



APPLICATION FORM
ASEAN Renewable Energy Project Awards
ASEAN Energy Awards 2022



Koh Bulon Don Renewable Energy Community Enterprise

Koh Bulon Don: Pay-As-You-Go Solar Home System



ASEAN Energy Awards 2022
Off-grid – Power



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ASEAN Renewable Energy Project Awards

ASEAN Energy Awards 2022



Introduction

Established on 1 January 1999, the ASEAN Centre for Energy (ACE) is an independent intergovernmental organisation within the Association of Southeast Asian Nations' (ASEAN) structure that represents the 10 ASEAN Member States' (AMS) interests in the energy sector. The Centre accelerates the integration of energy strategies within ASEAN by providing relevant information and expertise to ensure the necessary energy policies and programmes are in harmony with the economic growth and the environmental sustainability of the region. It is guided by a Governing Council composed of Senior Officials on Energy from each AMS and a representative from the ASEAN Secretariat as an ex-officio member. Hosted by the Ministry of Energy and Mineral Resources of Indonesia, ACE's office is located in Jakarta.

First held in 2000, the ASEAN Energy Awards is Southeast Asia's highest recognition for excellence, creativity, practicality and dedication to a cause in the field of energy. It is an annual event organised by ACE in collaboration with the ASEAN Specialised Energy Bodies (SEBs), in particular the Renewable Energy Sub-sector Network (RE-SSN) for the ASEAN Renewable Energy Project Awards. The ASEAN Energy Awards aim to promote awareness and greater private sector's participation.

Objective

1. To promote and disseminate best practices in renewable energy projects in the ASEAN member countries.
2. To encourage all sector participation in adopting and implementing innovative and creative RE projects to enhance business growth.
3. To promote RE as another form of energy resource; to complement and, to improve environmental quality in the ASEAN region.
4. Ultimately, the objective of the competition is for exchange in knowledge and experience in development and maintenance of the RE projects as part of the ASEAN spirit.

SUBMISSION GUIDELINE

Application Form for Category:

1. OFF Grid

- a. Power
- b. Thermal

3. Combined Heat and Power

2. ON Grid

- a. National Grid
- b. Local Grid

4. Biofuels

Application Format, Terms and Condition

The following is the general guideline for the submission of application:

1. Prequalification: RE source and at least one (1) year in operation
2. No. of page maximum 15 pages
3. A4 size, 12cpi and Times New Roman
4. Endorsement: By the focal point and authorization letter by the owner for site visit

Contents



APPLICATION FORM

ASEAN Renewable Energy Project Awards
ASEAN Energy Awards 2022



1. Originality: Max. **1 page**
2. Environment Consideration: Max. **2 pages**
3. Social Consideration: Max. **2 pages**
4. Technical, Economic & Market Consideration: Max. **3 pages**
5. Operation & Maintenance Scheme: Max. **2 pages**
6. Replicability: Max. **2 pages**
7. Figures, Tables, Photos: Max. **3 pages**

Application Number (Office Use Only)	
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Category	OFF Grid ☒ Power ☐ Thermal
	ON Grid ☐ National Grid ☐ Local Grid
	☐ Combined Heat and Power
	☐ Biofuels

Title of Activity/Project/Theme
Pay-As-You-Go Solar Home System : Koh Bulon Don RE Community Enterprise

Source of Energy	Solar PV
Age of Project/Commercial Operating Date (COD)	1 year 6 months, COD in August 2020

Applicant General Information	
Name of Company	Koh Bulon Don RE Community Enterprise
Primary Contact Person	Mr. Phirat Inphanich
Designation	Project Coordinator
Business Address	457 Moo 2, Paknam Sub-district, La-ngu district, Satun Province 91110, Thailand
Project Site Address	457 Moo 2, Paknam Sub-district, La-ngu district, Satun Province 91110, Thailand
Telephone	096 141 9710
Mobile Phone	096 141 9710
Email	Phirat ple@hotmail.com
Website	www.rechargethailand.com, www.facebook.com/ReChargeTH

Nature of Business
Koh Bulon Don community is the first community in Thailand using Pay-as-you-go solar home system. The community manages a revolving fund for maintenance, repairs and expansion which leads to the community being self-sustaining.



APPLICATION FORM

ASEAN Renewable Energy Project Awards

ASEAN Energy Awards 2022



Project Abstract

Koh Bulon archipelago situated at Moo 2, Pak Nam Sub-district, La-ngu District, Satun Province is under the responsibility of Moo Koh Petra Islands national park. The Bulon islands is 19 kilometers to the west of Pak Bara pier and is a 50 minute boat ride away from shore. Most of the people on the island are fishermen with Islamic beliefs, the community history dates back to 100 years ago with roots Urak Lawoi' or referred to as 'sea gypsies' (Chaoley in Thai), it is currently home to 79 households.

The Koh Bulon Don project was initiated to solve electrification problems on the island. Before having solar, the community was relying on a 50 kW diesel generator which is operated for 5 hours from 18:00 to 23:00 every day. Electricity is mainly being used for lighting, TV, fans and some houses with washing machines. Houses which are connected to the diesel generator share diesel cost which is priced at a fixed rate of 400-700 THB/month (~12-21 USD/month) depending on what appliances they have in their house and not by metered consumption. Due to the aging generator, power quality is an issue and power voltage sometimes drop to 140 V instead of 220V causing damages to some electrical appliances. Additional to electricity cost, each household is paying minimum 1000 THB/month (approx. ~30 USD) for ice used for preservation of food and vegetables.

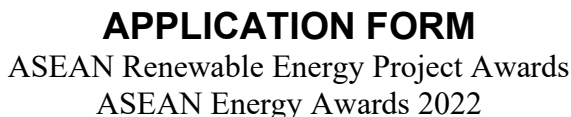
The project has three main objectives; firstly, to become a showcase for a community operated renewable energy enterprise in off-grid areas. Secondly, to promote community participation in project development. Finally, to utilize novel technology which improves community management. The project is executed by a network of partners to empower communities to become owners of their own renewable energy systems. The project team aims to achieve the highest level of participation, which is community empowerment, involving the community from start to operations. At present, the operations are conducted by 'Koh Bulon Don Renewable Energy (RE) Community Enterprise', who is responsible for the installation of solar home systems, performs operation & maintenance and collect payments, done by the community themselves.

The project selects highly efficient LiFePO₄ (LFP) batteries assembled in a plug and play solar home system, all are enabled with pay-as-you-go technology. Pay-as-you-go technology operates similar to the concept of prepaid mobile phones, users need to pay their monthly service fees before electricity is supplied. Users who don't pay will automatically get electricity cut off by the system until payment has been settled. Users pay cash at the collector on a monthly basis, collector issues an unlock token via a mobile app (10-digit code), user punches that code into their battery box at home. In this way, the pay-as-you-go technology ensures that monthly payments are collected, transparent and auditable. Rather than a one size fits all, the project opted for a tailor-made approach to size solar home systems which are based on the community's demand. Members are able to choose the size of solar home system they want and pays a monthly service and maintenance fee for a period of 48 months.

As of Q1-2022, the community enterprise has electrified 36 households or 50% of the community and is expected that 100% electrification of the community will be achieved in 2025. It is estimated that the community now consumes 304.14 kWh/month from renewable energy, reducing 567 liters of diesel consumption or a minimum of 17,010 THB/month (~515 USD/month), equivalent to 1535.436 kg CO₂/month. The calculated project financial IRR is 28%, with a payback period of 4 years. However, the money is being revolved in the community and collected money gets reinvested into new systems and expanded to more households.

Employment Opportunities

Executive: (Technical) ____1____ (Non-Technical) ____2____
Non-Executive: ____2____



A. ORIGINALITY

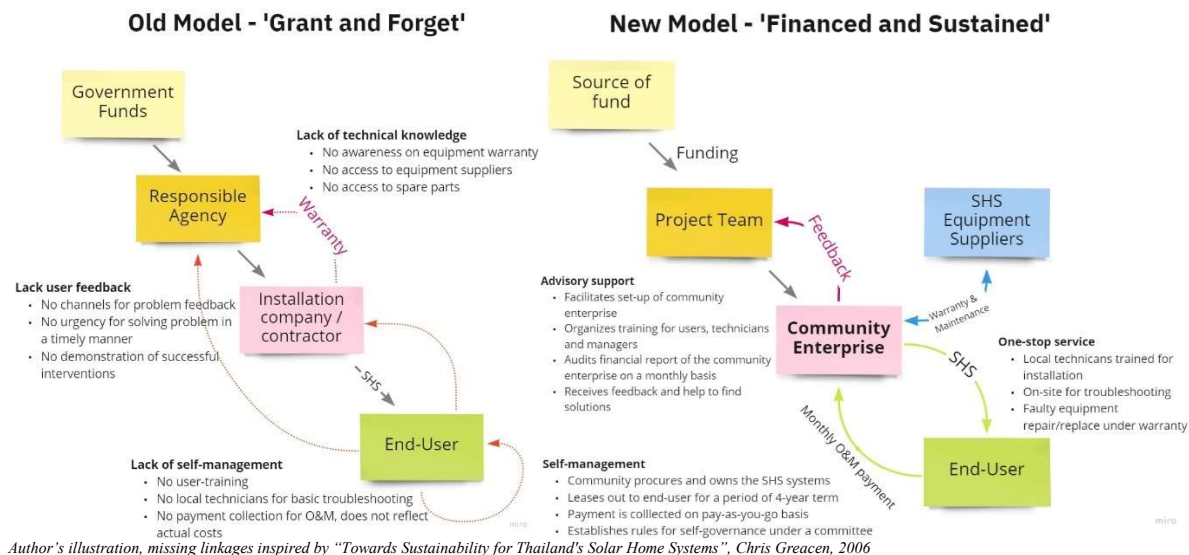
A.1 Project Profile

Design

Our core principle is to replace diesel with renewable energy from solar energy. Before the project, the community was paying high cost for electricity from diesel generator 400-700 THB/month (~12-21 USD/month) for 5 hours of electricity. The lack of electricity access means that each household need to use ice instead of refrigerator for food preservation and is paying approx. 1000 THB/month (~30 USD/month). The technical design of solar home system is well established and not a challenge, this project aims to ensure long-term sustainability by having the community become owners of their own renewable energy enterprise.

Technology design, the solar home system (SHS) sets comprise of PV panel, 12V_{dc} LiFePO 4 (LFP) battery box and direct current (DC) appliances (lights, fans, TV, fridge, freezer). The project team choose DC SHS technology because they are proven to be more efficient, economical and suiting to the community's need. Many electrical appliances are already using direct current (DC), such as LED lights, mobile phones, computers, TVs, fans are already in DC. Unlike traditional diesel gensets, solar PV panels is producing DC electricity, so to minimize conversion losses from DC to alternating current (AC) and AC back to DC, conversion losses can be 5-10% or higher. From an efficiency perspective, DC appliances is superior for a small solar home system. The fact that DC appliances are more unique and harder to find is a benefit to keeping electrical loads in check. Lessons learned from off-grid projects have summarized that rise in electrical load have led to premature failure of systems. For example, AC systems sized for lighting, TV and Fan will not be sufficient when the community starts to introduce AC rice cookers, water boilers and electric irons to their houses.

Sustainability design, the project team has seen failures of predecessor projects implementing AC solar home systems in the past, the lessons learned have been analyzed and come up with an improved solution. Past projects are usually governmental grants which are based on a '*grant and forget*' basis. Problems related to the old model can be summarized into three main missing linkages; 1) lack of user feedback 2) lack of technical knowledge and 3) lack of self-management. SHS have been observed to fail from simple and basic technical problems without being solved in a timely manner. Maintenance costs were not being collected or what was collected were not sufficient to buy replacements. The new model is based on a '*financed and sustained*' approach where a community enterprise is established to fill in missing linkages through self-management, local technicians and having a working feedback loop. The choice of plug&play DC SHS makes it easy for local technicians to troubleshoot problems and replace faulty equipment under warranty. Community owns the SHS assets and leases out to the end-users on a 4-year term collected under a monthly pay-as-you-go basis.





APPLICATION FORM

ASEAN Renewable Energy Project Awards

ASEAN Energy Awards 2022



Application

Since the model relies on the community enterprise to self-organize and self-manage, the project team searched and applied technology to help with governance. The pay-as-you-go system has been chosen because it removes the upfront capital expenditure (CAPEX) of using a solar home system. The CAPEX is being paid by the community enterprise and users pay fixed monthly fees back to the community enterprise on a monthly basis for 48 months. Users choose which size SHS suits their demand and pays these rates:

- Size S – 100 THB/month (3 USD/month)
- Size M – 120 THB/month (4 USD/month)
- Size L (refrigerator) – 900 THB/month (27 USD/month)
- Size XL (freezer) – 1300 THB/month (40 USD/month)
- Fan (Optional) – 60 THB/month (2 USD/month)
- TV (Optional) – 120 THB/month (4 USD/month)

Each battery box is embedded with pay-as-you-go technology which enables or disables the SHS on request, achieving a top-up payment structure similar to prepaid mobile phones. Every month, users need to pay before getting service. Users who don't pay on time will have their battery automatically lock and electricity will not be supplied. Users pay cash at the collector on a monthly basis, collector issues an unlock token via a mobile app (10-digit code), user punches that code into their battery box at home, battery box is unlocked and supplies power for the next month.



Approach

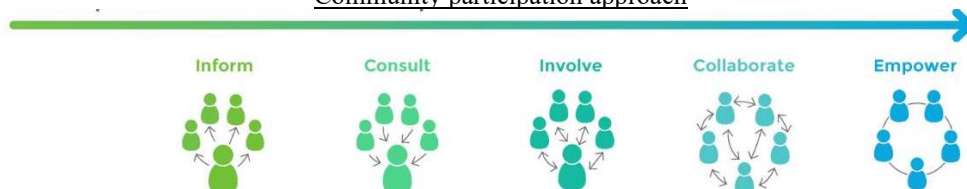
The approach is to work as a 'project team' utilizing the strengths of organization in the network. The project team included 1) ReCharge, a social enterprise project 2) Ministry of Energy, Base Load Power Plant Study and Development Division 3) German development agency (GIZ) under the Thai-German Climate Programme: Energy 4) Provincial Energy Office of Satun/

The project started in December 2019 after ReCharge got funded by the Australian Aid, Direct Aid Program (DAP) with a funded volume of 500,000 THB (approx. 16,000 USD). The project had a strong focus on developing processes for community participation in renewable energy projects. This is why we applied the core principles are based on the International Association of Public Participation (IAP2) Spectrum on Public

Participation. The project team aims to achieve the highest level of participation which is community empowerment, whilst going through all the steps as described below.

Participation level	Participation theory	Actions
Inform	Project team collects data and reflect key information to the community.	Energy data collected; amount of diesel being used, cost of diesel, current hours of electricity usage, cost of ice, energy access rate
Consult	Project team provides input and obtains feedback from partners on what they think about project and what ideas do they have, including the local community	Pilot SHS systems were installed on-site for 3 months. Feedback on its usage was gathered from the community.
Involve	Project team and community members are involved in designing a solution which is suited and balanced for the community.	Community was involved in sizing the systems according to their needs, evaluating cost per month and decided on a lease term.
Collaborate	The community is making decisions on the preferred solution and is no longer a participant but a owners and decision makers through committee under the community enterprise	Community enterprise was set-up with an elected committee. The committee is then taking responsibility of the systems and making decision on rules of governance.
Empower	The community is empowered beyond energy topics and is able to implement their own activities and decisions which are beneficial to the community members.	The community enterprise currently provides welfare benefits to its members such as providing wifi internet access enabled by having solar energy.

Community participation approach



กระบวนการมีส่วนร่วม 5 ขั้นตอนในการพัฒนา
กลุ่มพลังงานทดแทนและการออมเพื่อความยั่งยืนบ้านเกาะบุโหลนดอน อ.ละงู จ.สตูล



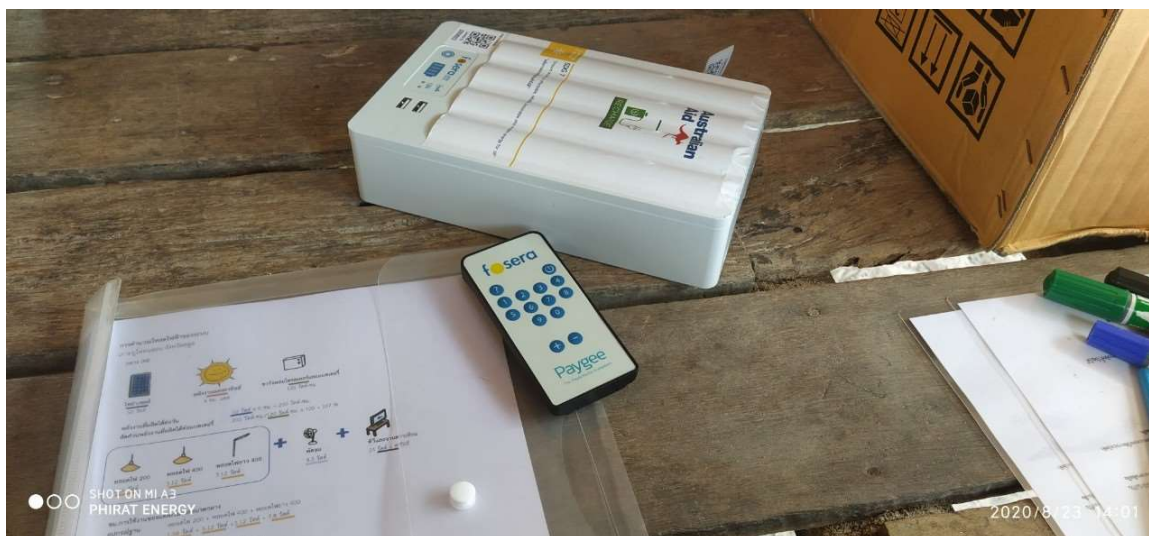
Project Team



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ASEAN Renewable Energy Project Awards

ASEAN Energy Awards 2022





APPLICATION FORM

ASEAN Renewable Energy Project Awards

ASEAN Energy Awards 2022



A. ENVIRONMENT CONSIDERATION

B.1 Amount of Emissions/Pollution Avoided				
No.	Parameters	Value and unit		
		Before	After	Carbon Emission Reduction
1	Primary GHG emission (Carbon dioxide, Methane, Nitrous oxide, CFC)	7,945.18 kgCO ₂ eq/year	0	7,945.18 kgCO ₂ eq/year
3	Fuel consumption	2,994 liters	0	-
Total Potential Carbon Emission Reduction				7,945.18 kgCO ₂ eq/year
B.2 Discussion (Simple calculation of conversion)				
- To produce 1 kWh of electricity from diesel, a typical generator consumes 0.494 L/kWh (specific consumption) - The standard emission factor of diesel combustion is 2.6987 kgCO₂ eq/L - To calculate the emission reductions from using solar energy, we use Size M – SHS which has a 50Wp panel and Size L -SHS which has a 300 Wp panel. - The average specific PV yield of Thailand is 4 kWh/kWp/day, this means that a 50 Wp panel will have the potential of producing 0.2 kWh/day. Additionally, it was assumed that not all is being used but on average 80% of the full potential will be used, so 0.16 kWh/day is used. On an annual level it is equivalent to 58.4 kWh/year per Size M system. - Diesel saving for a Size M – SHS is then 28.86 L/year per system or equivalent to 77.89 kgCO₂ eq /year per system - Applying the same methodology, Size L with a 300W panel will saves 173.18L/year per system or equivalent to 467.36 kgCO₂ eq /year per system. - In total there are 57 systems as of February 2022, the diesel savings is equivalent to 2,944.05 L/year and equivalent to 7,945.18 kgCO₂ eq /year - The project lifetime is expected to be at least 10 years so the total emission reduction is expected to be 79,451.8 kgCO₂ eq				



B.3 Project Objective & Criteria

Project's objectives

1. To become a showcase for a community operated renewable energy enterprise in off-grid areas.
2. To promote community participation in project development.
3. To utilize novel innovation and technology which improves community management

Economic improvements

- Reduction of diesel consumption from using solar: 300 THB/month per household
- Total island wide savings from reduced diesel consumption is estimated to be 88,321.5 THB(@ diesel price of 30 THB/liter)
- Local shops with freezer can reduce cost of buying ice: 1800-3600 THB/month per system
- Households with refrigerator can reduce cost of buying ice: 600-1200 THB/month per system

Environmental improvements

- Total island wide diesel consumption reduction is estimated to be 2,944.05 liters per year
- According to the Thailand Greenhouse Gas Management Organization (TGO) emission factor for diesel combustion is 2.6987 kgCO₂/L
- It is estimated that the island wide emission reduction is 7945.18 kgCO₂/year

Social improvements

- Increase hours of electricity access from 5 hours/day to 18-24 hours per day, enabling productive use of electricity for better quality of life
- The community enterprise is organized to promote public participation and democracy based on the foundations of righteousness, transparency and auditability. The management committee is re-elect every 2 years.
- Woman empowerment: Woman are highly involved in the management decision making process of the social enterprise.
- There is increased welfare for members which in the community enterprise, such as free internet access provided as welfare for households paying for SHS





APPLICATION FORM

ASEAN Renewable Energy Project Awards

ASEAN Energy Awards 2022



B. SOCIAL CONSIDERATION

C.1 Benefits (User, Community, Country)

User benefits

Users now have extended access to electricity from previously 5 hours to currently 18-24 hours of electricity. The additional hours of electricity is also supplied from renewable energy, so it is reducing diesel consumption avoiding both diesel costs and environmental impacts. To achieve the same hours of access with diesel generators each household would be paying a minimum of 9000 THB/month (270 USD/month) compared to using SHS with cost of 100-1300 THB/month (3-40 USD/month). User experience on SHS is highly improved, with local technicians available, any problems are being promptly supported by the local technician. Battery boxes have a 3-year warranty, so the community enterprise can help users send faulty batteries back to the factory for warranty claims.

Community benefits

Since the project started in 2020, Koh Bulon Don RE community enterprise has organically expanded from 15 solar home systems to 57 systems over the past 2 years. It shows that with an electrification project does not need to achieve 100% electrification since day 1, but organic growth can be very beneficial based on the readiness of each households. The community enterprise also provides welfare to community members, for example there is free internet access via community WIFI servicing 80% of the community area. The community enterprise also become community market sourcing hard to find products to sell to the community members. For example, high quality power banks, DC powered juice blender, internet SIM cards, solar boat lights etc.

Country benefits

On a country level, Koh Bulon Don RE community enterprise is proof that communities can be owners and users of solar home systems managing their own infrastructure without waiting for governmental funding. The Thai Ministry of Energy as part of the project team has replicated the success on Koh Bulon Don to other communities in Thailand, a neighbouring island is also now electrified with the same approach in 2021.

This project changes the paradigm from the 'grant and forget' approach to a 'financed and sustained' model which has proved to be replicable. A grant and forget will hand out solar home systems to every household on the island, all with the same size, each system is self-maintained and usually without successful collection of maintenance payment collection. The systems will be abandoned once there is a technical fault. The financed and sustained model is tailor-made and not one size fits all, each household is able to choose SHS size which fits perfectly for their willingness and ability to pay from S,M,L,XL sizes. With limited funding available, not every household needs to be electrified in day 1, the community enterprise grows by collection monthly payment from SHS users and uses the funds to purchase more SHS for new members.

C.2 Corporate Social Responsibility Program

The owners of the project is now Koh Bulon Don RE Community Enterprise, community owned and operated. There are no additional CSR activities needed, since their core activity is creating social benefits on a daily level. Welfare benefits provided by the community enterprise is not considered as CSR but a core activity of the enterprise.



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ASEAN Renewable Energy Project Awards

ASEAN Energy Awards 2022

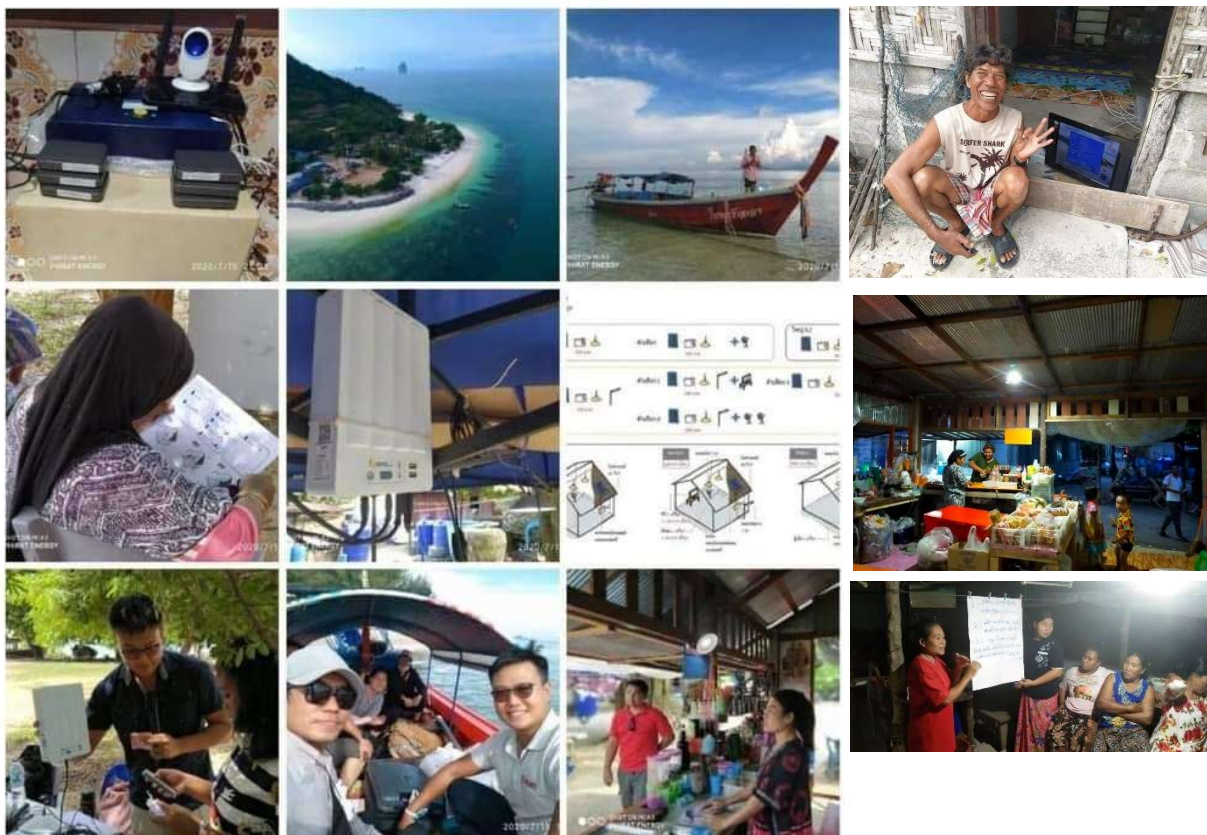


C.3 Community/People Awareness, Participation and Acceptance

As was already described above, the project has a strong focus on developing processes for community participation in renewable energy projects. Core principles are based on the International Association of Public Participation (IAP2) Spectrum on Public Participation. The project team aims to achieve the highest level of participation which is community empowerment.

Outcomes on community participation:

- **Community are owners:** Community members are not only users but owners and operators of their own renewable energy community enterprise.
- **Tailor made solutions:** Community was involved in sizing the systems according to their needs, evaluating cost per month and decided on a lease term of 48 months.
- **Elected committee:** A community enterprise was set-up with an elected committee. The committee is then taking responsibility of the systems and making decision on rules of governance.
- **Community welfare:** The community enterprise currently provides welfare benefits to its members such as providing wifi internet access enabled by having solar energy
- **Community Enterprise rules:** There are several rules which are established by the community themselves. An excerpt of the rules:
 - All payments are due on the 24th of every month
 - Every new SHS requires down payment calculated as three months of the monthly fee
 - Payments are collected by the treasurer of the Community Enterprise
 - Users who defaulted for 3 months, the community enterprise has the right to take back the system take the down payment
 - Community Enterprise management committee has a term of 2 years and re-election shall happen
 - Community Enterprise opens bank account with Chairman, Vice-Chairman and Treasurer as the authorized persons to withdraw
 - The Community Enterprise shall organize a meeting every month to announce financial report and audit.



C. TECHNICAL, ECONOMIC & MARKET CONSIDERATION

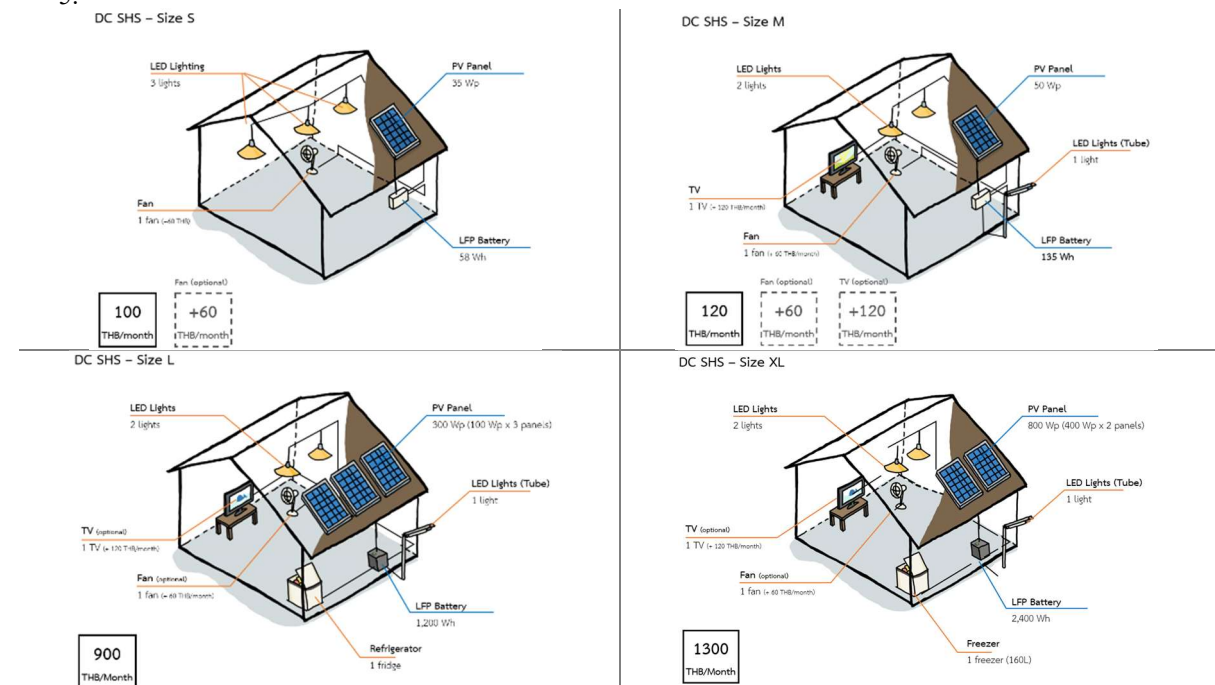
D.1 Technical Design

No	Parameters	Unit	Value
1	Year of the project's commencement		2020
2	Period of construction	Month	1
3	Capacity	kW	7.5 PV / ESS 20 kWh
4	Capacity factor	%	Average approx. 13%
5	Energy Generation	kWh/year	7,446 kWh
6	Useful Life	Year	PV: 25 years LFP ESS: 10 years

Solar panels produce direct current (DC) electricity, charge a 12V_{dc} LFP battery and electricity is supplied to the DC appliances, Lighting, Fan, TV, mobile phone, refrigerator, freezer. The size of panel and battery is designed according to the expected appliance as shown in the diagrams below. For example the refrigerator consumes approx. 800 Wh/day, the 300 Wp PV panel can produce 1200 Wh/day and the battery capacity is 1200 Wh, so there is enough electricity to supply the load.

There are 4 solar home sizes which community members can choose from:

1. Size S (100 THB/month): 35 Wp PV panel, 56 Wh LFP battery, 3 lights with optional fan (+60 THB/month).
2. Size M (120 THB/month): 50 Wp PV panel, 135 Wh LFP battery, 3 lights with optional fan (+60 THB/month) and optional TV (120 THB/month)
3. Size L (900 THB/month): 300 Wp PV panel, 1200 Wh LFP battery, 3 lights with optional fan (+60 THB/month) and optional TV (120 THB/month)
4. Size XL (1300 THB/month): 800 Wp PV panel, 2400 Wh LFP battery, 3 lights with optional fan (+60 THB/month) and optional TV (120 THB/month)





APPLICATION FORM

ASEAN Renewable Energy Project Awards

ASEAN Energy Awards 2022



D.2 Technical Performance

The SHS systems are plug&play, easy for installation and simple to use. LFP batteries which are used in this project is a superior technology compared to lead-acid technologies in the past; lifetime, depth of discharge and economics.

The project uses high quality LFP batteries with expected life of 10 years (3000+ cycles). This is a major improvement from lead acid batteries with expected life of 3 years (<1000 cycles). Across a project lifetime of 10 years, lead acid will need to be replaced at least 3 times. Additionally, LFP batteries have a depth of discharge (DOD) of 90%, compared to a recommended 50% DOD for lead acid batteries. So in order to achieve the same useable capacity (assuming 1 kWh_{useable}), then a LFP needs to be at 1.11 kWh capacity, but lead acid at 2 kWh capacity. When comparing economics, although LFP are currently around 2.5 times more expensive than lead acid in CAPEX/capacity, when factored a project viewpoint and OPEX needed to maintain and replace lead acid batteries, then lead acid is actually 4 times the total cost of ownership (TCO) of LFP.

The selected plug&play system comes embedded with pay-as-you-go technology (PAYG). PAYG is a technology which removes the upfront price barrier of Solar Home Systems (SHS), by allowing end users to pay in affordable amounts over time. This is accomplished by additional electronics, which enables or disables the SHS on request, achieving a top-up payment structure similar to mobile phones. In order to make a PAYG system work, there is a locking /unlocking functionality that needs to be integrated on the hardware of the system. All fosera. Solar Home Systems have the PAYG functionality included. Secondly, a PAYG software backend is needed to track customer payments and offer Customer Relationship Management (CRM) functions, which is offered by PAYG service providers. Depending on the chosen PAYG service provider, the backend also includes warehousing, service management and many other functionalities





APPLICATION FORM

ASEAN Renewable Energy Project Awards ASEAN Energy Awards 2022



D.3 Investment Indicator				
Financial Model	No	Parameters	Unit	Value
	1.	Total Capital Cost/Expenditure (CAPEX) — If available, please also provide the detail breakdown of capital cost, such as : pre construction stage, construction stage (equipment, machinery, etc.), installation/EPC, grid connection, etc.	USD	16,000
	2.	O&M cost (excluding fuel for biomass project)	USD or % CAPEX	5% of CAPEX/year
	3.	Fuel cost (for biomass project)	USD	None
	4.	Discount rate	%	6
	5.	IRR	%	28%
	6.	ROI	%	307%
	7.	Payback period	year	4
	8.	NPV	USD	29,723
	The project shows positive results on all financial indicators, the relatively short payback term and high internal return rates are attractive for expansion of such models.			
D.4 Financial Scheme/Livelihood Projects				
The CAPEX money is from Australian aid, it is a grant to community development activities without expectations for return. A monthly service and maintenance cost is collected and by the Koh Bulon Don RE Community Enterprise at rates (THB/system) associated to the size of SHS which the user is using. So the CAPEX money is not totally lost, but is return in a revolving fund style, collected money gets reinvested to buy new systems an increase electrification rate.				
D.5 Funder (Government and Non-Government)				
Koh Bulon Don RE Community Enterprise received its CAPEX funding from the Australian Aid under the Direct Aid Program (DAP). This was valued at 500,000 THB or approx. 16,000 USD. The Direct Aid Program (DAP) is a flexible small grants scheme for development activities. The program funds projects that provide direct benefits to those most in need in the local community, including vulnerable or disadvantaged groups.				



APPLICATION FORM

ASEAN Renewable Energy Project Awards
ASEAN Energy Awards 2022



D.6 Market Size (Potential Within 5 Years)
The growth rate of the business to manage the solar home system at Koh Bulon Don will be able to add on average 3 households per month. It is expected that within 3 years, by 2025, all households will have access to use renewable energy and achieves 100% electrification. After 2025, the community enterprise will continue to bring income to a revolving fund where members will have continual savings of 50 THB per month (1.6 USD/month) in order to expand their service into other topics such as ice production plant, on-demand washing machine, water purification for clean drinking water and mobile phone services. It is planned that members of the community enterprise will receive certain welfare related to birth, old age, sickness and death. Once this is achieved, the community will be less relied on external products, have increased self-dependency and improved circulation in the local economy.
D.7 Local Manufacturing/Content of System
100% of the equipment is sourced from Thai manufacturers or produce from Thai factories. The project team chooses the solar home system provider, FOSERA, which is a producer of DC SHS (Solar panel and battery boxes) with manufacturing in Thailand. Many of the components which goes into making the ESS is from Thailand, incl. electronic boards, plastic casing and labour. DC appliances are also sourced from local manufacturers in Thailand, i.e. LED light (Fosera), Fan (Fosera), TV (Alpha), fridge and freezer.
D.8 Amount of Fossil Energy Avoided (ktoe, etc)
Total island wide diesel consumption reduction is estimated to be 2,944.05 liters per year or 7,446 kWh/year produced from renewable energy. Equivalent to 1,071.63 GJ/year (2,944.05 liter/year x 36.4 MJ/l = 1,071,634.20 MJ/y)
D.9 Life of Project
The project life is minimum 10 years. This is estimated from the LFP battery lifetime, after which the community enterprise will have funds to replace the LFP battery in year 10, so the SHS can be continuously operated until the end of life of PV panels, 25 years.



APPLICATION FORM

ASEAN Renewable Energy Project Awards

ASEAN Energy Awards 2022



D. OPERATION & MAINTENANCE SCHEME

E.1 Operation Hours (Day/Month/Year)

Operational hours of PV is from 6 AM to 6 PM when there is sunlight, after which the electricity is supplied from the battery. The amount of hours which can be sustained by the battery is depending on how many appliances are being operated. The users are the ones who are controlling what they use, and usually fans are being prioritized.

For example:

Size – M battery has 135 Wh capacity.

LED lights consumes 6 W (2 W/lamp x 3 lamps). $135\text{Wh}/6\text{W} = 22.5$ hours of operational time

Fan consumes 9 W. $135\text{Wh}/9\text{W} = 15$ hours of operational time

TV consumes 30 W. $135\text{Wh}/30\text{W} = 4.5$ hours of operational time

In general, it can be said that the community have access to 18-24 hours of electricity per day.

E.2 Maintenance Scheme (In-House, Contracted Out Service, Government, Others)

Maintenance cost for the first 4 years is already added into the monthly payments. The community enterprise collects money from members of solar home users at the rate specified in each package. Local technicians living on the island are trained to install, troubleshoot and fix basic faults. This is full done in-house by the local technicians hired by the community enterprise. Users are trained to identify battery levels and basic faults, such as if the battery levels are low there will be red flashing alarm, 7 days before payment is due then there is a flashing orange alarm. So users know that they have to go pay at the treasurer.

E.3 Other Maintenance Measures (Training, After-Sales Service)

PV panels have performance warranty for their lifetime.

Fosera batteries have a warranty of 3 years, so any faults within 3 years the battery gets serviced by the Fosera factory. After 3 years, then Fosera will provide after sales service and provide maintenance as necessary.





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E.4 Energy Conservation and Cost Reduction System
Having local technicians on the island can reduce installation cost by 70% compared to having external technicians going into install the systems.
E.5 Local Service Content
The project team chooses the solar home system provider, FOSERA, which is a producer of DC SHS with manufacturing in Thailand. Many of the components which goes into making the ESS is from Thailand, incl. electronic boards, plastic casing and labour. DC appliances are also sourced from local manufacturers in Thailand, i.e. Fan, TV, fridge and freezer. https://fosera.com/news/detail/fosera-thailand-working-conditions
E.6 ISO for Environment and Quality
Fosera the main supplier in the project is certified for ISO:9001 for quality, ISO:14001 for environmental management and ISO:45001 for occupational health and safety. Fosera products are part of the lighting global list for off-grid products https://www.lightingglobal.org/fosera-3/. Lighting Global is the World Bank Group's platform to support sustainable growth of the international off-grid solar market as a means of rapidly increasing energy access to the 789 million people living without electricity. Lighting Global works with manufacturers, distributors, governments, and other development partners to build and grow the modern off-grid solar energy market.
E.7 Farm Management, Sustainability Supply and Resources of Raw Materials – For Biofuels Category Only
Not applicable



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E. REPLICABILITY

F.1 Relevance, Impact, Efficiency
The choice of using DC SHS is more efficient than AC SHS for households with small loads, like Koh Bulon Don. Pay-as-you-go systems allow payment collected to be ensured, transparent and auditable. Local technicians are key for efficiency of installation and speed of which problems can be troubleshoot. The community enterprise of Koh Bulon Don shows that self-governed RE projects can be successful and provides a better approach for rural electrification. The concept of finance and sustained can be replicated and adopted for all electrification projects, not only with solar home systems.
F.2 Cost Effectiveness (No, Low, High Cost)
For the use of direct current (DC) systems, it is the approach that leads to the lowest cost. If you ask why DC system is used, it is because most of the electrical appliances use direct current (DC), such as TVs, fans, light bulbs, mobile phones. Portable computers, etc. The electricity produced by a PV system is in DC form and is stored in DC form in the battery. Likewise, if electricity is to be used in an alternating current (AC) system, this DC power must be converted to AC to be sent into the distribution line system. And when the power is delivered to the user, many appliances eventually convert this AC power back into DC once again. It can be seen that the whole process led to many conversion losses. In remote areas where only a water heater or refrigerator is needed, the DC system is the lowest cost option. (The cost for an AC system can be nearly 4 times higher.) Therefore, DC is a better choice for areas that do not have electricity.
F.3 Sustainability of Project
As mentioned that one of the first objective of the project is for it to be a showcase. Now that the showcase is done, there activities to replicate and expand the success of the project to other islands and areas. For example, a neighbouring island to Koh Bulon Don is called Koh Bulon Lae. The project team has used the same approach of financed and sustained. To emphasize the key lesson learn from this project is that all types of rural electrification project needs community participation. Koh Bulon Don chose the highest level of participation which is to empower, but this doesn't have to be always the case, there are other weaker forms of participation like inform, involve, consult and collaborate. Project developers (private or public) shall tailor made their approach which is suiting to the needs and context of the local community. With high levels of community participation comes with sense of ownership and systems are being taken care of by the community themselves.



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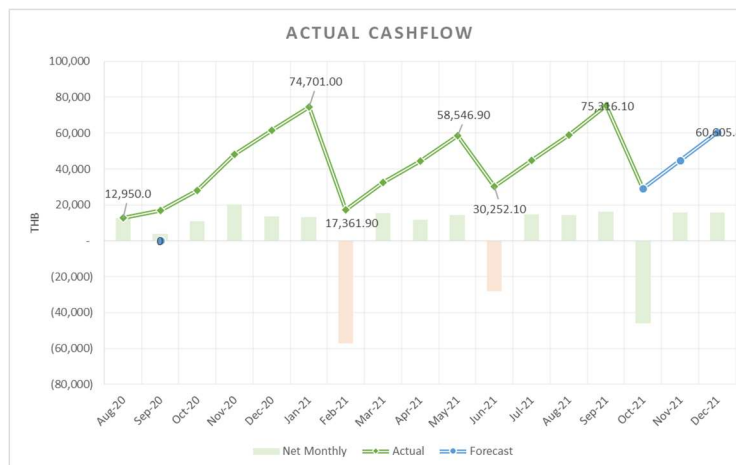


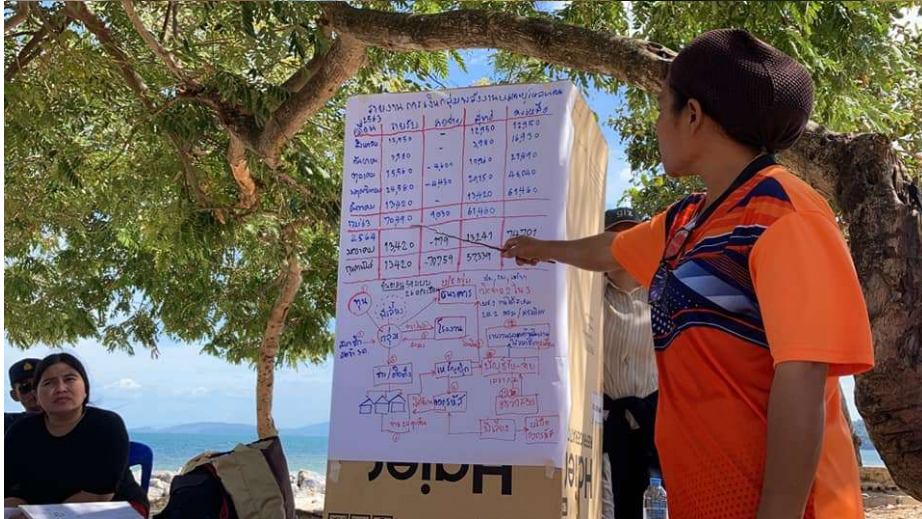
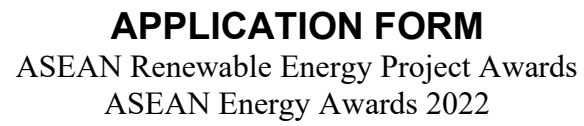
F.4 Others	
None	

G. FIGURES, TABLES, PHOTOS

THB	0	1	2	3	4	5	6	7	8	9	10
Cashflow -	500,000	61,460	854	246,840	246,840	246,840	246,840	246,840	246,840	246,840	246,840
Cumulative -	500,000	438,540	439,394	192,554	54,286	301,126	547,966	794,806	1,041,646	1,288,486	1,535,326

IRR 28.57%
 NPV 921,430
 ROI 307%







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