Royal Academy of Engineering | Africa Prize for Engineering Innovation

Spotlight on sustainable innovation in Africa

Africa is a crucial incubator of innovation

Foreword by Meredith Ettridge

Head of Sustainable Development at Royal Academy of Engineering

A sustainable society is one in which development meets the needs of the present without compromising the ability of future generations to meet their own needs. The globalisation of unsustainable practices, over hundreds of years, has contributed to Earth's climate crisis; one of the most serious challenges humanity has ever faced.

Engineers have a vital role to play in creating systems and solutions to address the climate crisis and support more sustainable use and management of natural resources, for the benefit of the planet as well as human populations.

Africa is a crucial incubator of innovation. Across the continent, pioneering approaches make use of local resources for infrastructure and energy solutions. The rocketing rate of urbanisation presents new opportunities to develop sustainable solutions for cities, with Africa projected to have the fastest urban growth rate in the world according to the OECD.

The lack of legacy infrastructure (both physical and process) across large swathes of sub-Saharan Africa means that community-led solutions are thriving and often delivering greener outcomes that traditional approaches ever could. Starting local is crucial to developing solutions that truly address challenges experienced in the community.

The Royal Academy of Engineering's international programmes have supported and brought together an incredible diversity of entrepreneurs, addressing issues relating to energy, housing, waste, and food – innovations that, when scaled, have the potential to tackle national and global challenges.

One innovator can build a greener community. A network can create more sustainable societies for all.

Sustainability in Africa: Overview

As most countries grapple with the ambitious emissions reduction targets set by global initiatives, net zero emission targets are less explicitly discussed in Africa. Of the continent's 54 countries, South Africa is the only nation to have made a formal commitment to net zero. As a continent, Africa has contributed the least to global greenhouse gas emissions – around 2% to 3% of global emissions come from the region. However, accelerating progress towards a sustainable society needs to be considered in a global context to be meaningful, and ties into both economic and environmental resilience.

In our path towards a truly inclusive and sustainable economy, we must innovate to improve competition and build resilience against threats to public health, security, safety, and stability, including the climate crisis. Climate change accelerates the risk of conflict, drought and agricultural impact, which are priority concerns in the region. As a result of the projected 4°C, from 1°C, increase in global temperatures relative to pre-industrial levels, Gross Domestic Product (GDP) across the African subregions could suffer a significant decrease of 2.25% to 12.12%.

As the pace and scale of climate impacts intensify significantly, many countries in sub-Saharan Africa will find it a challenge to reach their economic growth and development goals. However, climate issues also offer the opportunity to leapfrog, progressing climate-resilient infrastructure while not being locked into conventional carbon-intensive technologies and models.

A sustainable society, therefore, supports more than just the Sustainable Development Goals (SDGs) with the most immediate relevance to longevity, climate, and environment. It underpins everything from reducing inequality by improving living conditions, to increased food security and improving gender equality such as through greater access to safe and clean resources.

This guide focuses on four areas that African innovations are transforming: clean energy, sustainable housing, circular economy, and food. The Academy's network of African entrepreneurs, researchers and institutions work across these sectors, making extraordinary contributions to their communities by improving sustainability, generating employment and progressing technology.

Green energy

In sub-Saharan Africa, where energy access in almost all countries remains low – 600 million people lack electricity, around half of the population – the falling costs of renewable energy technologies provide a real opportunity to deploy green energy at scale. Macro-trends in African climate and energy industries include the move towards electric vehicles and the expansion of renewable sources such as wind, solar and hydro power, taking advantage of abundant natural resources.

Innovation across the continent has long been focused on addressing the challenge of energy access. Many regions have unreliable traditional power sources, with only one-third of Africans having access to grid-connected electricity – a clear factor thwarting economic growth. Pollutants from traditional fuels for providing heat, light and cooking often result in poor living conditions, posing risks to health.

Green energy technologies offer a safer and more sustainable solution than traditional fuels to those without electricity access, as well as offering opportunities in the long-term diversification process of African economies. Using efficient and clean energy sources to promote socioeconomic growth in the agricultural industry (which employs more than half of the population in sub-Saharan Africa) has the potential to reduce poverty two to four times faster than growth in any other sector. While transitioning to low-carbon pathways will require tailored approaches for each national economy, there are unique development opportunities to replace or even bypass traditional, non-renewable energy infrastructure. Unlike other regions of the world, most of sub-Saharan Africa's greenhouse gas emissions come from activities related to land use and forestry, agriculture and waste, rather than the energy sector.

Countries like Egypt, Ethiopia, Kenya, Morocco, and South Africa are leading energy transition efforts, with others including Cape Verde, Djibouti, eSwatini, and Rwanda setting ambitious renewable energy targets. Geothermal energy usage in East Africa is a global example of a transition to harnessing natural resources sustainably, and Kenya is currently the largest geothermal energy producer in Africa, with its power production contributing to over 40% of the country's electricity generation.

Entrepreneurs offering new and innovative energy solutions, tailored for the unique challenges of their local communities or nations, form a significant portion of African entries to the Academy's programmes every year.

Case study

GreenTower Microgrids

SDG 7: AFFORDABLE AND CLEAN ENERGY

André Nel and team, South Africa, Africa
Prize for Engineering Innovation Finalist 2017

GreenTower Microgrids is a hybrid solar microgrid solution that uses 90% less energy to heat water, helping to solve electricity and water supply problems in South Africa. Heating water often accounts for the majority of electricity costs in homes and offices in sub-Saharan Africa, and many go without due to limited grid access – in South Africa, this is the case for 15% of the population.

The system is designed to be scalable: a single unit (packaged in insulated recycled shipping containers) typically serves 15 homes, reducing a community's electricity demand by 65% and considerably easing the pressure on the national power grid. Remote monitoring and management of the solution through the Internet of Things (IoT) ensures optimum efficiency.

Over 20 pilot projects have been implemented to test the technology including a 10-year agreement signed in 2019 with a nursing home in South Africa. Within a year, this project alone reduced energy use by almost 47,000 kWh and saved over 580,000 gallons of municipal water for the community.

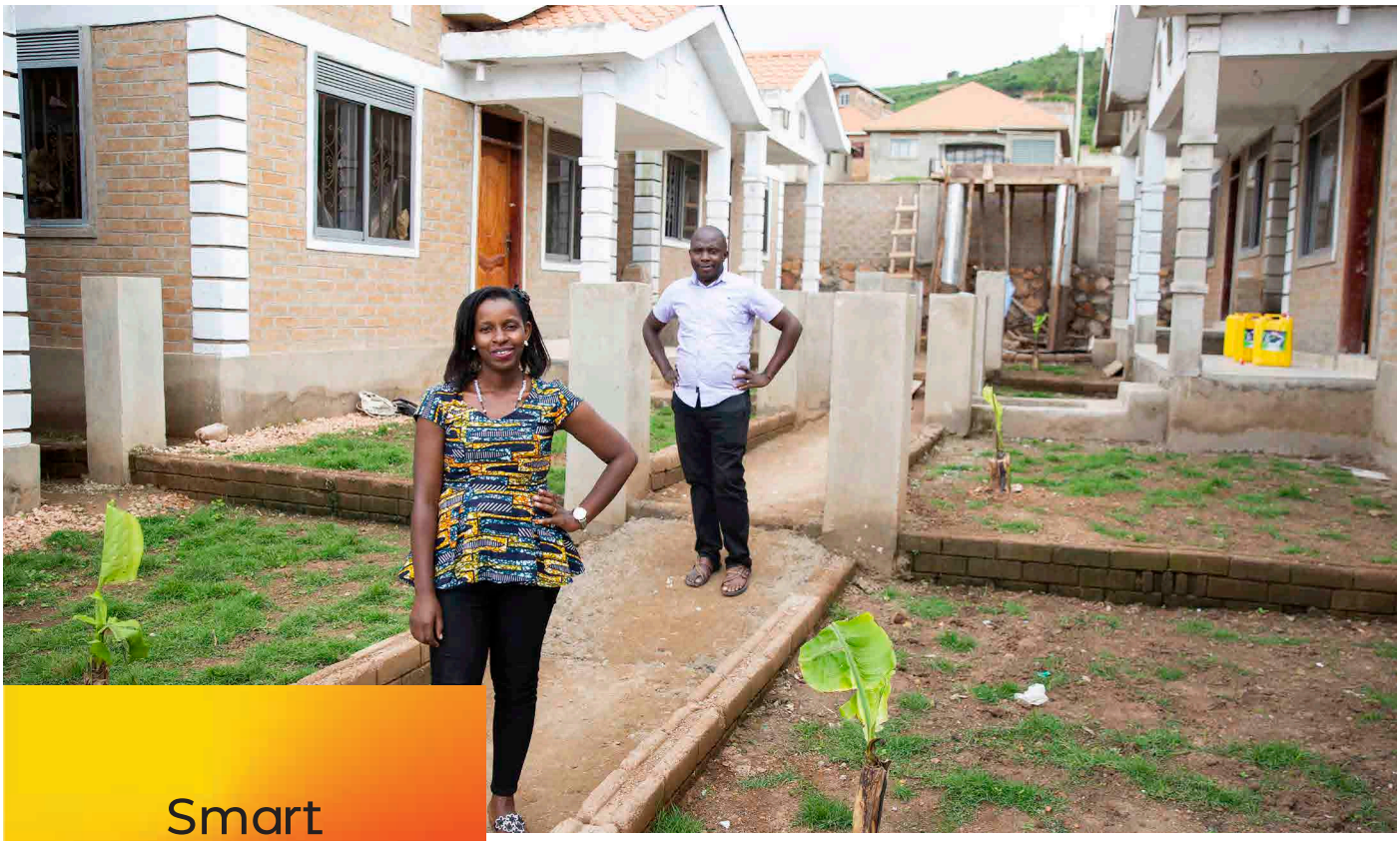
Sustainable housing

Sub-Saharan Africa is now urbanising faster than more advanced economies did during the industrial revolution. In Ghana alone, the urban population has more than tripled in the last three decades, and by 2050 Africa's cities will be home to an additional 950 million people. With more than 80% of global GDP generated in cities, urbanisation can contribute significantly to economic growth. However, it also puts immense pressure on housing and infrastructure, especially when it is rapid. As climate change impacts intensify, migration will increase, yet cities are also likely to bear the brunt of climate change because of rapid population growth, poor infrastructure, limited vegetation, and high concentrations of people.

Low-income cities are particularly at risk as people often live in hazardous areas, sensitive to issues with infrastructure and sanitation, with restricted healthcare and emergency services access resulting in limited means to recover. In sub-Saharan African cities, 56% live in informal settlements, lacking adequate housing, infrastructure, education, food, water, and health facilities to adapt to rapid population growth. However, this means the community's innovators, engineers and governments are presented with unique challenges and opportunities.

Cities that have seen sustained growth for longer periods have demonstrated how poor housing without proper facilities can quickly become polluting cities with poor living conditions. From observing these lessons there are many organisations looking for alternatives to the typical global patterns of city expansion. Taking lessons from traditional African building approaches – recognising the opportunities from local labour and knowledge – incorporating energy-conserving methods, and the creation and deployment of novel, sustainable materials, as well as promoting of reuse of materials, are all approaches being taken to cut housing costs and create sustainable accommodation in urban areas, particularly for the most vulnerable citizens.

Case study



Smart Havens Africa

SDG 5: GENDER EQUALITY
SDG 10: REDUCED INEQUALITIES
SDG 12: RESPONSIBLE CONSUMPTION AND PRODUCTION

Anne Rweyora, Uganda, Africa Prize for Engineering Innovation Finalist 2019

Smart Havens Africa develops sustainable, smart homes built from appropriate and affordable technologies, geared towards making home ownership more accessible to African women. Innovations in the homes include locally designed brickmaking that uses less material, designs that reduce temperatures in hot climates, custom biodigesters, and solar water and electricity installations to keep utility costs down.

In Africa, only 13% of women are sole house owners, with three times more men owning homes outright. Anne Rweyora's goal is to deliver affordable homes that provide security, release low-income women from the rental trap, and allow them to enjoy stable lives, raise families, work or study and have enough disposable income to live. Smart Havens Africa also provides employment and aims to empower communities.

To date, Smart Havens Africa has created 200 jobs for women, impacted 400 lives through access to safe, affordable housing, saved 4,050 African trees through sustainable brickmaking techniques, and transferred $1,584,00,000 USD of assets to women and low-income families.

Circular economy

There has been significant and concerning growth in waste generation in Africa, expected to be so significant that any decrease in waste generation in other regions globally will be overshadowed by Africa's increases. Waste collection services are limited, with only 55% of materials collected and more than 90% disposed of at uncontrolled dumps and landfills. In addition, only 4% of recyclable waste is recycled in Africa.

As a result, solutions to reduce the use and disposal of waste, especially plastics, are highly important for the safety and sustainability of the region. The 'circular economy', an economic system that aims to eliminate waste and champion the continual use of resources, can help to reduce the amount sent to landfill, and contribute towards sustainable development.

Innovative recycling systems and technologies have emerged in recent years. Vulnerability to the problem of waste build-up has sparked innovations that have multiple social, economic and environmental benefits. Awareness of reuse and recycling approaches is growing, as well as the development of more appropriate materials, such as bioplastics, which suit the limited waste and recycling opportunities in sub-Saharan Africa.

Rwanda is a model for sustainable management of waste plastics, having achieved a significant reduction in plastic use and waste after banning the import, manufacture and distribution of plastic (with a few exceptions) in 2008. Now the country says that 70% to 80% of its plastic is recycled, and there are many community initiatives focused on this issue.

The transition into a circular economy presents a multibillion-dollar opportunity for Africa. The efforts by the Rwandan government have resulted in 14 plastic recycling businesses that did not exist before the ban. In contrast to the expansion of 'green' employment opportunities in recycling, sending solid waste to landfill instead creates only one formal job per tonne of material. Sustainable solutions for a circular economy are not only highly positive for economic growth and development, but also foster innovation and upskilling of the workforce.

Case study

Farmz2U

SDG 2: ZERO HUNGER

SDG 12: RESPONSIBLE CONSUMPTION AND PRODUCTION

Aisha Raheem, Nigeria, Africa Prize for Engineering Finalist 2020

Farmz2U is a digital platform that prevents wastage of food by helping farmers plan their crops. Farmers simply tell the application how much land they have, what crops they want to grow, what their budget is, and even their target profit. It then calculates how many seedlings the farmer should get, what fertiliser and pesticides to use, and provides training guides and videos for certain crops, as well as providing information on produce demand, storage, weather, and financing that may impact their business.

The Food and Agriculture Organization of the United Nations (FAO) estimates that food losses in sub-Saharan Africa add up to $4 billion annually – or enough to feed at least 48 million people. Across Africa, most of this waste happens between harvest and the point of sale; largely due to inefficient processing and drying, poor storage, and insufficient infrastructure.

Today, Farmz2U has over 6,000 monthly users on its platform. The team is also working with the United Nations Development Program Cultiv@te program, creating opportunities for innovation in agriculture using data. Furthermore, in Nigeria, as elsewhere, the global pandemic has driven farmers online, and restrictions on trade have directly affected their income. Farmz2U has used support from the Africa Prize and the Academy's Project CARE (COVID Africa Rapid Entrepreneurs) to ensure that it is well positioned to respond to the increased demand for its valuable services.

The Royal Academy of Engineering network

In addition to supporting innovations combating climate change and improving sustainability in Africa and the rest of the world, the Academy supports entrepreneurs and engineers addressing other pressing global challenges through its international programmes, including tackling poverty, supporting international security and increasing access to vital services. As a national academy with a global outlook, the Academy's international interests include, developing collaborations with other national academies; leading debate and public policy projects; promoting the UK's engineering capabilities; and advancing engineering's contribution to a safer, healthier, more prosperous world for people in developing countries and emerging economies. Its programmes aim to foster innovation and entrepreneurship, create strong international alliances to support sustainable development, enhance socioeconomic prospects for target regions, and foster early-career researchers as well as enhance higher education opportunities.

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