SAHIF
SOUTH AFRICAN HOUSING & INFRASTRUCTURE FUND

Alternative Building Technologies

November 2020

Thought Paper

Contents

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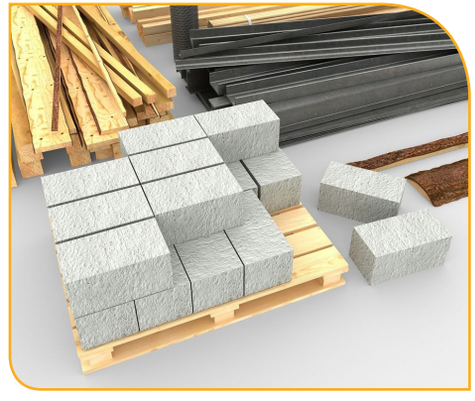


1. Introduction and background

The growing numbers of urbanisation globally, interventions to support the rapid delivery of affordable and sustainable shelter have been developed in response to the challenge. Most of the interventions employed in the earlier years, were of mass production to achieve speed of delivery to market. However, with the challenges of rapid urbanisation and technological advancements around the sustainability conversation of climate change – more sustainability integrations have been made to the materials of delivery of alternative building technologies (ABT).

Alternative building technologies (ABT) that encompass more economically effective and environmentally friendly building materials and construction methods are being considered and included in the production of housing, to make it quicker, easier and cheaper to build compared to traditionally built houses using bricks and mortar. Using alternative building technologies can also makes it easier to provide emergency shelter when disasters such as flooding, heavy storms, earthquakes and even more recently diseases such as Covid-19 pandemic strikes, or even be used to make houses more resilient against the impacts of climate change. As indicated in SAHIF's High-Level Market Assessment, a growing number of developments are starting to employ principles of green building and sustainability to design, construct, operate and maintain buildings which can reduce the operating and maintenance cost of housing and also make it more sustainable. This not only creates affordable housing opportunities but also impacts on a broader range of factors such as human health and well-being as well as quality of life, extending beyond just the individual footprint of the house including community-wide benefits.

Low income households do need access to affordable housing, and sustainable construction can play an important role in realising this. Sustainable construction is whereby ecological principles are put in place or practiced to create a healthy environment. Kibert states that sustainable construction focuses on six principles: "conserve, reuse, recycle/renew, protect nature, create non-toxic and high quality." Sustainable construction's main aim is to reduce the industry's impact on the environment by utilizing sustainable development practices, employing energy efficiency, and taking advantage of green building technology. Construction techniques, resources, and building practices have evolved over the years, and with the increased interest in sustainability and energy conservation, new methods of construction that focus on sustainability have been developed. Existing buildings can also be retrofitted with green building technologies to make it more sustainable and cost effective to operate. There are two things that go into sustainable construction: the materials that are used and the methods that are utilized.

Framework and Financing

To achieve a better and more sustainable future all UN Member States agreed to work towards achieving Sustainable Development Goals (SDGs) also known as Global Goals by the year 2030. The Sustainable Development Goals are the blueprint to achieve a better and more sustainable future for all. They address the global challenges we face, including poverty, inequality, climate change, environmental degradation, peace and justice. From the outlined 17 goals, goal 2, 6, 7, 9, 11, 12, 13, 14 and 15 highlight access to basic services, resource management and combating climate change.

As such, international development organisations, for finance as well as impact investors have begun to include the SDGs as part of their investment mandates, encourage responsible investing for sustainability. Projects are being measured for their contribution to sustainable living in order to garner the support. Companies are monitoring closely their ESG (Environmental,

Socio and Corporate Governance) calls for an observance of the SDG's focus by organisations. The following organisations, institutions and funds have begun to shift focus in various forms in order to support the goals of sustainable development.

Name of Institution/Fund	Focus /Institutional Mandate
Excellence In Design For Greater Efficiencies Edge — An innovation of IFC, a member of the World Bank Group	IFC created EDGE to respond to the need for a measurable and credible solution to prove the business case for building green and unlock financial investment. EDGE includes a cloud-based platform to calculate the cost of going green and utility savings.
greenfund — The Fund is managed by the Development of Bank of South Africa (DBSA) on behalf of Department of Environmental Affairs.	This unique national fund was established in 2012 to support green initiatives that contribute towards the transition of South Africa to a low carbon economy, resource efficient and climate resilient development pathway, delivering high impact economic, environmental and social benefits. An earmarked R120 million concessionary loan funding pool administered by Nedbank was established to facilitate the f approximately 400 affordable green housing units in the Western Cape and Gauteng Provinces.
AFD GREEN ENERGY FUND — IDC Special Scheme Fund, with an aim to provide finance to renewable energy and energy efficiency projects of smaller scale, as well as manufacturing of Green products in South Africa.	AFD Green Energy Fund provides finance to renewable energy and energy efficiency projects of smaller scale and manufacturing of Green products in South Africa. With focus on Renewable Energy (RE): Solar and biomass; and other technologies are considered on a case by case basis
first — RMB established the FIRST Fund with KfW Development Bank, powering smaller companies with access to funding for renewable energy and energy efficient projects.	FIRST is a partnership between international development funding and South African commercial banks to unlock funding for small renewable projects. KfW, the German Government's bilateral development bank, established FIRST with funds from the German government to stimulate the measures aimed at the reduction of carbon intensity in South Africa.

Source: Stated Company Websites

The Regulations

The National Building Regulations and Building Standards Act (No. 103 of 1977) forms the basis of how buildings in South Africa should be constructed and developed to suit human habitation. The New Building Regulations (NBR) were introduced in 2008. In 2011, the South African Bureau of Standards (SABS) introduced the SANS 10400: outlining the application of the National Building Regulations. This code sets out prescriptive provisions that are deemed to satisfy the technical aspects of the new NBR. In 2011, in an endeavour to make buildings more sustainable, and to decrease energy usage in South Africa, the XA (Energy Efficiency) part was added to SANS 10400 code. Part X deals with environmental sustainability, and Part XA deals with energy usage in buildings. Green building materials offer a wide variety of specific benefits to the building owner and building occupants. These include:

- Reduced maintenance/replacement costs over the life of the building.
- Energy conservation.
- Improved occupant health and productivity.
- Lower costs associated with changing space configurations.
- Greater design flexibility.

The design requirements for comfort and energy efficiency are influenced by climatic considerations. Energy intervention measures vary from region to region in South Africa. To achieve the best results, building design and construction materials should be appropriate to the climate of a region.

Considerations

Incorporating alternative building technology into affordable housing production should consider the following:

- The cost of the material inputs
- The time it takes to construct the house or housing development.
- The quality and durability of the materials used and of the end product (i.e. the house)
- The end user's perceptions of the alternative building method or materials used in the construction of the house.
- The environmental impacts of using the sustainable construction or ABT.
- Carbon emissions and carbon footprint and the reuse or recycling and upcycling of materials.
- The operating costs of the house.
- Maintenance of the ABT/sustainable method used, for example, a green roof may require more maintenance that a cool roof.
- The extent of the ability of the end user to maintain or replace the ABT used in the housing product.
- The compliance of the building materials and standards in line with local regulations and guidelines and the implications on financing and housing insurance.



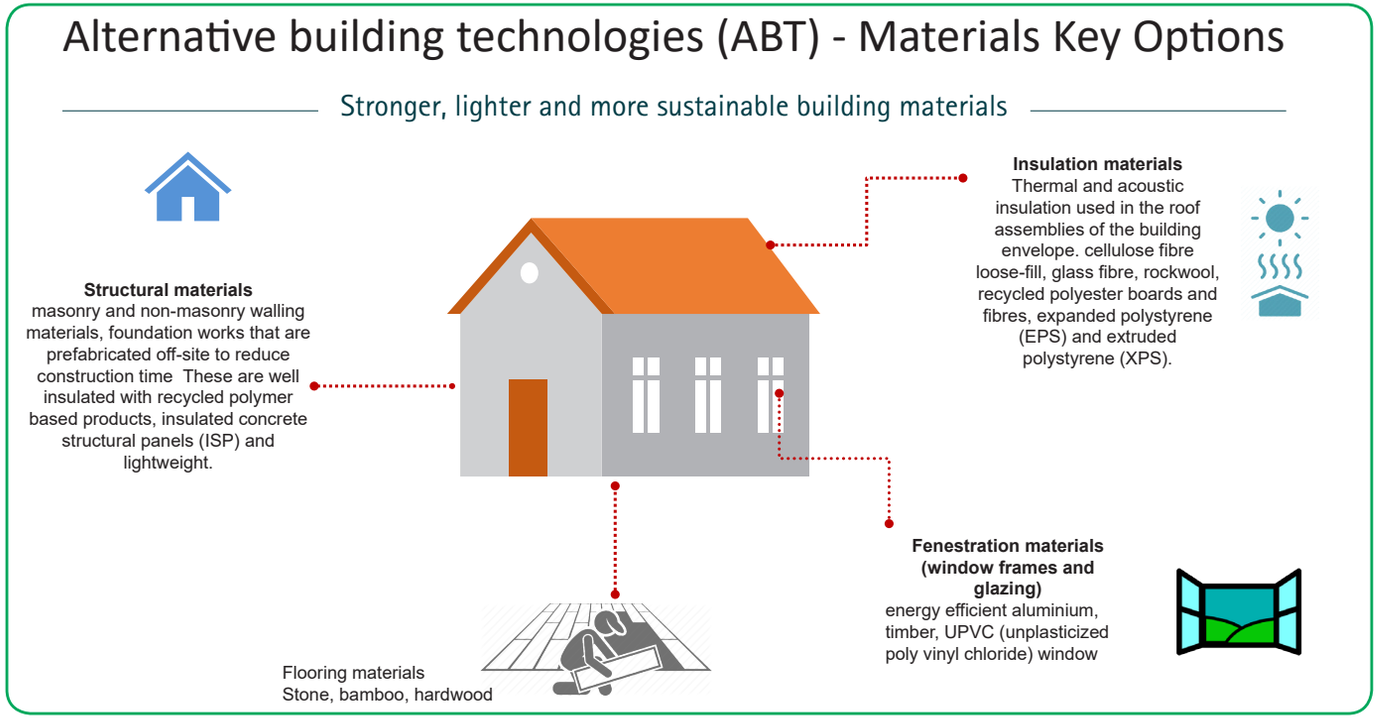

2. Construction Materials and Methods

2.1. Materials

One of the best ways to practice sustainability in construction is through using alternative building materials. A new generation of stronger, lighter and more sustainable building materials can help solve many problems in the industry as well as push current practices to be more sustainable. These materials have the added benefit of protecting the environment by reducing the carbon footprint of the buildings that incorporate these materials into its design. The local context becomes important in identifying and devising sustainable solutions for housing, for example, using locally sourced materials in the construction of a house can also further reduce carbon emissions and carbon footprint. They promote a cleaner Earth and a future of sustainability while also being aesthetically appealing and much more efficient. Alternative materials may include:

- Insulation materials - the main function of insulation is the reduction of heat loss, contributing to the reduction of energy consumption and thus cost savings. The cost saving is derived from reduced costs of air conditioning in the summer and heating costs in the winter, respectively.
- Structural materials – stone, sandbags, recycled polystyrene, prefabricated panels, concrete panels or sheets, hemcrete, hydraform interlocking bricks, cement bricks, green walls
- Flooring materials – bamboo, hardwood, stone, recycled plastics.
- Roofing materials – cool roofs (irrespective of material, ensuring that the roof is white or a light colour can have a cooling effect on a house as sun rays are deflected, and reduce the energy consumption of cooling devices used during the summer months), green roofs (using vegetation for a green roof has environmental has many benefits such as moderating the effects of heat, cleanses the air (acts as a 'green lung'), reduces the amount of rainwater runoff, and also provides space for subsistence farming), solar panel roofs.
- Recycled or upcycled materials – reusing salvaged or recycled materials such as reclaimed wood or recycled steel, shipping containers repurposed for residential use.

Figure 1: Alternative building materials opportunities

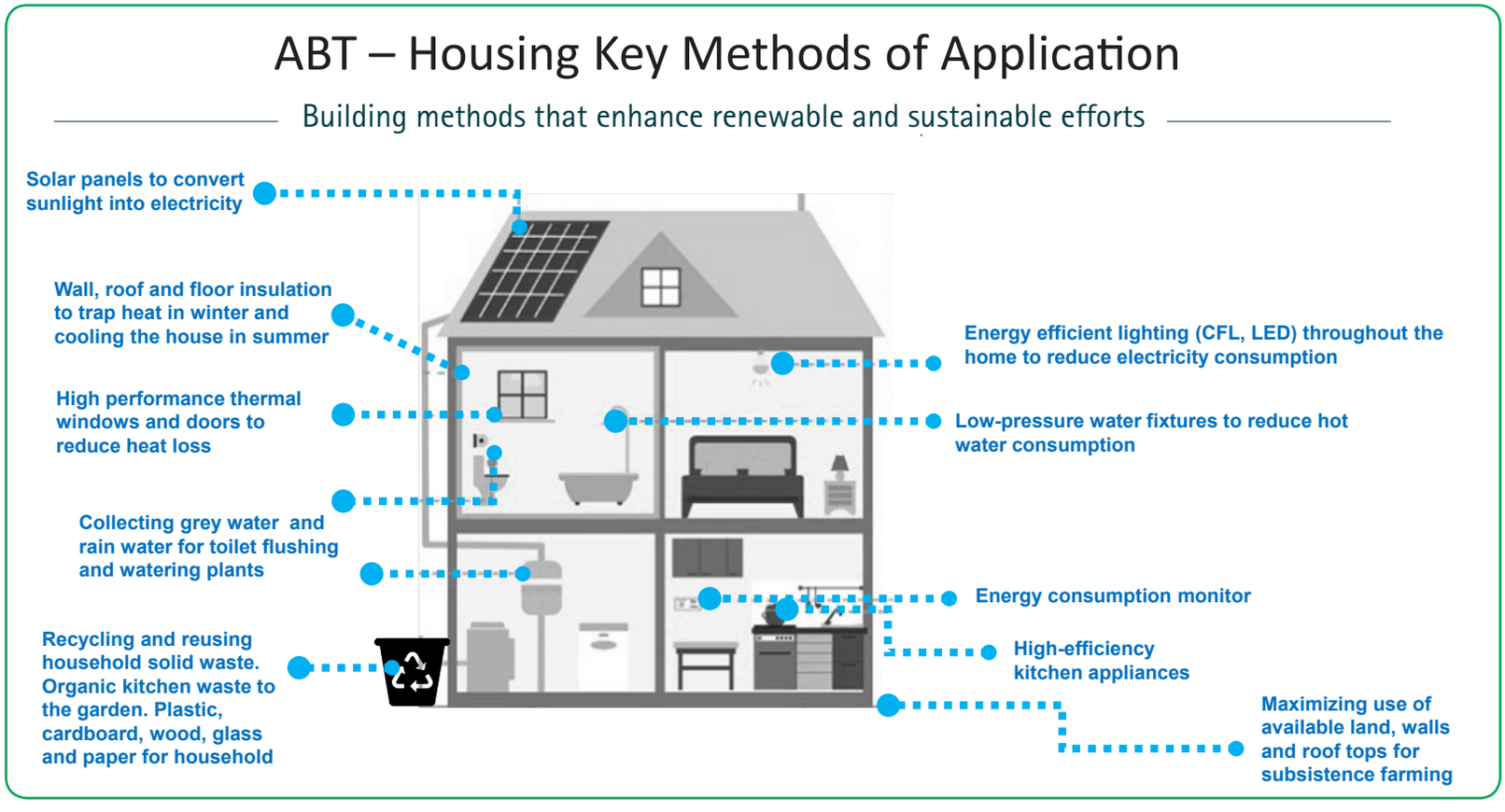


2.2. Methods

Sustainable construction is not just about using the newest materials; it is also about using building methods that enhance renewable and sustainable efforts. Some of these methods include:

- **Waste reduction systems** - Solid waste and sewage waste management, recycling and upcycling.
- Allocating and maximizing available spaces around buildings for subsistence farming (roof, walls and land)
- **Water efficiency** - Collection and use of water for household consumption and irrigation (greywater and rainwater).
- **Energy efficiency** - Conserving energy by introducing alternative energy sources (solar and wind energy), water pumps.
- Roofing systems
- Wall structure systems

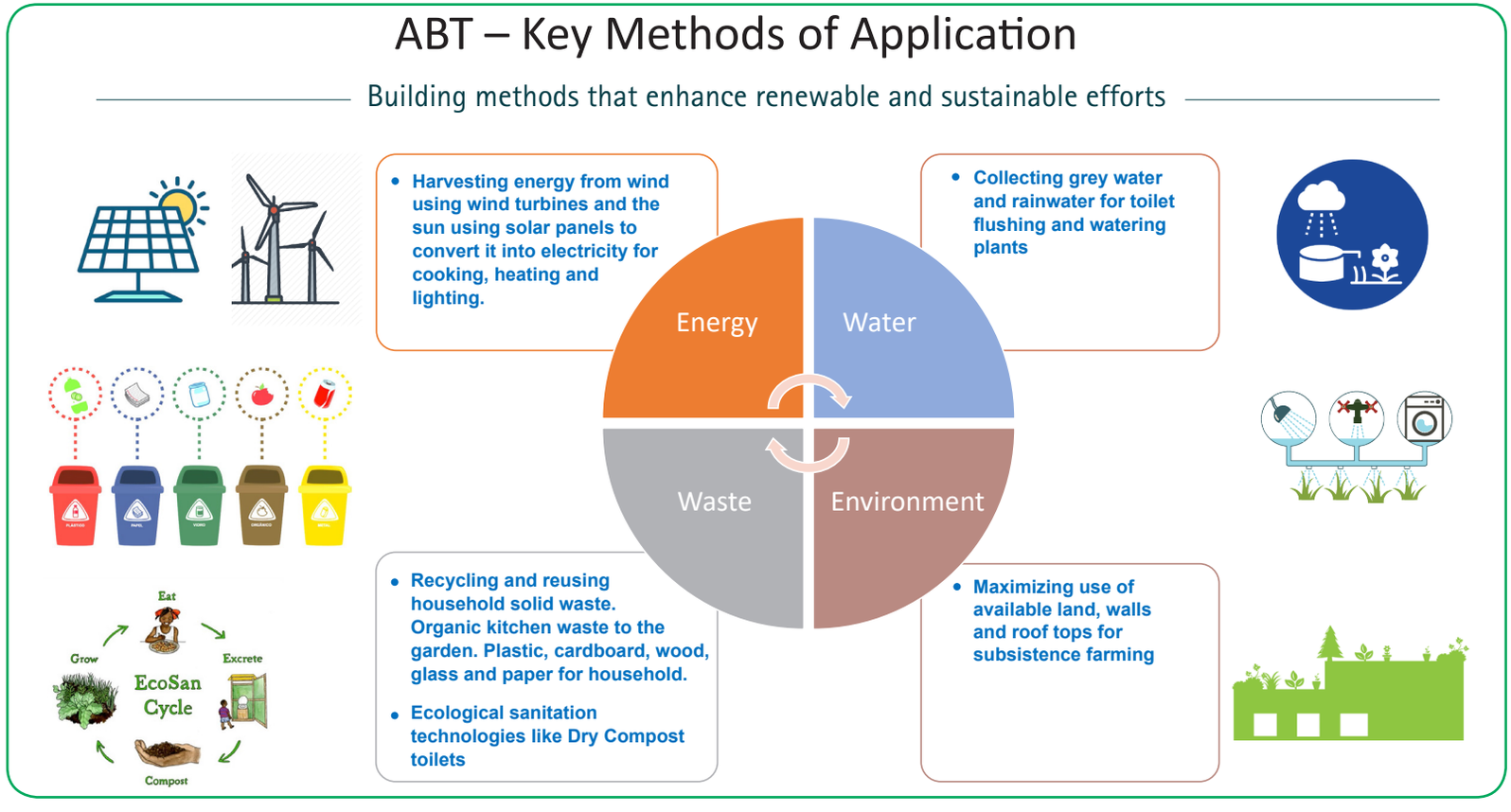
Figure 2: Application of Key Methods to House (Internal)



Although the benefits to sustainable construction are present and obvious, transitioning isn't an overnight process. It takes time and preparation to utilize the best practices. Training needs to be implemented in order to start practicing sustainable methods, and that takes time and financial resourcing. Another obstacle that many companies come across is the actual principal cost of sustainable construction. The general consensus is that sustainable construction comes at a premium and the cost is higher than what the demand actually is, despite the evidence to the contrary. Nevertheless, as more interest in sustainability efforts continue to rise, more construction firms are making the switch to sustainable construction, with green building activity on the rise.

Whether it's the price tag for the materials, the training that goes behind it, or resistance to adapting to new methods (why fix if it if it isn't broke as the old saying goes), there is some pushback on green construction. Despite that pushback, however, more owners and developers, both public and private, are turning to a greener and more sustainable form of construction. Especially since the effects of climate change can already be felt across the globe.

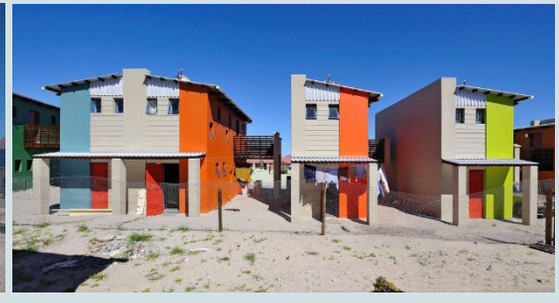
Figure 3: Application of Key Methods to House (External)

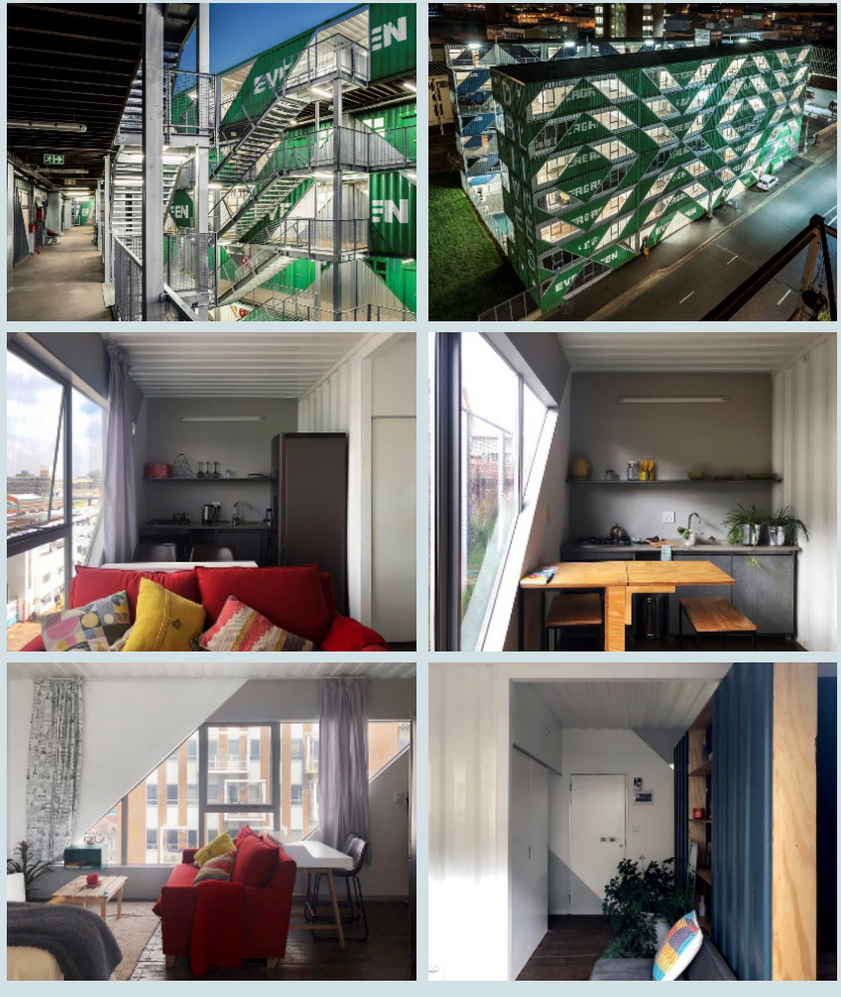


Sustainability is important for a variety of reasons, including a better quality of life and environmental quality. In order to have thriving and healthy communities, we need to have clean air, natural resources, and a non-toxic environment, and the construction industry can lead the way for greener projects.

3. Case studies in South Africa

3.1. Materials

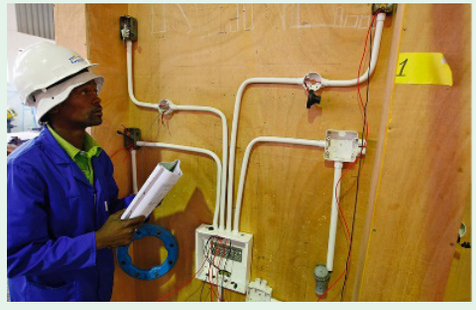
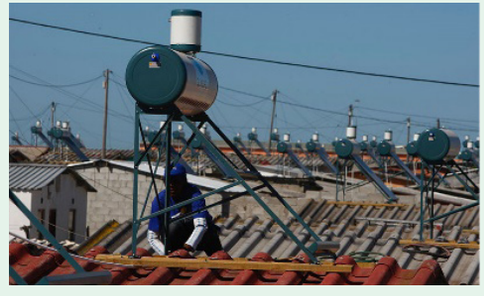
Material	Location/ Province	Project	Description	Project/Illustration Image
Sandbags	Freedom Park, Western Cape	10 X 10 Housing Project	This project made use of inexpensive, locally sourced materials and workforce from the local community. The Eco-Beam and sandbag system method used in this project creating a cheap, strong and safe way of delivering affordable housing that has good insulation, waterproof, fireproof and soundproof.	 
Moladi	Parklands, Western Cape	Parklands Cape Town Bonded by ABSA and FNB	This project uses a technology patented by Moladi, a South African company. A reusable and recyclable plastic formwork is used which is then filled with an aerated form of mortar. Once the mortar is set, the formwork can be removed and reused. The formwork is lightweight and is easy to transport and the wall structures can be put up within a day.	 

Material	Location/ Province	Project	Description	Project/Illustration Image
Shipping containers	Maboneng, Gauteng	Drivelines Studios	This multi-storey apartment project used upcycled ISO shipping containers repurposed to be liveable spaces.	

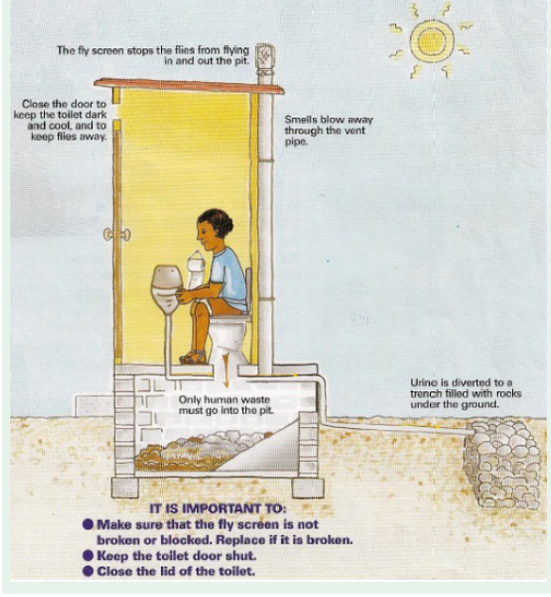
Material	Location/ Province	Project	Description	Project/Illustration Image
Greenlite Jumbo blocks	Pretoria, Gauteng	Westview 2 Security Estate, Yakh'indlu – Mosselbay, Western Cape	Greenlite Concrete Jumbo Blocks are light-weight masonry concrete blocks, comprising a mixture of Expanded Polystyrene (EPS) beads, cement, water and additives. The blocks have a compressive strength of at least 3 Mpa and a dry density of 550 kg/m3. The blocks are produced in moulds in a factory to the following dimensions or sizes: • 600 mm long x 300 mm high x 100 mm wide • 600 mm long x 300 mm high x 140 mm wide • 600 mm long x 300 mm high x 200 mm wide. Greenlite Concrete Jumbo Blocks are pre-grooved and are supplied with keys to interlock the blocks together in position and to interlock the next row above. The blocks are laid in conventional stretcher bond pattern whereby the first course is laid on 50% porcelain tile adhesive and conventional mortar and the rest of the courses using the tile adhesive as mortar. Once the blocks are laid, the mortar joint must always be between 5 mm to 8 mm thick. Before plastering the walls, a standard slush mixture of cement, bonding agent, sand and water must be applied on the Greenlite Jumbo Block walls, which improves plaster adhesion. Then a final layer of a 12 mm to 15 mm thick plaster must be applied on both sides of the walls.	

Material	Location/ Province	Project	Description	Project/Illustration Image
Hydraform interlocking block-making technology	Eastern Cape	Radway Green Farm Agri-Village	This project made use of the Hydraform interlocking soil-cement blocks which allows for the quick and cost-efficient construction of housing units and other buildings.	 

3.2. Methods

Methods	Location/Province	Project	Description	Project/Illustration Image
Energy (heating, cooking and lighting) and insulation	Khayalitsha, Western Cape	Kuyasa Low-income Urban Housing Project	This project saw the implementation of three types of technology interventions: energy efficient lighting, insulated ceilings, and solar water heaters. It is intended to reduce the dependency of households on grid electricity and paraffin which is typically used for lighting, water heating and thermo-regulation of homes. Besides the cost benefit that is incurred, other benefits include reduction in air pollution and risk of fires.	 
Energy and water efficiency	Belhar, Western Cape	Belhar Gardens Rental Estate	This multi-unit social housing project incorporates energy efficiency measures using heat pumps instead of conventional geysers, that saves 55% in energy consumption. This cost saving is passed on to the tenant/ end user. In addition, hot and cold water are metered separately through wireless water meters that can be read remotely and residents can monitor their water consumption. The window to wall ratio has also been reduced, and the external walls and roofs have been insulated.	 

Methods	Location/Province	Project	Description	Project/Illustration Image
Subsistence and small scale farming	Kwa-Zulu Natal	Umbumbulu Agri-Hub	This project originated from Newlands Mashu Community Development Centre, a non-profit organisation which has previously worked with PPT on a number of fruit tree establishment and food garden projects. The objective of the project is to improve the profitability of small farmers and community growers with limited access to capital, land and skills in the Umbumbulu sub-node of eThekwini Municipality by means of piloting an intervention that will capacitate and add value to loosely-arranged small farmers' groups in the area. The project aims to facilitate improved access to markets, improved technical and business skills and a co-ordinated support service to farmers as well as providing infrastructure such as a storage facility, sorting facility, cold room and office facilities which will provide input functions, light processing and output functions of vegetable and niche crops. The project originated from Newlands Mashu Community Development Centre, a non-profit organisation which worked with PPT on a number of fruit tree establishment and food garden projects. The objective of the project was to improve the profitability of small farmers and community growers with limited access to capital, land and skills in the Umbumbulu sub-node of eThekwini Municipality by means of piloting an intervention that aimed to capacitate and add value to loosely-arranged small farmers' groups in the area. The project aimed to facilitate improved access to markets, improved technical and business skills and a co-ordinated support service to farmers as well as providing infrastructure such as a storage facility, sorting facility, cold room and office facilities which would provide input functions, light processing and output functions of vegetable and niche crops.	

Methods	Location/Province	Project	Description	Project/Illustration Image
Waste management	Gauteng	Pikitup, City of Johannesburg	Wastes are encouraged to be separated at source at household level. Dry recyclable wastes (certain papers, plastics, metals, glass) is set aside for collection by Pikitup in areas where the separation at source service is available.	 
Sewage waste management	Kwa-Zulu Natal	Urine Diversion (UD) toilets peri-urban areas in Umbumbulu, KwaZulu Natal)	Urine diversion toilets is a cost effective and environmentally friendly technology towards addressing sanitation backlogs in peri-urban and rural areas in eThekwini Municipality, KwaZulu-Natal.	

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