Off-grid Solar-battery Systems in Rwandan Refugee Camps

Gihembe – 4 Advanced Solar Streetlights

Nyabiheke – Community Hall Solar System

Kigeme – a micro-grid powering 2 nurseries and a playground

HEED

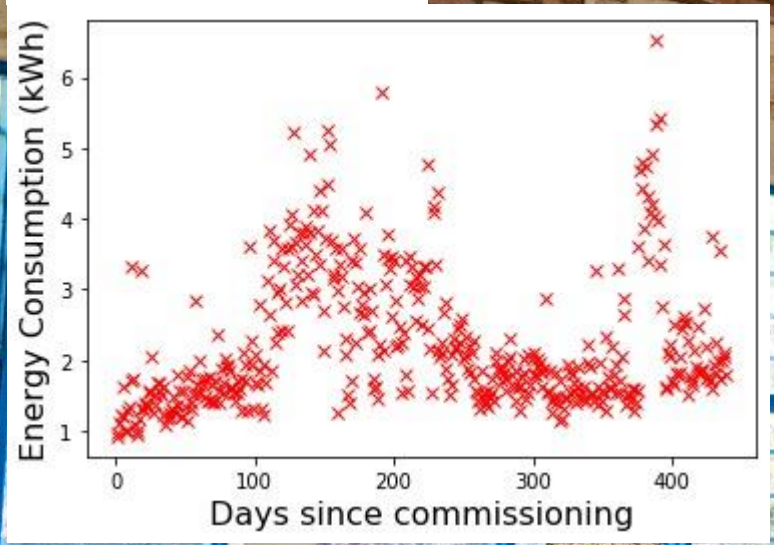
Humanitarian Engineering and Energy for Displacement

System Design

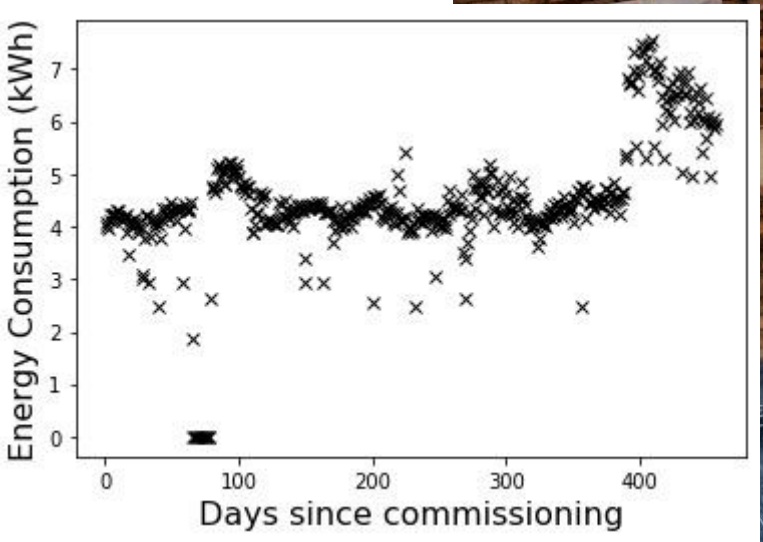
	Kigeme Micro-grid	Nyabiheke Hall	Gihembe Streetlight
			
System	Solar Panels – 2.55 kW (10 x 255 W) GEL batteries – 21.1 kWh (8 x 12V/200Ah) Inverter – 48V/1200VA	Solar Panels – 2 kW (8 x 255 W) GEL batteries – 10.6 kWh (4 x 12V/220Ah) Inverter – 48V/3000VA	Solar Panel – 320 Watt Li-ion batteries – 3.1 kWh (2 x 12.8V/120Ah) Inverter – 12V/180VA
Output	Two nurseries – 8 sockets/36 lights Playground – 2 sockets/15 lights Streetlights – 3	4 sockets 18 indoor lights /6 outdoor lights	Ground-level AC sockets with USB ports 60 Watt programmable light

Energy Consumption

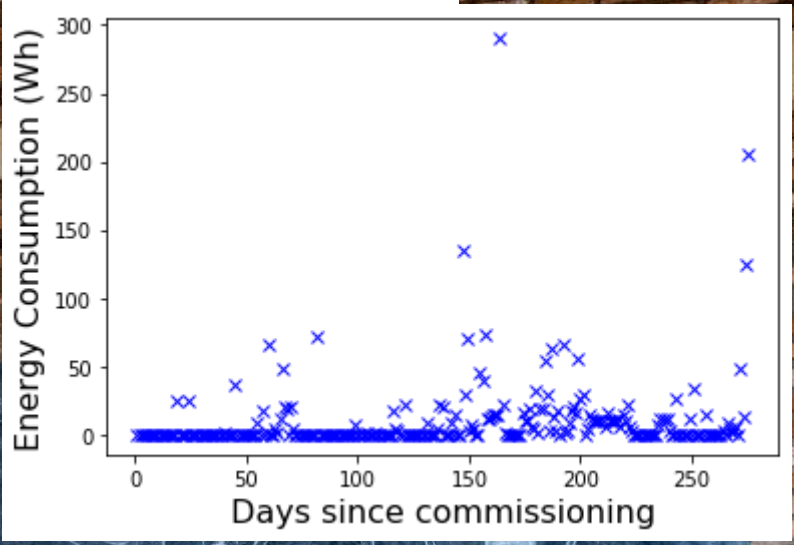
Kigeme Micro-grid



Nyabiheke Hall

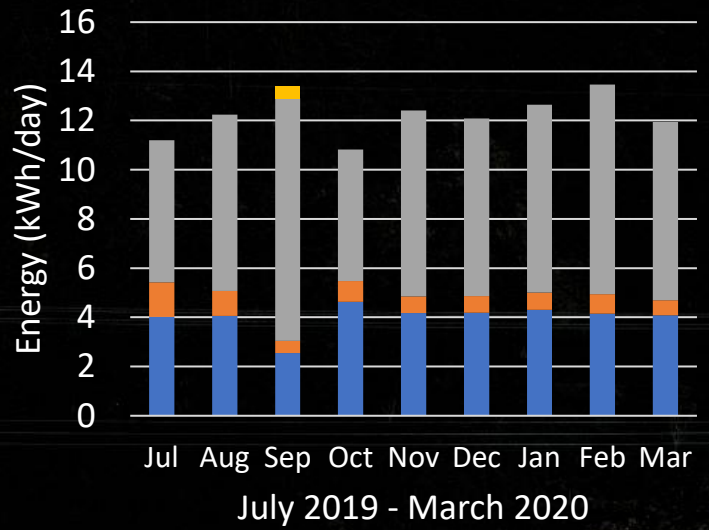


Gihembe Streetlight



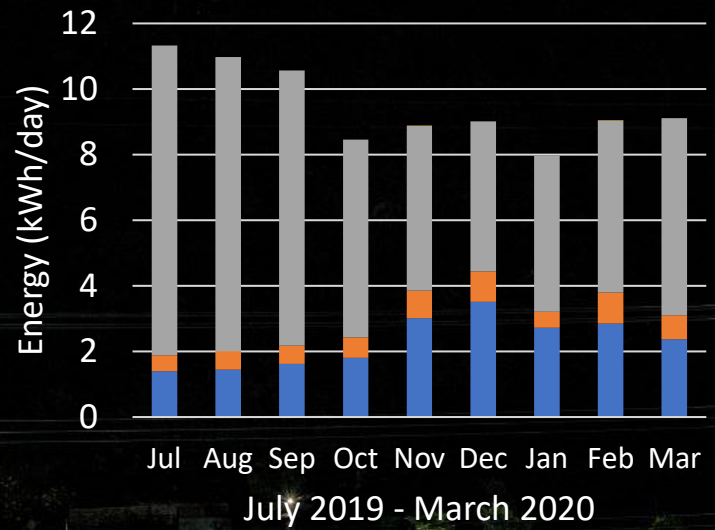
Energy Available

Kigeme Micro-grid



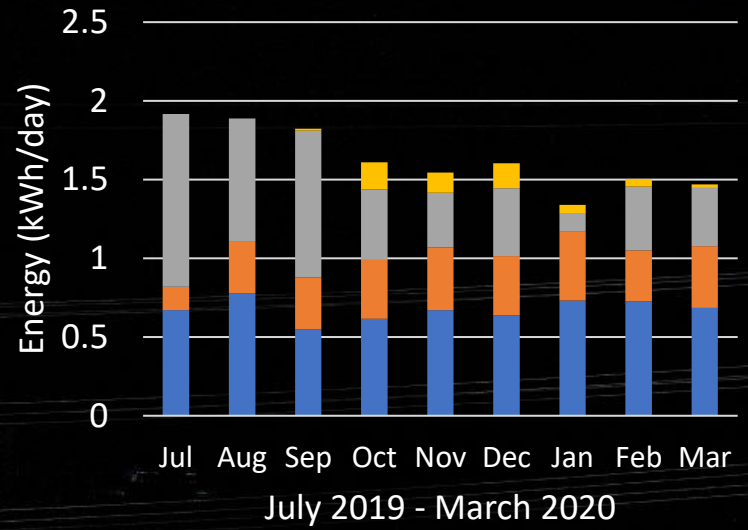
July 2019 - March 2020

Nyabiheke Hall



July 2019 - March 2020

Gihembe Streetlight



July 2019 - March 2020

System Performance

System performance was reduced due to:

- Generation-demand mismatch (supply vs utilisation)
- Component inefficiencies, availability and faults
- Limited access for users and suppliers

Implications for system design

- **Establish, manage and meet community energy demands in new ways**
  - Ascertain real energy demands prior to wider deployment where possible
  - Understand community use and access to facilities and electronic devices
  - Build flexible modularity into designs without increasing complexity to enable up/down scaling due to fluid situations and changes in downstream applications and energy demands
  - Implement energy management control systems to balance reliability (supply to meet demand), longevity of parts, component performance and cost of energy.

- **Perform pre-deployment site and local host market assessments**
  - Assess implementation challenges (access for vehicles and contractors; space for structures; terrain; environment, etc.) and opportunities for deployment at the design stage
  - Balanced use of advanced modern components and market-established products available in local host communities

- **Improve monitoring systems to support communities and improve post-intervention evaluations**
  - Implement sensor systems that can distinguish system outages (scheduled and unscheduled), faults, maintenance and communications issues
  - Use low-power, low-cost independently powered sensors
  - Use simple information technology to support fair sharing and access of a community energy resource