Mini-grid using Renewable Energy Sources for rural electrification in Myanmar

Professor Wint Wint Kyaw

Department of Electrical Power Engineering,
Technological University, Hmawbi

Dear Professor,

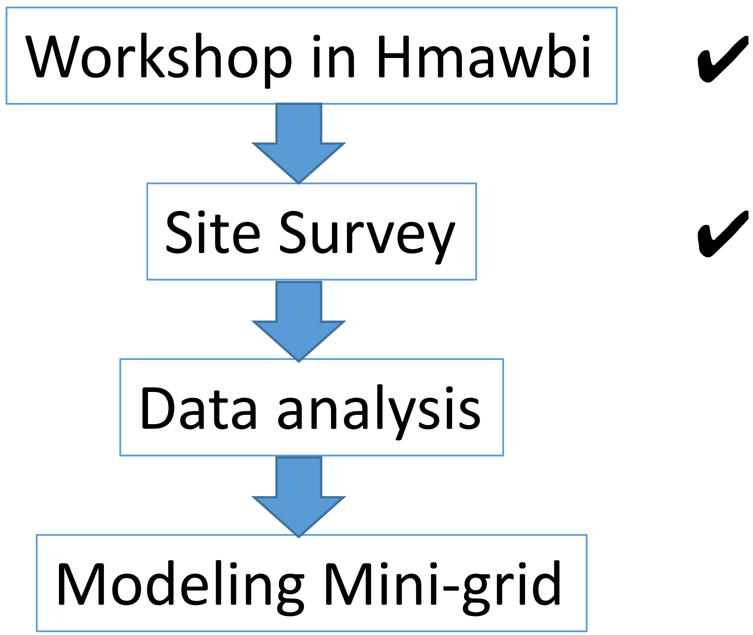
Yes sir. Dr wint wint kyaw is not in good condition. She is on leave right now for one month and my be she might resign the job afterwards. But our university would continue the MOU and projects . So please contact to me for the time being for workshop and Seminar. Can we send other professors from the same field to workshops and seminars to continue the international relations.

Thanks and Regards,
Dr Kay

Thu, 24 Jan 2019

Objective

- To develop electrification systems by using the renewable energy technologies, feasibility study of a mini-grid in one village in Myanmar.



Workshop on PV Minigird System for Rural Electrification in Myanmar

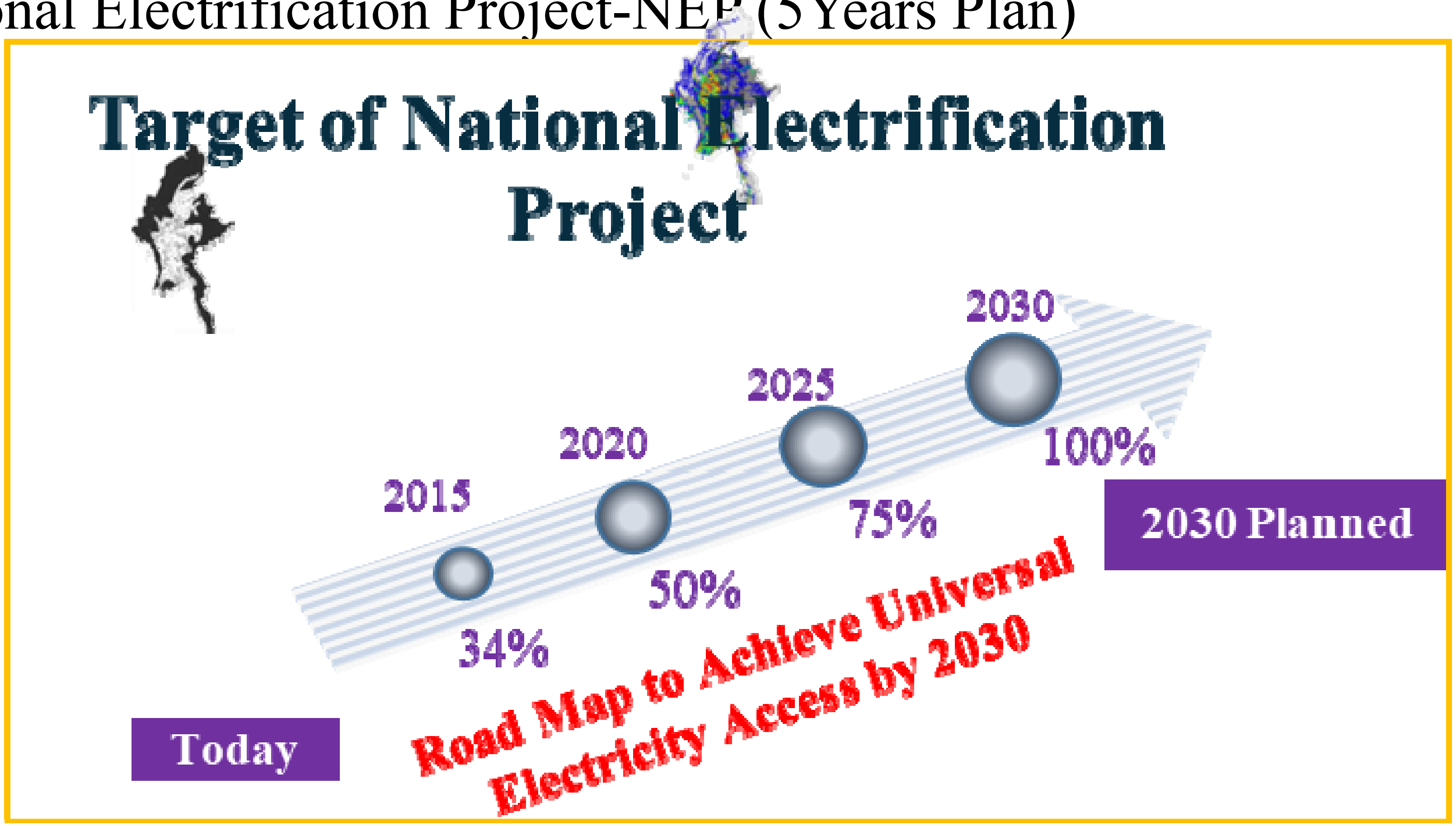
Technological University, Hmawbi, Myanmar

12th.December.2018

Dr. Kay Thi Lwin: Rector of Technological University, Hmawbi
Dr. Wint Wint Kyaw: Professor, Department of Electrical Power Engineering, Technological University, Hmawbi
Dr. Worajit Setthapun: Professor, Chiang Mai Rajabhat University, Chiang Mai, Thailand
Dr. Hla Myo Aung: Director, Renewable Energy Department, Department of Research and Innovation, Ministry of Education)
Ms. Masako Numata: Academic Assistant, The University of Tokyo
Dr. Hideaki Ohgaki: Professor, Kyoto University

National Electrification Plan

Off-grid Electrification Program using Renewable Energy Under National Electrification Project-NEP (5Years Plan)



Sr.	Fiscal Year	SHS		Mini-Grid		Total		Remark
		Village	Household	Village	Household	Village	Househld	
1	2016-2017	2708	141465	10	1503	2718	142968	Completed
2	2017-2018	1366	88019	16	3127	1382	91146	On-Going
3	2018-2019	2367	123864	100	10000	2467	133864	Plan
4	2019-2020	1500	122950	100	9095	1600	132045	Plan
5	2020-2021	1500	128550	100	7380	1600	135930	Pln
Total		9441	604848	326	31105	9767	635953	

Environmental and Social Safeguard Activities of NEP (Off-Grid)

- Organize Safeguard Team under NEP Project Manager Office
- Implement Environmental and Social Management Framework (ESMF) in line with the World Bank's Guidelines
- Ensure compliance with the environmental and social safeguards
- Take necessary action based on impact assessments
- Review environmental and social impact assessment and related measures to reduce or mitigate impacts of micro and mini-hydropower projects, biomass gasification, etc
- Oversee research on decommissioning and disposal of Mini-Grids and Solar PV systems (especially battery recycling)
- Provide training on environmental and social aspects of off-grid electrification at Union and

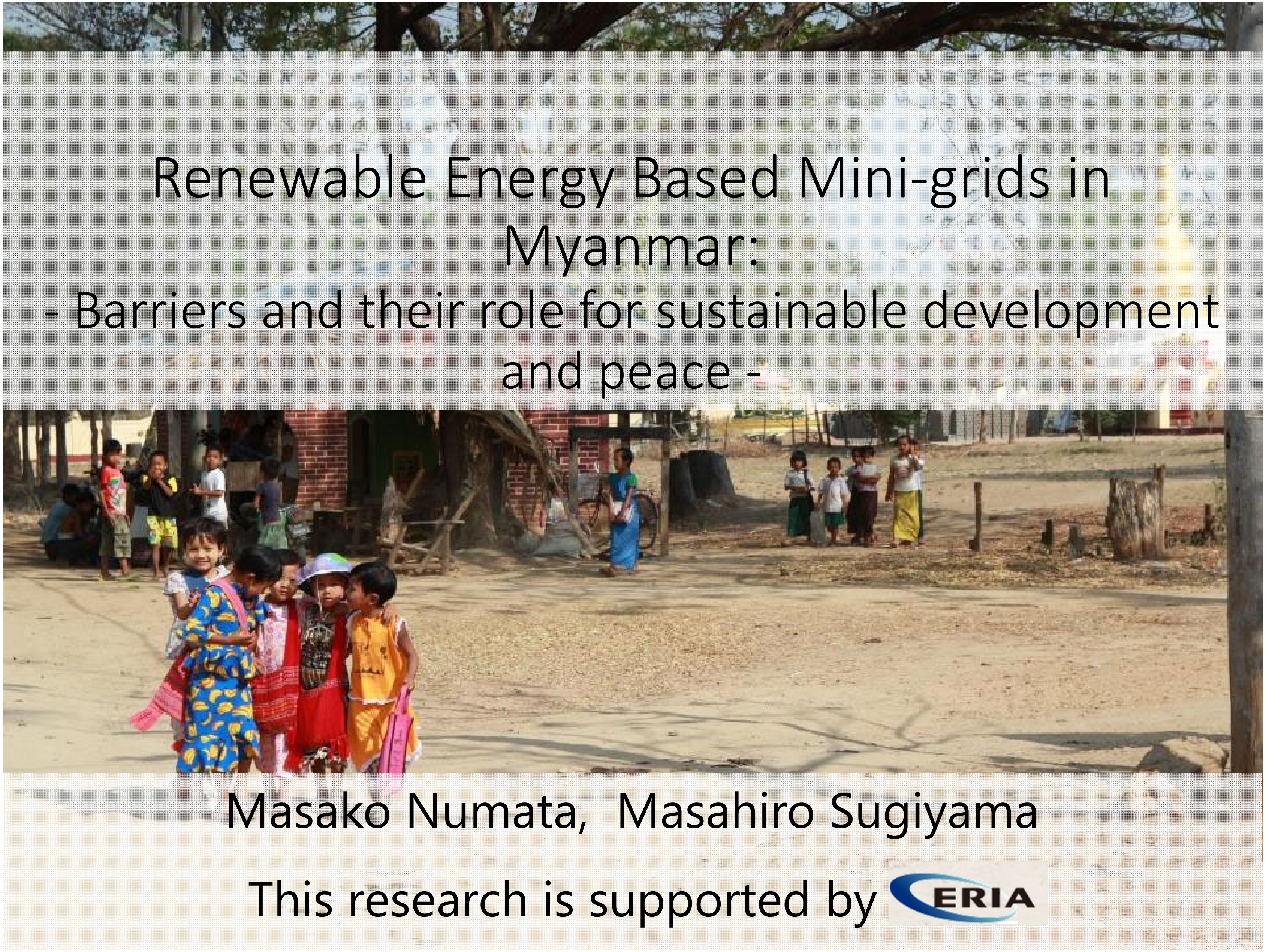
Actions to Promote Mini-Grid Projects

- Invite Call for Proposals (CfP) for Private Sector's Participation
- Budget Allocation - 60% by NEP Budget
  20% by Developers
  20% by Community
  100%
- Ownership - Co- Ownership of Community and Developer
  - Pay Back Period - 6~10 years (based on tariff rate)
  - Tariff Rate - 350 Kyat (0.22$) ~ 500 Kyat(0.33$)/kwh

Actions to Promote Mini-Grid Projects cont.

- After Sales Service of Suppliers - to provide O & M Training
- After Operation Period (Owner) - Community
- After Commissioning (O & M) - Community
- DRD's Responsibilities - Commissioning, Monitoring & Evaluation
- Finalize the Small Scale Electricity Enterprise Regulatory to provide Assurance for our Developers

Renewable Energy Based Mini-grids in Myanmar:
- Barriers and their role for sustainable development and peace -



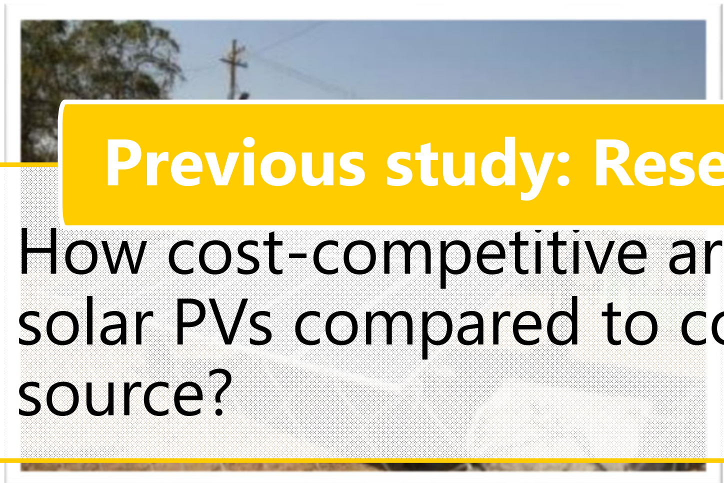
Masako Numata, Masahiro Sugiyama

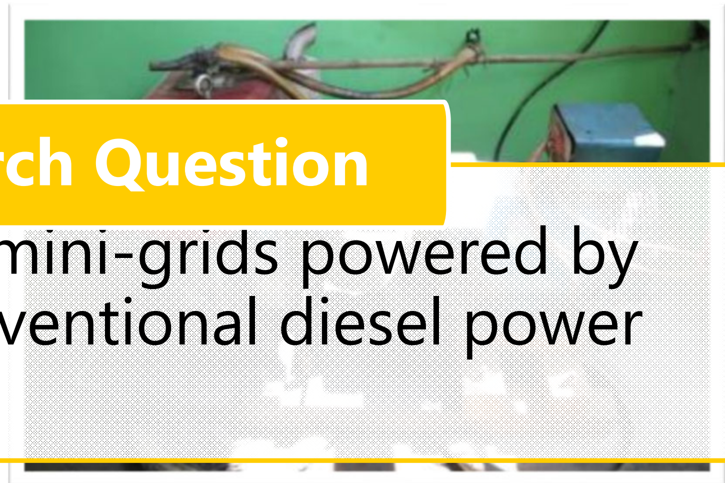
This research is supported by ERIA

Mini-grids in Myanmar

	No. of villages
Diesel generator	13,000
Mini hydropower	2,400
Biomass gasifier	1,200
Solar PV	150

Greacen (2017). Myanmar Mini-Grid Overview (p. 24). Nay Pyi Taw.





Previous study: Research Question

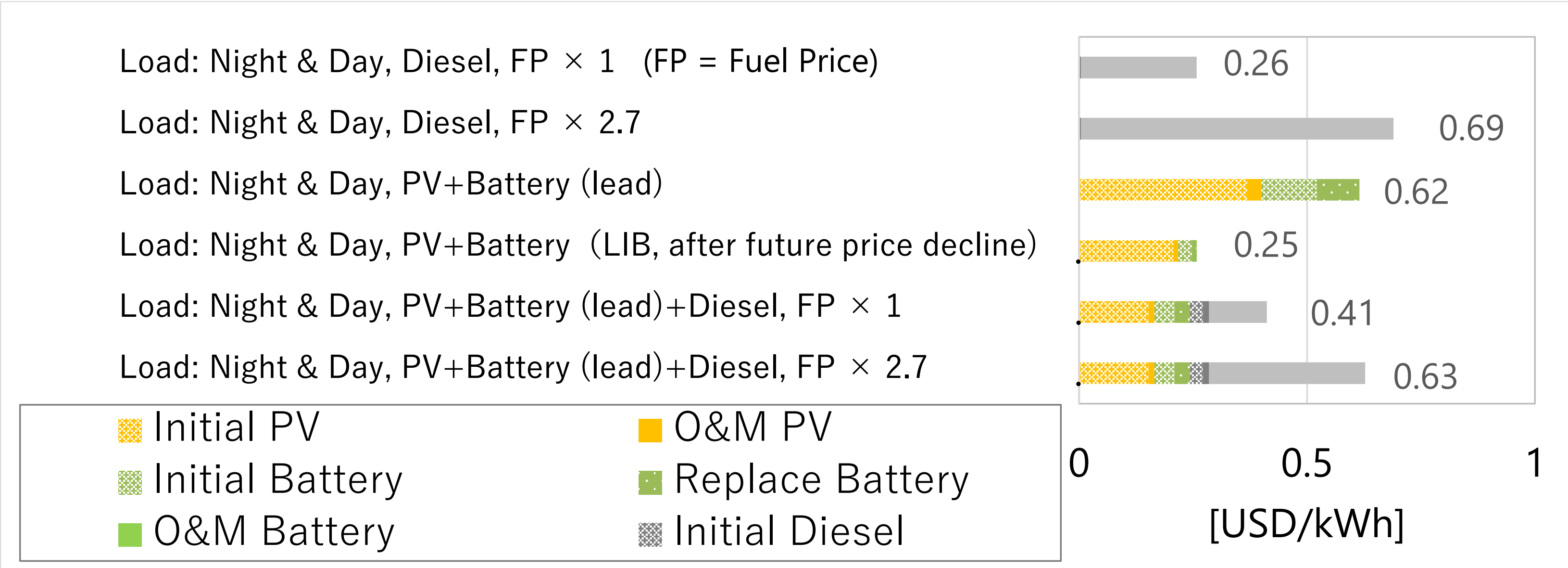
How cost-competitive are mini-grids powered by solar PVs compared to conventional diesel power source?

Previous study: Cost competitiveness of PV mini-grids

- Calculated LCOE (Levelized Cost of Electricity) based on interview and questionnaire survey data

Survey 1	
Date	February 2–3, 2017
Venue	Yangon Technological University
Method	Semi-structured interview Interview protocol (Comello et al., 2017)
Number of interviewees (companies)	7
Survey 2	
Date	April to July 2017
Method	Questionnaire
Number of interviewees (companies)	2
Survey 3	
Date	October 19–24, 2017
Method	Open interview
Number of interviewees (companies)	4

Comparison of LCOE

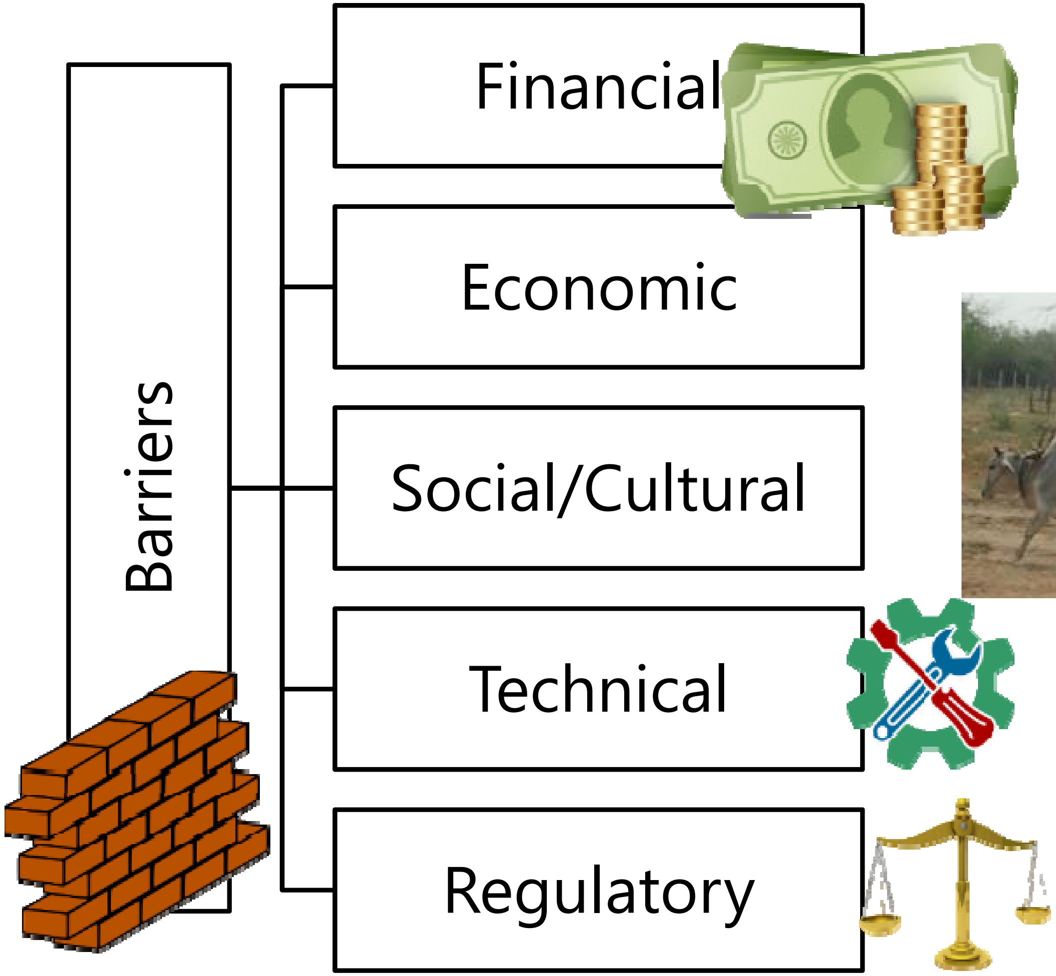


Numata et al., (2018) ERIA Discussion paper series. Forthcoming.

Research Question

In rural areas, where the fuel cost is high, what is the barriers to deployment of solar- and battery-powered mini-grids?

Barrier typology



Painuly (2001) “Barriers to renewable energy penetration: A framework for analysis”.

Barrier typology

Comello et al., (2017). "Enabling Mini-Grid Development in Rural India,",.
Greacen (2017). "Role of Mini-grids for Electrification in Myanmar - SWOT Analysis and Roadmap for Scale up."

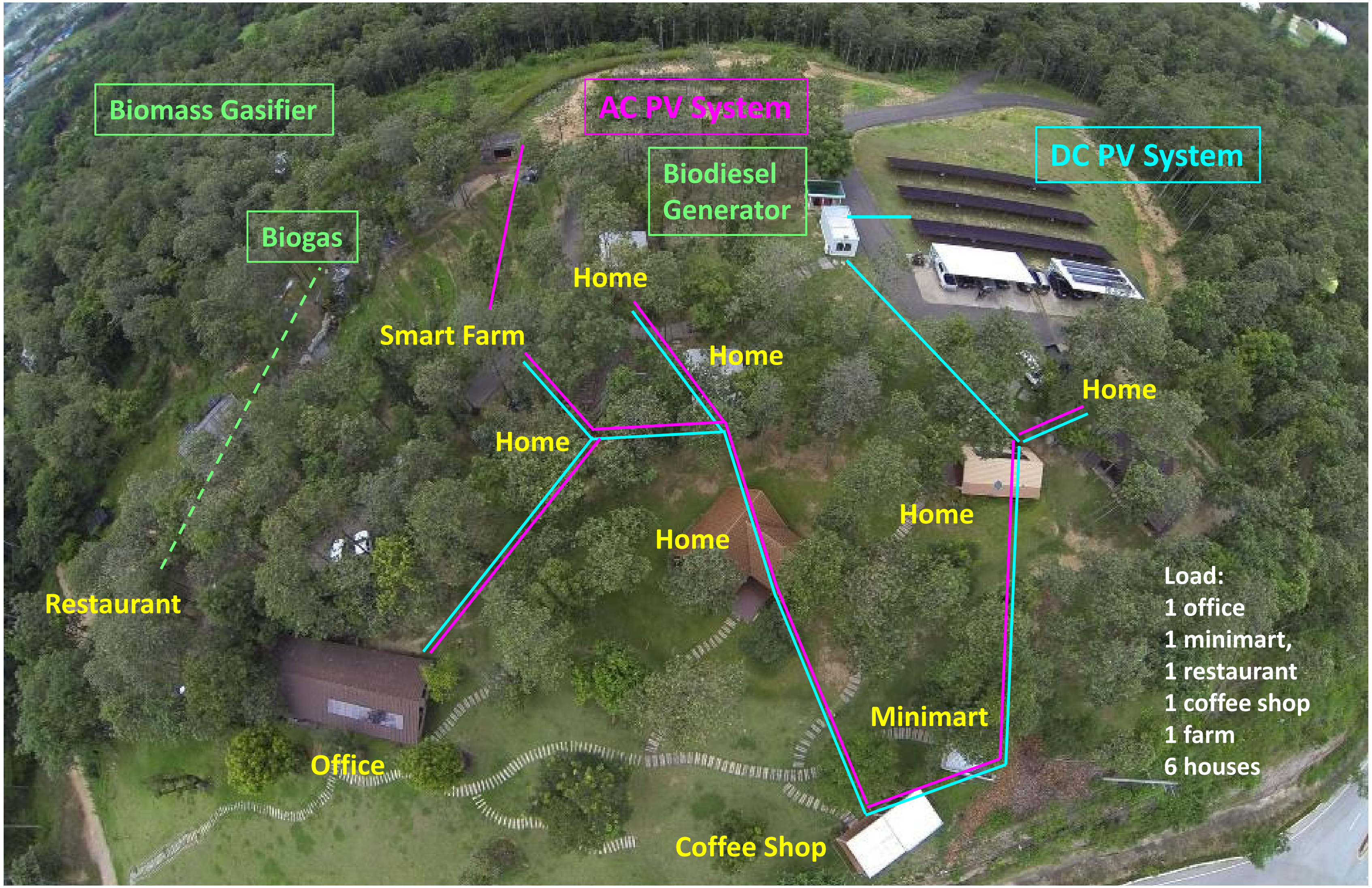
Financial barriers	Economic Barriers	Social/Cultural Barriers	Regulatory Barriers	Technical Barriers
Access to finance	Small market size	Negative externalities by international organizations	Lack of regulatory framework	Technology gap
High cost of capital	Low demand	Ethnic/ language difference	Lack of technical standards	Lack of inter-connectivity with main grid
Insufficient customers' capital	Cost-revenue gap: tariff structure	Education gap	Institutional capacity	Intermittency
Currency risk	Fee collection	Perception of inferior quality	Threat of grid extension	Operation and maintenance (O&M)

DC MICROGRID

CASE STUDY:

SMART COMMUNITY, CWGC
CHIANG MAI, THAILAND

Smart Community – DC Smart Grid



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Scope of DC Community

- Living Laboratory for community transition from
  AC → AC/DC → DC Community

- Evaluate Low Cost - Low Voltage DC Community Power System at the Smart Community
  - Phase 1: Lightings 24 VDC/ 1 House 240 VDC
  - Phase 2: Household Appliances 260-297 VDC

- Modify/Testing Household Appliances for DC & AC usage
  - Lighting, Refrigerator, Air Conditioner, Water Heater, Television, Computer, Rice Cooker, Microwave, Washing Machine

- Evaluate appliances during operation, stability and safety
  - Full DC
  - Full AC
  - Mixed DC & AC

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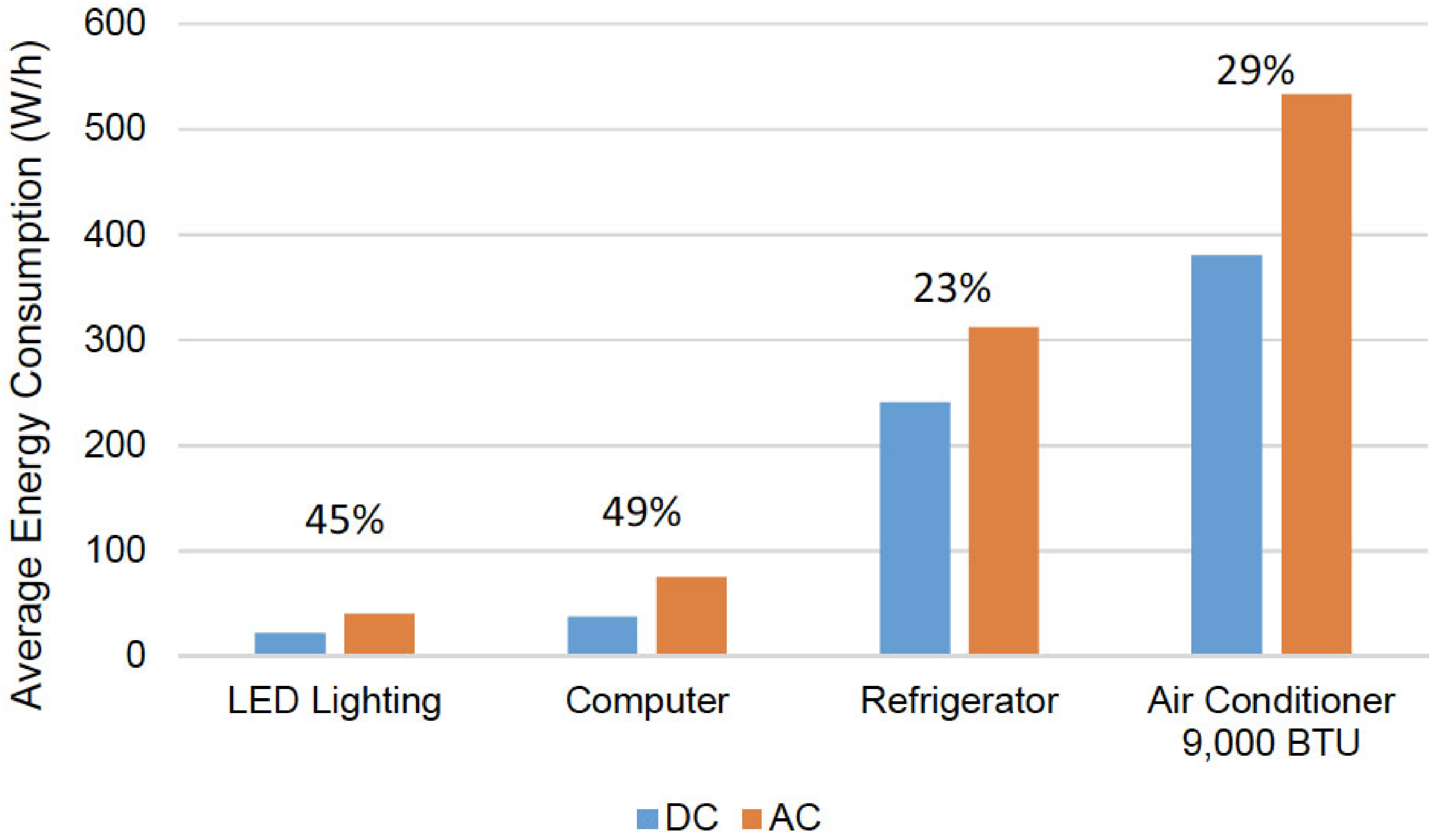
2nd Phase DC Microgrid

Mode	Central Battery Voltage Stage	Usage
Full	297 – 260 VDC	DC use directly from Central Battery bank
Battery Boosting	260 – 250 VDC	DC from Battery bank (260 VDC) & Booster (54 VDC)
Biodiesel Generator Start	250 – 242 VDC	Generator - Charge Battery Bank - Charge Booster Batteries If ran out of fuel, AC from Utility will convert to DC
Battery dead	Below 242 VDC	Automatically switch to AC

Note: Voltage range depends on Charger Specification, battery voltage range and electrical load device requirements.

DC vs. AC

Energy Consumption Comparison



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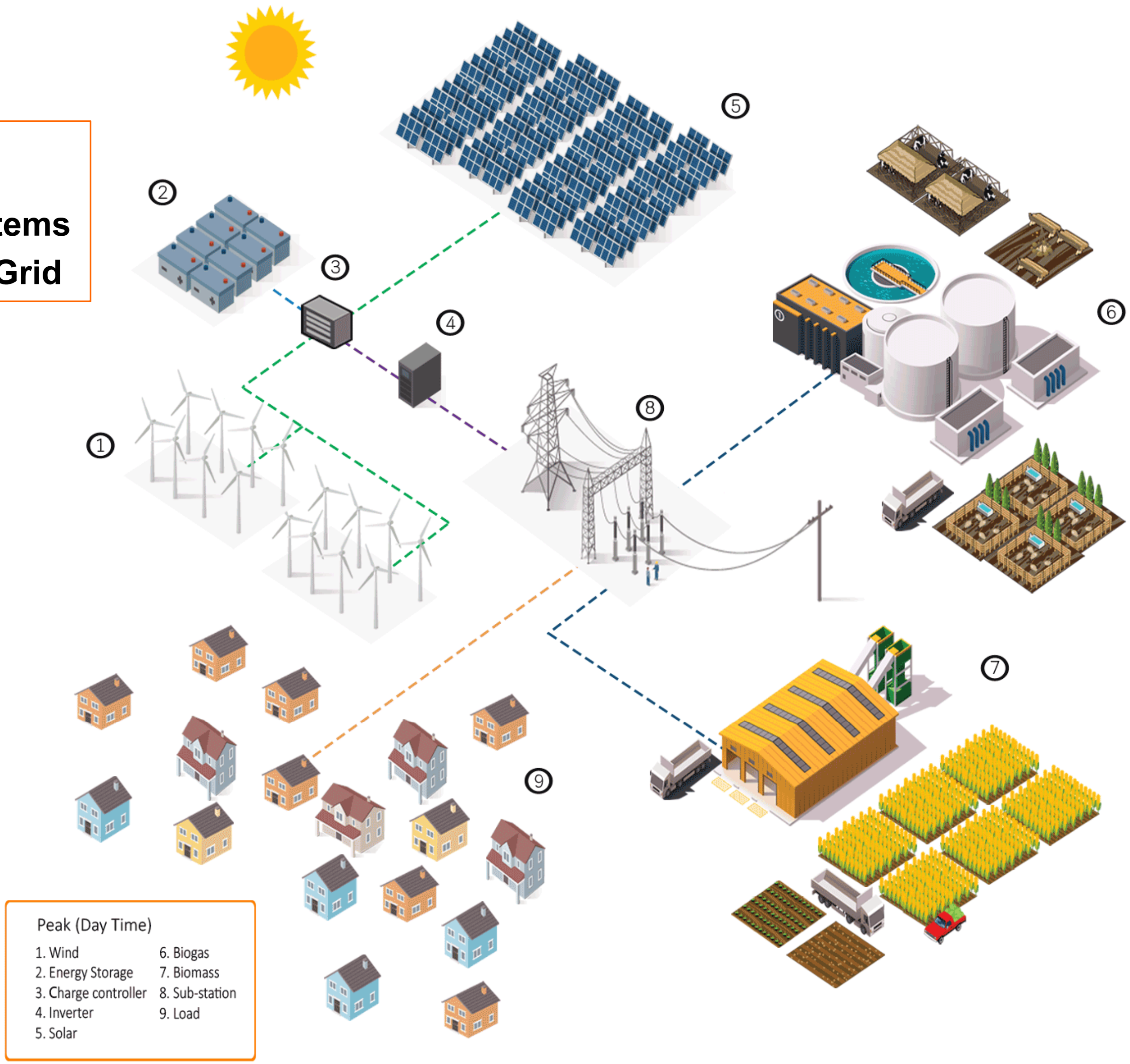
Issues to Overcome

- System Issues
  - Stability/Durability of components of the power supply when switching between DC and AC (capacitor, PLC)
  - The online connectivity with university network
  - Integrating Distributed Generations (voltage range - Diesel Generator)
- Nature Issues
  - During the rain, the voltage fluctuates from the utility line which cause the Hybrid Microgrid system to be disrupted.
  - Animals
- Human Issues

Goal

Demo-Site for

Energy Hybrid Systems Community Smart Grid



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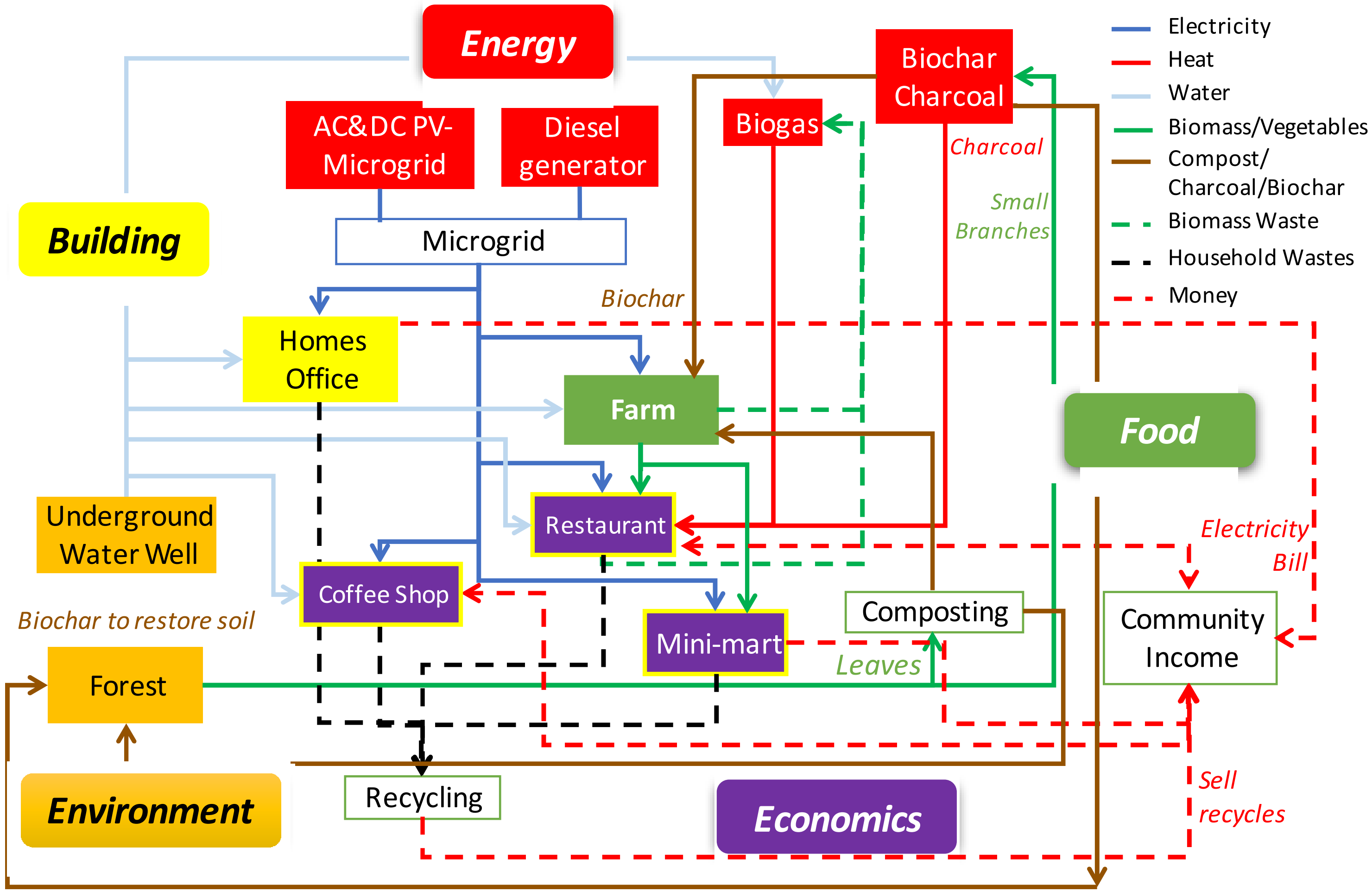
Goal: Realtime - Smart Community Monitoring



2017 Approved Project for Energy Conservation Fund, Ministry of Energy, Thailand

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Smart Community Database

Environmental

Recycle waste (kg)
Organic waste (kg)
Hazardous waste (kg)
The frequency of dumping waste (time)
Date/time

Food

Vegetable production (Kg)
Using fertilizer (Kg)
Another material in cultivation (Kg)
Consumption and sale of vegetable (Kg)
Date/Time

Energy

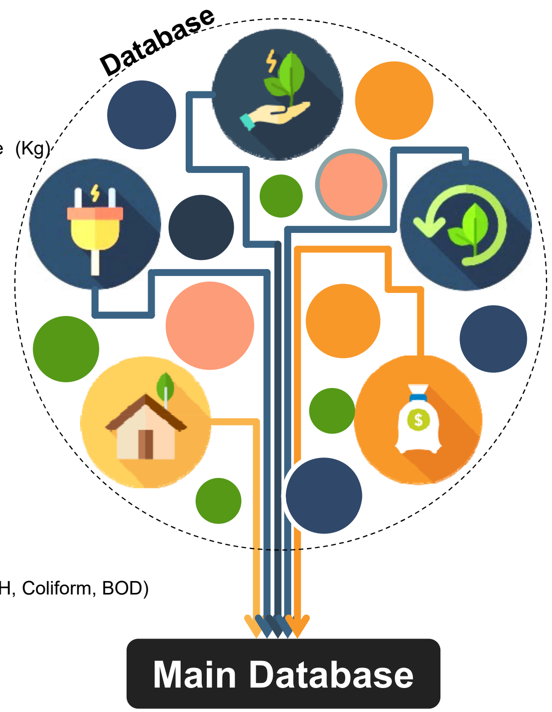
Production (kwh)
Consumption (kw)
Raw material of biogas and charcoal production (kg)
Biogas and charcoal yield/consumption (kg)
Fuel consumption in transportation (L)
Date/time

Economic

Expenses (Baht)
Income (Baht)
Date/Time

Building

Indoor/Outdoor temperature (° C) and humidity (%)
Outdoor solar intensity (W/m2) and wind velocity (m/s)
Water consumption (L) / Water flow rate average (L/min) and quality (Nephelometric Turbidity Units, pH, Coliform, BOD)
Particulate in the air (PM)
The frequency of using water (Time)
Date/Time



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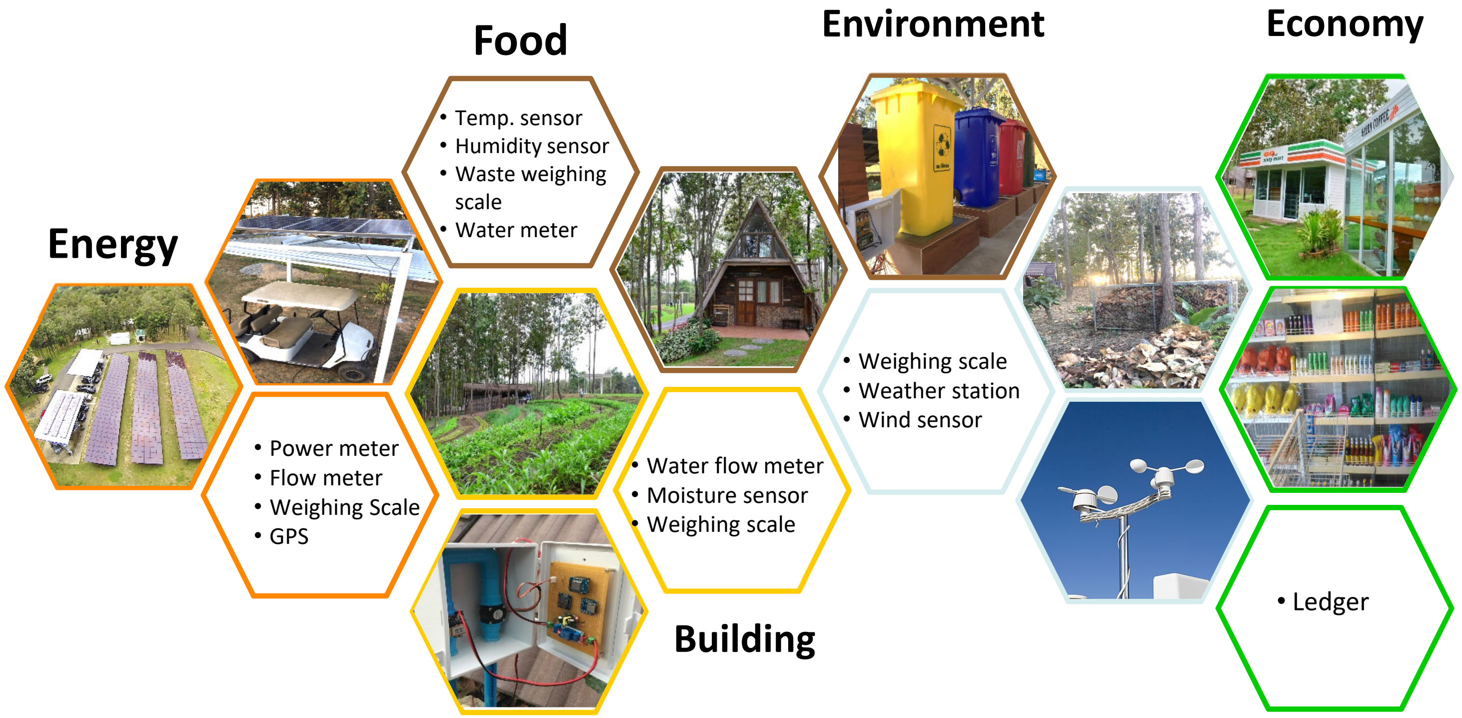
Instruments for Data Collection



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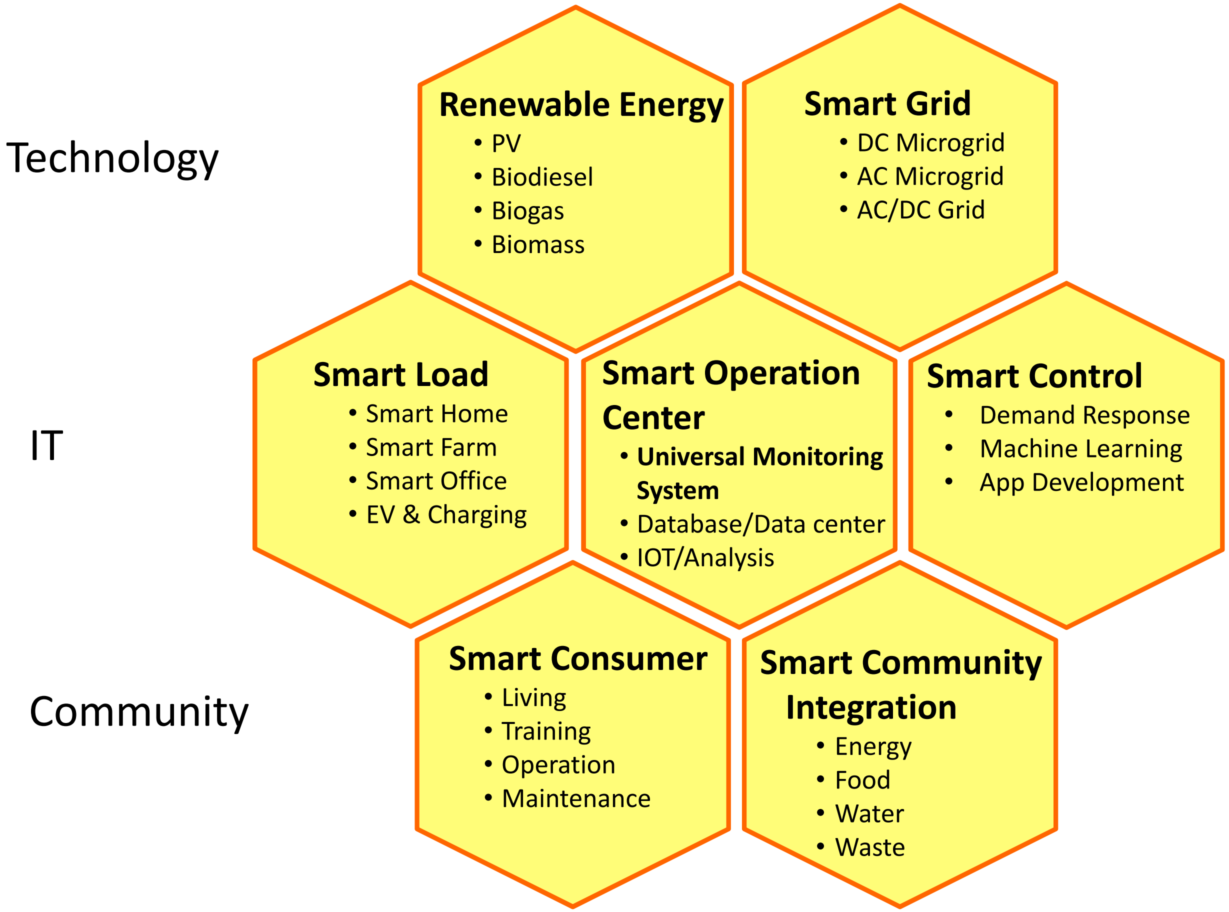
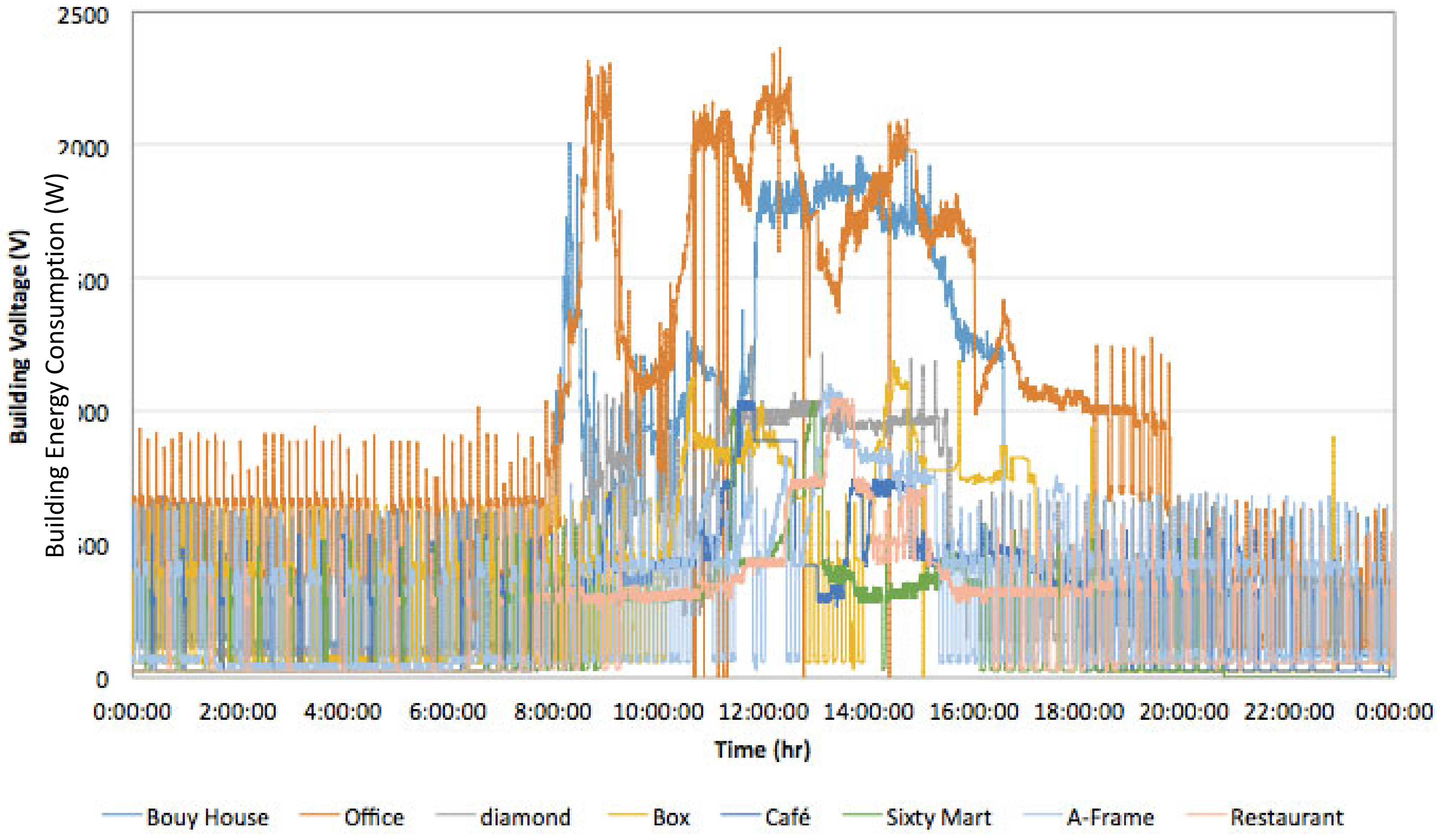
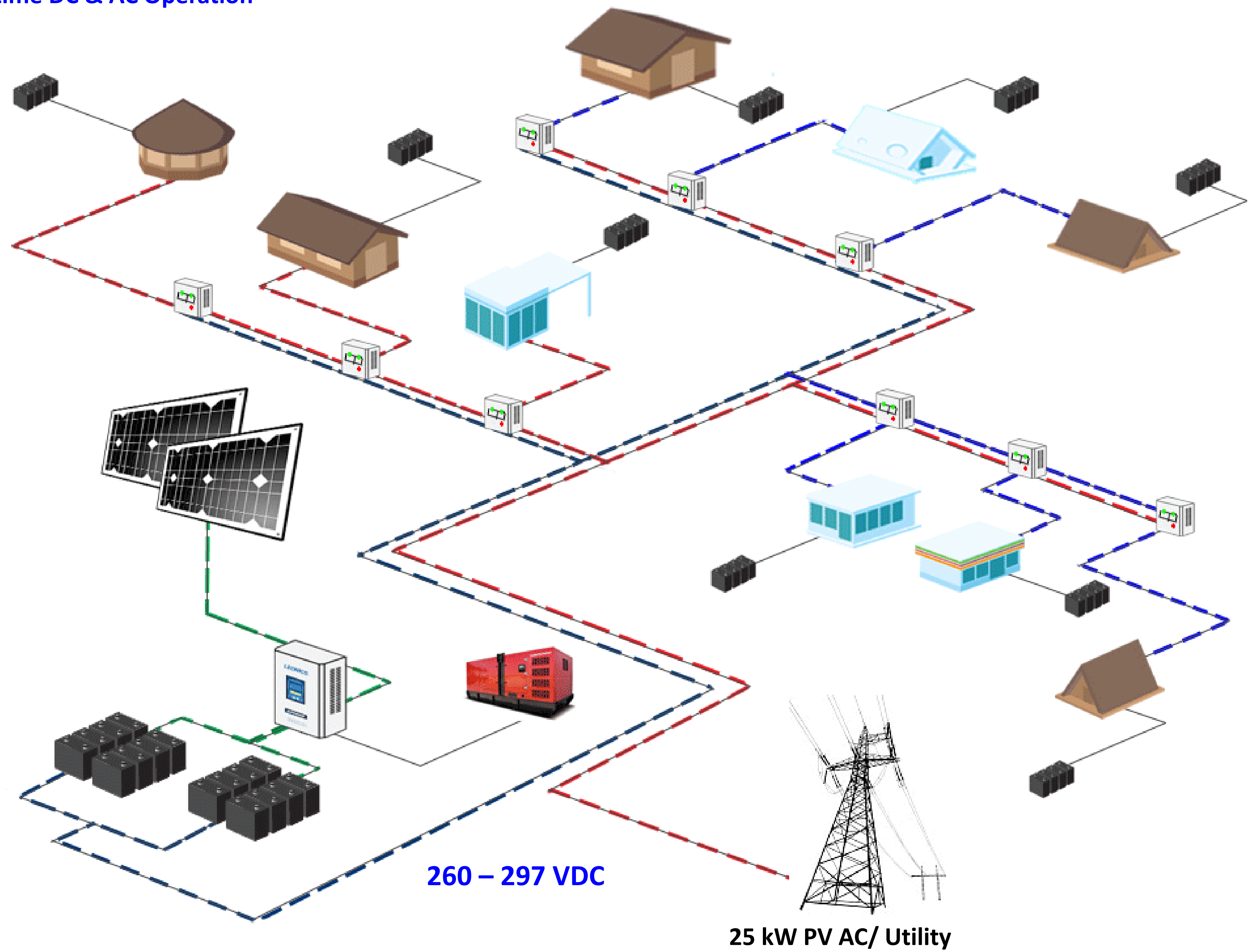
adiCET Smart Grid Component



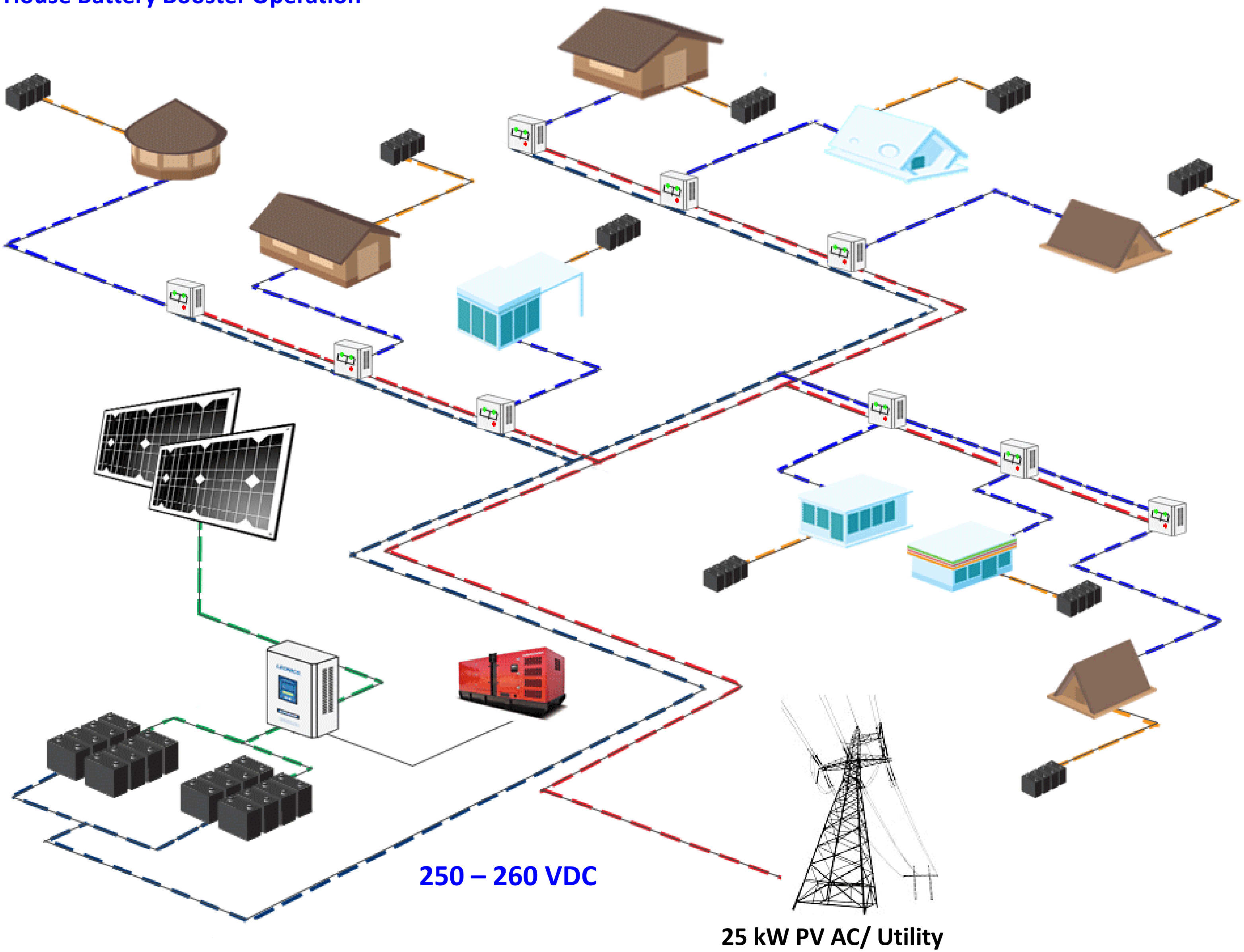
Phase 2:
Building Power Consumption



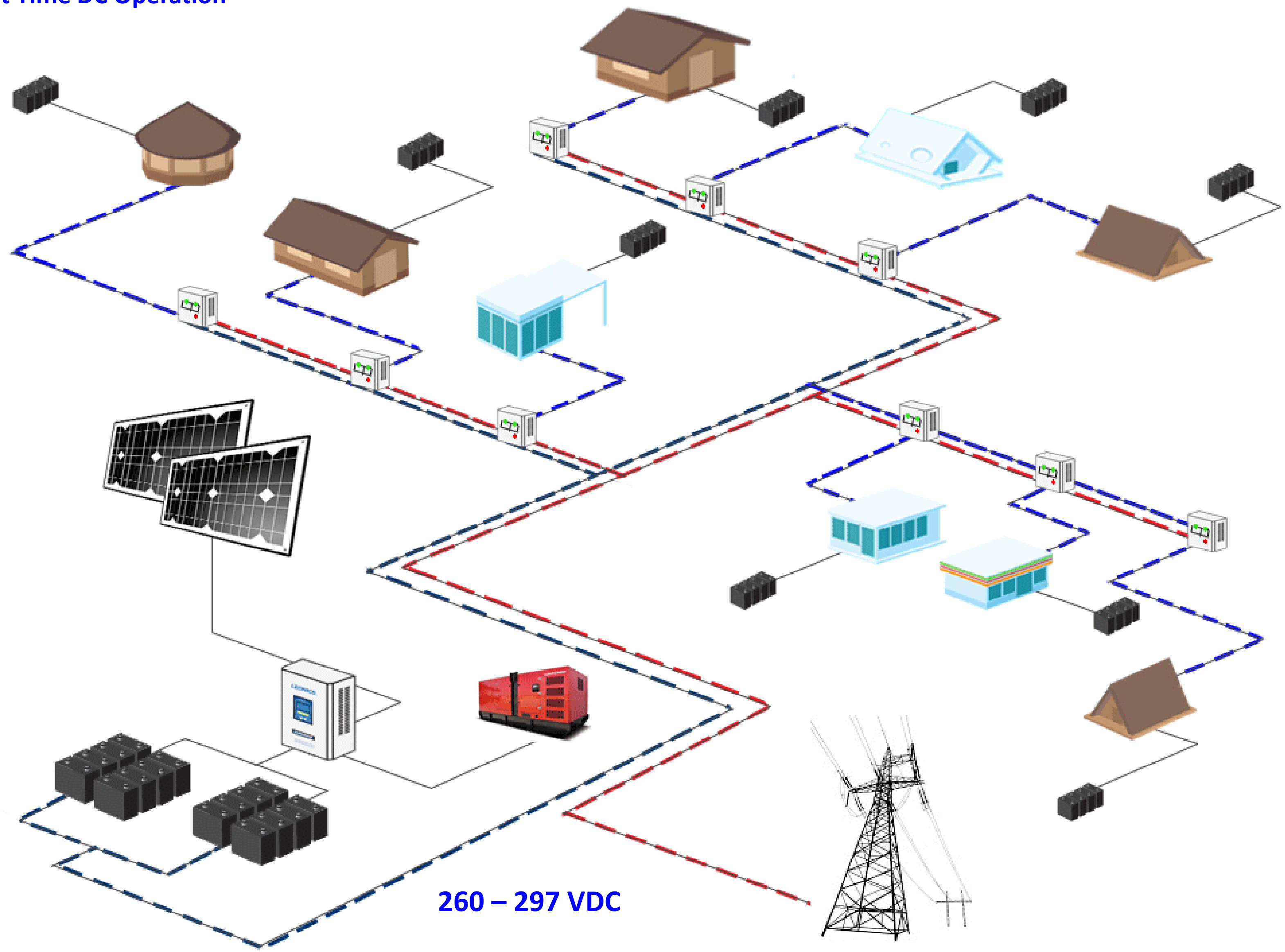
Daytime DC & AC Operation

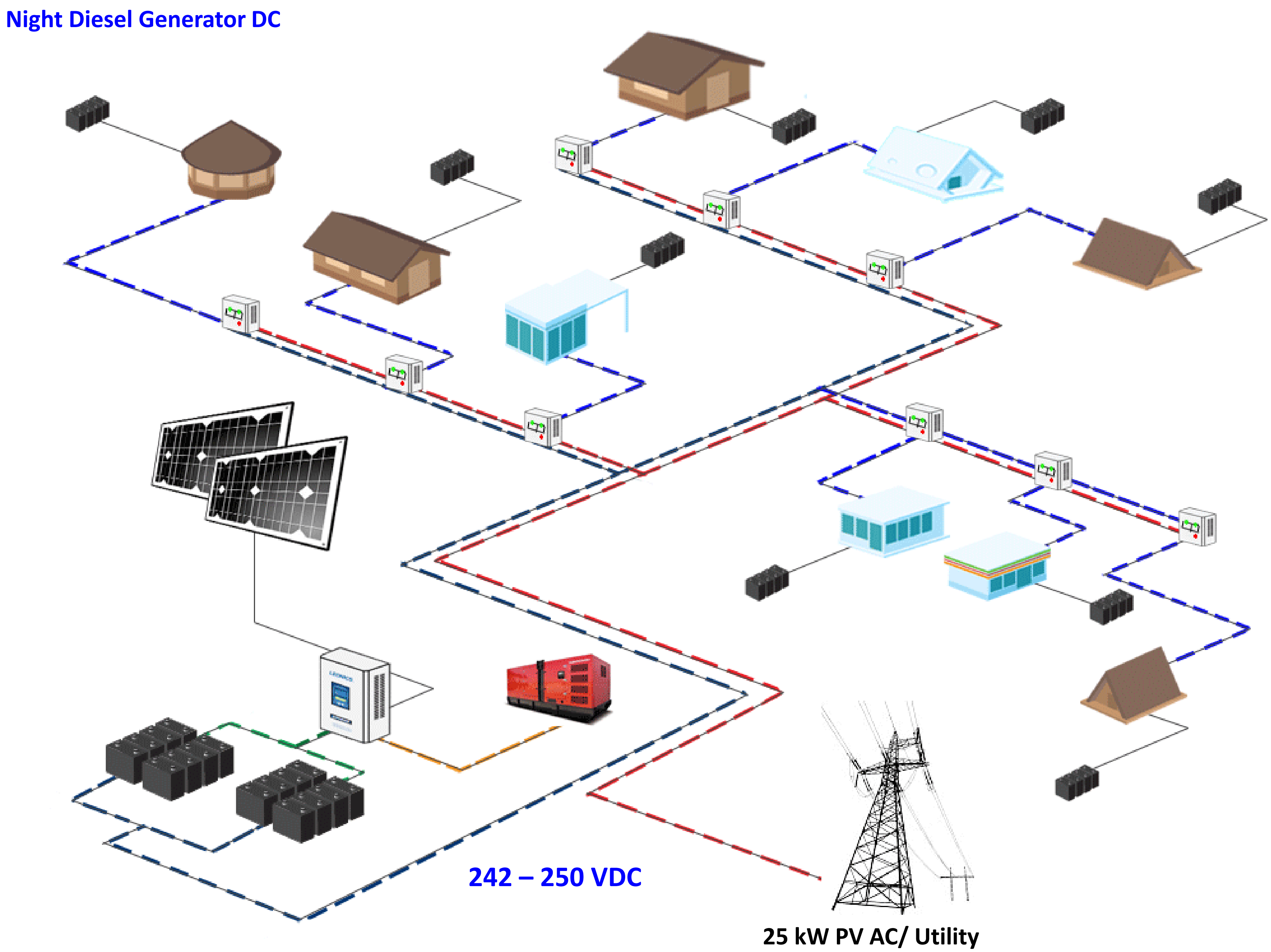


PV & House Battery Booster Operation

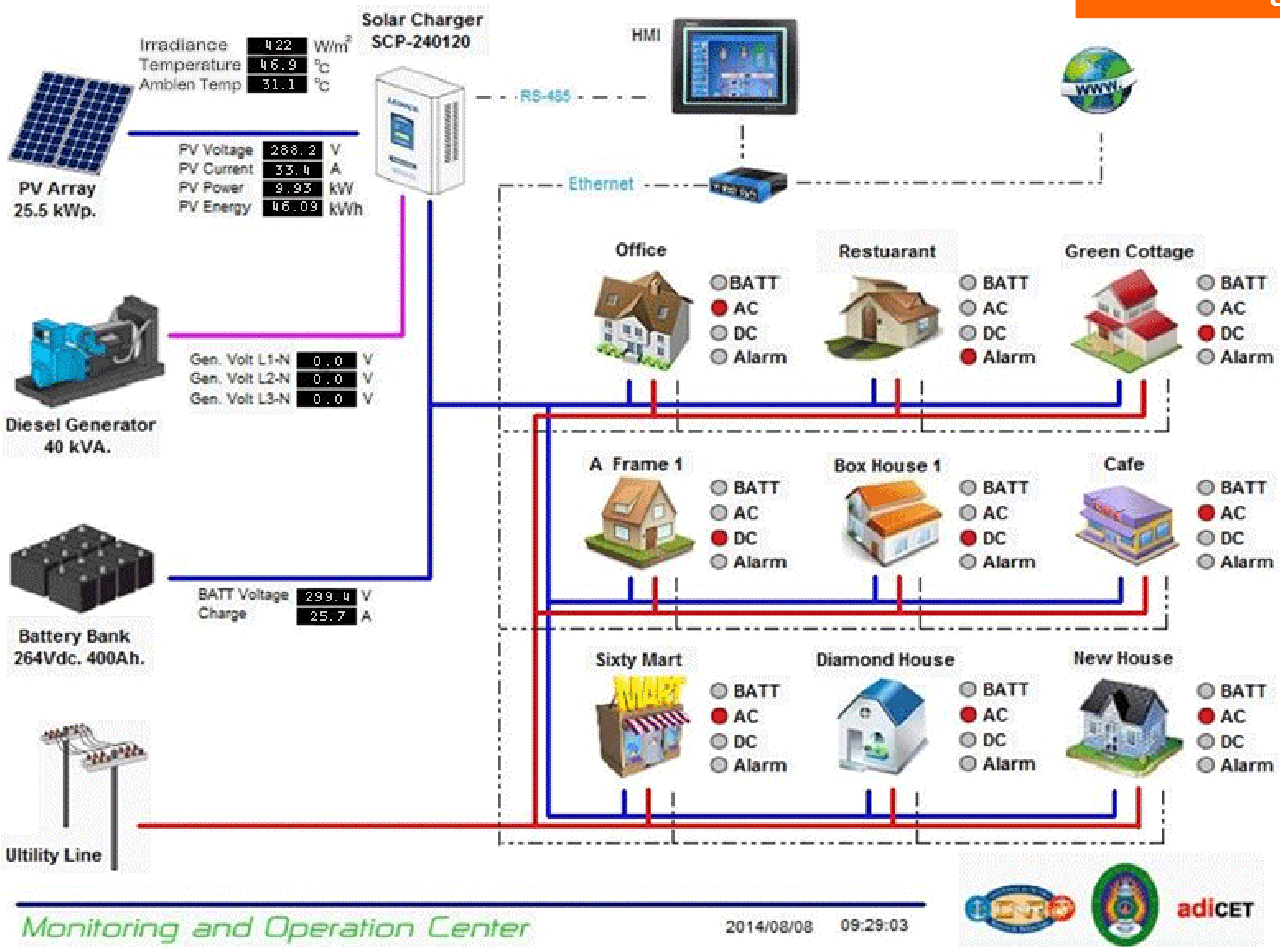


Night Time DC Operation




Night Diesel Generator DC
242 – 250 VDC
25 kW PV AC/ Utility

Monitoring DC Microgrid



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Load Test: Modify Each Appliance

- LED lightings
- Refrigerator
- Water Heater
- Television
- Air Conditioner 9,000 btu
- Air Conditioner 13,000 btu
- Air Conditioner 18,000 btu