

# Electrifying Lives with Community Empowerment

Team: Power@NUS [IEEE Empower a Billion Lives Competition]

## Introduction

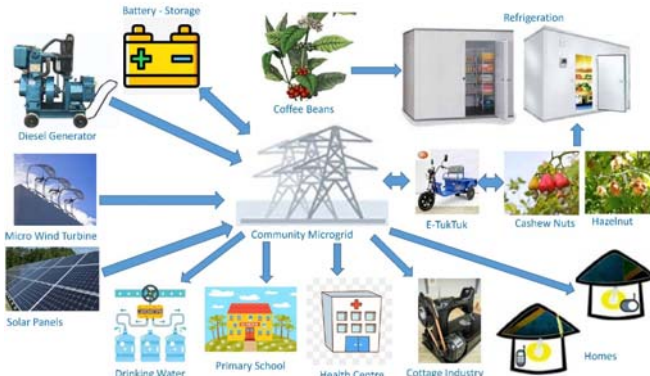
**Target area:** Sumba Island, Indonesia

- Source of Income: seasonal crops, fishing and textiles, mostly labour intensive
- Issues: electricity, crop storage, drinking water, health facilities, and unemployment

### Approach

- Centralized solution for power distribution:
  - ✓ Creating microgrid with renewable energy
  - ✓ Using renewable energy sources with minimum storage requirement
  - ✓ Facilitates economic activities through availability of energy
  - ✓ To improve public amenities

### Proposed system layout



## Economic Feasibility

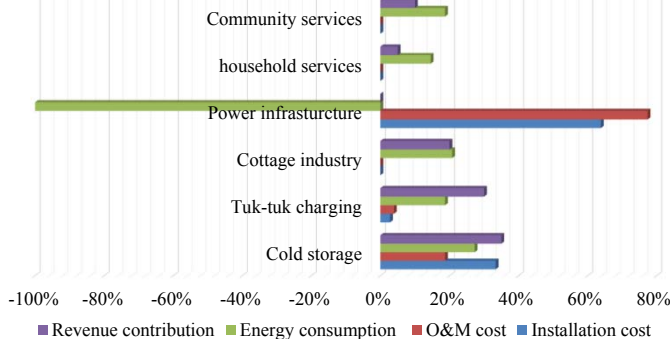
- Proposed to be funded and owned by external investors.
- Major source of Revenue: Small and micro enterprises (e-tuk-tuk charging, refrigeration and cottage industries)

Table 1: Estimation of Profit generation through revenue streams

S. No.	Revenue Source	Est'd. Revenue per month (USD)	No. of employees
1	Cottage Industry	1000	10
2	E-tuk tuk	2*900	6
3	Infrastructure Maintenance	300	3

Table 2: Estimation of Profit generation through cold storage

S. No.	Product	Density (kg/cu. Ft.)	Price/kg (USD)	Profit % in 3 months (assumed)	Profit per container (USD)	Profit per container per month (USD)
1	Coffee	17.24	1.5	10%	3320	1100.0
2	Cashew	31	1.88	10%	7460.0	2490.0
3	Hazelnuts	11.59	0.4	10%	593.0	198.0



**Expected Break even point : 3 years**

Table 3: Risk Analysis of the business model

Defaulted Cold storage SME	+21 months
Defaulted e-Tuk-tuk SME	+17 months
Defaulted cottage industry SME	+4 months
Losses in billing and collection system	+ 8 months (assuming 20% inefficiency)

## Project Description

### Loads

- Residential Consumers (50 Houses) and Public services: Housing load –LED, Small TV, phone charger, One primary health centre, drinking water supply plant
- Commercial Electric loads: Micro Cold Storage (4 nos,3500Wpk each), E-Tuktuk Charger (2 nos, 1500 Wpk), cottage industries

### Generation

- PV panels, Micro wind turbine
- Battery and Diesel generator for storage and emergency purpose.

Table 4: Consolidated details of energy generation and storage

Generation plant /Storage	Power rating (kW)	Efficiency	Number of Hours	Energy generated (kWh/day)	Cost (USD)
PV panel with MPPT converter setup	15	64%	4.5 (peak)	41.25	3460
Micro wind turbine with converter setup	6	80%	12 (peak)	52.35	5990
Diesel Generator	3			6	225
Battery (10 % of total energy per day) with 20 kVA inverter (for Solar and battery)	10		8 no. of 12V, 120 Ah of battery required		4430
<b>Total</b>	<b>24</b>			<b>99.6</b>	<b>14105</b>

Table 5: Consolidated energy consumption profile for residential and public services

Loads	Types of homes	Energy req. hours	Peak power consumption (W)	Energy Cons. (kWh/day)
Household Loads	Low energy homes (45 nos.)	1 hr day and 3 hrs night	2,250	14
	High energy homes (5 nos.)		1,000	
Service loads	Primary health centre	3 hrs	1,000	3
	Drinking water	3 hrs day	1,000	3
	School	3 hrs day and 3 hrs night	200	1.2
<b>Total consumption</b>			<b>24,450</b>	<b>93.6</b>
Energy consumption during day (kWh)				82.5
Energy consumption during night (kWh)				11.1

### Metering

- **Household Consumers:** Pay As You Go (PAYG) model with Prepaid Electricity Metering System Based on RFID, mechanism for shaping user consumption
- **Commercial Consumers:** NB-IoT connected smart meter for intelligent energy management

## Conclusion & Future works

Value generation through

- Cold-storage systems
- Cottage industry
- E-tuk tuk

- ✓ Affordable pricing: Estimated energy tariff for households is around 3.75 USD/month.
- ✓ Subsidized electricity for health center and schools.
- ✓ Selection of commercial electrical load brings robustness to the business model.
- ✓ Risks analyzed and can be covered

Present Activity: Field testing under emulated condition

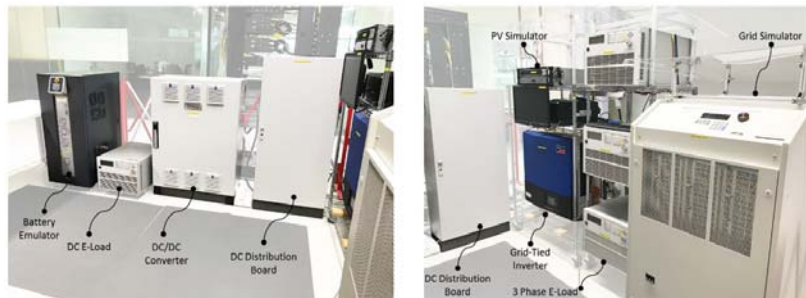


Fig: Experimental setup under the emulated SinBerBEST testbed's environment to validate the proposed community-based solution

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