The **Energy for Development (e4D) programme** implements rural electrification projects as learning entities to support universal energy access with both technological and people centric innovations.
In 2022, e4D delivered **Kenya's first community scale mini grid connectivity to the national grid** in Kitonyoni, Makueni County.


Kitonyoni, Kenya


Oloika, Kenya


Shompole, Kenya


Bambouti, Cameroon


Kyamugarura, Uganda


Kanyegaramire, Uganda

March 2022

Kitonyoni mini grid plant room 2022. Inset thermal image of inverters for performance analysis

Maintenance work at Kitonyoni mini grid distribution network, 2021

e4D mini grids a

Deployed e4D mini grids supply businesses, health centres, sch & households. Some project ar managed by elected members communities. Remainder are o electricity utilities with system monitored by the e4D team in

Kenya

The 13.5kWp Kitonyoni project the first PV-battery mini grid in in 2012. This project has been and connected to the utility gri **T**wo other PV-battery mini grid in Oloika (13.5 kWp) and Shom south of the country's Rift Valle

Uganda

Two identical PV-battery mini g 2015 in Kyenjojo, western Uga **13.5 kWp** capacity installed in Kyamugarura and Kanyegaram jointly funded by the e4D prog Electrification Agency (REA), U **These** projects are being upgra verted to 3-phase. There are pl these two mini grids.

REREC in Kenya and REA Ugand and maintenance of the projec

Cameroon

6 kWp mini grid was installed i effort with the University of So The project serves the local he provides a 'solar power hub' fo

(e4D) - Mini Grid Projects

at a glance

y electricity 24/7 to
ools, places of worship
re cooperatives,
of the local
perated by local
performance remotely
the UK.

t in Makueni County was
stalled in Kenya by e4D
upgraded to three phase
id in 2022.
ls were installed in 2015
pole (8.4 kWp) in the
ey near Lake Magadi.

grids were deployed in
nda.
the villages of
ire. These projects were
ramme and the Rural
ganda.
ded to 56 kWp PV, con-
lans to interconnect

da provide assistance
ts.

n Bambouti, as a joint
uthampton students.
alth centre and
r the villagers.

Resilience of e4D mini grid

Delivery model is built around key sustainability parameters:

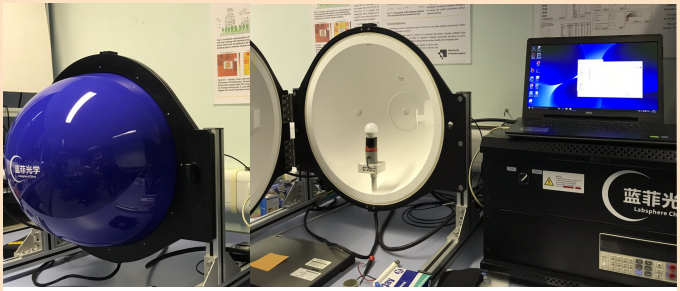
Stakeholder engagement.
Needs assessment, at the start and ongoing.
Quality of installation.
In country supply chain and technical support.
Regular monitoring to support performance, operation, maintenance and project expansion.
Cooperative business model, with micro financing.
Technological innovation and upgrading of plants to cope with demand growth

Community engagement , Kitonyoni, 2021

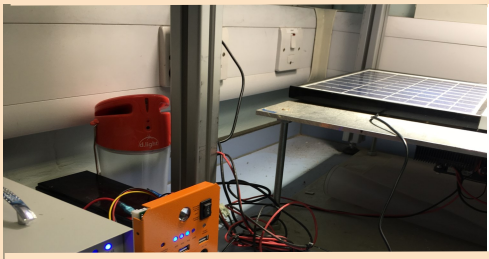
Comment on health:
"Previously I needed assistance using a kerosene lamp or I would hold a torch / mobile phone in my mouth to see what I am doing during a night consultation. Now I can work and perform deliveries 24 hours a day alone if needed. Thanks to e4D".

- Mercy Twili
Kitonyoni Health Centre Chief Nurse

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



Facilities for testing of luminous efficiency of LED light bulbs.



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

Power consumption study of a DC Television and LED bulbs.

Training in mini grids, energy efficiency, geospatial analysis to support capacity building in universal energy access in developing countries (Picture: Training in the Philippines)

Research and

The Energy & Climate Char
(energy.soton.ac.uk) unde
development in many field
renewables and energy eff
addition to mini grid resea
related to rural electrificat
being undertaken.

Optimised solar home sys

Low cost graduated PAYG

Research and developmen
demand side optimisation
economically viable SHS so

Off-grid DC appliances tes

Laboratory based DC appli
LED light bulbs, cooling fan
replicating field conditions

DC / AC mini grids

Efficient energy services so

Appropriate system design
support electricity access.
Unlocking the promise of h
nance DC mini grids for ele
Spatial planning for mini g

Capacity building

Capacity building in resear
energy access and energy

Mini grid system design an
Energy efficiency in buildin
Country-wide and regional
porting energy studies at n
(GIS, EnergyPlus®, HOMER

) - Research and Development

Capacity Building

nge Division
rtakes research and
ds of energy covering all
ficiency in buildings. In
arch, the following areas
tion and development are also

tems (SHS)

solar home systems
t to combine generation and
leading to a robust and
olution.

ting

ances (refrigerator, television,
, batteries etc.) testing by
.

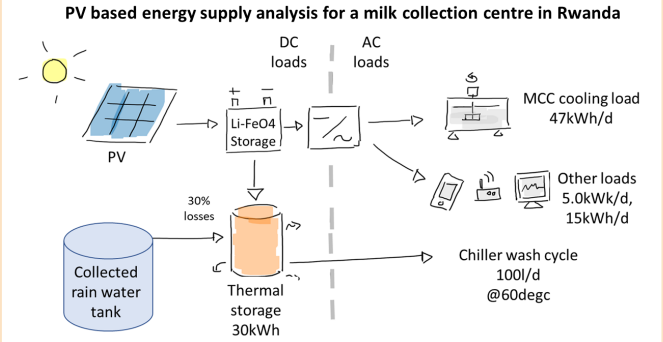
olution through mini grids
of AC mini grids to

high efficiency & low mainte-
ectricity access.
rids.

ch & development related to efficiency
nd performance analysis.
gs.
l geospatial analysis sup-
egional, city and village scales.
® etc.).

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

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



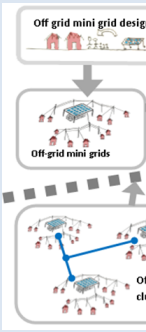
PV based electricity supply modelling for a milk collection centre in Rwanda to be used as energy hub. This includes water storage, hot water storage as well as electricity for the local community.

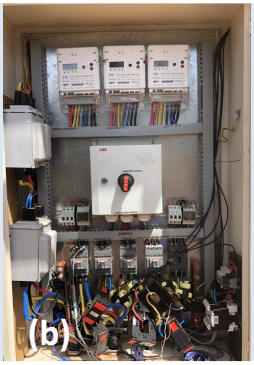
Onsite training for local engineers on 'Kitonyoni grid connected mini grid' 2022

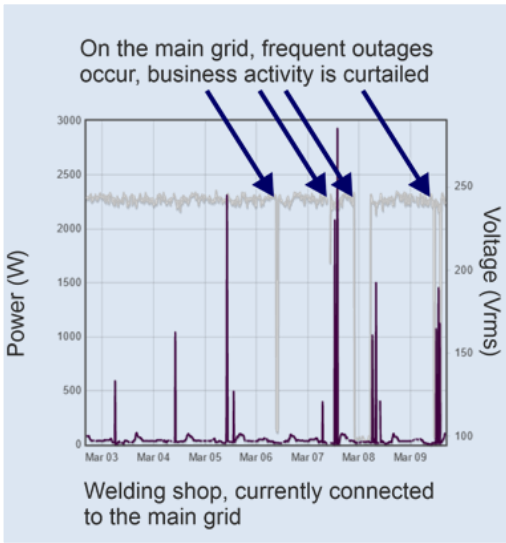
FORTIS UNUM (Stronger As One): Inn

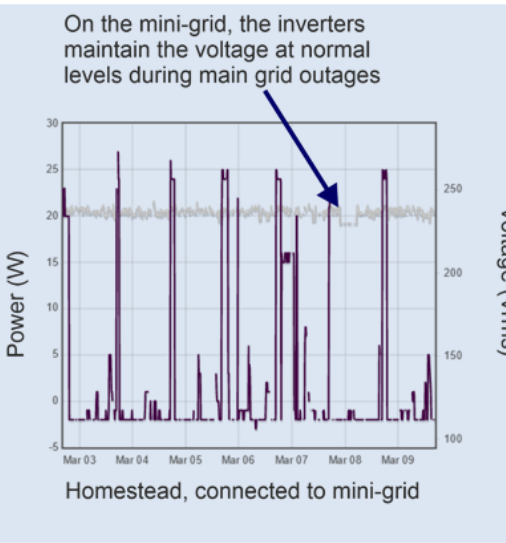
Fortis Unum builds on the extensive experience of the e4D team in the areas of energy access, mini grids and networks. This collaborative research with partners from Kenya and Uganda is studying off-grid mini grids and networks, in terms of their ability to:

Work individually.
Work collaboratively with each other in a small network cluster.
Work with utility grid at the following modes: individually and in clusters, to enhance supply security and resilience as part of the national grid.



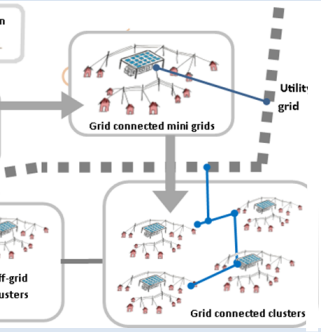






olation, Clustered or Connected to National Grid

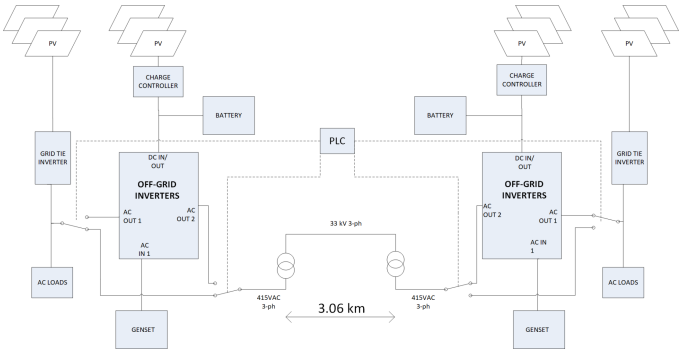
novations in Mini Grids and their Networks



Kitonyoni grid connected mini grid: (a) 3-phase plant room, (b) grid interconnection cabinet, (c) 100 kVA transformer connected to mini grid circuit (LV) and transmission line from substation (MV)

Fortis Unum research was structured to test and model mini grid systems and their network configurations to enable African households to thrive through optimised, flexible and upgradeable mini grid networks.

Key understanding and learnings cover:
Potential to cluster mini grids to form wider networks with greater stability and lower Levelized Cost of Electricity (LCOE).
Utilisation of highly stabile mini grids to support the near end line of the utility network.
Understanding the intermittent islanding operation of mini grid networks.
Demand side management approaches related to consumption profiles and mini grid network stability.



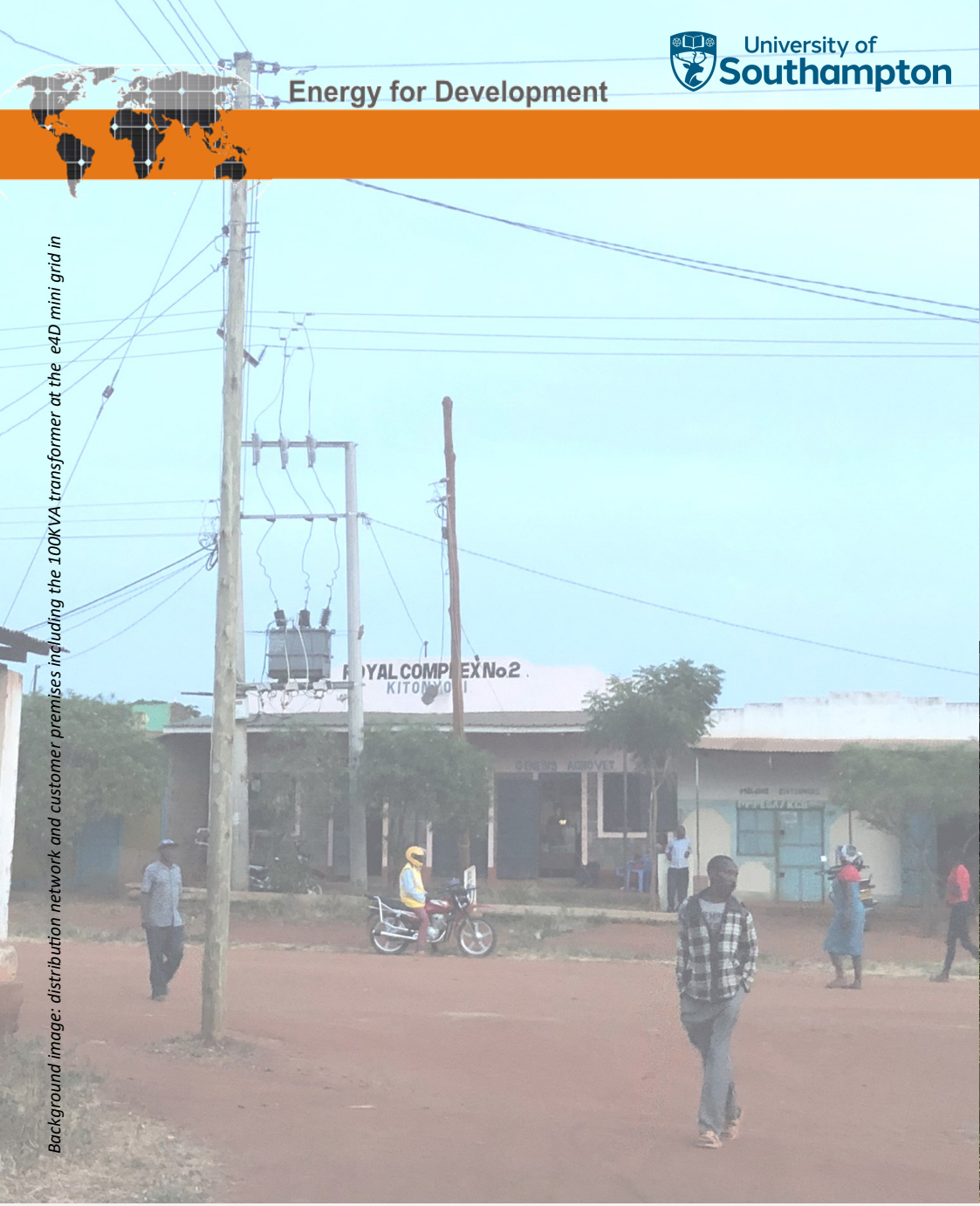
Conceptual model of clustering two mini grids in Uganda

Monitoring systems to provide diagnostics such as comparison of power supply of Kitonyoni mini grid vs utility grid.
Ongoing monitoring through Open Energy Monitor of parameters and devices to capture real power and voltage.

Utility grid stability (LV) and monitoring at the 100KVA transformer. This monitoring offers in-depth learning for future mini grid projects

Energy for Development

University of Southampton



Background image: distribution network and customer premises including the 100KVA transformer at the e4D mini grid in

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