Newton Prize

Newton Prize 2020

Front cover: Mr and Mrs Solomon and Mr Munge applying Safi Fertilizer on their rice farm in Mwea, Kenya

Professor Alice Gast FREng
Imperial College London President
Newton Prize Committee Chair

FOREWORD

Professor Alice Gast
Newton Prize Committee Chair

As researchers, we seek the best partners wherever they are in the world. We don't let political, cultural, or physical boundaries deter us. This is clear in the Newton Prize where we recognise and celebrate the power of collaboration and capacity building within countries with an emphasis on important cutting-edge research that matters.

We know international collaboration produces research with higher impact, papers that are more widely read, and insights and innovation that come from diversity of approach. New and fruitful networks between researchers can provide vital career opportunities and lead to more expansive projects.

The ability to attract and support a diverse range of activities is one of the key strengths of the Newton Fund. We received over 150 applications for the Newton Prize 2020 from Egypt, Jordan, Kenya, South Africa, and Turkey. The shortlisted projects this year were very interesting. Among them were; a new app to help people reach reliable and affordable emergency services, innovations to try and halt the progression of liver cancer and work that sheds a light on the true impact of plastic chemicals on animals and humans.

I would like to congratulate all the researchers highlighted by the Newton Prize. It's important to recognise that the names here represent teams of people, each making an essential contribution.

Choosing the winners was not easy, and our distinguished, independent international committee with representatives from the partner countries and from different disciplines was essential in that selection. I want to thank the committee for their hard work.

Our task would have been impossible though without the excellent work done by over 400 external reviewers from around the world who volunteered through UNESCO to review the applications.

Newton Funded projects are part of a UK, and indeed world-wide, endeavour to use science, research and innovation to help meet the Sustainable Development Goals. In recent decades, breakthroughs and transformative innovations have improved the health of millions of people, helped make the world a better place for women, and delivered real progress in our fight against climate change. While we know collaboration is good for science it's also very good for us personally too. After all, these projects create rewarding lifelong relationships.

INTRODUCTION

The Newton Fund builds outstanding research and innovation partnerships with select countries in Africa, Asia and Latin America to support economic development and social welfare, tackle global challenges and develop talent and careers.

The total budgeted UK investment for the Newton Fund is £735 million from 2014 to 2021, and partner countries provide matched resources within the fund, making it a truly equitable partnership. It is managed by the UK Department for Business, Energy and Industrial Strategy (BEIS) and delivered in the UK through seven UK delivery partners.

The Newton Prize

In 2020, the Newton Prize is a £1.5 million fund which celebrates the world-class research and innovation the Newton Fund has supported since its launch in 2014. It enables international research partners to continue working together on areas of critical importance for humanity and the planet.

Each year, from 2017 until 2021, outstanding Newton funded projects, fellowships or other awards will win the Newton Prize to advance or develop existing Newton funded work. The Prize will be awarded for the best research or innovation that promotes economic development and social welfare.

This year, the Newton Prize is for projects, fellowships or other awards as part of Newton Fund partnerships with Egypt, Jordan, Kenya, South Africa and Turkey.

Five prizes of up to £200,000 each will be awarded to a project with each prize country that demonstrates high quality research and impact, and an additional prize (the Chair's Prize) of up to £500,000 will be awarded for a project that also demonstrates how their research addresses one of three United Nations' Sustainable Development Goals: Good Health & Well-being, Gender Equality, or Sustainable Cities & Communities.

Newton-Mosharafa has awarded over 450 grants since 2014 to support UK-Egypt partnerships

Training in pottery reconstruction at Naqada, Egypt
© Farouk Ali Farouk, Earliest Egypt Project

EGYPT

"The Newton Fund has brought the UK and Egypt together not only to find innovative scientific solutions to some of the world's most pressing challenges, but to transform them into opportunities that drive economic growth and development."

Sir Geoffrey Adams, Her Majesty's Ambassador to Egypt

NEW TOOLS TO DIAGNOSE AND TREAT LIVER CANCER

Liver cancer is the most common type of cancer in Egypt due to the prevalence of associated conditions such as Hepatitis C, obesity and non-alcoholic fatty liver disease (NAFLD), all of which are steadily rising in developing countries. Poor understanding of how the disease develops in people affected by these chronic conditions is a major obstacle to preventing liver cancer.

Researchers from Egypt and the UK are trying to identify new diagnostic and prognostic biomarkers – molecules, genes, or characteristics that indicate the presence or severity of disease in the body – to halt the progression of the disease.

The team used an innovative 3D model for the first time to model the interaction between liver cancer tumours and stromal cells (connective tissue cells) expressing the SULF2 gene. They found a link between presence of SULF2 and severity of disease, indicating its use as a potential biomarker. The results have led to a collaboration with Cancer Research UK and Medimmune Alliance to develop a diagnostic/therapeutic anti-SULF2 antibody, which could improve the life expectancy of more than half of liver cancer patients.

Nowadays, immune therapy is widely and successfully used to treat many chronic diseases including cancer. Understanding the immune landscape of chronic liver diseases is the cornerstone to prevent and treat liver cancer. The team has developed and characterised a new mouse model to understand the biology of liver cancer associated with fatty liver disease. This model helps to identify novel immune therapeutic targets that can be blocked to stop cancer development.

The researchers now want to focus on investigating preventative strategies and strengthening the research capacity in Egypt by setting up a basic science laboratory to tackle the major chronic diseases among the Egyptian population, with liver cancer at the heart of the research process.

Human liver anatomy

The liver microenvironment - a driver of hepatocellular carcinoma

Project leads:
Professors Fiona Oakley and Helen Reeves, Newcastle University, UK and Dr Marco Zaki, Minia University, Egypt

Delivery partners:
British Council, UK and the Cultural Affairs and Missions Sector, Ministry of Higher Education and Scientific Research, Egypt

> **Prevention is not only about prohibiting disease from occurring, it is also about establishing a stronger research environment that can effectively support our efforts to beat the disease. This is what we want to achieve in Egypt.**
>
> Dr Marco Zaki, Minia University, Egypt

PROTECTING EGYPT'S EARLIEST HISTORY

Many lessons and insights can be drawn from the formative stages of Egyptian civilisation. Such insights include how climate change contributed to cultural developments, how Nile floods were crucial in food production, and how a new social order emerged as a result of political transformations. These are issues of great relevance today, to Egyptians, and to people across the globe, due to contemporary climatic, economic and political developments.

Protecting Egypt's Earliest History aims to embed knowledge from Egypt's past into the present and to provide the basis for safeguarding the vulnerable and fragile sites of Egypt's earliest past through engagements with all sectors of the community.

The *Earliest Egypt* Institutional Links project has made the first steps in enhancing the status of prehistoric and early historic sites such as Merimde Beni Salama, home to the first farmers by 5,000 BC, ancient Nubt (Naqada), one of three power bases central to the rise of the world's first nation state by 3,000 BC, and North Saqqara where the mastaba tombs of the elite officials of the first Egyptian Royal Dynasty are located. All three sites have been dangerously encroached upon since the 1980s.

The team has provided signage as well as measures to protect these threatened sites. The project trained groups of Ministry of Tourism and Antiquities (MoTA) staff in this earliest heritage and site management. The team also raised awareness through wider engagement activities, such as public lectures, a Science Café event at the Children's University in Egypt, and via a website and documentary.

The project team is committed to reducing gender inequalities and promoting opportunities for women. When advertising roles for the archaeological and heritage training initiative, the project committed to equality in distribution of places by gender.

Surveying equipment

Earliest Egypt: Conservation, Management, Valorisation and Capacity Building

Project leads:
Dr Joanne Rowland, University of Edinburgh, UK and Professor Mohamed Fekri Hassan, French University of Egypt

Delivery partner:
British Council, UK

> **Prehistoric and early historic sites are in desperate need of protecting and preserving. I think the first step is raising awareness about the importance of these sites.**
> Trainee feedback

MAKING WATER SAFE TO DRINK IN EGYPT'S RURAL COMMUNITIES

Several rural communities in Egypt lack access to drinking water. Many also have inadequate waste treatment and energy provision. These communities are mainly located in the western desert, Sinai, Nile Delta, and Mediterranean coastal areas. It is the people who live in these areas that stand to benefit most from this new initiative.

The researchers have developed a way to transform seawater or standing brackish water into drinking water using heat from solar energy and biogas from processing of biowastes. Excess biogas can then be used locally for producing electricity or for cooking in households replacing the use of bottled fossil gas.

The team has also developed a mathematical model to simulate the operation of the system in different environmental conditions and local resources. They can now estimate the cost of producing drinking water and renewable energy and compare it to alternative approaches, which in turn can be used to design appropriate systems for different communities in Egypt and worldwide.

A pilot plant has been set up at Port Said University and is able to make 2000 litres of drinking water every day. It will be used to train a new generation of engineers and academics.

In the future the team is hoping to upgrade the plant, develop new and sustainable business models for the innovation and raise awareness about sustainable solutions to water, waste and energy challenges.

Boy drinking water

A novel membrane water desalination pilot plant driven by a hybrid solar-biogas energy source

Project leads:
Professor Mohamed Pourkashanian, University of Sheffield, UK and Professor Ayman Ibrahim Mohamed, Port Said University, Egypt

Delivery partners:
British Council, UK and the Science, Technology and Innovation Funding Authority, Egypt

> **The project will be so essential to these vast places that suffer from the problem of lack of drinking water and treatment of wastewater and sewage sludge.**
>
> Dr Ibrahim Abd Elrahman, Port Said University

A SUSTAINABLE DIGITAL HERITAGE ECONOMY

From ancient Thebes with its Necropolis to the monastery of Saint Catherine, Egypt's heritage sites are world famous. But in the last decade Egypt's economy suffered a severe downturn affecting many sections of society dependent on tourism, and travel restrictions due to COVID-19 have added to the strain.

This networking project was set up to offer new techniques to record, analyse and disseminate information about Egypt's cultural heritage as a sustainable resource in the digital age. One that can survive developmental challenges such as travel limitations, disaster or conflict.

Experimenting with VR headset at a VHC workshop in Cairo

© Virtual Heritage Cairo Network

The team has developed a new collaborative network of specialist researchers and entrepreneurs working on heritage projects and digital archiving. They led the first international conference on virtual heritage in Egypt, trained numerous early career researchers and prepared the ground for future activities between Egyptian and British institutions.

The team delivered a roadmap for long-term digital heritage policy including proposed legislation to administer the growing demand on digital models of its antiquities.

By the end of the initial project, 45 entrepreneurs and researchers, as well as staff at the Ministry of Antiquities, were trained on virtual heritage systems, and five small and medium sized enterprises were established; all contributing to the start of a new virtual heritage industry in Egypt.

In a sector typically dominated by men, the project team has also prioritised the training of women who make up at least 50% of the leadership in all project teams.

In the future the team would like to establish an international centre of excellence in virtual heritage technologies that will build capacity to support the preservation and development of cultural heritage sites in Egypt.

Virtual Reality of Medieval Culture: Collaborative Network for Cultural-Feed Virtual Heritage (CfVH) platforms of medieval Cairo

Project leads:
Professor Mohamed Gamal Abdelmonem, Nottingham Trent University, UK and Professor Gad El-Qady, National Research Institute of Astronomy & Geophysics, Egypt

Delivery partners:
Arts and Humanities Research Council, part of UK Research and Innovation, and the Science, Technology and Innovation Funding Authority, Egypt

We are leaders in the field of virtual heritage platforms in Egypt and the new creative industry sector that emerged following the virtual heritage culture project and international conference in February 2017.

Mohamed El Eryan, CEO of VRTEEK, local SME

RECYCLING DRAINAGE WATER FOR SUSTAINABLE WHEAT FARMING

Egypt faces many challenges when it comes to water and energy. A two-year study has shown that using drainage water for irrigation is not only a sustainable use of water but can also save farmers money.

A UK-Egypt team investigated the suitability and benefits of using drainage water from fish farms for wheat irrigation instead of using fresh canal water.

They found that the nutrients in the drainage water can help achieve higher wheat yields and reduced the use of chemical fertilisers, creating much needed savings for farmers. Reducing the use of fertilizers is also good for the environment.

The study involved field experiments at the National Research Centre, Egypt, as well as modelling for soil moisture, salinity, nitrogen and yield to provide management guidelines for farmers for more efficient use of resources.

Further funding would enable the team to communicate the impact of their work and apply water management techniques to poor and marginalised farms.

Farmer working in the field

Using SALTMED model for substantial water management under Egyptian conditions

Project leads:
Professor Ragab Ragab, UK Centre for Ecology & Hydrology and Professor Abdelraouf Abdelghany, National Research Centre, Egypt

Delivery partners:
British Council, UK and the Science, Technology and Innovation Funding Authority, Egypt

Non-conventional water resources present an attractive solution. Treated waste water, drainage water, mining and agri-food industry waste water, breweries waste water, sugar industry waste water, rainfall harvesting etc. can all be used for irrigation to produce food and feed.

Professor Ragab Ragab, UK Centre for Ecology & Hydrology

Professor Zedan Kafafi, Yarmouk University, at the well-preserved Neolithic site of Ghwair 1 in southern Jordan

Over **180** researchers and innovators supported through the Newton-Khalidi Fund since 2017

JORDAN

"The innovative programmes that continue to emerge from this wonderful partnership are helping to unlock talent through engagement, collaboration and mentorship"

HRH Princess Sumaya bint Hassan

IMPROVING INFANT HEALTH IN LOW RESOURCE SETTINGS

The United Nations High Commissioner for Refugees reported that 60% of neonatal deaths in Zaatari Syrian refugee camp in Jordan were associated with premature birth and its related complications of respiratory distress syndrome, sever acute pneumonia and neonatal sepsis.

A UK-Jordan collaboration has developed a safe, wearable sensor to monitor the respiration rate of newborn babies. The sensor is made using an advanced inkjet printer that can deposit the ink of silver nanoparticles with high accuracy, creating conductive patterns that detect respiratory movement. The sensor is cheap and easy to use, making it suitable for infant healthcare in low-resource settings. It can be used remotely to detect respiratory rate in daily activities and is convenient for long-term monitoring.

The project has established a new line of research and a world-class multidisciplinary network in the region, attracting outstanding early-career researchers and increasing the international standing of the team involved. As a result of its successful implementation, the team partnered with the University of Jordan Hospital to investigate the sensor's use to detect the symptoms of Chronic Obstructive Pulmonary Disease.

Now the team want to assess whether the sensor could play a key role in supporting the response to the COVID-19 pandemic by remotely monitoring the respiratory rate of home-quarantined and isolated patients. This would reduce hospital admissions, limit the risk of virus exposure and support healthcare systems with limited resources.

Next, the team want to adapt and field test the device as well as develop data processing technologies for a public health surveillance system that connects clinicians, decision makers and healthcare officials to achieve early intervention and better distribution of medical resources.

Baby in hospital

Inkjet-printed respiratory rate wearable sensors for infants: Towards remote monitoring solutions for low-setting villages and refugee camps

Project leads:
Professor Dingchang Zheng, Coventry University, UK and Professor Ala'aldeen Al-Halhouli, German Jordanian University & Middle East University, Jordan

Delivery partners:
Royal Academy of Engineering, UK and the Industrial Research and Development Fund of the Higher Council for Science and Technology, Jordan

Goal-oriented scientific research has always been my primary focus, especially for providing better healthcare solutions in underprivileged communities. I have a responsibility towards all refugees who seek peace in Jordan.

Professor Ala'aldeen Al-Halhouli, German Jordanian University & Middle East University, Jordan

SUSTAINING JORDAN'S HERITAGE AND CULTURAL IDENTITY

Social studies in Jordan have found that school-age children to university students are poorly engaged in learning about their rich and diverse cultural heritage, putting the future of Jordan's cultural identity at stake.

This project is about improving the accessibility of Jordanian museums to young people and strengthening the capacity and sustainability of Jordanian museum education, through staff training, partnership building and experimental education events.

In the first year of the project essential partnerships were established with the museum and heritage sector, including an unprecedented formal partnership of six UK and Jordanian museum-related organisations, and an expanding, informal network of 22 Jordanian organisations.

The partnership provided a training programme in Jordan on museum communication and education, hosted by four museums. Participants attended from 20 cultural institutions across Jordan and many confirmed they had implemented changes in their museums because of the training. The team also provided a wide-ranging training programme in north east England for staff from Jordanian Department of Antiquities Museums and other heritage organisations.

The project will culminate with a set of guidelines for good practice in museum education to policy-makers in the Jordanian Department of Antiquities and Ministry of Education, which will ensure that the developments can be enshrined systemically to strengthen Jordanian museums in future.

The team want to build on this work through online education platforms and resources designed to be effective despite COVID-19 restrictions, and by maximising the potential of the ever-expanding collaborative network across heritage and education sectors.

Hashemite University students engaging children from Balqis Primary School, Hashemite University

Learning from multicultural Amman: engaging Jordan's youth

Project leads:
Professor Robin Skeates, Durham University, UK and Dr Shatha Abu-Khafajah, The Hashemite University, Jordan

Delivery partners:
Arts and Humanities Research Council, part of UK Research and Innovation and the Ministry of Higher Education and Scientific Research, Jordan

The project is different from any other project we have seen, it is changing the way people are thinking about Jordanian museums. A lot of people are getting motivated, they saw hope and felt they had someone on their side working to improve practice, strategies and procedures in the sector.

Lena Bakkar, Director of Archaeological Sites Management Directorate, the Department of Antiquities of Jordan

BUILDING CAPACITY FOR PREHISTORIC ARCHAEOLOGY IN JORDAN

Jordan has archaeological sites that preserve evidence of some of the most profound changes in the human past. However, with rare exceptions, prehistoric archaeological research has been dominated by international researchers and research agendas and has been marginal to archaeology and cultural heritage presentation within Jordan. This has an impact on both cultural and economic values within Jordan.

This UK-Jordan collaboration is developing a new generation of Jordanian scholars and cultural resource managers working in prehistoric research. The project builds capacity in the field of prehistoric archaeology, supporting Jordanian led prehistoric research and ensures that international research collaborations take place on a peer to peer basis.

The project will engage the wider Jordanian public in prehistory, where a lack of local interest translates into a lack of protection for these sites. Raising the profile of prehistory and showing its relevance to modern life is all vital to modern Jordanian society.

The team has established a new centre to serve as a location for this type of research based within the Department of Antiquities museum in Wadi Faynan. The centre will build long-term employment opportunities, encourage international researchers to undertake analysis within Jordan and employ Jordanian researchers, in addition to encouraging international collaborations and providing a facility for Jordanian research. Helping to ensure the sustainability of the museum, the research centre will support the employment of additional local staff.

The ambition is to develop the tourism potential of prehistory, locally and internationally, to provide direct economic benefits to rural communities and the Jordanian economy.

© Sam Smith, Oxford Brookes University

A student from Yarmouk University examines traces of use on ancient flint tools

Rewriting the prehistory of Jordan

Project leads:
Professor William Finlayson, Oxford Brookes University, UK and Dr Sahar Al-Khasawneh, Yarmouk University, Jordan

Delivery partners:
Arts and Humanities Research Council, part of UK Research and Innovation and the Ministry of Higher Education and Scientific Research, Jordan

In Jordan, archaeology has been mostly dominated by men because of cultural perspectives, forgetting that the archaeology of the region has been established by prominent female archaeologists like Gertrude Bell and Kathleen Kenyon. In our initial project, we young female archaeologists were side by side with male archaeologists in the remote fields of southern Jordan.

Dr Sahar Al-Khasawneh, Yarmouk University

FAYNAN'S CULTURAL HERITAGE OFFERS ROUTE TO SUSTAINABLE DEVELOPMENT

Jordan has few natural resources and faces numerous challenges, such as water shortages and the Middle East refugee crisis, but it also boasts spectacular sights and a rich history. Tourism is critical to its economic growth, but action is needed to ensure its benefits are received by local communities and the cultural and natural landscapes of Jordan are preserved.

This project, based in an impoverished region of southern Jordan called Faynan, is showing how cultural heritage can be used to support sustainable development via ecotourism with low-cost investment and benefits directly to the local community.

The project is developing the local museum by including representation of the last 100 years of Faynan to balance an existing emphasis on the ancient past. It is enabling members of the local community to tell their own history and stories about Faynan in their own way, and to have these represented within the museum.

The team supports six schools in Faynan to develop their awareness and understanding of Faynan's cultural heritage by providing educational resources and activities at the Faynan Museum. It provides teacher training to support the schools to use cultural heritage for teaching and learning across the curriculum. A new Faynan Heritage Trail established for tourists and schools highlights some of the most impressive and important archaeological sites in Faynan. This will be used to support the recently established Bedouin trekking camps and the Eco Hotel.

© Nabras Maslamani

Project team with community members at the Faynan Museum

The project has already won an award to build on the Newton funded research, but further funding will enable the team to help 50 women from the local community access skills and training opportunities to develop the 'Faynan Heritage Women's Cooperative' as a social enterprise and generate income for their households.

Our past, our future, all together in Faynan

Project leads:
Professor Steven Mithen, University of Reading, UK and Dr Fatima Al-Nammari, University of Petra, Jordan

Delivery partners:
Arts and Humanities Research Council, part of UK Research and Innovation and the Ministry of Higher Education and Scientific Research, Jordan

This project emphasises the need of preserving the history and culture of Faynan through education and development for visitors, students, and the community. It has increased community belonging to the region and will enable it to become a tourist destination.

Ali Hassasseen, Faynan Museum Curator

Female scientist © Getty Images

KENYA

"UK-Kenya Newton Fund Partnership has been a platform for knowledge sharing, encouraging technological innovation and entrepreneurship, and strengthening of networks for social and economic benefits."

Dr Salome Guchu, Outgoing CEO, Kenya National Innovation Agency

IMPROVING DIAGNOSIS OF MATERNAL INFECTIONS IN KENYA

Rates of maternal complications such as sepsis, still births, premature delivery, new-born sepsis, and new-born deaths are high in Kenya. A strong contributing factor is maternal infection with pathogens such as *Ureaplasma unrealyticum*, *Mycoplasma hominis* and *Group B hemolytic streptococci* (GBS). Successful treatment of these infections relies on fast and accurate diagnosis, but current methods are time-consuming, costly and often unviable in poor and remote regions where electricity is not always available.

A team of researchers from the UK and Kenya have collaborated to address the problem of maternal GBS, which is a predominant cause of stillbirths, neonatal sepsis and mortality in Kenya. The team has developed a simple-to-operate lab-on-a-chip device that can detect GBS in urine samples in less than 20 minutes.

Previous studies indicate that GBS infection rates for expectant mothers are around 12-20%, yet very few women receive routine diagnosis or treatment. This device, termed IFAST (immiscible filtration assisted by surface tension), ensures that patients can be diagnosed and treated quickly during their clinic appointment, reducing the health risks to mothers and their babies.

The researchers hope to adapt and further develop their IFAST platform to support efforts for affordable and robust point-of-care COVID-19 tests in Kenya. The test has been designed with end-users with the aim of establishing the tests within routine clinics to control spread of the pandemic in low resource settings.

Project team in lab

Pathogen point-of-care analysis

Project leads:
Professor Nicole Pamme, University of Hull, UK and Dr Jesse Gitaka, Mount Kenya University, Kenya

Delivery partners:
British Council, UK and the National Research Fund, Kenya

The test is simple to do, and the results do not take long to get. This has been very useful for us in deciding who to treat for the bacteria to prevent newborn sepsis.

Anne Nafula, Midwife, Bungoma Country Referral Hospital

CLEAN AND AFFORDABLE ENERGY SOLUTIONS FOR KENYAN HOUSEHOLDS

According to the World Health Organisation, indoor air pollution causes around 4 million deaths worldwide every year (WHO, 2018). Traditional biomass fuels, such as wood and charcoal, are used by people across the world every day to help heat and run their homes. However, in doing so individuals are exposing themselves to toxic pollutants which are harmful to human health.

In an effort to tackle this problem and minimise the negative environmental impacts of burning biomass fuels, Kenyan innovator, Peter Njeri has pioneered 'Mega Gas'. The innovation converts plastic waste into a gaseous fuel through a thermal cracking process of distillation and compression. The process produces no emissions, residue, or pollution and benefits low-income families by offering a clean and affordable cooking gas.

Since the project's inception over 10 metric tonnes of plastic waste has been converted, providing nearly 6,000 people with a cleaner and healthier cooking experience. This has had the added impact of saving 5,438kg of CO_2, which would have otherwise been released into the atmosphere through the burning of traditional biomass fuels.

Having made significant steps towards tackling indoor air pollution in Kenya, the project team are continuing to forge new partnerships across regional and global networks with the aim to share knowledge and implement this technology elsewhere. Their ambition is to expand the project's scope to focus on the growing problem of outdoor air pollution – one that is currently responsible for 8.8m early deaths every year across the world (PNAS, 2018).

Woman using Mega Gas

Mega Gas Alternative Energy

Project lead:
Mr Peter Njeri, Mega Gas Alternative Energy, Kenya

Delivery partners:
Royal Academy of Engineering, UK and the Kenya National Innovation Agency

Mega Gas Alternative Energy, through their cheaper and clean gas, has helped me to save money for other activities. The extra shillings that I save every month goes towards food for the family.

Catchpole Arunda

NEW GREEN TECHNOLOGY TO BOOST RURAL ECONOMIES

Most fertilisers today are produced in large-scale, centralised facilities and then shipped to rural areas in emerging markets such as Kenya. Due to the added transportation costs, rural farmers often pay much more for their fertilisers than the rest of the world. This adds to the cost of food production and drives small-scale farmers into a cycle of poverty. Over time, chemical fertilisers also acidify the soil, reducing crop yield and polluting nearby water sources.

A Kenyan innovator has developed a new fertiliser production technology that can be implemented in rural villages with locally available resources and labour. The innovation uses a novel chemical process called oxygen-lean torrefaction – this works to convert crop residues into carbon-rich forms that enhance the nutrient level and water retention capacity of the soil.

From the initial production, post-harvest yields have improved by 27% for 3,500 smallholder farmers, resulting in a net income increase of around 50%. With production taking place at the village level, communities can also benefit from a £100,000 annual boost to their local economies.

The project has also had important environmental benefits – recycling crop residues as opposed to open field burning has helped to reduce particulate emissions by more than 95%. In this case, more than 6,000 tonnes of crop residues have been recycled, saving the equivalent of 8,400 tonnes of CO_2. With the recent COVID-19 pandemic throwing many international supply chains into disarray, there are plans to further expand the project so small-scale, rural farmers can be best supported.

Samuel Rigu

Safi Organics: decentralised, customisable, and carbon-negative fertiliser production for rural communities using locally available resources and labour

Project lead:
Mr Samuel Rigu, Safi Organics Limited, Kenya

Delivery partners:
Royal Academy of Engineering, UK and the Kenya National Innovation Agency

> **Safi Organics has developed locally-run carbon-negative fertiliser production for rural communities that prevents soil degradation, protects food security, and increases income of smallholder farmers.**
>
> Mr Samuel Rigu, Safi Organics Limited

TRANSFORMING KENYA'S APPROACH TO SANITATION

Across Kenya, 70% of people lack access to basic sanitation solutions and poor sanitation accounts for 40% of deaths among children under five (World Bank, 2020). Kenya's growing population has pushed people into informal and low-income settlements, where there is little or no access to centralised piped water or sanitation. Onsite sanitation such as pit latrines are widely used but most don't safely treat human waste, risking people's health and polluting the environment.

A UK-Kenya collaboration has identified a new cost-effective way to safely treat human waste and convert it into useful resources using black soldier flies. Working with local communities, researchers collect human waste from container-based sanitation facilities. The collected human waste is transported to a processing plant where it's converted into fertiliser and useful proteins using the novel black soldier fly technology.

The technology was successfully piloted at a primary school in 2018 and is now operating in other schools and communities. The project has led to the establishment of Kenya's first Sanitation Research Centre, a 20-acre facility within Meru University of Science and Technology training students in Faecal Sludge Management research with the aim of increasing the uptake of non-sewered sanitation initiatives in Kenya.

Project team at sanitation centre

The researchers are playing a leading role in informing policy in Kenya, where support is growing for non-sewered sanitation solutions. Next the team want to scale up the technology to create an established circular economy and extend its impact into Kenya's cities and other developing countries.

Paradigm shift in faecal sludge management in Kenya for environmental management and food security

Project leads:
Professor Prasanta Dey, Aston University, UK and Dr Joy Riungu, Meru University of Science and Technology, Kenya

Delivery partners:
British Council, UK and the National Research Fund, Kenya

Our intervention has not only developed a cost-effective technology for handling human waste but also a business model that helps commercial deployment as new products are introduced to the Kenyan market and made available to farmers.

Professor Prasanta Dey, Aston University

80 innovators supported through the Leaders in Innovation Fellowships programme in South Africa

Professor Frank Tanser and colleague © Professor Frank Tanser

SOUTH AFRICA

"Through the Newton Fund we have witnessed one of the most successful collaborations in our bilateral partnership with the UK, lifting our science and innovation relations to a new level. We are very proud of this partnership and our relations are strong and sound."

Mr Khaya Sishuba, Director of Bilateral Relations in Europe & Gulf States in the South African Department of Science & Innovation

TACKLING FOOD INSECURITY IN THE WESTERN INDIAN OCEAN

The Western Indian Ocean (WIO) is facing a humanitarian crisis. The livelihoods of 60 million people depend on the ocean. Yet it is warming faster than any other. Coastal and marine ecosystems are rapidly declining, likely to collapse within the next 15 years if current trends persist. Poor communities lacking the tools and resources to quickly adapt will suffer the most from these changes.

Governments and international organisations need much more information and data to address this urgent but so far under-reported issue. A UK-South Africa collaboration has established an innovation bridge and regional hub network to provide eight developing WIO countries with immediate access to skills and infrastructure needed to tackle this regional challenge.

The project is making use of satellites, ocean models, marine robotics, and other state-of-the-art technologies capable of studying these complex and remote ecosystems. It will use the innovation bridge between world-class research institutions, develop local capacity, and encourage governments to protect these valuable yet vulnerable ecosystems.

The scale of the problem has brought world-class research institutions together to work in unfamiliar and harsh environments, pushing UK technologies and scientific expertise to a globally competitive level of excellence. The project has already provided crucial analysis of ecosystems in Kenya, Tanzania, South Africa and Madagascar. Many people depend on these. Now researchers want to help government and international organisations address the worsening marine ecosystem challenges facing Mozambique.

Professor Michael Roberts

© Heather Dougmore, Journalist

Food insecurity in the Western Indian Ocean – an impending humanitarian crisis driven by a warming ocean

Project lead:
Professor Michael Roberts, National Oceanography Centre, University of Southampton, UK & Nelson Mandela University, South Africa

Delivery partners:
British Council, UK and the National Research Foundation, South Africa

The ocean knows no national boundaries. This project is a real game changer as it has a regional approach that involves local research institutions. It builds state-of-the-art capacity in them – a legacy that will give WIO countries great independence and a stake in their destiny.

Professor David Vousden, Director of the UN ASCLME (Agulhas and Somali Current Large Marine Ecosystem) project

REDUCING RATES OF HIV INFECTION IN SOUTH AFRICA

Sub-Saharan Africa accounts for over 70% of HIV infections worldwide, with South Africa containing the highest number of HIV infections and the world's largest HIV treatment programme (UNAIDS, 2016).

Combination antiretroviral therapy (cART) is a treatment that prevents the HIV virus from making copies of itself in the body, lowering, or even removing, the risk of developing AIDS. Globally, the rapid upscaling of cART to more than 19 million people with HIV has resulted in substantial population level reductions in HIV related deaths. However, there has been limited evidence concerning its effectiveness in stemming the rate of new HIV infections within African populations, where the rate of new HIV infections remains unacceptably high.

A group of UK and South African researchers used one of the world's largest population-based HIV cohorts to identify the gaps in current HIV prevention programmes and determine why the rate of new HIV infections remains so high. The research provided the first clear evidence of dramatic population level declines in the rate of new HIV infections among both men and women. However, the results indicated the need to get more men onto consistent, suppressive cART so that new HIV infections can be further reduced among women.

Going forward, the researchers will use the population cohort to provide new insights into how the COVID-19 epidemic evolves in a rural African population, looking at how it can be controlled and seeking to understand the epidemic's co-occurrence with HIV.

Professor Frank Tanser and colleague

© Professor Frank Tanser

An epidemic in retreat? Establishing the population impact of combination prevention strategies in a resource-poor, hyper-endemic rural African population

Project leads:
Professor Andrew Phillips, University College London, UK and Professor Frank Tanser, Africa Health Research Institute, South Africa & University of Lincoln, UK

Delivery partners:
Academy of Medical Sciences, UK and the National Research Foundation, South Africa

It has been a huge privilege to study the HIV epidemic in one of the world's most severely affected rural communities and to witness first-hand the turning of the tide against this terrible disease.

Professor Frank Tanser, Africa Health Research Institute, South Africa and University of Lincoln, UK

NEW KNOWLEDGE TO COMBAT NON-COMMUNICABLE DISEASE IN SOUTH AFRICA

The World Health Organisation estimates that 85% of global premature deaths from non-communicable disease (NCD) occur in low and middle-income countries, driven by a combination of genetic and environmental factors.

Although an individual's genome does not change throughout their lifetime, short- and long-term environmental exposures can alter how their DNA is expressed, and changes in gene expression caused by environmental factors can affect disease outcomes. Epigenetic mechanisms, which bridge genetic predisposition and environmental exposure, can provide a useful and novel target for disease intervention.

Most epigenetic data is currently from European populations and it is unclear whether findings from this data can be extrapolated to other populations. This UK-South Africa study compared epigenetic data on cardiometabolic disease risk factors from the Batswana South African ethnic group with previously held data on other populations. It found that current blood-based epigenome-wide association study findings can largely be extrapolated to under-represented ethnicities for whom epigenetic data is not yet available, however differences in a subset of the tested associations suggests the need to include under-represented ethnic groups in future epigenetic research.

For developing countries to become internationally competitive, capacity building and access to state-of-the-art research infrastructure are critical. Collaboration with world leaders in epigenetic epidemiology research in the UK has developed the skills and expertise of South African researchers and will lead to more research on health questions relevant to populations of developing countries.

Having demonstrated for the first time the need for ethnically diverse data, the team now want to strengthen their findings and build on this important first step in developing targeted and evidence-based strategies that promote health and combat disease progression in South Africa.

Doctor treats patient

© Arne Hoel, World Bank

The roles of plasma levels and genetics of haemostatic factors in cardiovascular disease development in Africans

Project leads:
Dr Fiona Green, formerly University of Manchester, Professor Bernard Keavney, University of Manchester, UK and Professor Marlien Pieters, North-West University, South Africa

Delivery partners:
Academy of Medical Sciences, UK and the National Research Foundation, South Africa

Working closely together over a sustained period has cemented our partnership and we are now aiming to grow our successful collaboration further. As well as benefiting our respective groups and the wider scientific community, understanding health and disease in understudied populations continues to be essential.

Dr Hannah Elliott, University of Bristol

EARLY LANGUAGE INTERVENTION FOR SOUTH AFRICA'S CHILDREN

For children living in poverty in South Africa, inequalities in learning and educational performance are increased by limited home stimulation, poor education, and a lack of resources. Interventions in early childhood development enhance children's ability to succeed in the first few years of school, reducing school dropout rates and improving educational and life outcomes.

Early diagnosis of language difficulty can help caregivers and parents to provide stimulating interaction to facilitate their child's cognitive and mental health. However, data on typical development in South African languages is urgently needed to improve early child development, particularly in under-resourced and marginalised communities.

This UK-South Africa team has established baseline data for language development in six South African languages for children of 0-3 years. Collaboration with the South African Centre for Digital Language Resources will make language data available online for all eleven official languages.

Based on this work, the team are developing tools to measure early language and cognitive development to diagnose delays. They are working with speech and language therapists in under-resourced communities to develop digital technologies to make assessment tools and interventions in the indigenous languages of South Africa accessible to all.

Language development research team

Government, including policy makers, and NGOs working with children in the early years will use this scientific work to inform policies and interventions that will support children to become productive citizens, who contribute to the economy and wellbeing of their communities. Further research will generate evidence about how to support young children and families with new technologies and improve cognitive-linguistic development globally.

Training and knowledge exchange in early Bantu language development assessment

Project leads:
Dr Katie Alcock, Lancaster University, UK and Professor Heather Brookes, University of Cape Town, South Africa

Delivery partners:
British Academy, UK and the National Research Foundation, South Africa

This project is one of the most significant initiatives on the African continent to develop African languages and improve the lives of Africa's children.

Dr Michelle Pascoe, Communication Sciences and Disorders, University of Cape Town

OVERCOMING POVERTY AND HUNGER IN SOUTH AFRICA

Many South Africans still experience poverty and food insecurity. One in four children display stunted growth, an indicator of chronic malnutrition. This, despite a comprehensive social protection system, and a monthly child support grant which reaches two-thirds of all children.

Through the South African Research Chairs Initiative, Professor Stephen Devereux assessed how children, informal workers and farmworkers in South Africa are reached, and adequately protected against poverty and hunger.

Working with academia, government, civil society and neighbouring countries, Professor Devereux has made considerable progress towards improving social protection strategies and influencing public policy. The research has led to revision of the social protection chapter of the National Food and Nutrition Security Plan for South Africa.

Farm workers were identified as a highly vulnerable but neglected group. A collaboration with the non-governmental organisation Women on Farms Project uncovered widespread violations in minimum wages, living conditions, health and safety as well as seasonal hunger.

Having launched South Africa's first national conference on the future of farm workers, Professor Devereux presented a proposal for seasonal unemployment insurance to the Minister of Labour. The results of his farm worker labour rights violations research were also influential during a parliamentary select committee hearing in South Africa on the National Minimum Wage Bill.

Farmworkers in South Africa

The wider consequences of COVID-19 in South Africa are not yet fully understood. The next phase of this research will generate new evidence and draw on lessons learnt to improve social protection interventions and outcomes in future crises in South Africa and elsewhere.

Social Protection for Food Security in South Africa

Project leads:
Professor Stephen Devereux, Institute of Development Studies, UK & University of Western Cape, South Africa

Delivery partners:
British Council, UK and the National Research Foundation, South Africa

The next aim of this research is to ensure South Africa's social protection system is better equipped to respond to crises such as COVID-19 and better able to adapt and mitigate future threats to lives and livelihoods.

Professor Stephen Devereux

Over **400** projects supported through the Newton-Katip Celebi Fund since 2014

Suleymaniye Mosque complex, Istanbul, Turkey

TURKEY

"Thanks to the Newton Fund, some of the best scientists from the UK and Turkey are working together to solve the world's most urgent challenges, from healthcare to environmental sustainability."

Sir Dominick Chilcott KCMG, HM Ambassador to the Republic of Turkey

REDUCING CO_2 EMISSIONS WITH NEW GREEN CONCRETE

Climate change is primarily caused by too much carbon dioxide (CO_2) in the atmosphere. Human activity such as burning coal and cutting down forests is causing atmospheric CO_2 to increase at an unprecedented rate, with potentially devastating global consequences. Construction and demolition waste (CDW) is one of the main offenders, responsible for 30% of total urban waste and colossal CO_2 emissions. The landfilling of CDW is also extremely costly and harmful to the environment.

A new low-cost 'green concrete' made entirely from recycled CDW has been developed that not only reduces CO_2 emissions, but promises safe permanent storage of CO_2 through binding high levels of CO_2 to itself during production. The use of recycled CDW also decreases the quarrying of new raw materials, reducing the need to strip the earth of its natural resources.

The UK-Turkey GreenLegOuse project has created a flexible, Lego-like construction system that can be quickly built to provide affordable accommodation for low income communities, including the homeless, slum dwellers and refugees, not only in Newton Fund partner countries but countries all around the world. The system can also be disassembled and reassembled, increasing its reusability and recyclability with easy-to-implement, low-cost and energy-efficient techniques, and removing the need for heavy demolition processes and the pollution this creates.

© Kadir Celep, Unsplash

The project developed research capacity in Turkey and provided opportunities to initiate completely new lines of research in this field. By working closely with the construction industry, the team aim to increase the project's impact and contribute to global economic, environmental and social development.

Lego construction system of 'green' structural components for low-cost housing

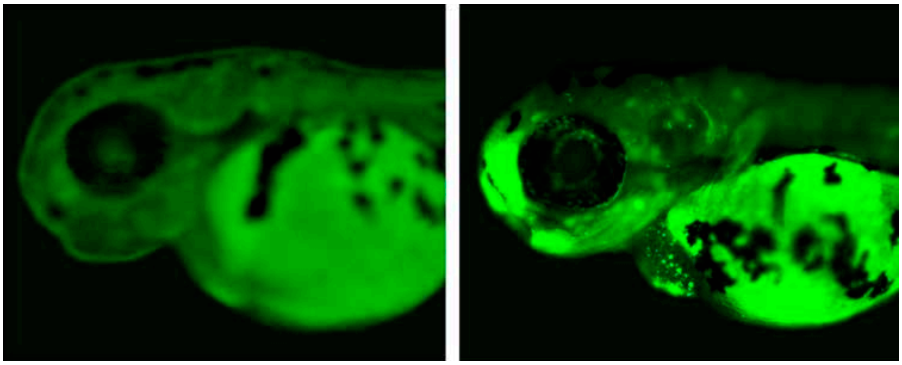
Project leads:
Professor Ashraf Ashour, University of Bradford, UK and Professor Mustafa Sahmaran, Hacettepe University, Turkey

Delivery partners:
British Council, UK and the Scientific and Technological Research Council, Turkey

> **The construction industry is a huge contributor to climate change. Our circular economy approach aims to drastically reduce waste, bring down CO_2 emissions and reduce environmental damage, while ensuring construction demands can be met.**
>
> Professor Mustafa Sahmaran, Hacettepe University, Turkey

UNCOVERING PLASTIC'S HARMFUL IMPACT ON HUMAN HEALTH

Apoptotic cells in Bisphenol (BPA) exposed zebrafish embryos



© Professor Ebru Emekli-Alturfan

Turkey discards millions of tonnes of plastic waste every year. Over time these plastics leak harmful chemicals into the environment.

This UK-Turkey collaboration has revealed how endocrine disrupting chemicals (EDCs) used in everyday plastic food containers and food packaging are damaging the brain development of human embryos, leading to new health-protecting regulations on plastic products.

Autism spectrum disorders (ASDs) and hyperactivity disorder (ADHD) have significantly increased globally over the last few decades. One in 10 children in Turkey suffer from ADHD, much higher than the 2.2% worldwide average. Epidemiological studies show that mothers with children diagnosed with ASD had more exposure to EDCs and that this exposure can have other diverse effects including impaired reproductive capacity, obesity and metabolic disease.

The researchers used the genetic similarity of zebrafish to humans to study the effects of exposure to EDCs during embryonic development. They discovered molecular defects, which point to the underlying mechanisms of the detrimental effects of EDC exposure during development, leading to the progression of cancer, endocrine and metabolic diseases later in life.

The results of this project have contributed to regulations on the use of products containing EDCs globally. New laws on the use of plastic bags have reduced their use in Turkey alone by over 77 percent.

Further evidence is needed to encourage the removal of EDCs from plastic products to reduce the prevalence of associated health problems. Now, the team aims to conduct research on how parental exposure to EDCs impacts brain development in the next generation.

Collaborative research on epigenetic effects of BPA, BPS and BPF as potential endocrine disrupting environmental pollutants in zebrafish embryos

Project leads:
Professor Ferenc Mueller, University of Birmingham, UK and Professor Ebru Emekli-Alturfan, Marmara University, Turkey

Delivery partners:
British Council, UK and the Scientific and Technological Research Council, Turkey

> **To achieve our goals, we needed to collaborate with a leading professional in the field. Professor Mueller from the UK believed in our joint project proposal and responded positively to our call, even though we had not met before.**
>
> Professor Ebru Emekli-Alturfan, Marmara University, Turkey

SENSING PHARMACEUTICAL CONTAMINANTS IN FRESH WATER

Fresh water pollution affects about 1.2 billion people worldwide. Researchers in Turkey and the UK have been working together to develop an easy to use, portable sensor to detect pollutants and remove them from the water source.

Turkey has a large agricultural sector and the pollution problem in water and soil due to pharmaceuticals including antibiotics and other drugs is a critical issue. The innovation uses a highly sensitive but inexpensive sensor strip that can rapidly detect these pharmaceuticals and provide real time analysis.

The team used a specially designed magnetic polymer to remove the identified pollutants from the wastewater systems and the developed sensor is ready to use to detect these pollutants. Sewage surveillance can also serve as an early warning of viral outbreak and re-emergence in towns and cities.

This low-cost sensor will also be useful in monitoring of water pollutants in other countries where water sanitisation is an issue and people suffer more severely from bacterial infections, further reducing the worldwide impact of water pollution.

The misuse of antibiotics by cattle and poultry farmers to improve productivity and profit causes antibiotics to end up in the soil through animal waste, which then leaks into rivers and streams. The team is part of a new international partnership between the UK, Turkey, Bangladesh and Brazil, tackling this global reliance on antibiotics for securing food production.

Together with Professor Roy Vellaisamy, University of Glasgow, the UK team is also applying their research to detect COVID-19 in wastewater so they can monitor the circulation of the coronavirus within communities and alert policymakers in good time.

Solution of magnetic polymeric networks, used to remove the pollutants from water sources

Turkish researcher testing drug pollutant

A SPR sensor system using molecular imprinted polymer-nanoparticle composites for ultrasensitive detection of pharmaceutical emerging contaminants in fresh water sources

Project leads:
Professor Humphrey H Yiu, Heriot-Watt University, UK and Professor Memed Duman, Hacettepe University, Turkey

Delivery partners:
Royal Society, UK and the Scientific and Technological Research Council, Turkey

We believe that the developed system can be easily adapted to sewage surveillance to monitor viral outbreaks such as COVID-19.

Professor Ahmet Mete Saatci, Head of Turkish Water Institute, Turkey

IMPROVING THE DIAGNOSIS AND TREATMENT OF RARE DISEASES

There are more than 6000 rare diseases and most of them have no effective treatment. Often rare diseases are chronic and life-threatening, with symptoms such as loss of sight, kidney disease, diabetes, and reduced intelligence. With over 300 million patients affected worldwide, these diseases represent a major global health challenge.

In Turkey, there is very little clinical understanding of rare diseases at the basic molecular science level. A collaboration between the UK and Turkey is helping to reveal how two rare diseases work at the molecular level. The project has produced new knowledge and raised awareness among decision-makers with the aim of opening up new avenues for diagnosis and therapeutics.

The research combined the Turkish partner's expertise in cell biology and proteomics with the UK collaborator's proficiency in genetics. The team shared the results of their research with clinicians and geneticists who study rare genetic diseases in Turkey, Europe and the USA. In doing so they were able to use existing resources more efficiently to identify the molecular mechanisms underlying these diseases.

The researchers want to further investigate ciliopathies – largely untreatable and underdiagnosed developmental disorders that affect multiple organs and systems – to uncover how mutations cause the disease and to lead to new avenues for accurate and effective diagnosis and treatment.

Cytoskeleton lab members doing experiments and discussing data

Dissecting the role of centriolar satellites in spatiotemporal regulation of centriole duplication

Project leads:
Dr Fanni Gergely, Oxford University, UK and Dr Elif Nur Firat-Karalar, Koc University, Turkey

Delivery partners:
Royal Society, UK and the Scientific and Technological Research Council, Turkey

> **Hearing directly from rare disease patients about their experience and the hopes they have for treatment and diagnosis has been a driving force of my research career.**
>
> Dr Elif Nur Firat-Karalar, Koc University

Dr Akbulut, Ms Ece Polen Budak, and Ms Hande Eyisoylu working on the initial formulations for the breast models, Sabanci University, Turkey

CHAIR'S PRIZE

The project that best addresses one of three United Nations' Sustainable Development Goals will be awarded up to £500,000.

Goal 3
Good Health & Well-being

Goal 5
Gender Equality

Goal 11
Sustainable Cities & Communities

SPEEDY ACCESS TO EMERGENCY SERVICES TO SAVE LIVES

5 GENDER EQUALITY

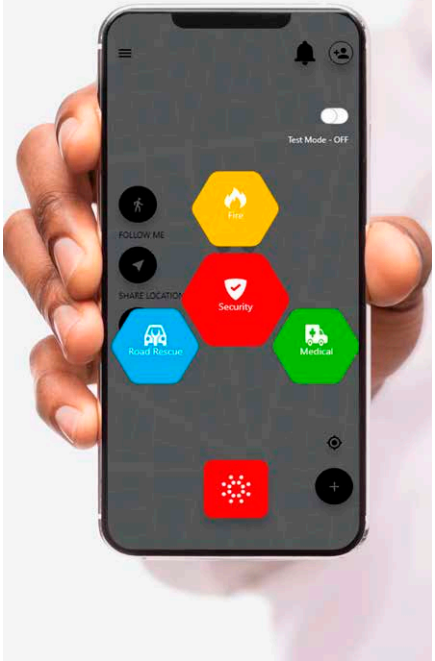
In an emergency, quickly dialling a three-digit number to alert the relevant emergency services might feel commonplace for some, but for a lot of people it is not that simple. In Nairobi in Kenya there are more than 50 numbers to call in an emergency, many of which go to expensive private providers with no guarantee they'll turn up in time to save lives.

Upesy is a new free mobile app helping people access affordable and reliable emergency services at the touch of a button. With support from the Leaders in Innovation Fellowships programme, the app's creators already have more than 5000 subscribers in Nairobi. During a six-month pilot with Kenya's national police service more than 2500 emergency incidents were reported and resolved.

To raise an alert, you simply tap your phone's power-button four times in quick succession, or press any of the emergency buttons in the app. The app, which shares users' real-time location, can notify medical, fire, security and roadside rescue service providers as well as users' social network, such as family and friends. The technology reduces provider administration costs and passes it onto the users, so people can connect to more reliable providers at more affordable rates.

The team behind the app plan to have Upesy working in at least 10 African countries in the next five years. They are developing the app to use the latest artificial intelligence and machine learning technology. The data will be used to target groups and geographic areas more at risk of gender violence and discrimination. The enhanced technology will improve coordination between organisations and agencies that monitor, respond to, and educate on gender issues.

Upsey app



Upesy - A mobile emergency services platform

Project lead:
Mr Eric Kithinji, Upesy World Limited, Kenya

Delivery partners:
Royal Academy of Engineering, UK and the Kenya National Innovation Agency

> **It's great to have that peace of mind knowing that in case of an emergency help is at your fingertips. Upesy redefines what it means to raise an alarm, be it to your friends, police or other emergency responders.**
>
> Joe Kapten, emergency services expert

NEW CLEAN ENERGY SOLUTIONS FOR SOUTH AFRICA'S INFORMAL SETTLEMENTS

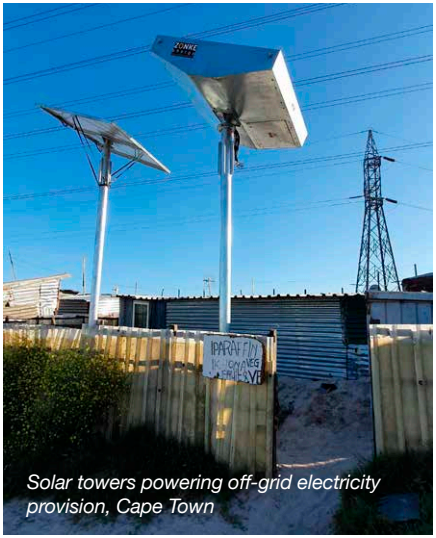
Energy poverty is a common problem for South African communities living in off-grid informal settlements. Without access to safe, affordable and reliable energy families struggle to power businesses, women and children bear the brunt of health impacts from burning harmful cooking fuels, and children lack reliable electricity to study after dark.

A lack of good data about the energy needs of informal settlements has so far hampered effective energy policy for poorer South African communities. Now, a team of experts from South Africa and the UK have found a way to support economic activity and reduce reliance on polluting fuels while collecting data to inform and improve long-term energy policy.

The team held discussions with officials in Johannesburg and Polokwane, non-governmental organisations, community representatives and UK energy organisations to come up with solutions based on settlements' specific energy needs. This led to new work testing solar mini-grids in an informal settlement in Cape Town which were found to produce energy up to 40% cheaper than current energy sources.

By pairing solar mini-grids with app-based pay-as-you-go sustainable business models the team hope to scale and replicate solar innovations to plug the energy provision gap in South Africa and boost economic prosperity and wellbeing.

The project has resulted in further funding to install mini-grids and benefit communities in the Philippi area of Cape Town. It has also been pivotal in connecting local innovation businesses to government funding opportunities. For the next phase of the project the team want to implement solar refrigeration capacity and provide women in informal settlement communities with access to a clean and sustainable source of income based on refrigeration businesses.



Solar towers powering off-grid electricity provision, Cape Town

Urban transformation in South Africa through co-designing energy services provision pathways

Project leads:
Dr Federico Caprotti, University of Exeter, UK and Dr Jiska de Groot, University of Cape Town, South Africa

Delivery partners:
Economic and Social Research Council, part of UK Research and Innovation and the National Research Foundation, South Africa

> **Working with informal settlement communities from the start of the project has highlighted the potential for projects of this kind to achieve real, measurable and replicable change.**
>
> Dr Federico Caprotti, University of Exeter

IMPROVING SURGICAL OUTCOMES FOR BREAST CANCER PATIENTS

3 GOOD HEALTH AND WELL-BEING

Breast cancer is the most common cancer in women worldwide. Surgical treatment of breast cancer can have a significant impact on a woman's body and self-identity. A patient's physical and mental wellbeing depends on the medical and aesthetic success of the surgery.

Researchers have developed an innovative and cost-effective model to train surgeons in oncoplastic techniques where surgeons can simulate retaining the healthy tissue as much as possible while removing tumours from breast cancer patients. This breast-conserving approach was found to affect women positively.

Surgitate's breast model offers a tactile platform that responds realistically to surgical interventions and allows surgeons to practice modern oncoplastic techniques at their own pace for better patient outcomes.

International School of Oncoplastic Surgery workshop, India

In collaboration with leading training organisations, Surgitate contributed to the education of more than 1500 surgeons. It has also delivered a breast cancer awareness campaign, working with more than 60 companies to place information boards with hands-on breast models in women's bathrooms to remind women to check their own bodies and show them what to look for. So far, they have reached more than 1000 women and four women have been early diagnosed through interactions with these boards.

Connecting to medical professionals in the UK and other entrepreneurs through the Leaders in Innovation Fellowships programme has helped the team further develop and market their products and contributed significantly to their business plan.

Half of the 1.7 million annual breast cancer cases worldwide occur in under-resourced settings with no or limited access to oncoplasty. The next step is to establish a programme, for the first time, which combines the benefits of the physical model with an online platform and state-of-the-art digital performance assessment techniques. This would enable surgeons in these settings to access world-class training and expert advice from anywhere in the world.

Design and fabrication of synthetic tissue and organ models for surgical training

Project lead:
Dr Ozge Akbulut, Sabanci University, Turkey

Delivery partners:
Royal Academy of Engineering, UK and the Scientific and Technological Research Council, Turkey

> **These breast models provide an excellent platform for learning and understanding the 3D principles of a range of modern oncoplastic breast procedures in the safety of the laboratory setting. They are a really useful addition to the modern skills lab, and to small group teaching in this rapidly expanding field.**
>
> Dr Richard Rainsbury, Co-chair of the International Forum of the Association of Breast Surgery, Past President of the Association of Breast Surgery

CONNECTING PEOPLE AND PLACES FOR SUSTAINABLE DEVELOPMENT

Access to safe, reliable and affordable transport is an important part of sustainable development. Transport connects rural and urban places and gives people access to decent work and essential services. Despite this, only half of the world's population has convenient access to public transport.

Professor Mpofu is a national research chair. His new technology business incubator is delivering transport manufacturing solutions, to increase social and economic mobility in South Africa. Incubators act as support services for early-stage businesses, giving young companies the networks and resources they sometimes find difficult to access. In this case it is helping researchers and budding entrepreneurs to set up micro-enterprises to supply the transport manufacturing sector.

Several micro-enterprises have been supported through the incubator, including one that has delivered £10,000 sales supplying production-jigs to a railcar manufacturer. Five patents have been registered and three prototypes are being tested to support a sustainable transport manufacturing sector.

Postgraduates from South Africa and the continent have been equipped to solve manufacturing challenges. Senior career pathways have been facilitated to support the next generation of 'techno-preneurs'.

Professor Mpofu now wants to take this work to the Southern African Development Community region's informal settlements, to understand their transport challenges and support micro-enterprises that meet their needs. Collaborations with the UK and African countries have led to new funding proposals to deliver accessible and inclusive transport solutions and create economic opportunities for local communities.

Commuters on public transport

© Hendri Lombard, World Bank

Bending press commercialisation for manufacturing sustainability

Project lead:
Professor Khumbulani Mpofu, Tshwane University of Technology, South Africa

Delivery partners:
Royal Academy of Engineering, UK and the Technology Innovation Agency, South Africa

> **Through well-grounded manufacturing research and business incubation, we are developing new and innovative ways to support youth techno-preneurs.**
>
> Professor Khumbulani Mpofu, Tshwane University of Technology

A NEW GEL TO PROTECT AGAINST HIV AND IMPROVE REPRODUCTIVE HEALTH

3 GOOD HEALTH AND WELL-BEING

Over 20 million people in East and southern Africa live with HIV – over half of the total number of people living with HIV in the world. (UNAIDS Data, 2019). A new medical gel designed to protect against HIV infection is about to undergo human clinical trials. If successful, the gel could benefit millions of people across Africa.

UniPron works by lowering and stabilising vaginal pH at levels that are too acidic for HIV to survive. Dr Peter Mwethera has already commercialised two by-products of the gel. Smugel gel addresses vaginal dryness and reduces pain during sex. It is used to safely deliver babies and is particularly beneficial for women who have undergone female genital mutilation (FGM) – a cultural practice which affects 27% of women in Kenya and causes recurrent infections, chronic pain, infertility and childbirth complications. Smuscan gel allows the monitoring of a baby in the womb.

Kenya currently imports 70% of its medical supplies, but the COVID-19 pandemic has made it difficult to import medicines from abroad. This is the first time these products have been developed and manufactured in the country and the gels are half the cost of competing products.

Having received support through the Leaders in Innovation Fellowships programme, Dr Mwethera and his team are hoping to commercialise UniPron and scale up Smugel and Smuscan into other countries in Africa. This will enable them to make the products freely available to women in areas where access to modern family planning methods is a challenge and the prevalence of FGM is very high.

© Dr Peter Mwethera

Dr Gichuhi Mwethera explains how the products work to attendees at a Nairobi exhibition

Development and commercialisation of medical products, UniPron (a gel aimed at preventing both HIV/AIDS and pregnancy), Smugel and Smuscan

Project lead:
Dr Peter Mwethera, Institute of Primate Research, Kenya

Delivery partners:
Royal Academy of Engineering, UK and the Kenya National Innovation Agency

This project has demonstrated that scientists and medical researchers can convert their knowledge into products and services. It has helped to raise awareness of reproductive health issues – often seen as a taboo subject – and has the potential to have a huge impact in preventing life-limiting HIV.

Dr Peter Mwerthera, Institute of Primate Research

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DELIVERY PARTNERS

The Department for Business, Energy and Industrial Strategy would like to express special thanks to the UK National Commission for UNESCO, in particular Sarah Shaw and Ellie Anghileri for all their work in delivering the 2020 Newton Prize.

We would also like to thank all of the UK and partner country delivery and funding partners involved in this year's Prize for their role in supporting the application and verification process, as well as their continuing work in making the Newton Fund such a successful and impactful initiative.

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British Academy

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- Engineering and Physical Sciences Research Council (EPSRC)
- Innovate UK
- Medical Research Council (MRC)
- Natural Environment Research Council (NERC)
- Science and Technology Facilities Council (STFC)

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Cultural Affairs and Missions Sector, Egyptian Ministry of Higher Education & Scientific Research

Science, Technology & Innovation Funding Authority (STDF)

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Higher Council for Science and Technology (HCST)

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Royal Scientific Society (RSS)

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Kenyan National Innovation Agency (KENIA)

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National Research Foundation (NRF)

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