Building & Operating a Solar-Hybrid Microgrid for Rural Electrification in Palawan/ Philippines: Design, Benefits & Challenges

Fabian Weber
Director of System Integration and Technologies, **WEnergy Global Pte Ltd**

Singapore, November 2022

Table of Content

I. Site & Project Objectives

II. Project Design & System Characteristics

III. Benefits/ Achievements

IV. Challenges

V. Future Plans

I. Site & Project Objectives

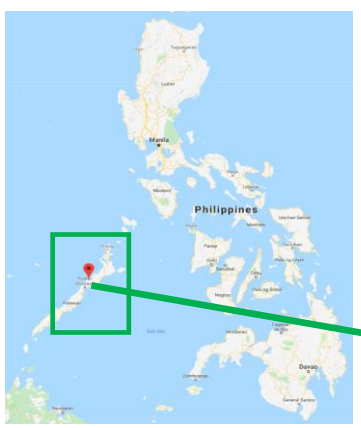
Site Characteristics

Energy Demand and Ecological Requirements in Bgy Cabayugan

Sights/ Attractions:

- Puerto Princesa Subterranean River National Park
  - Protected Area
  - Tourist Attraction

→ Ideal for green growth projects



Customers:

- ~ 600 Households
- Public buildings (schools, churches, etc.)
- Hotels/ cottages/ restaurants
- Small businesses/ shops

Objectives and Targets

Reliable, Green and Affordable Power

Objectives

- To provide electricity to households and businesses
- At 24/7
- For an affordable price
- In the cleanest possible way
- Within the shortest possible time

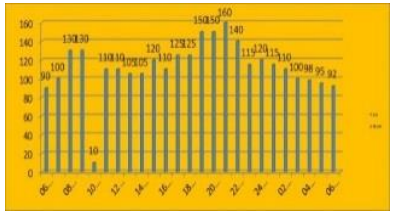
4 Targets to meet:

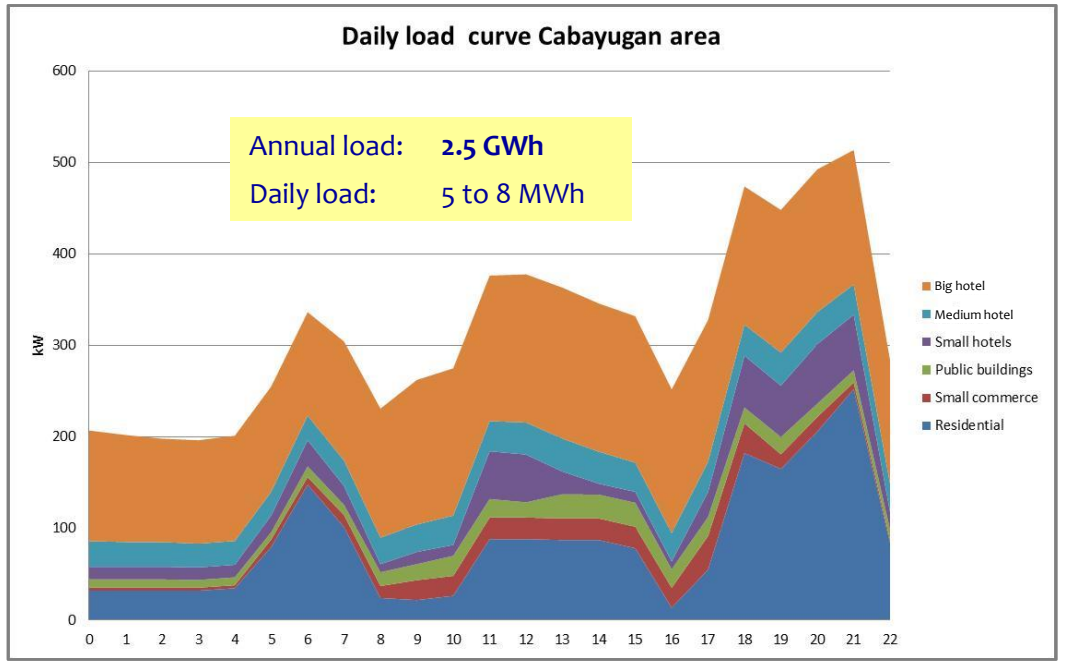
- Continuous power supply
- As green as possible
- Affordable
- In compliance with the Philippine regulatory framework

II. Project Design & System Characteristics

Load Estimate

24-hours Load Curve is Key for Solar Hybrid System – Not only Peak Load



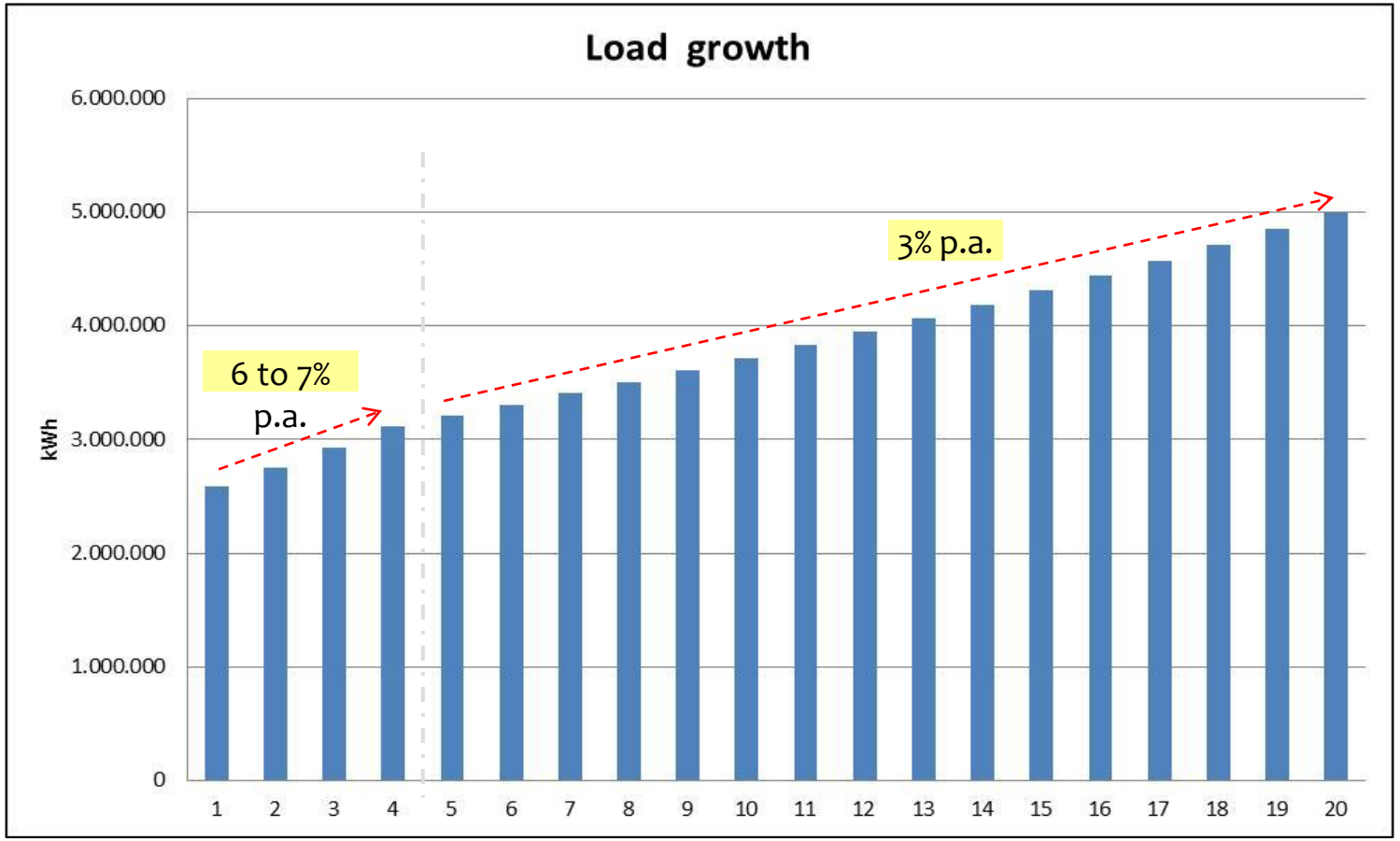


Load estimates based on:

- Interviews regarding consumers‘ economic status and their future consumption needs & demands if given 24/7 electricity

Energy Demand Projection

Estimate for the Load Growth in Cabayugan

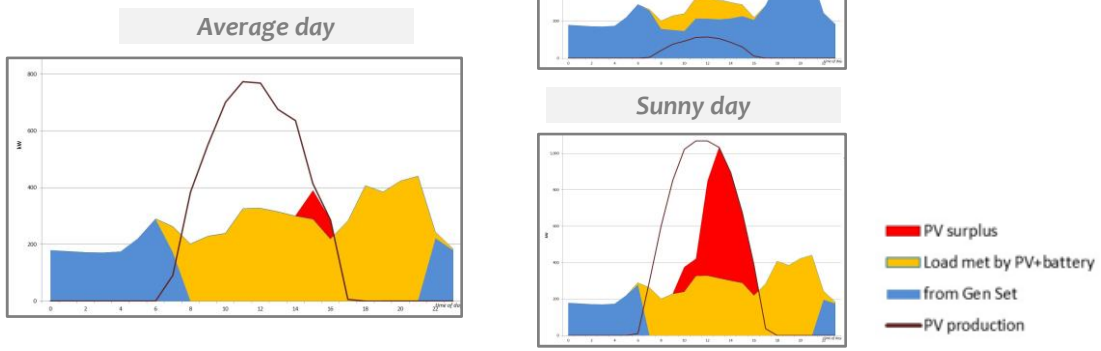


Sizing of Generation and Storage Facilities

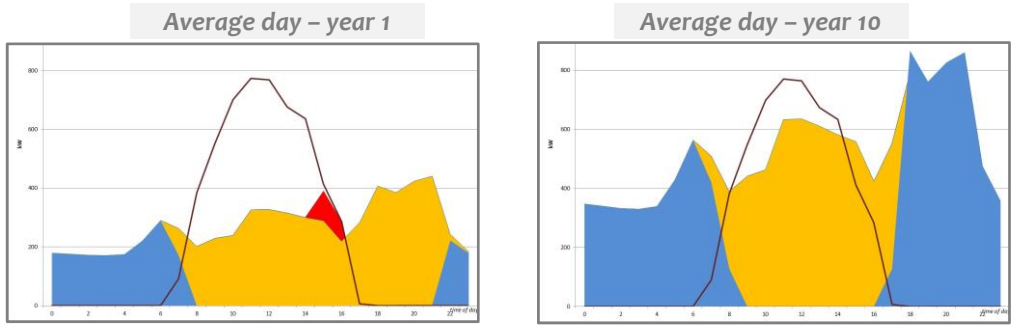
High RE Share and Low PV Surplus → Economical Solution

Sizing for different days:

- Rainy and sunny days



- Over entire project lifetime



Snapshot of Typical Load & Supply Curves

***Sizing of PV & battery*:**

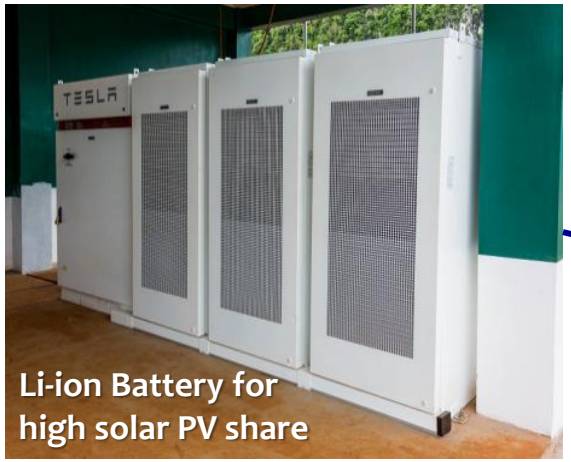
- High RE share to reduce diesel fuel consumption
  → PV & battery to reach an RE share of >50%
- Efficient use of RE capacity: Avoid oversizing
  → High use of potential PV energy (low PV surplus)

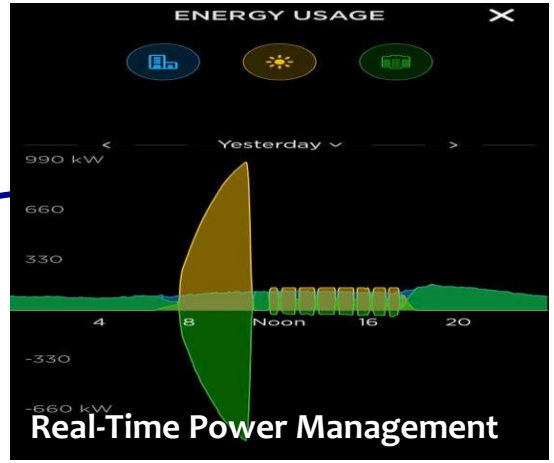
***Sizing of diesel gensets*:**

- Units small enough to run efficiently even at low loads
- Total capacity big enough to provide maximum power requirements

The Solar-Hybrid Power Plant

1.4 MW_p Solar PV, 2.4 MWh BESS and 1.2 MW Diesel

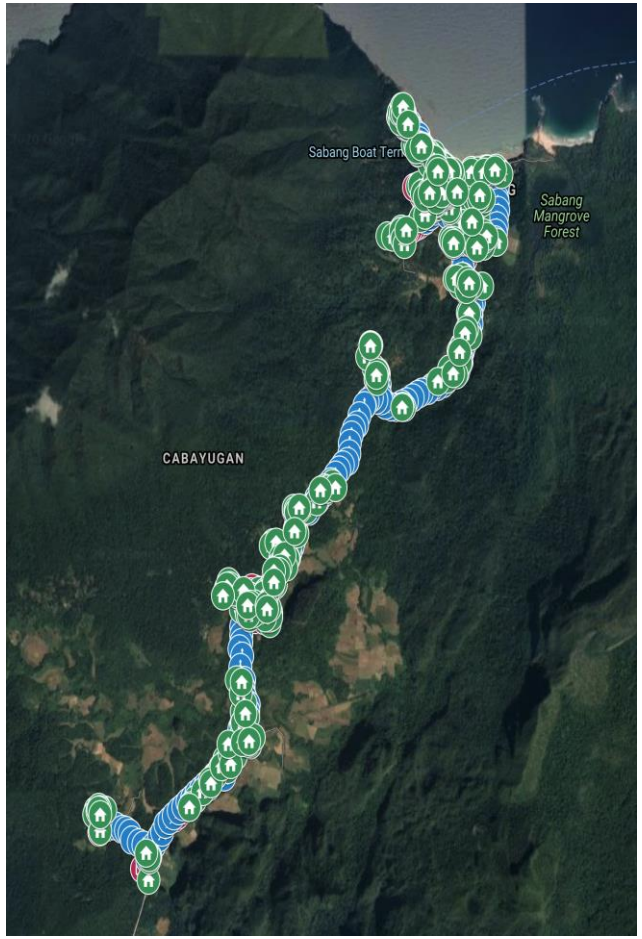




WEnergy GLOBAL

The Distribution Grid

14 km of Grid Serving More Than 590 Customers



Distribution grid:

- Total length: 14 km
- Grid voltage: 13.8kV/ 240V

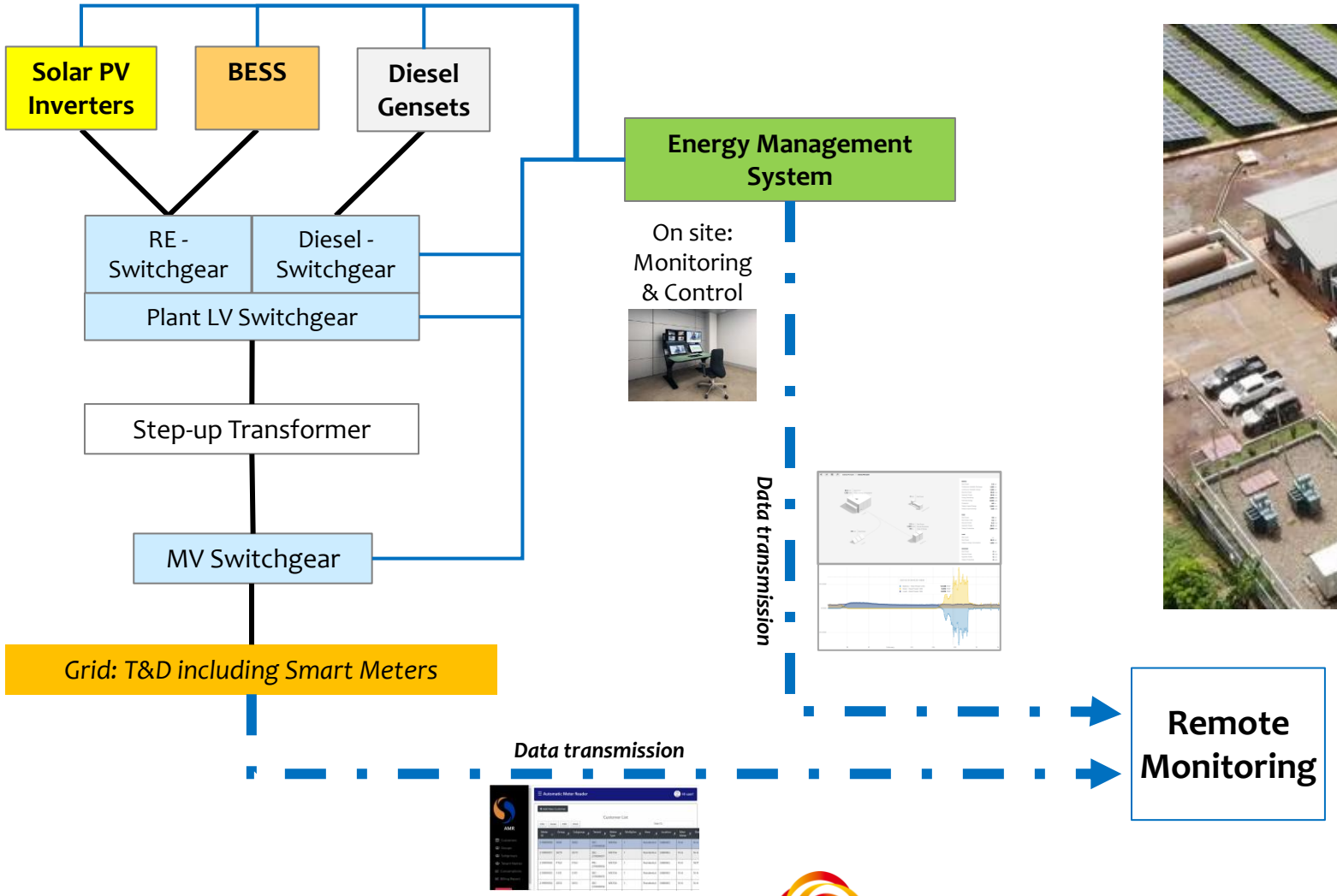
Customers:

- 560 residential
- 35 commercial (incl. 2 hotels)

WEnergy GLOBAL

Typical Configuration of a Hybrid Powered Microgrid

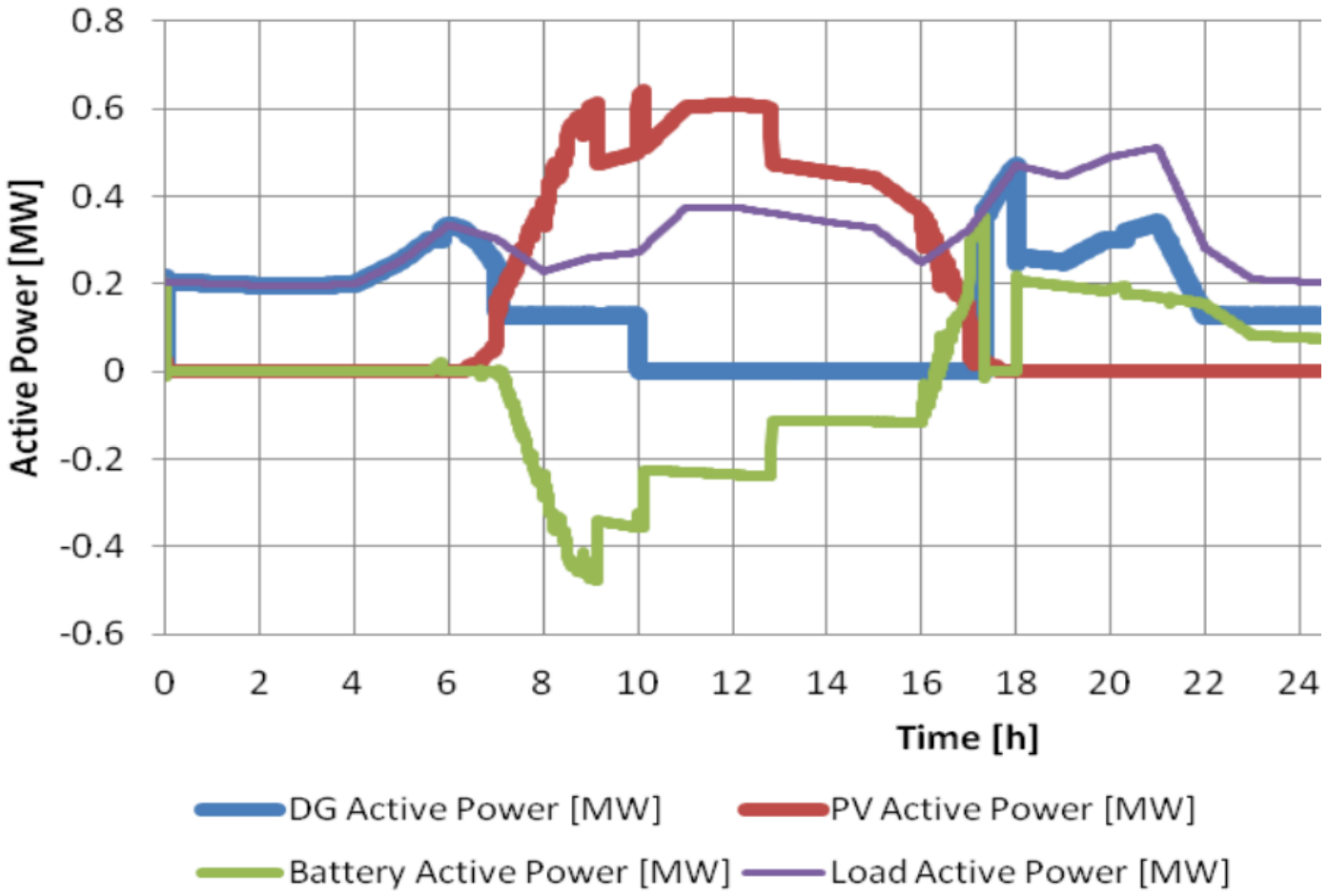
Overall System Overview



Mode of Operation of the Hybrid Plant

Solar & Battery During the Day, Diesel at Night

Example for the plant operation at an average day:



III. Benefits/ Achievements

Provide Affordable & Reliable Power

Reliable Power to Enhance Economic Development

- **24/7 power supply to 3,000 people**
- **Increased overall productivity, value-added economic activities, and community revenues**
- **New employment and sustainable livelihood opportunities** for the entire community
- **Children** are **able to study longer at night,** especially during the stay-at-home period
- **Safer community at night** with full street and home lighting, with common institutions, clinics, churches, and police precinct stations **fully energized and functional 24/7**

WEnergy GLOBAL

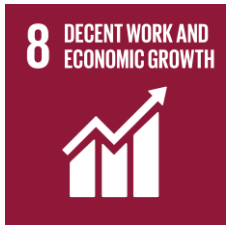
SREC Helps to Achieve Sustainable Development

Green & Reliable Power Boosts Sustainable Development

- Community prepared to host cold storage facilities for vaccines and rolling out vaccinations.

- Children able to study after dusk.
- Teachers can print documents in the school instead of travelling to the nearest town with electricity.

- 24/7 electricity also during pandemics and disasters.



- Creation of local employment.
- Increased productivity during the day & after dusk.

- Business development and employment without pollution of Nature reserve area.

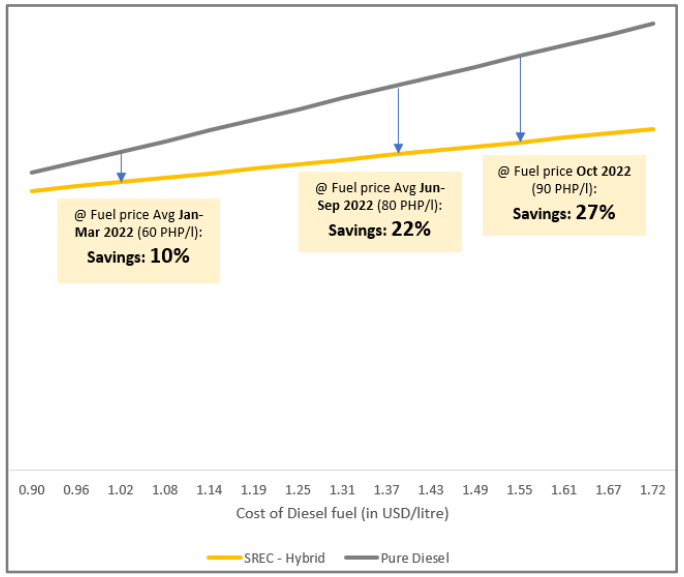
- More than 21,000 tons CO_2 emissions in 20 years are expected to be saved through the avoidance of diesel consumption.

- Preservation of the protected forest area and the UNESCO World Heritage Site Puerto Princesa Underground River.

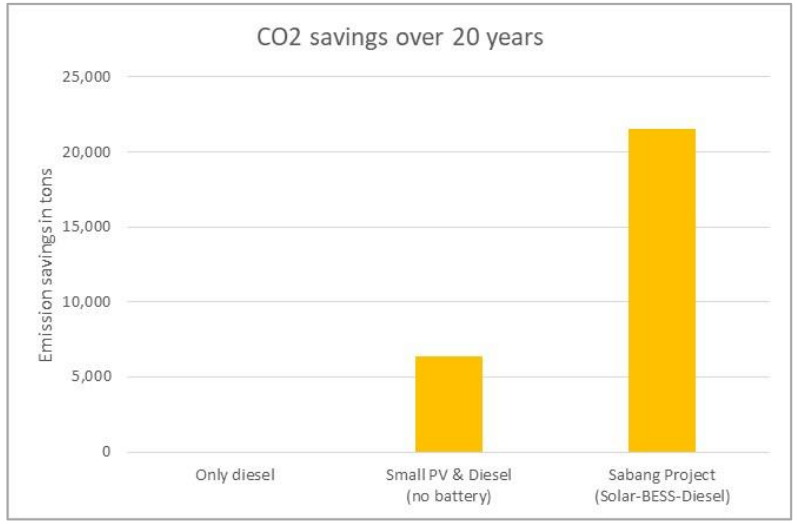
WEnergy GLOBAL

Cost & Emission Savings

Solar-Diesel Hybrid Provides Cleaner Power for Lower Price Than Pure Diesel System



Cost savings between 10% and almost 30% compared to Pure Diesel system!



More than 21,000 tons of CO_2 emission savings over lifetime!

WEnergy GLOBAL

IV. Challenges

General Challenges in Developing Micro Grid Projects

Old Protocols, New Technologies

Governments

- Unsuitable frameworks for RE Hybrid Systems & Micro Grids
- High transaction cost, due to
  - Old Policies
  - Lack of synchronicity

Banks/Financial Institutions/Insurance Companies/Pension Funds

- Lack of experience/knowledge in RE Hybrid Systems and Micro Grids
- Thresholds for project sizes are too high
- Lack of knowledge in policy frameworks
- Excessive IRR expectations

Companies

- Either technology or finance driven: both is needed!
- Weak ability to work in complex decision-making environments

WEnergy GLOBAL

Effects of the Pandemic

Reduction/ Slower Ramp-up of Consumption

- Local economy mainly based on tourism

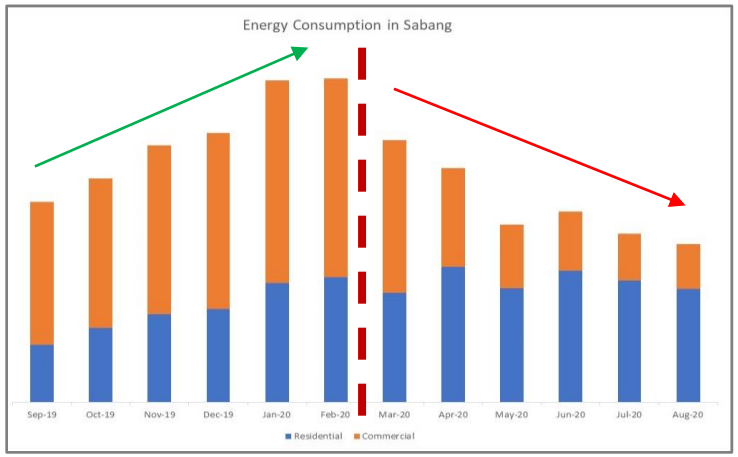
  → total breakdown of tourism

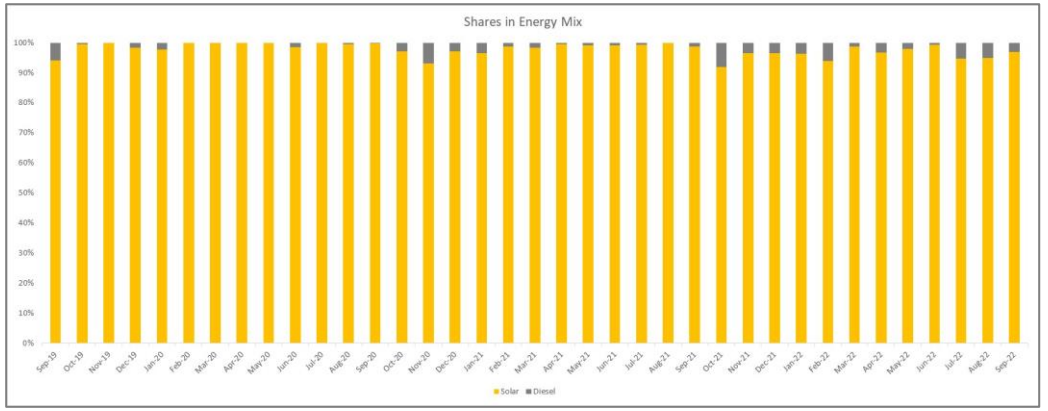
  → sharp reduction of consumption of hotels & small commerce

- Loss of income of residents who live from tourism

  → reduced power consumption of residentials

→ 50% drop in tourism electricity demand for over 2 years!





… on a positive note: Solar share in mix almost 100%

Effects of the Hurricane

Destruction of Parts of Grid and Our Customer's houses

Just before Christmas 2021, **Typhoon Rai/ Odette devastated Palawan and Sabang** in an unprecedented level of loss and damage.

→ Destruction in the **community**

- **75%** of houses **heavily damaged**
- **20%** of houses **fully destroyed**

→ Destruction of **distribution lines**

- **30% of poles & lines** partially damaged

Support of the Community

Providing Shelter and Basic Services for Those in Need

- The power plant itself withstood the typhoon – it was still operating and able to **provide power** within the plant premises.
- Our offices were opened to the community as a **safe haven for families who had lost their homes.**
- For the community members whose houses were destroyed, we conducted fund raising and are currently **rebuilding customers' houses** together with the community

WEnergy GLOBAL

Fast Reconstruction

Reconnection of All ready Customers After 3 weeks!

- Within **days**: most of the **essential consumers** (police, primary health care centres, water supply company) were reconnected

- Within **3 weeks: all consumers** which were not destroyed by the hurricane, were reconnected

WEnergy GLOBAL

Quick Recovery

Power as a Key to Get Back to a Normal Life

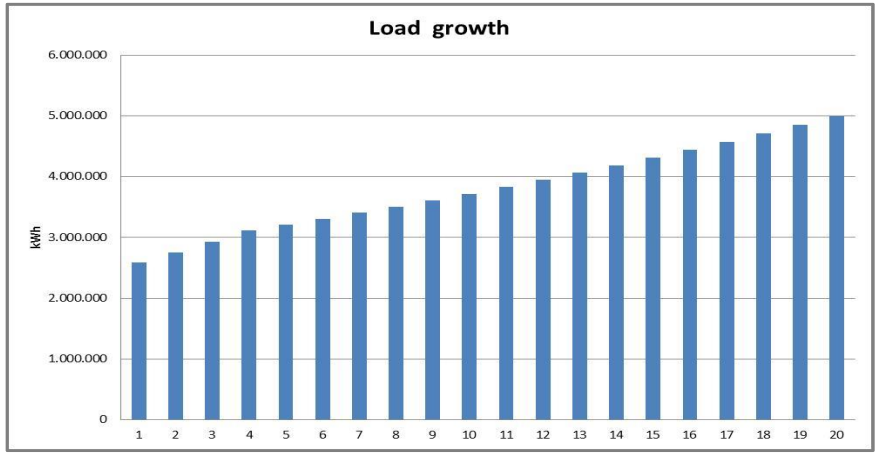
Pictures from March 2022

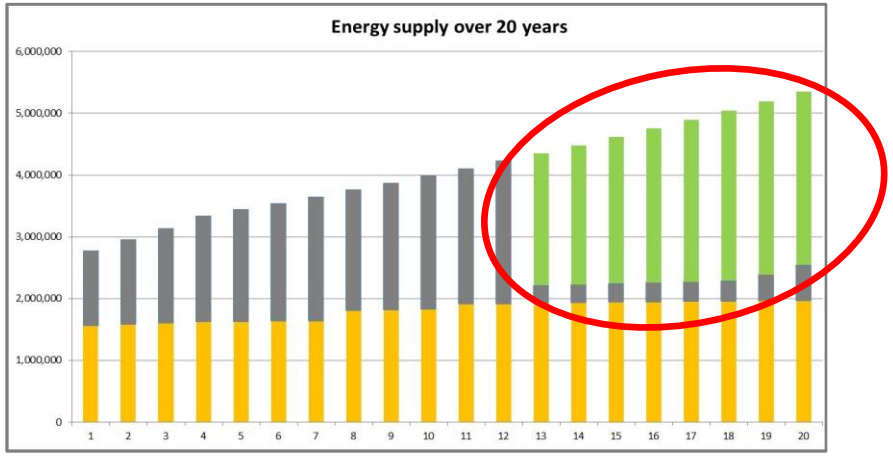
WEnergy GLOBAL

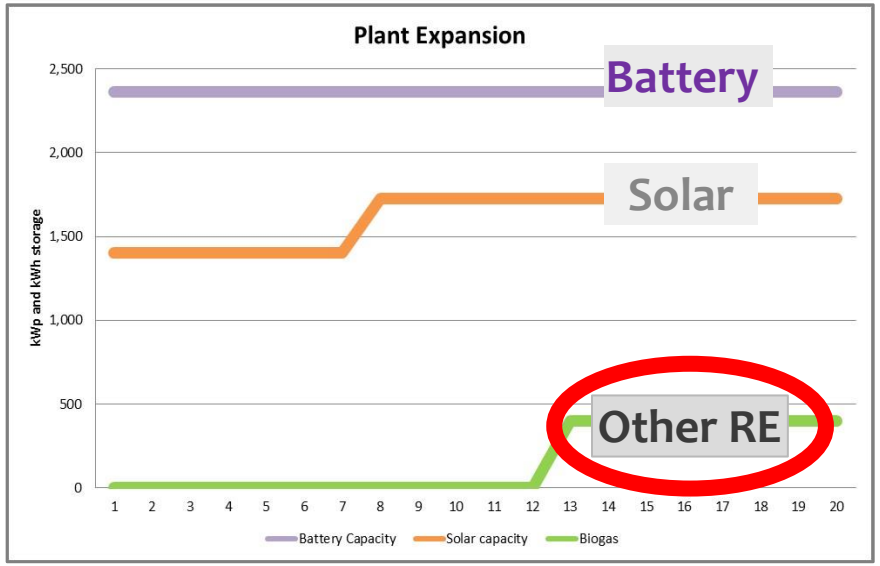
V. Future Plans

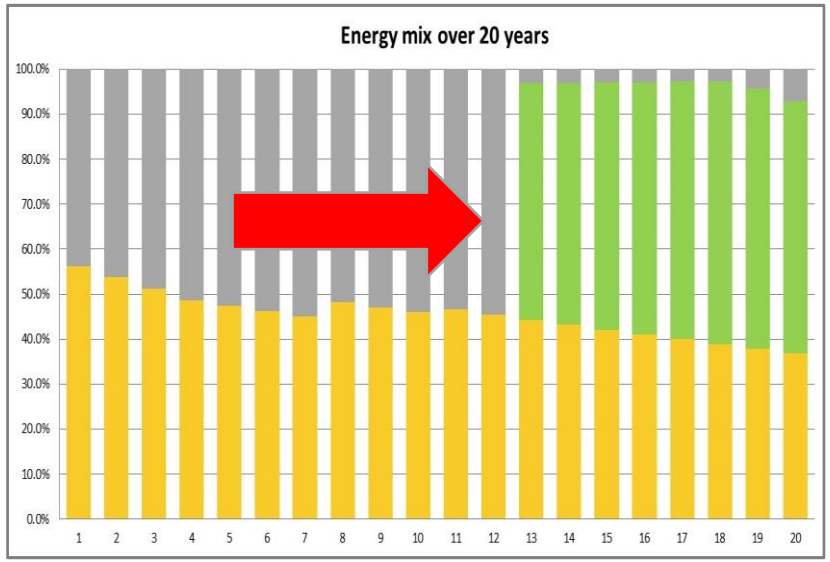
Plant Design for Future Development

Potential Roadmap for Technology Deployment – Getting Diesel Out!





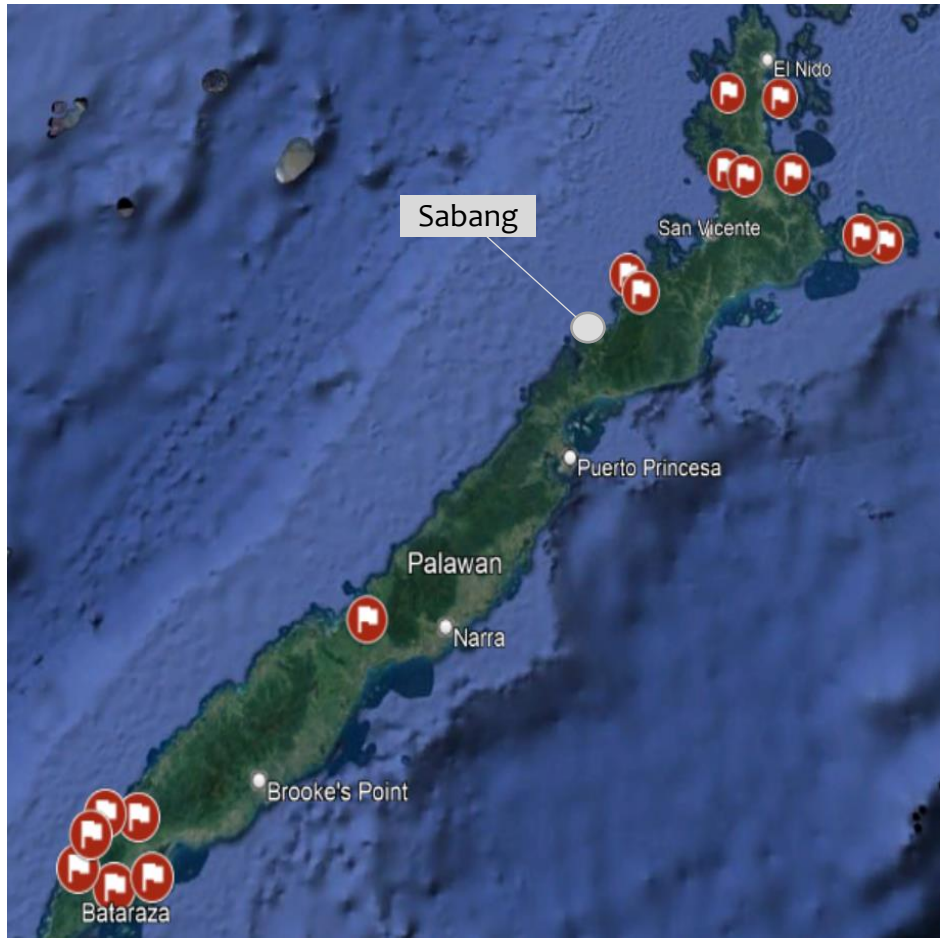




WEnergy GLOBAL

Scaling Up: 16 New Rural Mini-grids Across Palawan Island

Use the Knowledge from Sabang to Connect 30,000 Palaweños More



- 16 PV-hybrid plants & microgrids
- Energize > 7,100 households, > 30,000 people

- 3.8 MW_p PV, 4.2 MWh battery, 2 MW diesel gensets
- > 170km distribution grid

- 2022: awarded projects by PALECO after winning tender
- Construction expected to commence by Q3-2023

Thank you!

Disclaimer

This presentation has been prepared by WEnergy Global Pte. Ltd. for informational purposes only.

The information and opinions contained in this presentation are not intended to be the sole basis upon which the implementation of the operation contemplated herein (the "Operation") can be decided. It is therefore advisable for the recipient(s) to make its/their own judgment and assessment of the information and the Operation contained in this presentation.

Opinions expressed herein reflect the judgment of WEnergy Global Pte. Ltd. as of the date of this presentation and may be subject to change without notice if WEnergy Global Pte. Ltd. becomes aware of any information, whether specific to the Operation or general, which may have a material impact on any such opinions.

WEnergy Global Pte. Ltd. will not be responsible for any consequences resulting from the use of this presentation as well as the reliance upon any opinion or statement contained herein or for any omission.

This presentation is confidential and may not be reproduced (in whole or in part) nor summarized or distributed without the prior written permission of WEnergy Global Pte. Ltd. The recipient(s) of this report agree(s) to keep its content strictly confidential and undertake(s) not to disclose the information contained herein to any person other than those of its/their employees who strictly need access to it for the purpose of the Operation.