- ◊ Energy for Development (e4D) programme implements rural electrification projects as learning entities to support energy access.
- ◊ Projects target improvement of living standards of the poor in communities in rural Africa, and provide pathways for growth and development.
- ◊ To date, the e4D programme has installed six community managed solar PV mini grid systems in Sub-Saharan Africa with more in the planning.


Kitonyoni, Kenya


Oloika, Kenya


Shompole, Kenya


Bambouti, Cameroon


Kyamugarura, Uganda


Kanyegaramire, Uganda

Energy for Development (e4D) - Mini Grid Projects

Ease of installation with multipurpose structures for PV modules, water collections and shading (Kitonyoni), Kenya.

Containerised PV System. Redundancy in design with all projects with 2 inverters (master-slave) - Kitonyoni, Kenya.

Remote data acquisition system used in all e4D mini grids.

Kanyegaramire mini grid - trading centre at night, (Uganda).

e4D mini grids at a glance

Deployed e4D mini grids supply electricity 24/7 to businesses, health centres, schools, places of worship & households. All project are cooperatives, managed by elected members of the local communities. Performances remotely monitored by the e4D team in UK.

Kenya

- ◊ The 13.5kWp Kitonyoni project in Makueni county was the first PV-battery mini grid installed in Kenya by e4D in 2012. This project was fully funded by the e4D programme.
- ◊ Two other PV-battery mini grids were installed later in the Maasai villages of Oloika (13.5kWp) and Shompole (8.4kWp) in the south of the country's rift valley near lake Magadi. These two projects were jointly funded by the e4D programme and Rural Electrification Authority (REA) Kenya.

Uganda

Two identical PV-battery mini grids systems were deployed in 2015 in Kyenjojo, western Uganda:

- ◊ 13.5kWp capacity installed in each village of Kyamugarura and Kanyegaramire. These projects were jointly funded by the e4D programme and Rural Electrification Agency (REA), Uganda.

REA in Kenya and Uganda provide assistance and maintenance of the projects.

Cameroon

- ◊ 6kWp installed by e4D in Bambouti, eastern Cameroon with Cameroon Catalyst, a student led organisation from the University of Southampton. The project serves the local health centre and provides a 'solar power hub' for the villagers.

Resilience of e4D mini grid

Delivery model is built around key sustainability parameters:

- ◊ Stakeholder engagement.
- ◊ Needs assessment, at the start and ongoing.
- ◊ Quality of installation.
- ◊ In country supply chain and technical support.
- ◊ Regular monitoring to support performance, operation, maintenance and project expansion.
- ◊ Cooperative business model, with micro financing to the community.

Community engagement for all projects (Kitonyoni shown)

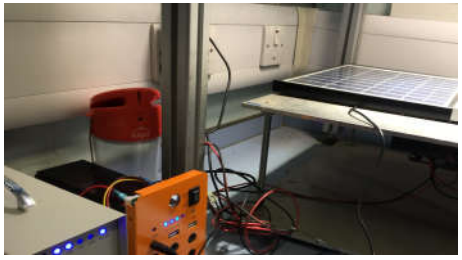
Comment on health:
"Previously I needed assistance using a kerosene lamp or I would hold a torch / mobile phone in my mouth to see what I am doing during a night consultation. Now I can do consultations and deliveries 24 hours a day alone if needed. Now mothers are coming from far and wide, as they know Kitonyoni has electricity. Thanks to e4D".

- Mercy Twili
Kitonyoni Health Centre Chief Nurse

Energy for Development (e4D) - Research and Development

In addition to mini grids, e4D undertakes research addressing key areas of energy access. Laboratory facilities include luminous efficiency, battery and appliances performance testing & small PV module characterisation.

Facilities for testing of luminous efficiency of LED lighting.



Testing and simulation of solar home systems including appliances, battery, charge controller etc.

Power consumption characteristics study of a DC Television and LED bulbs.

Training in mini grids, energy efficiency, geospatial analysis to support capacity building in energy efficiency and access in developing countries.

Research and Capacity Building

The Energy & Climate Change Division / Sustainable Energy Research Group (SERG, www.energy.soton.ac.uk) undertake research and development in many fields of energy covering all renewables and energy efficiency in buildings. The following areas are related to the activities in rural electrification and development.

Optimised solar home systems (SHS)

Low cost graduated PAYG solar home systems

Research and development to combine generation and demand side optimisation leading to a robust and economically viable SHS solution.

Off-grid DC appliances testing

Laboratory based DC appliances (refrigerator, television, LED light bulbs, cooling fan, batteries etc.) testing by replicating field conditions.

DC / AC mini grids

Efficient energy services solution through mini grids

- ◊ Appropriate system design of AC mini grids to support electricity access.
- ◊ Unlocking the promise of high efficiency & low maintenance DC mini grids for electricity access.
- ◊ Spatial planning for mini grids.

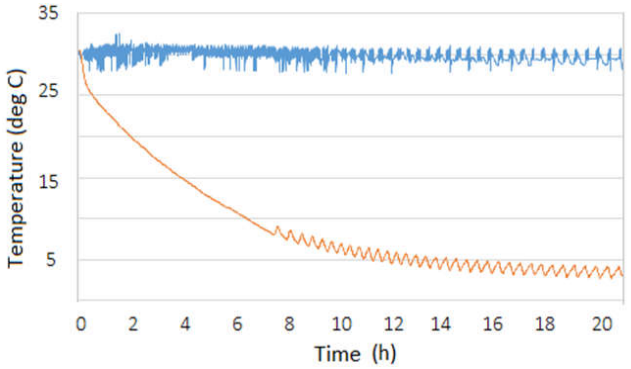
Capacity building

Capacity building in research & development embedded in case studies related to energy access and energy efficiency in the built environment

- ◊ Mini grids system design and performance analysis.
- ◊ Energy efficiency in buildings.
- ◊ Country-wide and regional geospatial analysis supporting energy studies at regional, city and village scales (GIS, EnergyPlus, HOMER etc.).

Experimental testing schedules to replicate the real world operation of appliances' performance supplied through optimised renewable energy power generation systems.

A 50W DC powered refrigerator testing in an environment chamber to understand its performance under various conditions.



Study of thermal characteristics of a 50W, 45l DC refrigerator. Orange line indicates the temperature & time it takes for the fridge to reach the set internal temperature. Blue line is the controlled environment chamber temperature.

Battery discharge characterisation under various loads - appliances, resistance (left) and LED light bulbs (right)

Energy for Development (e4D) - Mini Grids in Isolation, Clustered or Connected to National Grid

FORTIS UNUM (Stronger As One): Innovations in Mini Grids and their Networks

Fortis Unum builds on the extensive experience of the e4D team in the areas of energy access, mini grids and networks. This includes in country field experience of research and development in delivering 6 modular PV driven power generation and distribution systems in rural Sub Saharan Africa (SSA) affecting ~ 20,000 people in Cameroon, Kenya and Uganda.

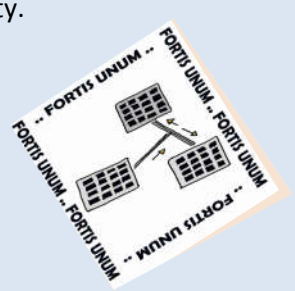
In addition to the e4D team, the Fortis Unum project also brings in partners from Kenya and Uganda. Such a partnership with over 100 years experience, will harness their complementary skills and capabilities across network design, power generation and transmission, distributed generation, mini grids, policy development, fieldwork and stakeholder engagement. The project will test off-grid networks, in terms of their ability to:

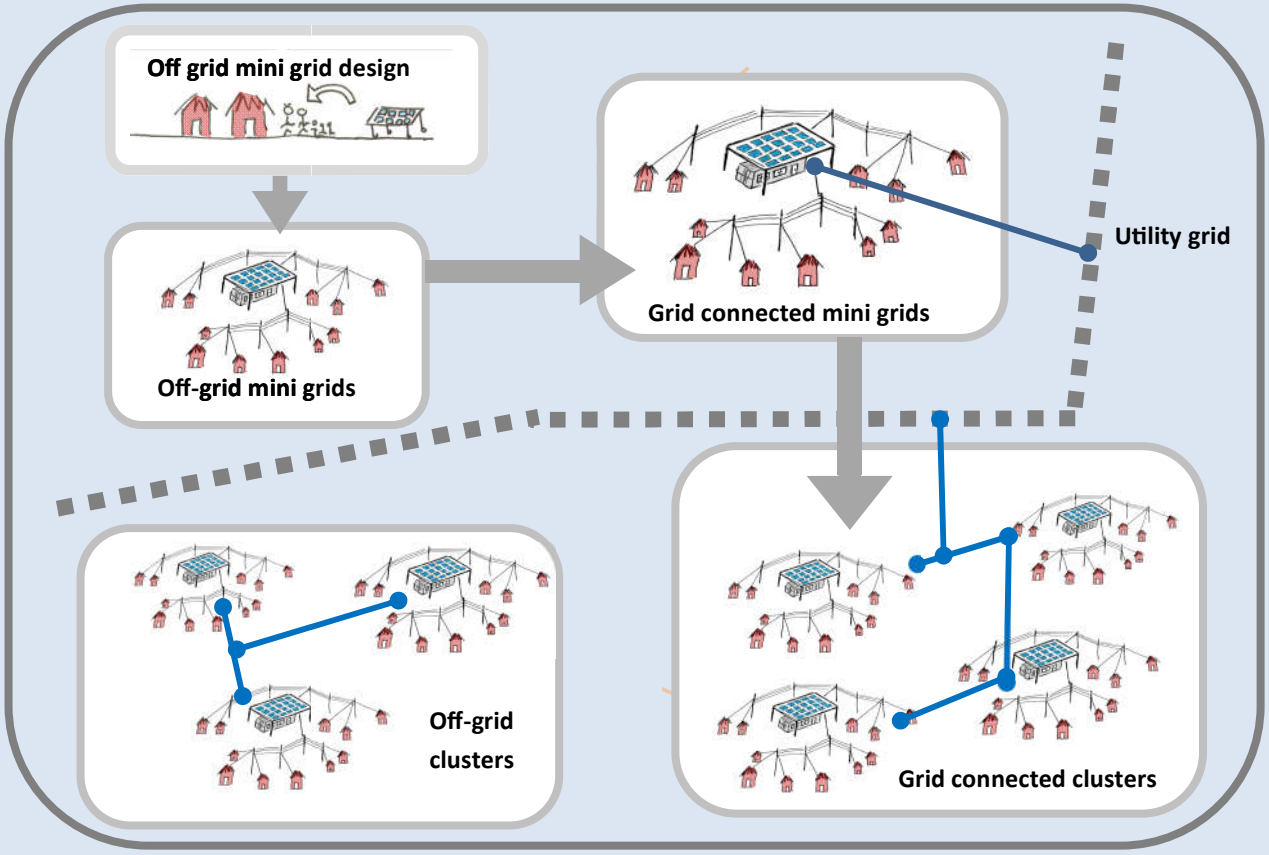
- ◊ Work individually.
- ◊ Work collaboratively with each other in a small network cluster.
- ◊ Work in parallel with the national grid, individually, in clusters and transitioning these as a formal part of the national grid.

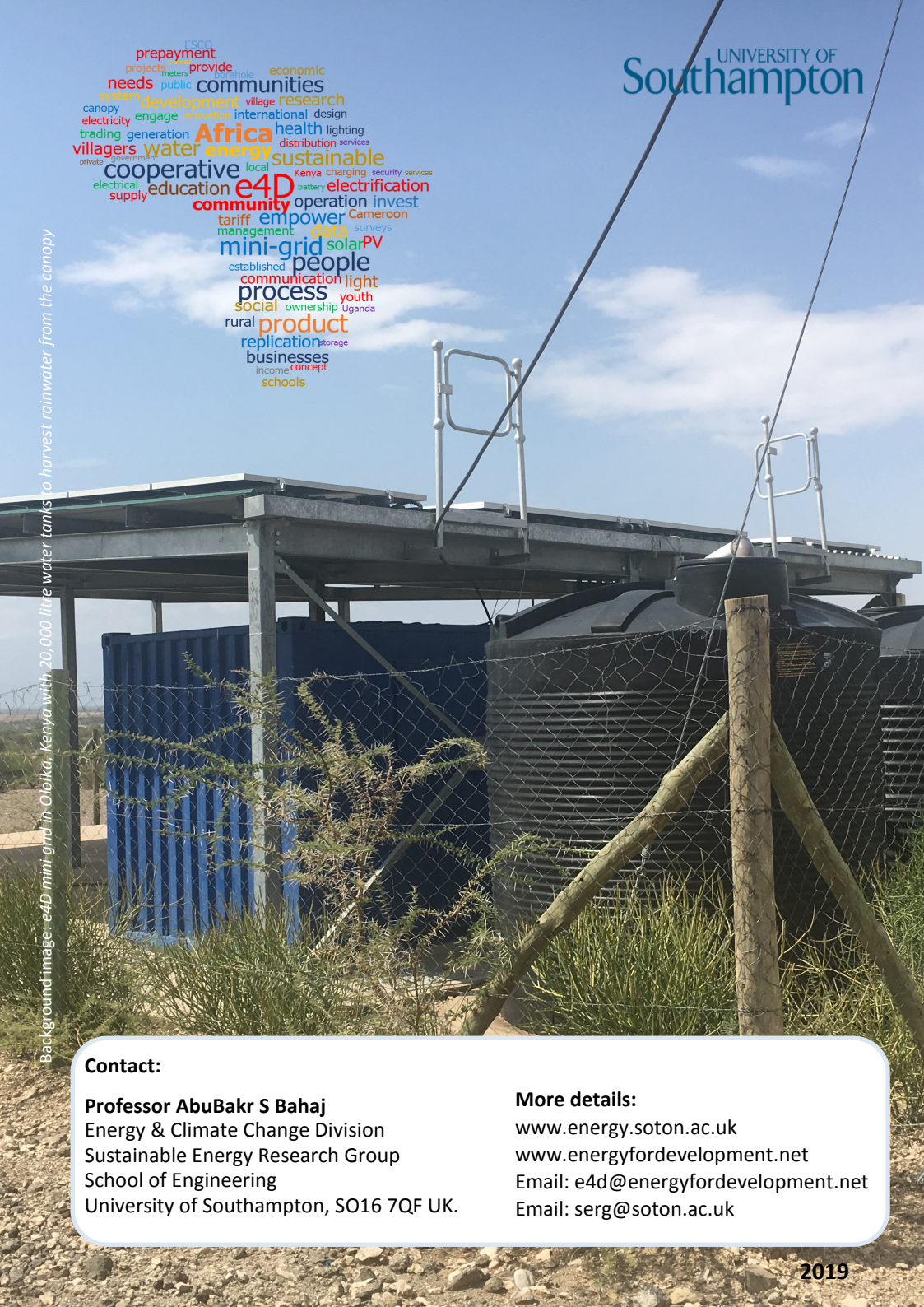
The research is structured to test and model the above systems and their configuration to enable African households to thrive through optimised, flexible and upgradeable mini grid networks.

Key understanding will cover:

- ◊ Exploration of options to cluster mini grids to form wider networks with greater stability and lower Levelised Cost of Electricity (LCOE).
- ◊ Utilisation of high stability mini grids to support the near end of line utility network.
- ◊ Understanding the intermittent islanding operation of mini grid networks.
- ◊ Demand side management approaches related to consumption profiles and mini grid network stability.







UNIVERSITY OF Southampton

Background image: e4D mini grid in Oboika, Kenya with 20,000 litre water tanks to harvest rainwater from the canopy

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