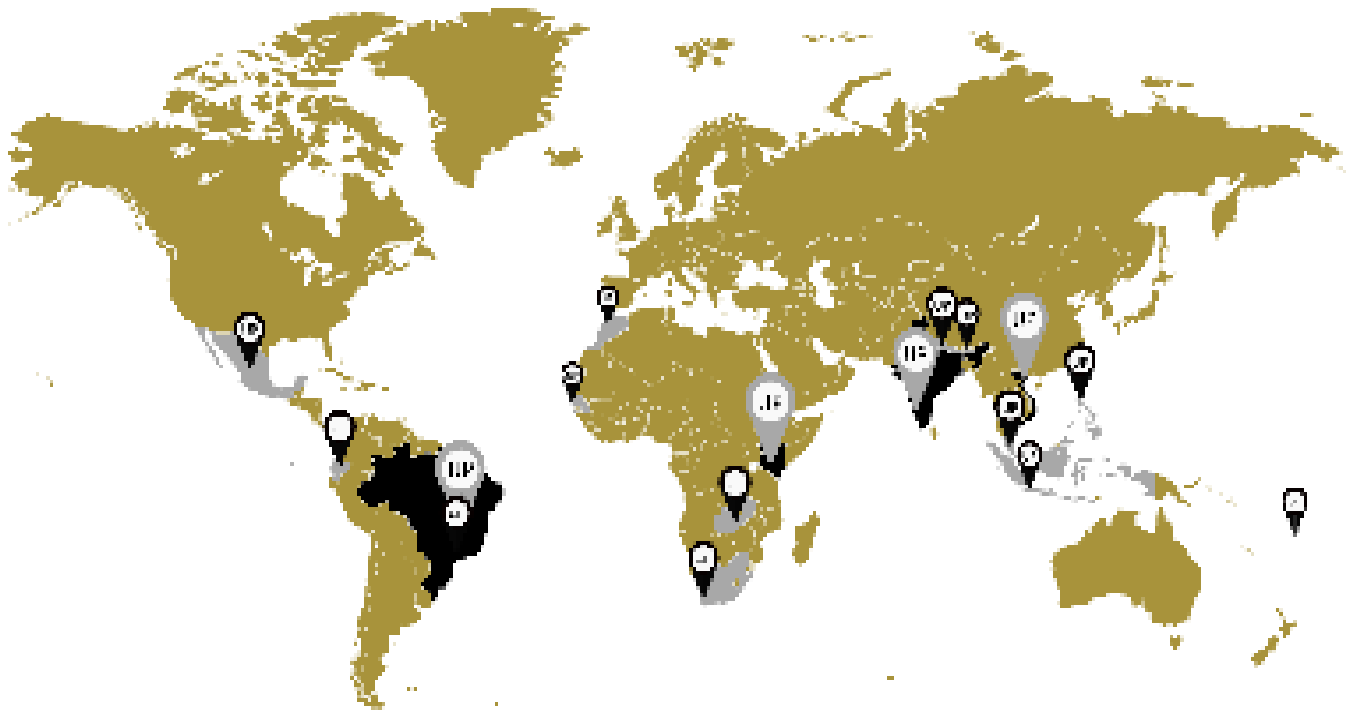
# PATHWAYS

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# URBAN PATHWAYS PILOT CITIES



## Tiny houses

Sustainable building optimises energy use and incorporates renewable energies, saves water and ensures its reuse/recycling, uses efficient means of transport and reduces distances, undertakes site planning and biodiversity conservation, improves indoor environmental quality and occupant's health with thermal comfort, reuses and recycles materials and manages waste effectively - aiming at the reduction of the environmental footprint of buildings (see also Urban Pathways factsheet on 'Green Buildings'). In other to demonstrate this, a prototype of sustainable living unit in the Tropics was designed and executed by the Urban Energy Unit of UN-Habitat in May 2019, partly supported by Urban Pathways project. The prototype of the sustainable living unit "Tiny house" is an affordable house provided with all basic services including: clean energy, food production, onsite waste management, natural lighting and ventilation and many more sustainable design principles (UN-Habitat, 2019). Within the floor area of 56m<sup>2</sup>, the tiny house has all the basic needs in an ecological and affordable manner.



# COUNTRY OVERVIEW

## Kenya

Kenya has developed an ambitious climate change strategy, which includes a pledge to reduce its GHG emissions by 30% by 2030 relative to the BAU scenario of 143 million tCO<sub>2</sub>eq in line with its sustainable development agenda (GoK\_ INDC, 2015).

## OVERVIEW

Kenya is home to 49.69 million people living on a total land area size of 582.646 km<sup>2</sup> consisting of 11,230km<sup>2</sup> of water surface and 571,416km<sup>2</sup> of land area – with an urban population growth rate of 4.3% per year and a growing share of its population living in urban areas. By 2050 about half the population is estimated to be living in cities (World Bank, 2016). The urban population of Kenya is concentrated along the Northern Corridor, which has led to the development of three urban hubs, the central hub (with Nairobi the focus city); the coastal hub (centralised around Mombasa); and the western hub (around the urban centers of Kisumu, Eldoret, Kericho, and Nakuru). The World Bank estimates that Kenya's capital city, Nairobi, will become home to 6 million people by 2030 currently Nairobi is home to 4 million people (World Bank, 2016).

It is the fifth-largest economy in sub-Saharan Africa with a gross domestic product (GDP) of USD 60.9 billion, a GDP per capita of USD 1,246 and gross national income (GNI) per capita of USD 1,280 in 2014 (World Bank, 2016). Approximately 42 per cent of Kenya's national GDP is derived from its natural resource sectors (agriculture, forestry, fishing, water supply and energy). The services sector (which includes transport and communications, wholesale and retail trade, and financial and other services) accounts for about half of GDP. The industrial sector (manufacturing, construction, mining and quarrying) contributes the remaining 10 percent (World Bank, 2014). The employment to population ratio percentage ages 15 and older is 60.9% (UN Human Development Reports, 2016). Kenya's economy was evaluated to have been performing well even though in 2017 it experienced a prolonged election period and a severe drought (IMF, 2018). The IMF has further concluded, during its March 2018 visit, that "Kenya's external current account deficit rose to an estimated 6.4 per cent of GDP in 2017 from 5.2 percent in 2016, reflecting higher imports, including fuel. The exchange rate has remained stable and foreign exchange reserves have risen to US\$7.1 billion as of end-January 2018 and are sufficient to withstand any potential near-term external shocks".

## Project Concept



**The design features of the sustainable living unit “Tiny house” prototype are (UN-Habitat, 2019):**

Building orientation and allocation of spaces within the house

The long axis of the building is along East- West to minimise direct solar radiation penetration in the building and reduce heat gain.

- The veranda and the kitchen are located on the East and West facing walls to act as buffer zones against heat gain but benefitting from daylighting;
- Space is optimised to make it the most efficient use e.g. the staircase provides spaces for storage with a mobile bed.
- Beds provide additional storage spaces.
- The building occupies a total space of 56m<sup>2</sup> to minimise the foot print.

Daylight, opening and natural ventilation

- Window to wall ratio does not exceed 20% and are mainly placed on North and South facades;
- Sun shading are provided from the roof overhangs;
- The vegetation wall in the north (vertical farming - aquaponic) are utilised to produce food while minimising heat gain;
- Roof vents and openings are utilised to enhance natural ventilation and lighting.

Building envelope materials

- Local available building materials are used to minimise the cost and reduce carbon footprint;
- Laminboards, used as wall, are made of recyclable and re-usable materials with low toxic emissions;
- Light colour exterior reflect solar radiation and light coloured interior finishing enhance natural lighting;
- The walls and floor are made of locally available recyclable materials

Renewable energy

- A photovoltaic system is placed on the roof to generate clean energy (2 kilowatt);
- A solar hot water system provides hot water for the occupants
- A biogas digester provides the home with gas for cooking and natural fertiliser for farming.

Water conservation and efficiency

- Rainwater harvesting systems is utilised to collect and store water.
- Water efficient appliances and water- saving fixtures are included in the design

Sanitation

- on-site waste water treatment system is installed to produce biogas and natural fertiliser
- The toilet (WC) is connected to the biogas system.

Solid waste management

- Waste segregation bins are available in the house to promote waste separation at source

Food production

- Self-sufficient vertical aquaponics system provides fruits and vegetable increase food security and a balanced diet for the family

Incremental housing unit

- “Incremental Housing” is a strategy to satisfy housing demand in rapidly urbanising context.
- It has been designed to stand alone or configured in a modular connected layout. This will allow its inhabitants to expand their sustainable living unit according to the spatial needs and budget of the family.



**Tiny  
Houses**

## Project Financing

The Sustainable living unit is built with a careful selection of appropriate technologies for the tropics and design that provide economic, environment and social benefits.

**The total cost of a unit is 18,500 Euros.**

The design feature of increasing floor or built stand alone or modular connected layout provide flexibility according to the spatial need and budget availability.

### Cost of UN-Habitat tiny house:

Building materials	8,000 \$
Solar system	3,000 \$
Vertical farming	2,000 \$
Biogas system	650 \$
Solar hot water system	850 \$
Labour	4,000\$
<b>Total:</b>	<b>18,500 USD</b>
 Car charging facility:	 3,900 USD

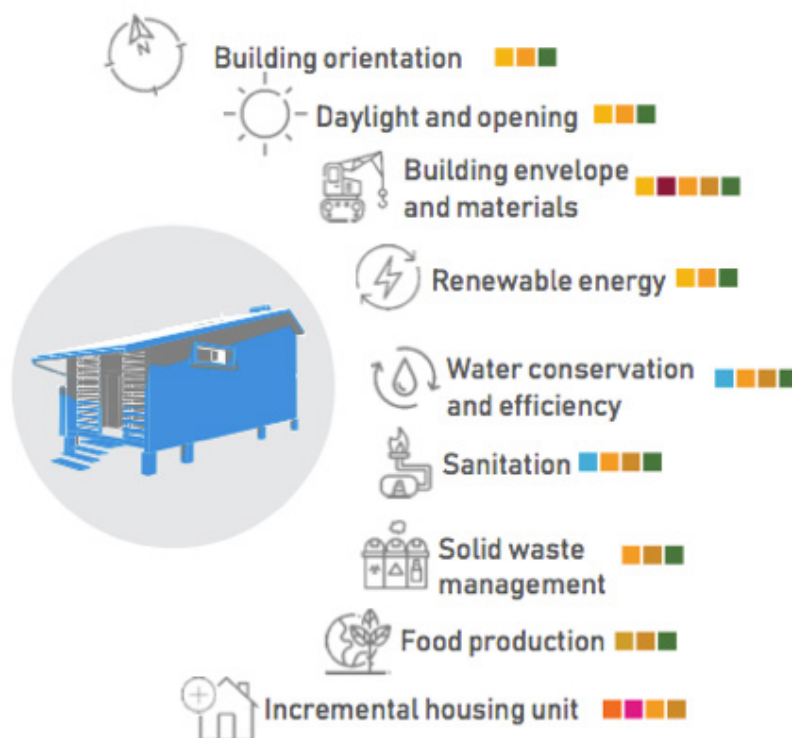


# Project Results

The Tiny house prototype shows that an eco-house can be built efficiently and affordably. It aims to meet shelter needs through Low Carbon Pathways. Passive design features of natural daylight and ventilation reduces the need of extra appliances to cool or heat the room, which saves energy and gives pleasant thermal environment. The locally available materials or recycled materials used in the building contribute to less environmental footprint. The renewable energy use, rainwater harvesting, food production within the building makes the house self-sufficient with clean energy (for lighting and partly cooking), saved water and fresh vegetables consumption respectively. The Tiny house also minimises waste generation and separates waste at the source. With all the features, the tiny house addresses UN Sustainable development Goals 2, 6, 7, 8, 9, 10, 11,12,13.

The prototype support raise awareness on eco-housing to various stakeholders (planner, designer and citizen).

- Building Orientation: SDG 7, 11 and 13f
- Daylight and opening: SDG 7,11 and 13
- Building envelope and materials: SDG 7, 8, 11, 12 and 13
- Renewable energy: SDG 7,11 and 13
- Water conservation and efficiency: SDG 6, 11, 12 and 13
- Sanitation: SDG 6, 11, 12 and 13
- Solid waste management: SDG 11, 12 and 13
- Food production: SDG 2, 12 and 13
- Incremental housing unit: SDG 9, 10, 11 and 12







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