University of Strathclyde, Glasgow, UK

Deep Dive1: Technical Design of Minigrids and Off-Grid systems

Rural Energy Access through Social Enterprise and Decentralisation
Project Closing Dissemination Event
Blantyre, April 2024

https://ease.eee.strath.ac.uk/

University of Strathclyde Engineering

Overview

- Minigrid Design Process, System Sizing, and Technology Choice – *Beston Ntepa Gama, BNG Electrical*
- Minigrid Design Tools - *Aran Eales, University of Strathclyde*
- Maintenance of Minigrids – *Edson Kathumba, Self Help Africa*
- Solar Cold Storage system design – *Community Energy Malawi*
- Questions and discussions

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Minigrid Design Process, System Sizing, and Technology Choice

Beston Ntepa Gama,
BNG Electrical

University of Strathclyde Engineering

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Minigrid Design Tools

Aran Eales,
University of Strathclyde

HOMER Pro

Hybrid optimization for multiple energy sources

- On-paid basis – 1 month free trial
- Basic module and advanced modules purchased separately
- There are options for individual PC or concurrent license
- The basic support given is ~3 days or acquiring premium support gives 24-h guarantee time

Introduction to HOMER Pro

1. **Simulates** *all* viable, possible combinations of equipment
2. It **optimizes** according to selected criteria (by default: net present cost) and models the impact of variables above your control (prices, energy resources, etc)
3. **Allows sensitivity analysis** with different constraints or sets of inputs imposed manually

What it doesn't do:

- Fully design a system, specify cabling, safety gear, ancillary devices etc
- This should be done and signed off by a qualified electrical engineer

Mini-grid power plant modelling

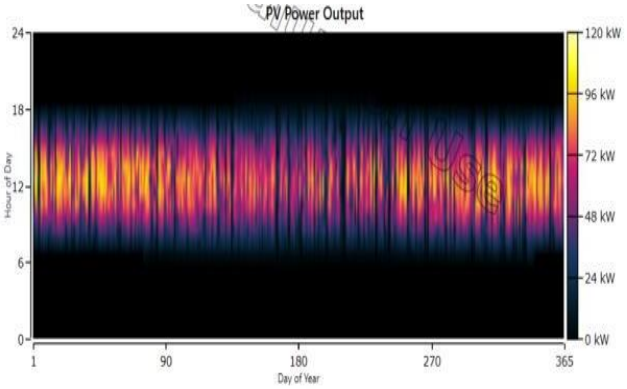
Inputs

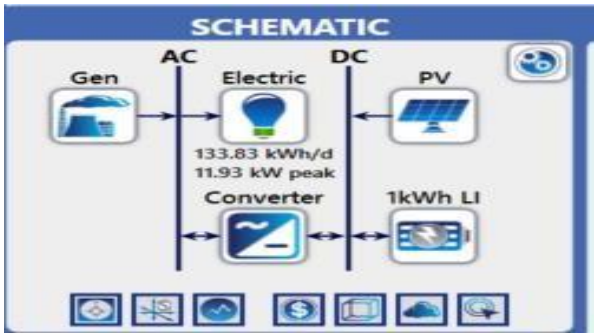
- Demand profile (current and future)
- Costs
- Component specifications
- RE resource
- Financial and other Inputs

Outputs

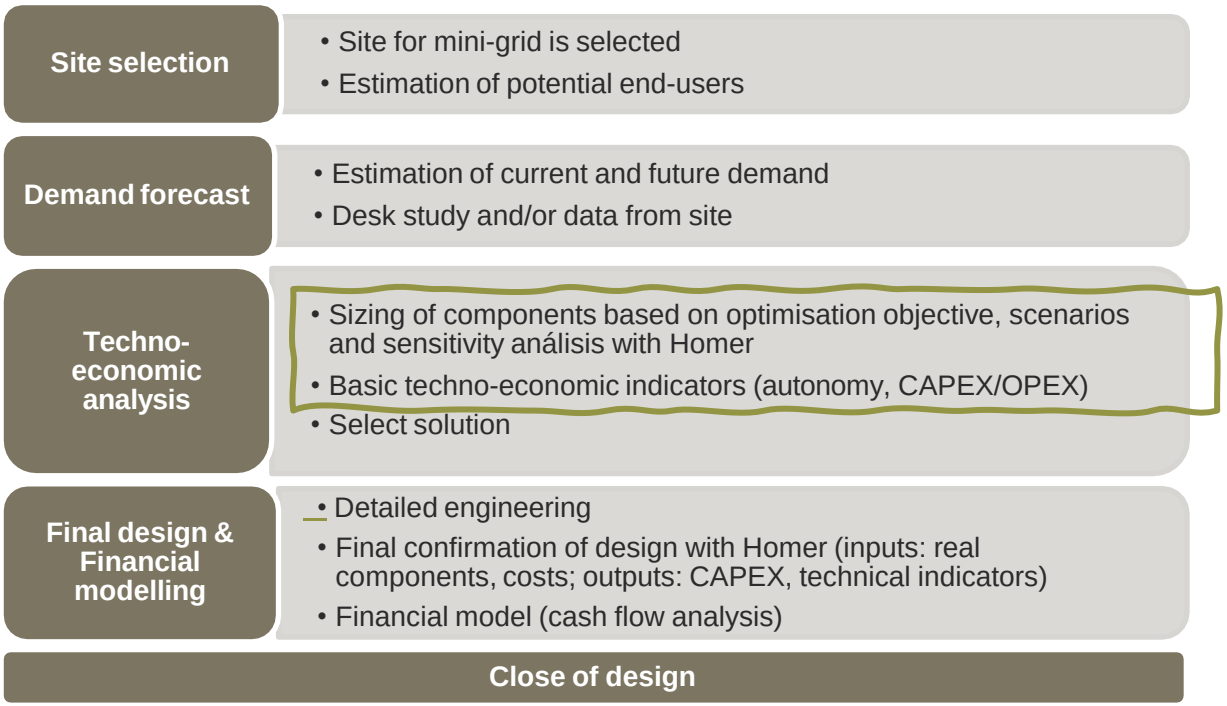
- Component sizes
- Cost of Energy
- Net Present Cost
- Electrical and economic performance graphs

Models are only as good as the data that goes into them!





In which project stage should we use Homer?



Other design tools

- GIZ's mini-grid Builder - https://www.minigridbuilder.com/
- SMA off-grid calculator - https://sma-off-grid-configurator.software.informer.com/1.0/
- Demand Analyst® - https://www.ied-sa.fr/en/tools-and-training/our-tools/demand-analystgb.html
- PVSyst - https://www.pvsyst.com/
- Energypedia catalogue of minigrid tools: https://energypedia.info/wiki/Catalogue_of_Mini-Grid_Tools

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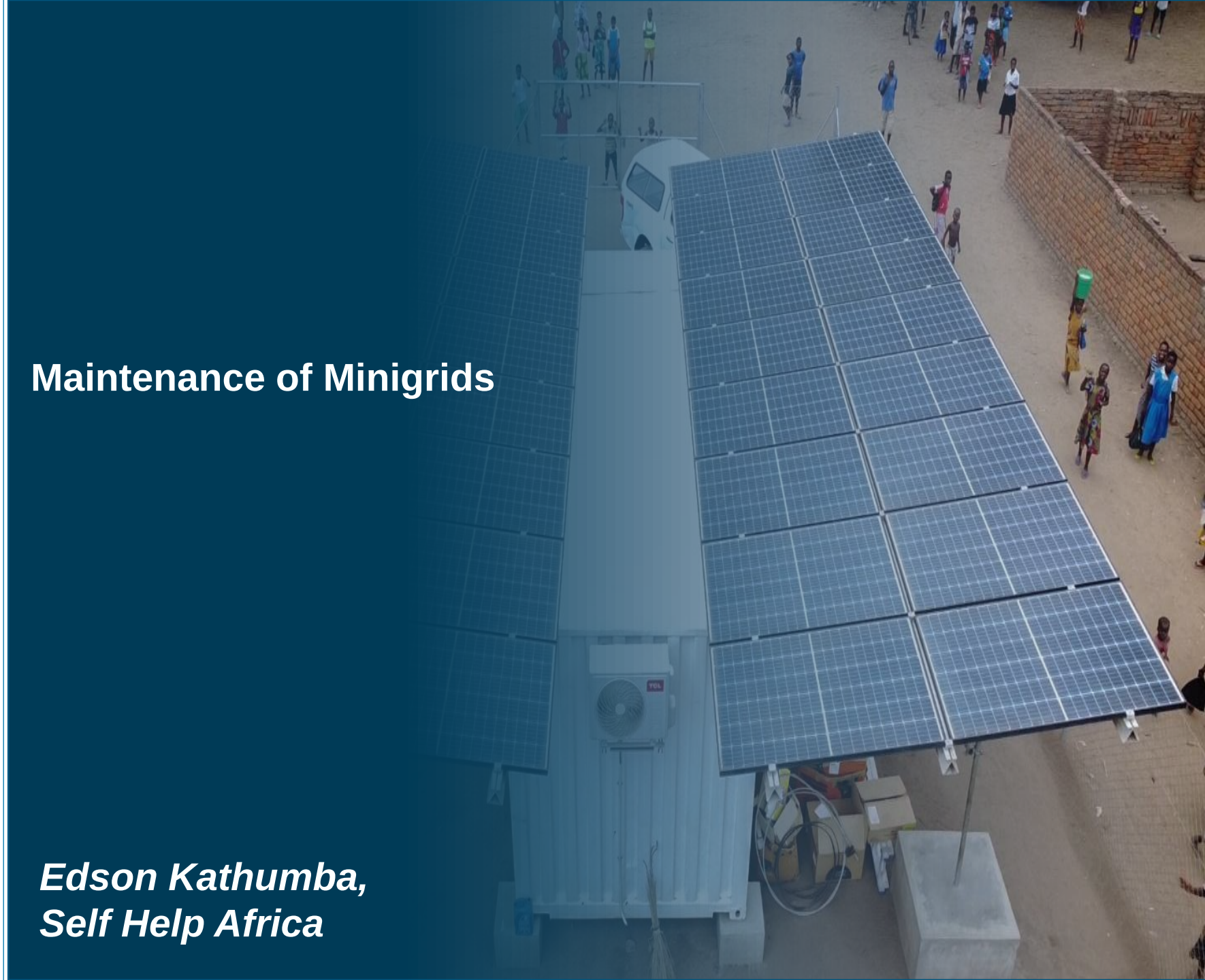
Maintenance of Minigrids



Edson Kathumba,
Self Help Africa

MAINTENANCE OF MINIGRIDS

EASE PROJECT DISSEMINATION WORKSHOP

VENUE:

MALAWI UNIVERSITY OF BUSINESS AND APPLIED SCIENCES (MUBAS)

PRESENTED BY:

EDSON KATHUMBA

FIELD OFFICER (EASE PROJECT)

SELF HELP AFRICA

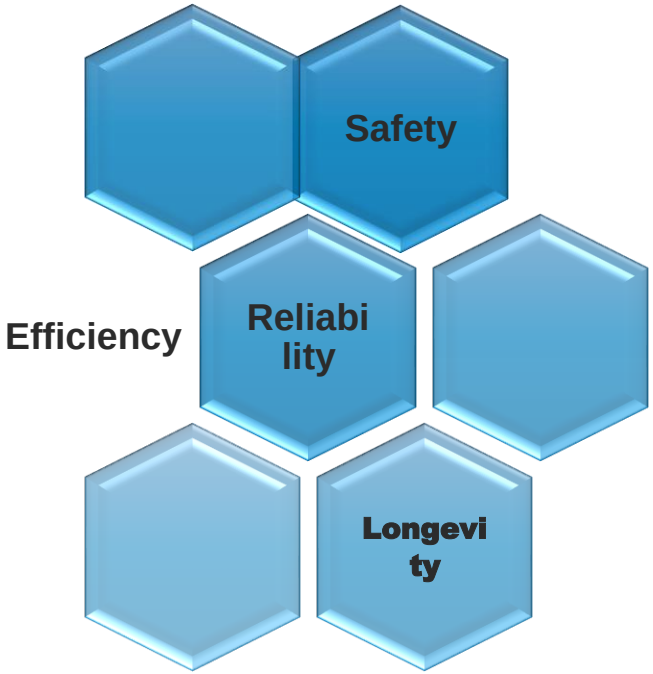
PRESENTATION OUTLINE

- Introduction
- Why routine maintenance?
- Focus areas
- Maintenance Schedule
- Lessons learnt from EASE project

Introduction

- A solar mini-grid is a small scale electricity network whose source is solar energy.
- Main Components of solar mini-grid; Solar photovoltaic panels, safety components, inverters, energy storage (batteries) and a management system.
- Overall performance of the mini-grids depend on the effective operation of all system components. components
- Routine monitoring and maintenance of mini-grids facilitates sustainability

Why routine Maintenance?



FOCUS AREAS

PV array

- General conditions, cables, connections, mounting structure

Components inside generation room

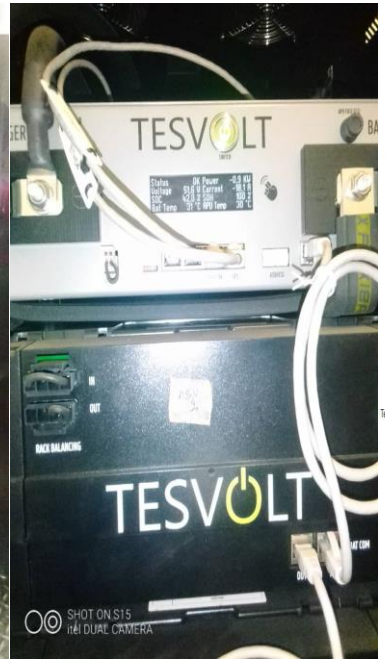
- State of combiner boxes, measure polarity and the voltages of the PV cables, inverter settings and physical components, Check battery state of health and holding capacity, Check air conditioning system, General status of the distribution board and data boards.
- General condition of the room

Distribution

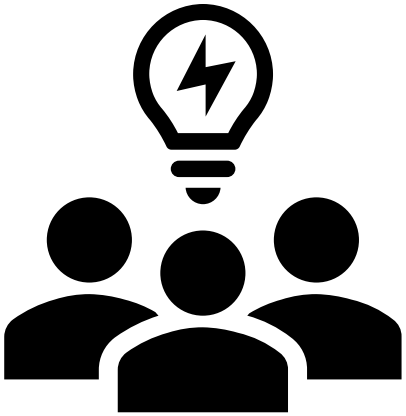
- Illegal connections and tampering, status of the poles and overhead lines, status of the core and smart meters, testing voltage levels and state of customer wiring.
- Wayleave clearing

PICTORIAL FOCUS OF SYSTEM COMPONENTS

Mthembanji solar
Microgrid system



Capacity building



- Training for maintenance personnel
- Awareness programs for electricity customers
- Empowering communities for self-sustainability

MAINTENANCE SCHEDULE

SITE AGENTS

- Daily cleaning
- Daily inspection
- Addressing minor faults

FIELD OFFICER

- Daily remote system monitoring
- Weekly and monthly physical inspection
- Testing; Voltage, current and system performance
- Repairs; addressing faults

LESSONS LEARNT FROM EASE PROJECT

- Routine maintenance has contributed to the sustainability of the operations.
- Involvement of the site agents in routine monitoring and maintenance of minor faults leads to quick rectification of faults.
- Orientation of electricity customers in safety and efficient use of electricity also reduces the frequency of faults.
- Involvement of community leaders and electricity customers in safety of distribution line components has led to low vandalism incidences.

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THE END

THANK YOU

Self Help AFRICA

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Scottish Government
Riaghaltas na h-Alba
gov.scot

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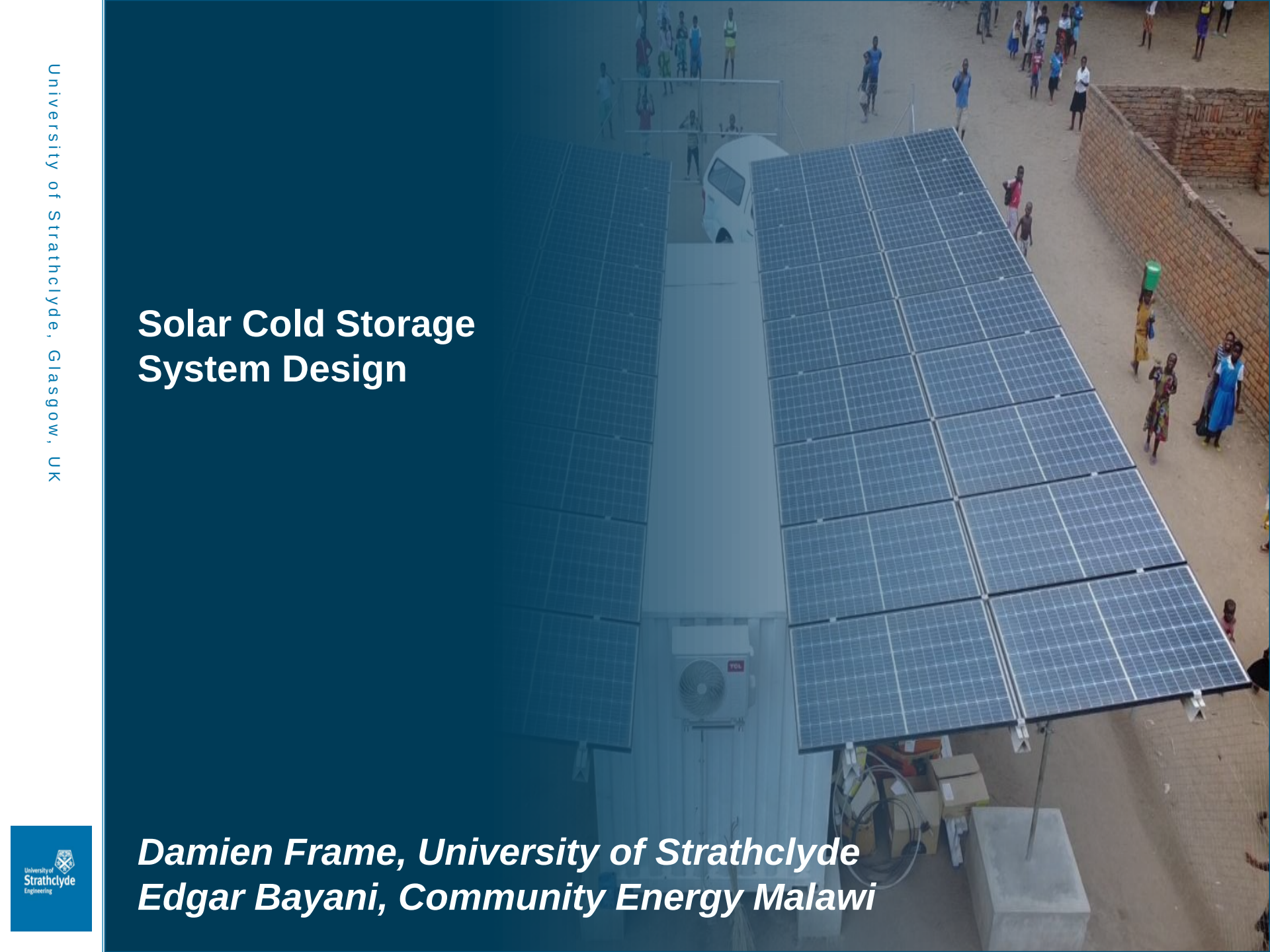
Solar Cold Storage System Design



Damien Frame, University of Strathclyde
Edgar Bayani, Community Energy Malawi

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Questions and Discussion

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