



Ban Doi Kaew: Social Enterprise for the unelectrified Area Area ASEAN Energy Awards 2023 On-grid (Local Grid)



ผูลนธวสาหกจพลงงานชุมชน Enterprise Community Energy Foundation ศูนย์กลางประสานการมีส่วนร่วมของประชาชนด้านหลังงาน

Enterprise Community Energy Foundation (ECEF)



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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 region's economic growth and environmental sustainability. 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 exofficio member. The Ministry of Energy and Mineral Resources of Indonesia hosts ACE's office 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 energy field. It is an annual event organised by ACE in collaboration with the ASEAN Specialised Energy Bodies (SEBs), particularly 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 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 improve environmental quality in the ASEAN region.
- 4. Ultimately, the objective of the competition is to exchange knowledge and experience in developing and maintaining the RE projects as part of the ASEAN spirit.

SUBMISSION GUIDELINE

Application Form for Category:

1. OFF Grid

- a. Power
- b. Thermal
- 2. ON Grid

a. National Grid b. Local Grid

3. Combined Heat and Power

4. Biofuels

Application Format, Terms and Conditions

The following is the general guideline for the submission of an 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 authorisation letter by the owner for the site visit



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Contents

- 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)

	OFF Grid
	□ Power
	Thermal
	ON Grid
Category	National Grid
Category	🗹 Local Grid
	Combined Heat and Power
	Biofuels

	Title of	Activity/Pro	iect/Theme
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Ban Doi Kaew: Social Enterprise for the unelectrified Area

Source of Energy	Mini local grid hybrid power generation (solar and biomass synthetic gas)
Age of Project/Commercial Operating Date (COD)	3 years / January 2021

Applicant General Information			
Name of Company	Enterprise Community Energy Foundation (ECEF)		
Primary Contact Person	Mrs. Kanrapee Kaewmaneephat		
Designation			
Business Address	33/3 Moo 3, Phapang Subdistrict, Maeprik District, Lampang Province, Thailand zip code 52180		
Project Site Address	Ban Doi Kaew (Ban Mae Pok Bon patch and Ban Hin Fon patch) No. 5, Mued Ka Subdistrict, Doi Tao District, Chiang Mai Province, Thailand zip code 50260		
Telephone	+6654837091		
Mobile Phone	+66988892942		
Fax	+6654837091		
Email	tha_kanrapee@hotmail.com		
Website			



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Nature of Business

Small enterprise to conduct the sustainable energy to the community.

Project Abstract

Ban Doi Kaew (Ban Mae Pok Bon and Ban Hin Fon), Village No. 5, Mued Ka Subdistrict, Doi Tao District, Omkoi Wildlife Sanctuary, National Park Department, Chiang Mai Province. It is a community living in a geographically limited area and the legal aspect, far from power transmission lines and not worth investing in electrical energy, economically, the community household energy comes from lamp, candles, and firewood collected from the forest. There is still no access to stable, quality, non-polluting electricity. This project has therefore initiated the installation of potential renewable energy production systems in the area, including solar and biomass. So that "people" can live together with "forests" by upgrading the potential and ability of personnel in the area to know the skills of community technicians in producing energy for the use, maintenance, and management of energy to be able to develop by selfreliant energy from biological resources available in the local area which is energy development to achieve sustainable energy development, ensure access to affordable, reliable, sustainable and modern energy for all.

Social enterprise for areas without electricity (Ban Doi Kaew) project; conceptual of implementing small enterprise projects to conduct sustainable energy to the community, received budget support from the Provincial Electricity Authority (PEA). System efficiency, produced by mini local grid from renewable energy by hybrid power generation; solar and biomass synthetic gas from Solar PV: 50kWp, Energy storage: 105 kWh, Syngas (bamboo) generator: 20 kW/ Solar 8 hrs. 33%, Battery 10 hrs. 41.6 %, Bamboo charcoal 6 hrs. 25% In the comparative case, if diesel fuel is used to produce 100% electricity, the amount of greenhouse gases that can be reduced 177,707 kg- CO2 eq/year or 3,554,140 kg-CO2 eq can be avoided over the project life of 20 years. Rate of return such as payback

period, IRR 9.3%.

The benefit of the project brings to the community by creating community participation, such as allowing people to participate in the project providing opportunities for people to study and learn about energy. Listen to community opinions before starting the project, hiring local workers during system installation. A community working group was formed to collect revenue to support maintenance. In addition, the ability to disseminate and expand results that can be extended further in other areas in Thailand and the ASEAN region, which is a guideline for promoting the use of renewable energy at the small scale, especially in remote areas, to create participation for communities Including moving towards a low carbon society. energy development, ensure access to affordable, reliable, sustainable, and modern energy for all.

Employment Opportunities

Executive: (Technical) 1 (Non-Technical) 1 Non-Executive: 2



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CERTIFICATION AND ENDORSEMENT

The Enterprise Community Energy Foundation (ECEF) hereby agreed to allow the ASEAN Board of Judges and other experts that may be designated by ACE to visit the RE project site and verify the authenticity of the data. However, two weeks advance notice is required to allow for necessary arrangements.

We also hereby agree that ACE can publish the whole submission in ACE publications and website without any prior consent of the owner of the RE project. If the submission is published in other publications, the consent of the concerned RE project owner would be required.

We, the undersigned, certify that the information given is true, accurate, and prepared with the consent of the party/ies involved.





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A. ORIGINALITY

A.1 Project Profile

Design

Design

Since the community is in an area far from power transmission lines. Located as a wildlife sanctuary. The community household energy comes from lamps, candles, and firewood collected from the forest. There is still no access to stable, quality, non-polluting electricity.Various facilities including construction energy facilities require permission before proceeding, which is a legal restriction Installing the electricity system is difficult due to inconvenient transportation routes, making high operating costs, and the difficulty of the government sector facilitating after the system has been commissioned which are the important obstacles of energy development in remote areas.

This project has therefore initiated the installation of potential renewable energy production systems in the area, including solar and biomass. So that "people" can live together with "forests" by upgrading the potential and ability of personnel in the area to know the skills of community technicians in producing energy for the use, maintenance, and management of energy to be able to develop by self - reliant energy from biological resources available in the local area which is energy development, to achieve sustainable energy development, ensure access to affordable, reliable, sustainable and modern energy for all.

Application

This project received budget support from the Provincial Electricity Authority (PEA) initiated two parts: installing a potential renewable energy production system in the area, including solar and biomass,By installing the Mini local grid hybrid power generation system (solar and biomass synthetic gas) from Solar PV: 50kWp, Energy storage: 105 kWh, Syngas (bamboo) generator:20 kW / Solar 8 hrs., Battery 10. hrs. 41.6 %, Bamboo charcoal 6 hrs. 25% and creating personnel in the community to manage it, viewing Community electricity system as "Community business" that the people in the community can be manage.

Approach

Results obtained after the project has been completed: More than 85 households have access to lowcost electricity from local resources. After installing the renewable energy production system People in the community have a better quality of life. dangers from traveling at night. Have more hours of electricity use, able to work.Children have done their homework and have access to communication. There is a refrigerator to keep food of good quality and keep it edible for a longer time. manage the community's own electricity business was born. A team of community technicians has emerged that can take care of basic systems, reducing reliance on outside help, which shows an approach to managing relationships between "people" can live together with "forests" by upgrading the potential and ability of personnel in the area to know the skills of community technicians in producing energy for the use , maintenance, and management of energy to be able to develop by self-reliant energy from biological resources available in the local area.



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B. ENVIRONMENT CONSIDERATION

B.1 Amount of Emissions/Pollution Avoided				
	Parameters	Value and unit		
No.		Before	After	Carbon Emission Reduction
1	Primary GHG emission (Carbon dioxide, Methane, Nitrous oxide, CFC)	-	177,707 kg-CO2 eq/year	177,707 kg-CO2 eq/year
2	Electricity consumption	-	134,386 kWh	
3	Fuel consumption	-	65,849 L	
Total Potential Carbon Emission Reduction				177,707 kg-CO2 eq/year

B.2 Discussion (Simple calculation of conversion)

Summary of the overall picture of resource reduction and environmental protection

• Electricity from solar and biomass 134,386 kWh per year.

• Replace the use of diesel fuel for a total of 65,849 liters per year or 100% replacement.

Because Ban Doi Kaew (Baan Mae Pok Bon and Ban Hin Fon patch) is an off-grid area with no access to transmission lines, so electricity is produced Mini Off Grid Hybrid Power Station from Ban Doi Kaew (Baan Mae Pok Bon and Ban Hin Fon patch) is an off-grid area with no access to transmission lines, so electricity is produced Mini Off Grid Hybrid Power Station from Solar PV: 40 (30+10) kWp, Energy storage: 105 (60+45) kWh Syngas (bamboo) generator : 20 kW / Solar 8 hrs. 33%, Battery 10 hrs. 41.6 %,Bamboo charcoal 6 hrs. 25% In the comparative case, if diesel fuel is used to produce 100% electricity, greenhouse gas emissions of 177,707 kg- CO₂ eq/year per year or 3,554,140 kg- CO₂ eq/year can be avoided over the project life of 20 years.

Assumptions for calculating the amount of greenhouse gases that can be reduced from using renewable energy to produce electricity.

1. Evaluate the emission factor: How many liters of oil does the production of electricity from 1 kWh of diesel use? Get a figure of 0.494 L/kWh.

2. Evaluate how much CO_2 eq combustion of 1 liter of diesel fuel releases, which from the IPCC

database already has a default emission factor equal to 2.6987 kg- CO₂ eq /L.

B.3 Project Objective & Criteria

Project implementation emphasizes environmental standards. All steps of the project, the preparation period, Processing period and after the project expires, complies with checklist of measures for design and installation according to the Code of Practice of solar power producers from photovoltaic panel technology; issued by the Energy Regulatory Commission in the preparation period selected equipment designed and installed according to IEC standards.in the construction phase implemented a plan regarding the disposal of waste brought into the community and do not throw garbage into the community's drainage channels or water sources during the operation period There is a tank prepared to receive general waste generated in the project. and includes consideration of how to dispose of solar panels and other equipment.



C. SOCIAL CONSIDERATION

C.1 Benefits (User, Community, Country)

The community owns renewable energy power plant. Benefits to entrepreneurs as project owners (user or owner) The Ban Doi Kaew Social Electricity Project is a joint operation between the community and the Community Energy Enterprise Foundation, which is the P'Liang team (Coaching Team) jointly developing the project under a grant from PEA as joint owners of the project. By taking advantage of community labor to participate in the development of spatial plants and managing the electricity business as overseers who are people in the community. In addition to collecting electricity bills with a system "Ban Doi Kaew Community" which manages the integrated renewable energy microgrid system, has upgraded to become a full-fledged legal entity. and manage it more systematically for example, financial statements are reported every year. Conduct an annual audit by a licensed auditor. Make accounting transparent.

Benefits to the community/people living around the project (community)

After receiving the system update the community gets to use electricity 24 hours a day that comes from 100% renewable energy. Before the community project, there was no electricity at all, only flashlights and bonfires. When there is electricity 24 hours a day, the quality of life of the people in the community improves. Because necessary electrical equipment such as refrigerators, electric light bulb can be used continuously. Without having to worry that the power will go out for a long time, the contents of the refrigerator will be damaged. or a fan, which is a necessary cooling device. Raising businesses the level from being a user to being a system administrator. Socially, there is a gathering of communities in the form of an electricity committee of village that can jointly set policies and directions regarding





electricity, such as the community electricity tariff policy after improving the system is set to not exceed 5 baht per kWh unit, and there is a policy to exempt the collection of electricity tariffs. From the use of public sector agencies of the community, such as schools, temples, Christian churches, and streetlights, which are considered beneficial to the public and do not cause such agencies to bear the burden of public utility expenses consumption.

Benefits to the country

The development of electricity systems for islands and remote areas is one of the drivers for all countries to achieve the Sustainable Development Goal (SDG), a goal set by the United Nations. In Goal 7, there will be clean energy that is accessible to everyone. which for Thailand There is information from the Provincial Electricity Authority (PEA) as of October 22, 2020. It is found that PEA has expanded the electricity network to households across the country, accounting for 99.21 percent. However, there are still a number of households that still do not have electricity. Use or lack of access to a large amount of electricity at all times. Most are located in the national park area. national forest reserve or forest areas under the responsibility of the National Park Department Wild animals and plants (Wildlife) and remote island areas This causes many delicate issues in operations, both legal and social. But at present, the development of modern technology has been developed and applied, causing the cost of many types of equipment and systems related to electrical systems in remote areas to decrease, such as solar energy technology, biomass, and energy storage systems, etc. together with new business models that have been introduced It can help Thailand achieve its goal of having electricity in every area of the country completely (100 percent), which will also support other benefits, such as lower energy costs than in the past. Environmental friendliness, etc.

Cooperation partners from communities, states, state enterprises have joined forces with agencies under the Ministry of Energy. In the study to make policy recommendations for the development of the electrical system, focusing on several factors such as the reduced cost of renewable energy technology. Including emphasizing the dimension of building capacity in administration and management of systems within the community to make the energy production system sustainable. and can respond to the energy needs in the area Under reasonable and not too expensive electricity costs. This study has presented case studies including Ban Doi Kaew, Chiang Mai Province, and Ko Jik, Chanthaburi Province. and Bulon Don Island, Satun Province. Important development issues for projects on the various islands are community participation in system management and building ownership of the system. By strengthening the potential of electrical system users to manage the collection of electricity and lost opportunities. Creating a hybrid renewable energy system is therefore a solution to the above-mentioned heat problem.

C.2 Corporate Social Responsibility Program

The use of renewable energy to replace fossil fuels by up to 100% shows that the community can support itself with the resources it has within the community and is a source of energy that does not cause air, noise, odor, and water pollution and promotes participation processes at the empowerment level instead of comprehensive government operations.



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C.3 Community/People Awareness, Participation and Acceptance



This project is developed through the public participation process; inform, consult, involve, collaborate, empower. To jointly manage the community's electricity business by practice makes the community aware of managing electric power according to their spatial potential. To be Trained to accept the rules for living together under a democratic system. Accept the rules for managing the community's electricity business. To achieve sustainability

D. TECHNICAL, ECONOMIC & MARKET CONSIDERATION

D.1 Technical Design

No	Parameters	Unit	Value	
1	Year of the project's		4 years since	
	commencement		commencement	
2	Period of construction	Year	1 years	
3	Capacity	KW	Ban Doi Kaew (Baan Mae Pok Bon and Ban Hin Fon patch) is an off-grid area with no access to transmission lines, so electricity is produced Mini Off Grid Hybrid Power Station from Solar PV: 40 (30+10) kWp, Energy storage: 105	
			(60+45) kWh Syngas (bamboo) generator 20 kW, solar 8 hrs. 33%, battery 10 hrs. 41.6 %, bamboo charcoal 6 hrs. 25% In the comparative case, if diesel fuel is used to produce 100%	
Δ	Capacity factor	0/0	electricity	
5	Energy Generation	GWh/year or GJ/year or ktoe or litres/year(for biofuel)	134,386 kWh	
6	Useful Life	Vear	At least 20 years	





The electricity price structure reflects costs. Cheapest among RE systems: Install a Mini Off Grid Hybrid Power Station electricity generation system using solar energy to produce electricity during the day for 8 hours, use bamboo charcoal biomass fuel to produce energy and electricity at night for 6 hours, and use an energy storage system. Battery electricity for 10 hours. Summary and electricity production for each patch of house as follows.

1. Mae Pok Bon Ban sub-group There are 60 households using electricity, 1 school, 1 temple, 1 health station, 1 Christian church. Electricity production capacity installed by Mini Off Grid Hybrid Power Station PV system 30 kW, Syngas biomass 20 kW, ESS 60 kWh, system installed in Ban Mae Christian Church area. Pok Bon Electricity service is set at 6 baht (originally 5 baht/unit). Total investment budget is 4,279,158 baht. Project payback is 9.66 years.



2. Ban Hin Fon sub-group There are 25 households using electricity, 1 school, 1 temple (6 households have moved to a new house in the nearby area). There is an electrical generating capacity installed with a Mini Off Grid Hybrid Power Station system, PV 10 kWh, biomass Syngas 5 kWh, ESS 45. kWh install area production system Ban Hin Fon Educational Service Area Office Calculate electricity at a price of 7 baht (originally 6 baht/unit) in a total investment budget of 2,239,782 baht with a project payback period of 9.79 years.





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D.2 Technical Performance

The battery selection is a new technology, lithium LFP, which has a much better charge-discharge efficiency than lead-acid batteries. The LFP technology chosen can supply electricity up to 90% Depth of Discharge (DOD) and when recharged, the LFP battery can be charged. At a C-rate, or a charging rate that is five times faster than lead-acid, overall with similar battery capacity, LFP batteries are more efficient than lead-acid and use a Syngas biomass gas generator from high quality bamboo charcoal 50 kg. + 10 kW electricity generator. 0.4 kg. of charcoal = 1kWh. 50 kg. of charcoal = 20 kWh. (Walk continuously for 6 hours and then rest.) 100% substitute for diesel power generators, used in combination with solar power plants.





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	No	Parameters	Unit	Value							
	1. Total Capital Cost/Expenditure (CAPEX) Total CAPEX										
	- 176,813.60 US If available, please also provide the detail Machinery: 65										
		breakdown of capital cost, such as : pre	USD	EPC: 20%							
construction stage											
	(equipment, machinery, etc.), construction:5										
	installation/EPC, grid connection, etc. Administrative: 10%										
	2.	O&M cost (excluding fuel for biomass	USD or								
		project)	%								
			CAPEX	3%							
	3.	Discount rate	%	7%							
	4.	IRR	%	9.3% (project IRR)							
Financial	5.	ROI	%	90%							
Model	6.	Payback period	year	9							
withder	1.) B	an Mae Pok Bon sub-group There are 60 hous	eholds usin	ig electricity, 1 school,							
	1 temple, 1 health station, 1 Christian church. Electricity production capacity										
installed by Mini Off Grid Hybrid Power Station PV system 30 kW, Syngas											
	bi	omass 20 kW, ESS 60 kWh, system installed	in Ban Mae	e Christian Church area.							
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							si Si	stem PV 10 kWh biomass Syngas 5 kWh F	SS 45 kWl	n install area production	
							5)	stem Ban Hin Fon Educational Service Area	Office Calc	ulate electricity at a	
							system Ban Hin Fon Educational Service Area Office Calculate electricity at a				
						price of / bant (originally 6 bant/unit) in a total investment budget of 2,239,/82					
bant with a project payback period of 9.79 years.											
D 4 Financial Scheme/Livelihood Projects											
Ban Doi Kaew: Social Enterprise for the unelectrified Area There is a "free CSR scholarship" to											
support participation in promoting innovation development. Electrical energy technology from											
Provincial Electricity Authority (PEA) to be a tool to drive the process of improving quality of life											
that the Karen athric community has expressed expersion of "community affairs" that are not											
"activities" to solve inequality problems Economic, social, and environmental equality in the											
activities to solve inequality problems Economic, social, and environmental equality in the											
community "investors". The investors make a 6,518,940 bath (176,813.60 USD) (1.)Ban Mae Pok Bon											
sub-group 4,2	2/9,158	bant + 2.)Ban Hin Fon sub-group $2,239,782$ b	aht) invest	timent for the new							
renewable energy assets (Solar PV + LFP battery + inverter + syngas genset)											
D.5 Funder (Govern	iment and Non-Government)									
Funder by Pi	rovincia	al Electricity Authority (PEA) 100%									

D.6 Market Size (Potential Within 5 Years)

In ASEAN countries rural area, the rate of access to electricity still low in majority of countries. The electricity price had also tendency to raise, so this is the constraint to rural households. Over the past years, Solar and biomass energy is extensively used in ASEAN countries, particularly in Thailand is perceived useful not only in providing low-cost energy sources and reducing costs of agricultural inputs but also in minimizing the negative impacts of agriculture production systems on the environment, Thailand's market potential remains high for solar and biomass., as well as



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appropriate technologies that significantly contribute to sustainable electricity generation agriculture and rural development in the region.

D.7 Local Manufacturing/Content of System

Technology for producing electricity from biomass gas, 100% produced in Thailand.

The project uses main equipment and services from the following manufacturers:

Solar panels from Sunshine Solar Tier 1 Panel

Batteries and inverters from Atess Solar ESS

Solar panel installation work by Construction of equipment storage building by Community Energy Enterprise Foundation and people in the Ban Doi Kaeo community

D.8 Amount of Fossil Energy Avoided (ktoe, etc)

In the past, Ban Doi Kaew used firewood and head torches, without a gasoline generator. Currently, the project can produce 100% electricity from sunlight and biomass. produce electricity and can replace 65,849 liters of diesel fuel per year. Reduce greenhouse gas emissions by 177,707 kg-CO2 eq/year

D.9 Life of Project

The project lifetime is 20 years or until the end-of-life of the PV Panels. During the operational period of the project, batteries and other consumables will be replaced and maintained.

E. OPERATION & MAINTENANCE SCHEME

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

The optimization and preservation approach to maintain the project as a successful benchmark and practical. By designing the use of mixed energy sources in each period a day as follows:

- Operation of the electrical supply system 24 hours a day
- 00:00 a.m. 06:00 a.m., use biomass gas energy.
- 06:00 a.m. 06:00 p.m., use the remaining electricity from solar cells to store in batteries.
- 06:00 p.m. 00:00 a.m., uses battery power.

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

Giving importance to safety measures in use, therefore, safety issues in using synthetic gas have been studied in the Final Report: Innovation study and development project and prototype demonstration Increasing the efficiency of utilization of biological resources available in local communities for synthetic biomass energy substitute fossil fuels to solve the energy crisis in holistic circular community economic development Bio-Circular-Green Economy: BCG, Received a budget from the Energy Conservation and Promotion Fund Office. In the fiscal year 2022, the study found that.

Due to the production of charcoal using a carbonization pyrolysis reactor furnace. (Carbonization pyrolysis) from the fast pyrolysis process in the absence of oxygen. It is a process of physical change. Thermal chemistry creates synthetic gas (synthetic gas) or Syngas, a mixed fuel gas. The main ingredients consist of Methane gas (CH4), hydrogen (H2), carbon monoxide (CO) and carbon dioxide (CO2) at a high temperature of 400 -800 degrees Celsius, which is a technique from physical change with thermochemistry. The vapor quickly condenses into a liquid. and becomes a non-condensing gas (Non-condensable gas) creating clean energy



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fuel (Green Energy) without releasing pollutants into the atmosphere. Therefore, it is not harmful to the environment. and health in any way.

In addition, participation in electrical maintenance is created. Including financial and accounting systems by training community representatives to carry out daily weekly and monthly maintenance is done in-house by local technicians in the area.

- 3 Employees (Head technician, cashier and accountant)
- PV panel cleaning 4 times a year
- Trees trimming 3 times a year to avoid shading of PV panels

- Biomass Genset inspection and maintenance, exchange of engine oil, air filter, oil filter etc.

For routine preventive maintenance, every 6 months and 1 year. Then Enterprise Community Energy Foundation (ECEF) personnel are sent to the area for routine inspection and maintenance. LFP Batteries are expected to have a lifetime of 10 years, after which the batteries will be replaced.

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

The local technician receives basic training for basic operation and maintenance. This includes visual inspection, procedures for the system power on-off, basic maintenance of the genset and safety training for battery and syngas generator handling.





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E.4 Energy Conservation and Cost Reduction System

Ban Doi Kaew has a long standing community commandments where several high wattage appliances are banned, such as Air conditioning units, electric cook stove, high wattage hair dryer for example. This is to control peak load of the system to not overload the inverter.

E.5 Local Service Content

Project uses equipment for maintenance Including all domestic services and mainly using local labor in maintenance activities and financial accounting

E.6 ISO for Environment and Quality

The project complies with the system installation standards from the Provincial Electricity Authority. Ban Doi Kaew complies with the code of practice (COP) for quality,

environmental and waste management stipulated by the energy regulatory commissioning of Thailand (ERC).

The PV panels were chosen to comply to the following certifications:

IEC 61215, IEC61730, UL61730

ISO9001:2008 ISO quality management system

ISO 14001:2004: ISO Environment Management system

OHSAS 18001:2007 Occupational Health and Safety

E.7 Farm Management, Sustainability Supply and Resources of Raw Materials – For Biofuels Category Only

Promote the cultivation of bamboo as a renewable energy source in the community.





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F. **REPLICABILITY**

F.1 Relevance, Impact, Efficiency

Solar and biomass syngas systems selected for use The results can be expanded to other businesses, such as water pumping, cold storage, rice mills, kitchens, fertilizer, chopper wood drying machine which villagers in the area can produce for their own use, and the government must support the budget for production and training of technicians in the community. and develop into renewable energy entrepreneurs in the community



F.2 Cost Effectiveness (No, Low, High Cost)

The cost of producing electricity from solar cells and biomass is 90% lower than electricity produced from diesel fuel. By optimizing for a well balanced Renewable energy share. The Solar hybrid microgrid biomass is proven to be able to outcompete diesel microgrid. Eventhough, solar microgrids have a higher CAPEX, But when biomass is mixed Tracked over the project's 20-year lifespan, total electricity costs for the hybrid system are much lower.

F.3 Sustainability of Project

Ban Doi Kaew microgrid has a complete business and financial model going forward. Electricity payments are being ensured and maintenance routinely planned. The financial model suggests that at the end of the project lifetime of 20 years, the community of Ban Doi Kaew have sufficient funds to self-invest in their next upgrade with the state-of-the-art technology at that time. This means that Ban Doi Kaew community will be self-reliant and needs no external funding for their own energy supply.

The project to produce electricity from solar energy and biomass is sustainable. Because it is a project that helps reduce environmental impacts. Reduce greenhouse gases in line with the COP26 commitment as well as the country's renewable energy plan that promotes the

production and use of renewable energy.

F.4 Others



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G. FIGURES, TABLES, PHOTOS

• The dynamic and meaningful fact and evident would reflect clearness on the elaboration







<image>







Ban Mae Pok Bon sub-group There are 60 households using electricity, 1 school, 1 temple, 1 health station, 1 Christian church. Electricity production capacity installed by Mini Off Grid Hybrid Power Station PV system 30 kW, Syngas biomass 20 kW, ESS 60 kWh, system installed in Ban Mae Christian Church area.



Ban Hin Fon sub-group There are 25 households using electricity, 1 school, 1 temple (6 households have moved to a new house in the nearby area). There is an electrical generating capacity installed with a Mini Off Grid Hybrid Power Station system, PV 10 kWh, biomass Syngas 5 kWh, ESS 45. kWh install area production system E ducational Service Area Office

