



Design of a Sub-Regional Renewable Energy Mini-grid Program for Pacific Island Countries and Territories

October 2018



This Design of a Mini-grid Programme for Sub-Regional Pacific Island Countries and Territories has been submitted to the United Nations Industrial Development Organization by One Energy Island Co., Ltd as the third report required under Contract No. 3000055492 - **Consultancy Services for the Design of a Sub-Regional Renewable Energy Mini-grid Programme for Pacific Island Countries and Territories**

Outline of the Design of the Mini-grid Programme

Item	Content
Country/Region	Regional (Pacific Island Countries and Territories, PICTs)
Programme Name	Renewable Energy Mini-Grid Programme for the Pacific Islands (REMPP)
Introduction	<p>The Pacific Centre for Renewable Energy and Energy Efficiency (PCREEE), based in Tonga, was established to promote renewable energy and energy efficiency in partnership with the Pacific Community (SPC), the Sustainable Energy Island and Climate Resilience Initiative (SID DOCK) and the United Nations Industrial Development Organization (UNIDO). While increasing clean energy access in a sustainable manner is an important issue in the region, there are still challenges remaining, including geographical, socio-economic and technical issues which prevent the active utilization of renewable energy resources in this region. The design of a mini-grid programme is expected to provide some practical solutions in overcoming challenges to provide clean, affordable and reliable energy in the PICTs.</p>
Justification	<p>Most PICTs are heavily reliant on fossil fuel-based energy which causes greenhouse gas emissions and unpredictable costs for electricity due to oil and transportation price fluctuations. Moreover, there are still countries with a low rate of electricity access in rural areas such as Papua New Guinea, the Solomon Islands, Vanuatu and Kiribati; where more than half of the population lives without electricity. To mitigate the issues in the region and achieve the nationally determined contributions (NDC) established by the Paris Agreement in 2015, active utilization of decentralized renewable energy is essential.</p> <p>Mini-grids are electricity generators, generally in the range of 10 kW – 100 MW which provide power to customers in a specific geographic area and operate separately from national electrical transmission networks. Mini-grids operate under a different institutional, financial and technical environment compared to the better established national utilities. Previous studies on the mini-grid market in the Pacific islands identified that mini-grids have had mixed results. While mini-grids have the potential to improve access to electricity, reduce reliance on fossil fuel and improve the livelihood of rural communities, there are still many challenges in implementing them.</p> <p>The design of a mini-grid program focuses on increasing and improving the mini-grid system through components in order to overcome challenges identified through (i) market intelligence, (ii) capacity building and public and private partnerships, and (iii) technical advancement of mini-grid systems in the region. A separately attached concept note document will include funding details.</p>

<p>Programme Objectives, Outcomes</p>	<p>Development Objective: Increased clean energy access and improved livelihoods for communities through the promotion of a mini-grid programme to achieve the Sustainable Development Goals (SDGs) throughout the PICTs.</p> <p>Component 1 (Market intelligence): Enhanced awareness of the mini-grid market and strengthened mini-grid market knowledge through market intelligence development.</p> <p>Component 2 (Capacity building and public and private partnerships): Empowered local institutions and private sector through targeted capacity building and reinforced public private partnerships.</p> <p>Component 3 (Technical advancement): Improved access to more reliable, cleaner and more affordable electricity services through the effective design of mini-grid systems and more efficient system operation.</p>
<p>Beneficiaries and Impacts</p>	<p>The design of the mini-grid programme is targeted to benefit Pacific Island Countries and Territories (PICTs) including the 22-member countries in the Pacific Community. Although countries have different political backgrounds, they share similar challenges in the market to expand off-grid electrification to increase energy access for inhabitants. Through enhanced public and private partnerships, it is expected to empower local companies in the Pacific community to be able to participate in providing clean, affordable and reliable energy.</p>
<p>Executing Organization</p>	<p>SPC's (Pacific Community) Pacific Centre for Renewable Energy and Energy Efficiency (PCREEE)</p>
<p>Consulting Organization</p>	<p>One Energy Island Co., Ltd.</p>
<p>Programme Period</p>	<p>5 years (2019 – 2024)</p>
<p>Budget</p>	<p>US\$ 8,440,000</p>

1 Background of the Mini-grid Programme

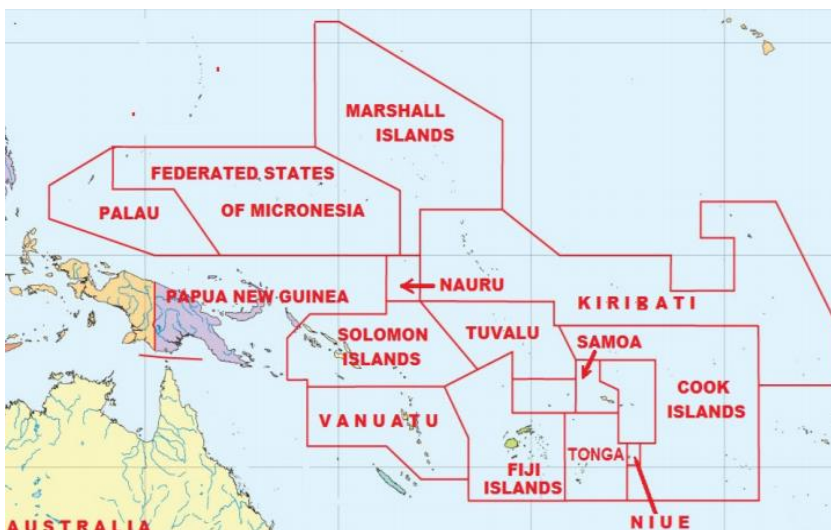
Pacific Island Countries and Territories (PICTs) include of 22 members divided into three sub regional divisions, Melanesia, Micronesia, and Polynesia. A total of about 10 million inhabitants are spread out on the islands with a total land area of about 553,409 km². Many people are living on remote islands in rural areas with insufficient energy access. Countries including Papua New Guinea, the Solomon Islands, Vanuatu, and Kiribati still have more than half of the population living without electricity. The remote geography of the islands remains a primary reason for making the energy supply difficult and expensive to deliver.

While the agriculture and tourism industry are important economic sources in the PICTs, a low rate of energy access hinders their economic growth throughout the region. Moreover, most of the PICTs are heavily reliant on fossil fuel energy sources which generate greenhouse gas emissions (GHG) making the islands more vulnerable to weather events caused by climate change. In addition, marine transportation of those energy resources also puts countries at a high risk to oil spills.

To mitigate these energy issues in the PICTs, the Pacific Center for Renewable Energy and Energy Efficiency (PCREEE) was established as a knowledge hub with a focus on information exchange regarding regional interventions, tools, and methodologies in partnership with stakeholders to promote renewable energy in the PICTs. In recent years, decentralized renewable energy systems, called mini-grids, have become an important solution to provide electrification on remote islands at an affordable cost.

Due to the complexity in renewable energy mini-grid markets and industries, the Pacific community is faced with many challenging barriers to overcome. The design of a mini-grid programme is suggested based on the identified barriers from the previous market and industry analysis in order to overcome those challenges and promote a decentralized mini-grid system. The programme aims to provide economically, environmentally and socially sustainable energy to local inhabitants. It includes three

main outcomes including market intelligence, capacity building and partnerships, and technical advancement of the mini-grid system. Through the outcomes of the mini-grid programme, it is expected to expand the development of mini-grids to increase clean, reliable and affordable energy access for local people living in the PICTs.



Source: Dornan M. (2015)

Figure 1 Map of Pacific Island Countries and Territories

2 Key Findings Identified in the Pacific Island Countries and Territories

The PICTs are located in the middle of Pacific Ocean and share many characteristics in terms of mini-grid development. Although the PICTs have only contributed to less than 1% of global climate change, there are still many areas where energy is not available. Due to this, the PICTs have been making efforts to increase energy access in a sustainable way and make the transition to clean energy.

Table 1 depicts the status of energy access in each country. Although many PICTs have over 90% access to energy, Micronesia, Papua New Guinea, the Solomon Islands and Vanuatu are still dealing with low access to electricity which hinders economic development both nationally and locally. More importantly, they are highly dependent on fossil fuel-based energy generation which results in greenhouse gas emissions. Though most PICTs maintain renewable energy targets, there has been a lack of significant progress due to the significant challenges in the region.

Table 1 Electricity Status in Pacific Island Countries and Territories

Country Name	GDP per capita (US\$)	Access to electricity (% of total population)	Renewable electricity output (GWh)	Renewable Electricity Targets by 2020 (%)	Renewable electricity share of total electricity output (%)	Total electricity output (GWh)	Total CO2 emissions (kt)
Cook Islands	15,002	99.98	2.40	100%	8.16	29.40	-
Fiji	4,922	97.12	411.62	100%	45.02	914.40	1,169.77
Kiribati	1,424	90.56	2.00	10%	7.27	27.50	62.34
Marshall Islands	3,386	91.51	0.20	20%	0.23	85.70	102.68
Micronesia, Fed. Sts.	3,016	73.55	1.10	30%	1.60	68.70	150.35
Nauru	8,053	99.00	0.10	50%	0.40	25.10	47.67
Palau	13,501	99.16	-	20%	-	94.85	260.36
Papua New Guinea	2,183	22.19	1,442.00	No Target	34.53	4,176.00	6,318.24
Samoa	4,149	99.94	40.70	+10%	30.35	134.10	198.02
Solomon Islands	1,922	55.10	2.19	50%	2.26	96.79	201.69
Tonga	4,094	96.18	3.27	50%	5.91	55.41	121.01
Tuvalu	2,970	99.03	2.00	100%	28.17	7.10	11.00
Vanuatu	2,806	44.67	13.50	65%	21.26	63.50	154.01
American Samoa	7,874 (2007)	-	1.50	-	0.89	169.40	-
French Polynesia	21,071 (2006)	100.00	229.69	-	32.01	717.51	803.07
Guam	23,134 (2007)	100.00	-	-	-	1,730.60	-
New Caledonia	37,993 (2008)	100.00	409.23	-	14.09	2,903.43	4,290.39
Niue	11,985 (2009)	-	0.07	100%	1.97	3.39	-
Northern Mariana Islands	16,820	100.00	-	-	-	429.80	-
Wallis and Futuna	12,640 (2005)	-	-	-	-	18.34	-

Source: World Bank Data (2015), IRENA (2013)

The country case studies indicate that most island countries share similar challenges in mini-grid development. Table 2 contains a summary from the country case studies, including key challenges.

Table 2 Summary of Key Challenges from Country Case Studies

Region	Country	Key Challenges Identified
Melanesia	Vanuatu	<ul style="list-style-type: none"> • Institutional challenges in designing the structure of off-grid program • Insufficient number of skilled technicians • No standardized RE system which leads to challenges in O&M • Financing modality • Private sector engagement needs to be encouraged • Low awareness from locals
	The Solomon Islands	<ul style="list-style-type: none"> • Lack of an energy database • No policy framework for mini-grid development • Financial and technological capacity issues • Geographical characteristics increase cost of development
Polynesia	Tonga	<ul style="list-style-type: none"> • Long-term financial instability in the energy sector • Limited land availability • O&M issues • Scaling up from home solar systems to mini-grids • High criteria for local businesses for business opportunities
Micronesia	Kiribati	<ul style="list-style-type: none"> • Lack of policy framework to develop mini-grid development • Inadequate capacity to manage grid stability. • Inventory control is needed for spare parts • Funding modality and coordination needed

Source: PCREEE (2018). Market and Industry Assessment Report; IRENA (2015). Renewable Readiness Assessment.

Key Challenges Identified in the Pacific Community

- ***Limited market knowledge and data for private sector involvement***
Currently there is no consolidated market information which refers to past or current mini-grid development and practices. Moreover, participation requires a high level of expertise and experience, making it difficult for local business to contribute to projects.
- ***Limited financial allocation in energy sector***
Although the energy sector is considered a primary focus in developing countries, funding projects with limited financial resources is a difficult task to overcome. Nonetheless, renewable energy based mini-grid projects have very compelling socio-economic benefits. However, in order for mini-grid projects to be highly prioritized for the government’s funding decisions, operational

performance must be proven to be reliable and the anticipated socio-economic outcomes must be fulfilled through sustainable operations.

- ***High risk in private sector involvement and limited economic scale***
The existing hurdles and risks are high for private companies doing mini-grid projects in the PICTs. The remote nature of the islands in the PICTs and the harsh marine environment poses challenges due to accessibility issues and the lack of economies of scale. Such unfavorable physical conditions result in a high cost and risk of doing business which often prevents private companies from actively coming in and pursuing business opportunities. As a result, there has been a vacuum of responsibility for the sustainable operation of mini-grid projects, which in turn results in unsatisfactory operational performance and unfulfilled socio-economic benefits of mini-grid projects.
- ***Limited capacity in project development and technical skills***
Most PICTs have announced ambitious goals of renewable energy contributions, from 20 to 50 percent by 2020 to 2025, however, those goals have not been achieved despite the rich renewable energy resources and promising potential benefits. The limited business capacity in project development and limited number of skilled workers makes it difficult to manage system sustainably. These key challenges must be overcome in order to facilitate mini-grid development and achieve the stated goals of the PICTs.

3 Suggested Solutions for Development of Mini-grid

The empowerment of the local community is essential in the design of a sustainable mini-grid system that is simple and easy to operate and manage by local people with governance and incentive models that encourage participation of private companies and invite the shared responsibility of all local stakeholders. To enable more effective mini-grid programs across the Pacific, it is suggested to overcome challenges as below:

- ***Existing Challenge 1: Limited market knowledge and data for private sector involvement***

Suggested Solutions:

- Develop a web-based database repository to access regional market information which traces, records, and accumulates performance and troubles of mini-grid projects in the PICTs. The database will be a repository to facilitate the sharing of operational data for mini-grid projects between countries and the SPC, and builds a comprehensive statistical data base of records of key troubles including the operational performance of individual mini-grid projects. Such a database will provide a critical knowledge base for market information and optimal design with best practices guidance for future mini-grid projects in the PICTs.

- ***Existing Challenge 2: Limited financial allocation in energy sector***

Suggested Solutions:

- Promotion of investment: Due to the high risk and complexity of investing in the PICTs the barriers to entry must be lowered and costs reduced so that international partnerships can be formed which take advantage of the opportunities for RE development in the PICTs.

- ***Existing Challenge 3: High risk in private sector involvement and limited economic scale***

Suggested Solutions:

- Categorizes islands into sub-groups based on similarities in geographical, economic and demographic conditions, and adopt different mini-grid technical and business models for each subgroup.
- Apply UNESCAP’s “5Ps model” to the business practice of mini-grid projects. The main objective of the ‘5Ps model’ is to help reduce the business and financial risks to private companies in the PICTs so that private companies may focus on their core activities—sustainable operation of mini-grid systems and the provision of a reliable electricity supply.

- ***Existing Challenge 4: Limited capacity in technical skills and project development***

Suggested Solutions:

- Establish a capacity building program to upgrade knowledge of the advancement in technologies and impacts of changes in policies and legislation. In addition, organize regular networking events to share experiences and develop strong partnerships to facilitate the development of mini-grid projects.
- Design and operate an ‘Integrated Mini-grid O&M (Operation and Maintenance) platform to reduce the cost of operations and maintenance of individual mini-grid projects while providing timely and professional technical services to mini-grid projects in isolated locations.

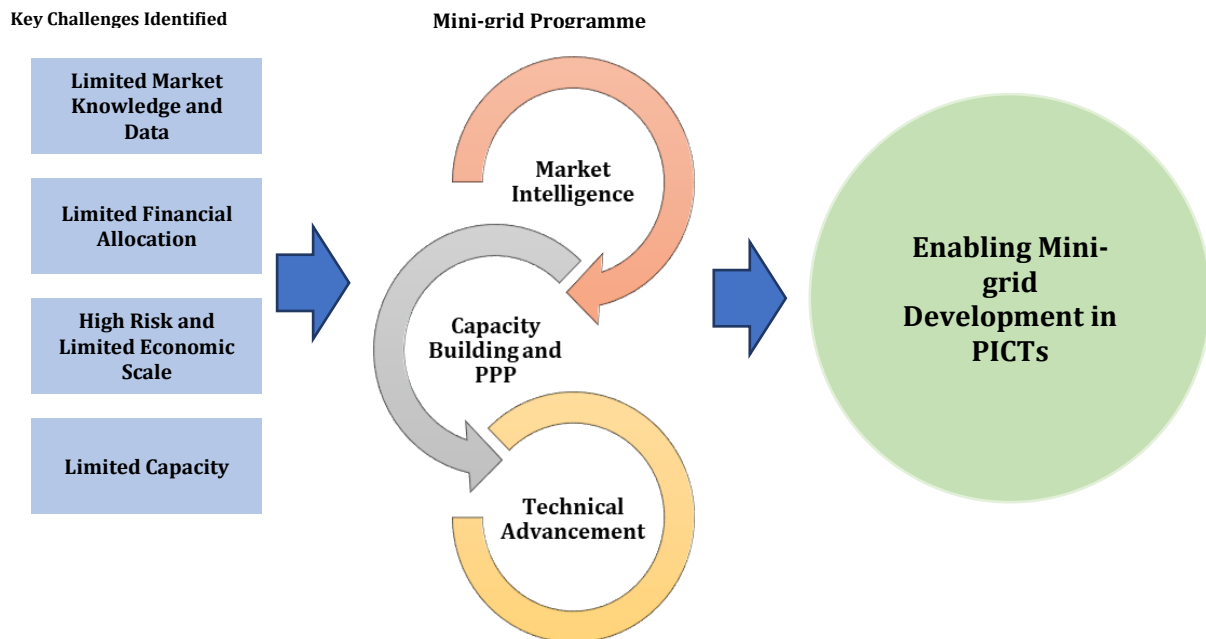


Figure 2 Key Challenges and Suggested Solutions in PICTs

4 Description of Activities from Mini-grid Programme

1. Development Objective

The goal of the mini-grid program is to increase clean energy access and improve livelihoods throughout the Pacific community through the development of mini-grid systems which achieve the Sustainable Development Goals (SDG) including; (i) SDG 7, “to ensure access to affordable, reliable, sustainable and modern energy for all”, (ii) SDG 9, “to build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation”, (iii) SDG 13, “to take urgent action to combat climate change and its impacts”.

The design includes specific objectives to generate outcomes; (i) to enhance awareness of mini-grid market and strengthen market intelligence development, (ii) to empower local communities and the private sector, and to promote project development through capacity building, networking and partnership programs, and (iii) to improve sustainability of mini-grid systems and implement standardized technical equipment and design through technical advancement.

Indicators:

- Percent increase of affordable and reliable energy access in the PICTs
- Increased business and income generation activities in rural communities
- Percent decrease in fossil fuel-based electricity generation
- Increased number of local businesses which participate in mini-grid projects
- Increased employment opportunities in local communities

Baseline and targets:

In order to better assess the progress of the mini-grid program in the PICTs, targets have been set which track progress and show an improvement in local markets.

- 20% increase of affordable and reliable energy access for local communities in PICTs
- 20% decrease in fossil fuel-based electricity generation
- 80% permitted local businesses in mini-grid project development
- 10% additional job creation

Means of verification:

- Regional statistics in energy balance.
- Regional data in permissions and licenses provided.
- Assessment report of NDC in PICTs.

Risks and assumptions:

- Regional energy environments are expected to be favorable to development of mini-grid projects
- Criteria for funding modality in international standard is expected to be still high
- Each country's internal security in development and stable political condition will highly influence the development of mini-grid projects.

1.1 Outcome 1: *Enhanced awareness of mini-grid markets and strengthen market knowledge through market intelligence development*

The first outcome is to develop a shared market database on a web-based platform which includes regional up to date mini-grid developments. The activities include, (i) a web-based market knowledge platform to disseminate information in the region, (ii) up-to-date market information including policies, legislation and tariffs for stakeholders to utilize in their business development, (iii) mini-grid data storage including system performance and technical troubles per type of installation, and web-based GIS maps to visualize regional information and promote business opportunities.

The purpose of market intelligence development is to enhance awareness of mini-grid markets and strengthen market knowledge to share with stakeholders including institutions, development partners, the private sector, and local communities. The up to date information will play an important role for businesses to participate in actual mini-grid projects. Most importantly, a performance record and database of common technical troubles of mini-grid systems will provide governments, public agencies, and private participants with valuable knowledge concerning the optimal design and operation of mini-grid systems in the future.

Indicators:

- Strengthened regional mini-grid market information
- Percent of the population in PICTs with awareness of the mini-grid programme
- Percent of information gathered throughout the PICTs
- Number of stakeholders utilizing the knowledge sharing database

Baseline and targets:

Although dissemination of knowledge of RE has greatly increased from PCREEE, there are still areas for improvements in the market intelligent including updated market information and specific standardized guidelines in order to increase awareness from stakeholders and build further development opportunities based on existing information gathered of mini-grid projects.

- An established platform for market intelligence

- Increase awareness of the programme
- 90% of mini-grid market information gathered from each country's utility

Means of verification:

- Shared documents and market information on a web-platform
- Statistics of data access of market intelligence
- Registered stakeholders and attendance
- Qualitative measurement of awareness of local communities

Risks and assumptions:

- Availability of market information from countries
- Staff resources to manage up to date market intelligence in a timely manner
- Quantifying the result-based achievements
- Access to the web platform from remote islands

1.1.1 Activity 1 *A web-based market knowledge platform to be established to disseminate knowledge in the region. (e.g. Market information, Database, Helpdesk)*

Indicators:

- The website to be launched for the mini-grid programme by PCREEE
- Volume of inquiry through the helpdesk
- Satisfaction surveys to be conducted

Baseline and targets:

- The website to be launched for the mini-grid programme by PCREEE
- 90% of members to visit and access to the market intelligence platform
- Timely mannered response to inquiries

Means of verification:

- A website to disseminate market information
- Statistics of inquiries through website to be developed

Risks and assumptions:

- There is growing interest in mini-grid development throughout the region.
- The web-based platform can act as intermediary starting point for private participation in mini-grid project development

1.1.2 Activity 2 *Up-to-date market trends to be shared, including policies, legislation and tariffs in the region related to the mini-grid system and share business opportunities (e.g. legislation, business opportunities, licenses and permits by countries)*

Indicators:

- Market trend section by countries to be established on the web platform
- Number of updates made for PICTs in a regular basis
- Web-based guidelines to be developed for each category of market information

- Number of certified & permitted businesses

Baseline and targets:

There is no existing regional mini-grid market information platform

- Market trend section by countries to be developed
- Manual of permit and licenses to be developed
- Market trend updates related to each country in PICTs
- 20% increase of certified & permitted businesses

Means of verification:

- Updates and documents shared through a website
- Permits and licenses guidelines shared through a web platform

Risks and assumptions:

- Up to date market information in the region
- Private sector to get better information in the stage of mini-grid development on a regional basis

1.1.3 Activity 3 *The mini-grid system data in the region to be stored in the database including system performance and technical troubles per type of installation and GIS mapping including cooperation with utilities in the PICTs*

Indicators:

- Percent of information gathered in the database from mini-grid systems
- Effective mapping with mini-grid location including basic information
- Up to date information

Baseline and targets:

There are online libraries which collect publications but no existing consolidated statistical database to extract and analyze the current system

- 90% of information gathered in the PICT database
- Visualization map with available summaries in the Pacific region
- Bi-annually updated information

Means of verification:

- Dedicated database which comprises all electricity generation and system performance records of mini-grid systems in the PICTs
- GIS with summaries of mini-grid developments in the region

Risks and assumptions:

- Statistical data is expected to be analyzed for system improvements
- GIS is widely used to map out the status of installations

1.2 Outcome 2: *Empowered local institutions and private sector and increased project developments through capacity building and reinforced networks and partnerships between*

stakeholders

The second outcome of the design is to develop human capacity and promote mini-grid projects through networking and partnerships. The activities include, (i) a 5P business development model curriculum and guidelines to reduce business risks and promote active participation from the private sector, (ii) capacity building programs in project development, funding models and technical operations and maintenance (O&M) with the needs of all stakeholders, (iii) promotion of mini-grid investment through regular workshops and networking events and strengthened public and private partnerships, and (iv) the establishment of national sustainable energy industry associations.

The capacity building and public-private-partnership program is expected to empower local communities and contribute to strong partnerships which expand mini-grid project development. The 5P based curriculum and guidelines will leverage the approach of partnerships to increase the participation of the private sector. Moreover, regular workshops and networking events are expected to generate project opportunities and partnerships for local businesses. Lastly, the industry association will play a key role in further PPP cooperation to achieve RE policy goals.

Indicators:

- Strengthened knowledge and technical capabilities to be applied in mini-grid systems
- Yearly developed capacity building strategies and curriculums
- Number of local businesses participation in mini-grid projects
- Number of mini-grid projects including co-funded developments
- Amount of financial resource investment (US\$) for mini-grid project development
- Number of established national sustainable energy industry associations
- Up to date alumni database management for regular contacts
- Job creation for local socio-economic development
- Gender balance and equality in the mini-grid projects

Baseline and targets:

There are gaps for private sector involvement in the mini-grid development process. PCREEE can play a key role in minimizing the gaps as an intermediary organization through promoting investment and capacity building programs

- Development of capacity building strategies and curriculums
- At least 20 mini-grid projects to be developed and funded
- 90% of registered businesses for energy industry association
- Up to date alumni database management for regular contacts
- At least 10% increase of job creation for local communities
- Gender balance of the energy development to be included throughout the curriculum to increase awareness

Means of verification:

- The progress report on regional capacity building based on the strategies and curriculum
- Amount of investment increased
- Developed solid strategies and curriculum for capacity building programs

- Mini-grid proposals and concept note by local with PCREEs guidance
- Alumni data and attendance of events
- Registration of private sustainable energy businesses

Risks and assumptions:

- Coordination with governments in the PICTs.
- Participation of stakeholders in funding promotion events
- Willingness of local business participation
- Securing specialized instructors
- Logistic of training programs for participation in PICTs

1.2.1 Activity 1 *5P Business Development Model Curriculum and Guidelines to be developed by identified categorization of mini-grid groups in order to reduce business risks and promote active participation from private businesses*

Indicators:

- Apply the 5P guidelines to the PICTs local conditions
- Number of local business participation in mini-grid projects
- Percent of awareness in PICTs of the 5P model

Baseline and targets:

Currently, most mini-grid projects are funded by international donors. However, there are opportunities for the private sector to get involved

- 5P model of categorization in PICTs to be developed
- At least 50% of new projects suggested under the 5P model
- Increase of awareness in PICTs of the 5P model

Means of verification:

- Detailed guidelines applied in PICTs through 5P model project development

Risks and assumptions:

- 5P model is developed by UNESCAP and is well recognized

1.2.2 Activity 2 *Capacity building program to be developed and managed by PCREEE including the programs in project development, funding modality and technical operations and maintenance with consideration of gender balance*

Indicators:

- Organized training curriculum to be developed with gender balance
- Number of proposals made for mini-grid projects
- Number of training programs organized
- Percent of skills to be applied in the mini-grid development and O&M
- Satisfactory survey to be conducted
- Number or participants attending training programs

Baseline and targets:

As the RE sector has growing attention, there is still room for capacity building to minimize the gap in knowledge and skills and keep up with global trends

- Organized training curriculum to be developed
- At least 20 project proposals a year to be submitted for mini-grid projects
- Project development and O&M training programs to be organized
- 80% of received skills to be applied in mini-grid development and O&M
- Satisfactory survey to be conducted
- 90% of invited participants attend the training programs

Means of verification:

- Capacity plan development documents
- Developed project documents
- Utilization of O&M platform
- Record of certification from trainings
- Attendance and evaluation of trainings
- Curriculums and training materials

Risks and assumptions:

- There are greater numbers of private businesses interested in mini-grid development

1.2.3 Activity 3 *Promotion of investment of mini-grid and technology sharing through regular workshops and networking events between stakeholders to strengthen partnerships and contribute to the PCREEE training and alumni networks*

Indicators:

- Number of stakeholders to participate in the workshop
- Number of collaborations of the project
- Investment volume (US\$) for mini-grid projects gathered
- Number of alumni registered in the database

Baseline and targets:

PCREEE recently launched and the organization is in the developing stage. Regular workshops and networking events can create a solid network for mini-grid programs and it will contribute to partnerships which attract funding for RE development. Currently there is no record of existing network information shared through training and events.

- 90% of stakeholders to participate in the workshops
- At least 15% increase of collaboration in project development
- At least 30% increase in volume of funding (US\$) for mini-grid projects
- Alumni registered in the database
- Bi-annual updates

Means of verification:

- Statistics on funding results
- Prepared workshop documents
- Attendance of stakeholders
- Agreements of collaborations
- Alumni data and track of records in attendance of events

Risks and assumptions:

- There are growing interests in private sector involvement and events will help gathering people to make business opportunities
- Alumni can be participate and vitalize partnerships

1.2.4 Activity 4 *Establishment of national sustainable energy industry associations*

Indicators:

- Number of businesses to register for the association
- Number of collaborations of mini-grid development projects

Baseline and targets:

There is no currently integrated industry association which covers the region. The association can work together with each government for public private partnerships and regional standard for mini-grid design

- 90% of registered businesses for energy industry association
- At least 20% increase of PPPs performed by the association

Means of verification:

- Registration numbers of industry
- Regular meetings held

Risks and assumptions:

- Industry association can collaborate in integrated model and PPP in mini-grid projects

1.3 Outcome 3: *Improved sustainability of mini-grid system and implemented standardized technical equipment and design*

The last outcome of the design is to improve the technical portion of the mini-grid system. The activities include, (i) developing guidelines for the standardized of mini-grid systems including technical equipment, mini-grid design and assessment methodology, (ii) developing an integrated operations and maintenance (O&M) platform to ensure the technical quality of the system.

The technical standards for mini-grid systems in the PICTs have not been developed yet although there is a potential need for standardization. The design of a mini-grid system can be standardized by different geographical conditions and socio-economic characteristics of the energy environment; key components of a mini-grid system can be customized to fit into specific climate and geographical conditions of the PICTs. Standardized and customization, if achieved

to a proper level, is expected to help promote mini-grid systems in PICTs and increase the performance of mini-grid systems. Poor operation and maintenance practices have been found to be the biggest challenge to achieving the sustainability of mini-grid projects in the PICTs. To sustain the quality of the mini-grid system, standardization will need to be implemented as well as an operations and maintenance platform which can operate independently.

Indicators:

- Percent of utilization of standard model of mini-grid systems
- Percent of installed standardized parts and equipment
- Percent of technical quality improvement of mini-grid systems
- Percent of decrease in problems in the system

Baseline and targets:

Due to the development of separated donor funded mini-grid systems, there is no integrated model developed to improve O&M at the regional level. It remains a challenge to make the standardized RE for sustainable operations. Lack of capabilities in the local communities for operations and maintenance hinder the efficient system operation and sustainable energy access.

- 50% of utilization of standard model of mini-grid systems
- 50% of installed standardized parts and equipment
- 20% of technical quality improvement of mini-grid systems
- 20% of decrease in problems occurred in the system

Means of verification:

- Proposed mini-grid system with standardized design and equipment
- Statistics on O&M registered on the platform
- Progress reports in quality assurance

Risks and assumptions:

- Coordination between technical developers and local O&M companies
- Financial stability to provide long-term technical assistance to implement and settle O&M management
- Staff resources to sustain management

1.3.1 Activity 1 *Guidelines for standardized technical equipment, design and assessment methodology by categorization of islands to have optimal mini-grid system in the region*

Indicators:

- Standard technical guidelines for the project development
- Implement standardized equipment, designs, and assessments
- Percent of improvement in mini-grid system quality

Baseline and targets:

PICTs have unique territories with remote islands, so it can be categorized into three groups based on size. Although there are standardized suggestions on technical

equipment, it is not widely applied throughout the region.

- Developed guidelines for standardized technical equipment, design, and assessment methodology of mini-grid systems by volume of energy generation
- At least 50% of projects applied through the technical model guidelines
- 30% improvement in mini-grid system quality

Means of verification:

- Standardized technical design documents
- Assessment documents and progress reports

Risks and assumptions:

- Strong cooperation from donor organizations is needed
- Regular basis assessment will ensure the technical quality of the system

1.3.2 Activity 2 *Integrated Operations and Maintenance Platform to be managed to ensure the technical quality for the system. (e.g. Standard O&M Manual, Platform Structure Design, Energy Management System, Component Management, Communication)*

Indicators:

- Number of mini-grid system utilize O&M platform
- Percent of up-to-date information
- Number of problems fixed through O&M platform
- Percent of quality improvement by utilizing the O&M platform

Baseline and targets:

Isolation is the main challenge for O&M in order to sustain the quality of the system. Moreover, there is no existing consolidated O&M management platform to monitor the mini-grid system. The lack of technical skills and transportation time are challenging to fix any technical issues in a timely manner.

- At least 50% of mini-grid system utilize the O&M platform
- Real time basis record for O&M
- At least 30% of problems fixed through the O&M platform
- 20% increase of quality improvement by utilizing the O&M platform

Means of verification:

- O&M platform statistics

Risks and assumptions:

- The mini-grid system linked with ICT connection is important

5 Sustainable Development Benefits of the Mini-grid Programme

Environmental Benefits

Mini-grid development is expected to replace conventional diesel generations in the PICTs. If the RE policy goals of each country are fully implemented, PICTs can altogether reduce a significant amount of the CO₂ produced from diesel generation. The following table shows the RE policy goal scenario and calculation based on emission factor in the assumption of reduced fossil-fuel based electricity generation.

Table 3 RE Goal Achievement Scenario

Country Name	RE target	Renewable electricity output (GWh)	Total electricity output (GWh)	Scenario 1 (30% achievement of RE target)			Scenario 2 (60% achievement of RE target)			Scenario 3 (100% achievement of RE target)		
				RE target output from total electricity output (GWh)	Amount of RE electricity to increase (GWh)	Reduced CO ₂ equivalent calculated from increased RE electricity output (Metric Ton)	RE target output from total electricity output (GWh)	Amount of RE electricity to increase (GWh)	Reduced CO ₂ equivalent calculated from increased RE electricity output (Metric Ton)	RE target output from total electricity output (GWh)	Amount of RE electricity to increase (GWh)	Reduced CO ₂ equivalent calculated from increased RE electricity output (Metric Ton)
Cook Islands	100%	2.40	29.40	8.82	6.42	4,778 (5,267t)	17.64	15.24	11,342 (12,502t)	29.40	27.00	20,094 (22,150t)
Fiji	100%	411.62	914.40	-	-	-	548.64	137.01	101,968 (112,401t)	914.40	502.77	374,171 (412,453t)
Kiribati	10%	2.00	27.50	-	-	-	-	-	-	2.75	0.75	558 (615t)
Marshall Islands	20%	0.20	85.70	5.14	4.94	3,678 (4,054t)	10.28	10.08	7,505 (8,272t)	17.14	16.94	12,607 (13,897t)
Micronesia, Fed. Sts.	30%	1.10	68.70	6.18	5.08	3,783 (4,170t)	12.37	11.27	8,384 (9,242t)	20.61	19.51	14,520 (16,005t)
Nauru	50%	0.10	25.10	3.77	3.67	2,728 (3,007t)	7.53	7.43	5,530 (6,095t)	12.55	12.45	9,266 (10,213t)
Palau	20%	0.00	94.85	5.69	5.69	4,235 (4,669t)	11.38	11.38	8,471 (9,337t)	18.97	18.97	14,118 (15,562t)
Papua New Guinea	No Target	1442.00	4176.00	-	-	-	2505.60	1063.60	791,549 (872,534t)	4176.00	2734.00	2,034,689 (2,242,861t)
Samoa	+10%	40.70	134.10	-	-	-	-	-	-	44.77	4.07	3,029 (3,339t)
Solomon Islands	50%	2.19	96.79	14.52	12.33	9,175 (10,114t)	29.04	26.85	19,980 (22,024t)	48.40	46.21	34,387 (37,905t)
Tonga	50%	3.27	55.41	8.31	5.04	3,749 (4,133t)	16.62	13.35	9,934 (10,951t)	27.70	24.43	18,181 (20,041t)
Tuvalu	100%	2.00	7.10	2.13	0.13	96.7 (107t)	4.26	2.26	1,682 (1,854t)	7.10	5.10	3,796 (4,184t)
Vanuatu	65%	13.50	63.50	-	-	-	24.77	11.27	8,384 (9,241t)	41.28	27.78	20,671 (22,785t)
Niue	100%	0.07	3.39	1.02	0.95	707 (708t)	2.03	1.97	1,464 (1,614t)	3.39	3.32	2,474 (2,727t)

Source: World Bank Data (2015), EPA Emission Factor Calculation

(<https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references>)

Economic Benefits

Energy access in itself is not a panacea to rural poverty issues. A successful intervention has the potential to stimulate development by modernizing existing needs and introducing new services. Energy access can allow households to engage in a more diverse range of income-generating activities as well as make pre-existing activities more efficient. With the necessary infrastructure to ensure sustainability, new livelihoods developed via energy access can have a huge impact on long term poverty reduction.

Social Benefits

Building, operating, and maintaining mini-grids have generated positive social impacts in addition to economic benefits. They encourage integrated government cooperation and the participation of the private sector in all aspects of mini-grid implementation. Rural communities in developing nations stand to benefit greatly from electrification and the opportunities that come with it. Affordable and clean energy is a requirement in developing countries and inclusive implementation has been shown to generate a positive impact. The process of sharing power and resources to achieve a common goal helps to bring communities together to invest in future progress.

The impacts of energy access also have positive impacts on education. Improved energy resources can reduce the time and labor required to achieve certain tasks such as collecting fire wood and water as well as mechanizing many activities. This could lead to increased enrolment of children in schools, since they no longer have to spend so much time assisting with household duties. In addition, access to lighting in the home increases the time available for study and hence may positively impact achievement levels.

A decentralized approach to energy interventions led by local needs and contexts is necessary, particularly with smaller communities and rural populations. Starting with the people and not the technology can lead to improved and more widely disseminated energy technologies. In the Pacific, the Talanoa framework serves as a dialogue platform which encourages inclusive, participatory, and transparent communication between the stakeholders of a project and between nations in the Pacific.

6 Financial Budget Outline

The table below summarizes the allocation of funding per outcomes from the mini-grid programme.¹

Component	Description	Budget (US\$)
1. Market Intelligence	Enhanced awareness of mini-grid market and strengthen market knowledge through market intelligence development.	2,195,000
	<i>Activity 1: Web-based market knowledge platform</i> <i>Activity 2: Up-to date market information</i> <i>Activity 3: Data storage and GIS of mini-grid systems</i>	
2. Capacity Building and Public and Private Partnerships	Empowered local institutions and private sector and increased project developments through capacity building and reinforced networks and partnerships between stakeholders.	2,640,000
	<i>Activity 1: 5P business development model curriculum</i> <i>Activity 2: Capacity building program</i> <i>Activity 3: Promotion of mini-grid and public private partnerships</i> <i>Activity 4: Establishment of national sustainable energy industry associations</i>	
3. Technical Advancement	Improved sustainability of mini-grid system and implemented standardized technical equipment and design.	3,605,000
	<i>Activity 1: Guidelines for standardized mini-grid system</i> <i>Activity 2: Integrated Operations and maintenance (O&M) platform</i>	
Total		8,440,000

Conditions:

1. The numbers in the budget table are preliminary
2. The budget is designed to cover capital expenditure and 2 years operation of proposed program activities
3. Budget for on-going operation and improvements should be considered extra

¹ Annex II. Financial Budget Details.

Annex I. Result-based framework of Mini-grid Programme

The following table is a result-based framework from each objective, outcome and activity. It shows clear indicators and targets to achieve the development objectives.

Development Objective (ultimate outcome)	Indicators	Baseline and targets	Means of verification	Risks and assumptions
Increased clean energy access and improved livelihoods throughout the Pacific community through the development of mini-grid systems to achieve sustainable development goals.	<p>Percent increase of affordable and reliable energy access in PICTs</p> <p>Increased business and income generation activities in rural communities</p> <p>Percent decrease in fossil fuel-based electricity generations</p> <p>Number of local businesses which participate in mini-grid projects</p> <p>Increased employment opportunities in local communities</p>	<p>Baseline:</p> <p>There are countries which have not yet reached full energy access for the local communities and most countries in PICTs have a high dependency on fossil fuel-based energy generation</p> <p>Target(s):</p> <p>20% increase of affordable and reliable energy access for local communities in PICTs region by mini-grid system</p> <p>20% decrease in fossil fuel-based electricity generations</p> <p>80% permitted local businesses in mini-grid project developments</p> <p>10% additional job creation of the local communities from distributed mini-grid systems</p>	<p>Regional statistics in energy balance</p> <p>Regional data in permissions and licenses provided</p> <p>Assessment report of NDC in PICTs</p>	<p>Regional energy environments are expected to be favorable to development of mini-grid projects</p> <p>Criteria for funding modality in international standard is expected to be still high</p> <p>Each country's internal security in development and stable political condition will highly influence on mini-grid projects</p>
Intermediate Outcome (mid-term)	Indicators	Baseline and targets	Means of verification	Risks and assumptions

Design of a Sub-Regional Renewable Energy Mini-grid Program for PICTs

<p>Outcome 1: Enhanced awareness of mini-grid markets and strengthen market knowledge through market intelligence development.</p>	<p>Strengthened regional mini-grid market information</p> <p>Percent of the population in PICTs with awareness of the mini-grid programme</p> <p>Percent of information gathered throughout the PICTs</p> <p>Number of stakeholders utilizing the knowledge sharing database</p>	<p>Baseline:</p> <p>Although dissemination of knowledge of RE has greatly increased from PCREEE, there are still areas for improvements in the market intelligent including updated market information and specific standardized guidelines in order to increase awareness from stakeholders and build further development opportunities based on existing information gathered of mini-grid projects.</p> <p>Target(s):</p> <p>An established platform of market intelligence</p> <p>Awareness increase between beginning of the programme and end of the programme</p> <p>90% of mini-grid market information gathered from each country's utility</p>	<p>Shared documents and market information on a web-platform</p> <p>Statistics of data access of market intelligence</p> <p>Registered stakeholders and attendance</p> <p>Qualitative measurement of awareness of local communities</p>	<p>Availability of each market information from countries</p> <p>Staff resources to manage up to date market intelligence in a timely manner</p> <p>Quantifying the result-based achievement</p> <p>Access to the web platform from remote islands</p>
<p>Outcome 2: Empowered local institutions and private sector and increased project developments through capacity building and reinforced networks and partnerships between stakeholders</p>	<p>Strengthened knowledge and technical capabilities to be applied in mini-grid systems</p> <p>Yearly developed capacity building strategies and curriculums</p> <p>Number of local businesses participation in mini-grid projects</p> <p>Number of mini-grid projects including co-funded developments</p> <p>Amount of financial resource investment (US\$) for mini-grid project development</p> <p>Number of established national sustainable energy industry association</p> <p>Up to date alumni database management for regular contacts</p> <p>Job creations from local socio-economic development</p> <p>Gender balance and equality in the mini-grid project developments</p>	<p>Baseline:</p> <p>There are gaps for private sector involvement in the mini-grid development process. PCREEE can play a key role in minimizing the gaps as an intermediary organization through promoting investment and capacity building program</p> <p>Target(s):</p> <p>Development of capacity building strategies and curriculums</p> <p>At least 20 mini-grid projects to be developed and funded</p> <p>90% of registered businesses for energy industry association</p> <p>Up to date alumni database management for regular contacts</p> <p>At least 10% increase of job creation for local communities</p> <p>Gender balance of the energy development to be included throughout the curriculum to increase awareness</p>	<p>The progress report on regional capacity building based on the strategies and curriculums</p> <p>Amount of investment increased</p> <p>Developed solid strategies and curriculum for capacity building programs</p> <p>Mini-grid proposals and concept note by local with PCREEEs guidance</p> <p>Alumni data and attendance of events</p> <p>Registration of private sustainable energy businesses</p>	<p>Coordination with the governments in PICTs</p> <p>Participation of stakeholders in funding promotion events</p> <p>Willingness of local business participation</p> <p>Securing specialized instructors.</p> <p>Logistic of training programs for participation in PICTs</p>

<p>Outcome 3: Improved sustainability of mini-grid system and implemented standardized technical equipment and design.</p>	<p>Percent of utilization of standard model of mini-grid systems</p> <p>Percent of installed standardized parts and equipment</p> <p>Percent of technical quality improvement of mini-grid systems</p> <p>Percent of decrease in problems occurred in the system</p>	<p>Baseline:</p> <p>Due to the development of separated donor funded mini-grid systems, there is no integrated model developed to improve O&M at the regional level. It remains as a challenge to make the standardized RE for sustainable operations. Lack of capabilities in the local communities for operations and maintenance hinder the efficient system operation and sustainable energy access.</p> <p>Target(s):</p> <p>50% of utilization of standard model of mini-grid systems</p> <p>50% of installed standardized parts and equipment</p> <p>20% of technical quality improvement of mini-grid systems</p> <p>20% of decrease in problems occurred in the system</p>	<p>Proposed mini-grid system with standardized design and equipment</p> <p>Statistics on O&M registered on the platform</p> <p>Progress reports in quality assurance</p>	<p>Coordination between technical developers and O&M local companies</p> <p>Financial stability to provide long-term technical assistance to implement and settle O&M management</p> <p>Staff resources to sustain management</p>
<p>Outcome 1: Enhanced awareness of mini-grid market and strengthen market knowledge through the market intelligence development.</p>				
Activities	Indicators	Baseline and targets	Means of verification	Risks and assumptions
<p>Activity 1.1 A web-based market knowledge platform to be established to disseminate the knowledge in the region. (e.g. Market information, Database, Helpdesk)</p>	<p>The website to be launched for the mini-grid programme by PCREEE in the connection to PCREEE's website</p> <p>Number of website visitors</p> <p>Volume of inquiry through the helpdesk</p> <p>Satisfactory survey to be conducted</p>	<p>Baseline:</p> <p>No existing regional base market information platform</p> <p>Target(s):</p> <p>The website to be launched for the mini-grid programme by PCREEE</p> <p>90% of members to visit and access to the market intelligence platform</p> <p>Timely mannered response to inquiries</p>	<p>A website to disseminate the market information</p> <p>Statistics of inquiries through website to be developed</p>	<p>There is growing interest in mini-grid development throughout the region</p> <p>The web-based platform can act as intermediary start point for private participation in mini-grid project development</p>
<p>Activity 1.2 Up to date market trends to be shared including policies, legislation and tariffs in the region related to the mini-grid system and share business opportunities (e.g. legislations, business opportunities, licenses and permits by countries)</p>	<p>Market trend section by countries to be established on the web platform</p> <p>Number of updates made for PICTs in a regular basis</p> <p>Web-based guideline to be developed for each categories of market information</p> <p>Number of certified & permitted businesses</p>	<p>Baseline:</p> <p>There is no existing regional mini-grid market information platform</p> <p>Target(s):</p> <p>Market trend section by countries to be developed</p> <p>Manual of permit and licenses to be developed</p> <p>Market trend updates related to each country in PICTs</p> <p>20% increase of certified & permitted businesses</p>	<p>Updates and documents shared through a website</p> <p>Permits and licenses guidelines shared through a web platform</p>	<p>Up to date market information in the region</p> <p>Private sector to get better information in the stage of mini-grid development as a regional basis</p>

Design of a Sub-Regional Renewable Energy Mini-grid Program for PICTs

<p>Activity 1.3 The mini-grid system data in the region to be stored in the database including system performance and technical troubles per type of installation and GIS mapping including cooperation with utilities in the PICTs.</p>	<p>% of information gathered in the database from mini-grid systems in PICTs</p> <p>Effective mapping with mini-grid location including basic information</p> <p>Up to date information</p>	<p>Baseline:</p> <p>There are online libraries which collect publications but no existing consolidated statistical database to extract and analyze the current system</p> <p>Target(s):</p> <p>90% of information gathered in the database</p> <p>Visualization map with available summaries in the Pacific region</p> <p>Bi-annually updated information</p>	<p>Dedicated database which comprises all electricity generation and system performance records of mini-grid systems in the PICTs</p> <p>GIS with summaries of mini-grid developments in the region</p>	<p>Statistical data is expected to be analyzed for system improvements</p> <p>GIS is widely used to map out the status of installation</p>
---	---	---	---	--

Outcome 2: Empower local institutions and private sector, and increased project developments through capacity building and reinforced networks and partnerships between stakeholders.

Activities	Indicators	Baseline and targets	Means of verification	Risks and assumptions
<p>Activity: 2.1 5P Business Development Model Curriculum and Guidelines to be developed by identified categorization of mini-grid groups in order to reduce business risks and promote active participation from private businesses.</p>	<p>Applied 5P guideline to the PICTs local condition</p> <p>Number of local business participations in mini-grid projects</p> <p>Percent of awareness in PICTs of the 5P model.</p>	<p>Baseline:</p> <p>Currently, most of mini-grid projects are funded by international donors. However, there are opportunities for the private sector to get involved.</p> <p>Target(s):</p> <p>5P model by categorization in PICTs to be developed as manual</p> <p>At least 50% of new projects suggested under the 5P model</p> <p>Increase of awareness in PICTs of the methods in 5P model</p>	<p>Detailed guidelines applied in PICTs through 5P model project development</p>	<p>5P model is developed guideline from UNESCAP and is well recognized</p>
<p>Activity 2.2 Capacity building program to be developed and managed by PCREEE including the programs in project development, funding modality and technical operations and maintenance with consideration of gender balance.</p>	<p>Organized training curriculum to be developed with gender balance</p> <p>Number of proposals made for mini-grid projects</p> <p>Number of training programs organized</p> <p>Percent of skills to be applied in the mini-grid development and O&M</p> <p>Satisfactory survey to be conducted</p> <p>Number or participants attended in the training programs</p>	<p>Baseline:</p> <p>As RE sector has a growing attention, there is still room for capacity building to minimize gap in knowledge and skills to keep up with global trends</p> <p>Target(s):</p> <p>Organized training curriculum to be developed</p> <p>At least 20 project proposals a year to be submitted for mini-grid projects</p> <p>Project development and O&M training programs to be organized</p> <p>80% of received skills to be applied in the mini-grid development and O&M</p> <p>Satisfactory survey to be conducted</p> <p>90% of invited participants attend the training programs</p>	<p>Capacity plan development documents</p> <p>Developed project documents</p> <p>Utilization of O&M platform</p> <p>Record of certification from trainings</p> <p>Attendance and evaluation of trainings</p> <p>Curriculums and training materials</p>	<p>There are greater number of private sector businesses interested in mini-grid development</p>

Design of a Sub-Regional Renewable Energy Mini-grid Program for PICTs

<p>Activity 2.3 Promotion of investment of mini-grid and technology sharing through regular workshops and networking events between stakeholders to strengthen partnerships and contribute to the PCREEE training and alumni network.</p>	<p>Number of stakeholders to participate in the workshop</p> <p>Number of collaborations of the project</p> <p>Investment volume (US\$) for mini-grid projects gathered</p> <p>Number of alumni registered in the database</p>	<p>Baseline:</p> <p>PCREEE is recently launched and the organization is in the developing stage. Regular workshops and networking events can create solid network for mini-grid programme and it will contribute to strengthen partnerships and attract funding for the development. Currently there is no record of existing network information shared through training and events.</p> <p>Target(s):</p> <p>90% of stakeholders to participate in the workshop</p> <p>At least 15% increase of collaboration in project development</p> <p>At least 30% increase in volume of funding (US\$) for mini-grid projects gathered</p> <p>Alumni registered in the database</p> <p>Bi-annual updates</p>	<p>Statistics on funding results</p> <p>Prepared workshop documents</p> <p>Attendance of stakeholders</p> <p>Agreements of collaborations</p> <p>Alumni data and track of records in attendance of events</p>	<p>There are growing interests in private sector involvement and events will help gathering people to make business opportunities</p> <p>Alumni can participate and vitalize partnerships</p>
<p>Activity 2.4 Establishment of national sustainable energy industry associations.</p>	<p>Number of businesses to register for the association</p> <p>Number of collaborations of the mini-grid development project</p>	<p>Baseline:</p> <p>There is no currently integrated industry association which covers the region. The association can work together with each government for public private partnership and regional standard for mini-grid design.</p> <p>Target(s):</p> <p>90% of registered businesses for energy industry association.</p> <p>At least 20% increase of PPP performed from the association.</p>	<p>Registration numbers of industry</p> <p>Regular meetings held</p>	<p>Industry association can collaborate in integrated model and PPP in mini-grid projects</p>
<p>Outcome 3: Improved sustainability of mini-grid system and implemented standardized technical equipment and design.</p>				
Outputs	Indicators	Baseline and targets	Means of verification	Risks and assumptions
<p>Activity 3.1 Guidelines for standardized technical equipment, design and assessment methodology by categorization of islands to have optimal mini-grid system in the region.</p>	<p>Standard technical guidelines for the project development</p> <p>Implemented standardized equipment, designs, and assessments</p> <p>Percent of improvement in mini-grid system quality</p>	<p>Baseline:</p> <p>PICTs have unique territories with remote islands, so it can be categorized into three groups based on the size. Although there are standardized suggestions on technical equipment, it is not widely applied throughout the region.</p> <p>Target(s):</p> <p>Developed guidelines for standardized technical equipment, design, and assessment methodology of mini-grid system by each volume of energy generation</p> <p>At least 50% of project applied through the technical model guidelines</p> <p>30% improvement in mini-grid system quality</p>	<p>Standardized technical design documents</p> <p>Assessment documents and progress reports</p>	<p>Strong cooperation from donor organizations is needed</p> <p>Regular basis assessment will ensure the technical quality of the system</p>

Design of a Sub-Regional Renewable Energy Mini-grid Program for PICTs

<p>Activity 3.2 Integrated O&M platform to be managed to ensure the technical quality for the system. (e.g. Standard O&M Manual, Platform Structure Design, Energy Management System, Component Management, Communication)</p>	<p>Number of mini-grid system utilize O&M platform</p> <p>Percent of up-to-date information.</p> <p>Number of problems fixed through O&M platform</p> <p>Percent of quality improvement by utilizing the O&M platform</p>	<p>Baseline:</p> <p>Isolation is the main challenge for O&M in order to sustain the quality of the system. Moreover, there is no existing consolidated O&M management platform to monitor the mini-grid system. The lack of technical skills and transportation time are challenging to fix any technical issues in a timely manner.</p> <p>Target(s):</p> <p>At least 50% of mini-grid system utilize O&M platform</p> <p>Real time basis record for O&M</p> <p>At least 30 % of fixed problems through O&M platform</p> <p>20% increase of quality improvement by utilizing the O&M platform</p>	<p>O&M platform statistics</p>	<p>The mini-grid system linked with ICT connection is important</p>
---	---	--	------------------------------------	---

Annex II. Financial Budget Details for the Mini-grid Programme

Component 1. Market Intelligence Development

Activity / Task	Projected Budget by Year					Budget	Budget comments
	2019	2020	2021	2022	2023	Total	
Activity 1: Web-based market knowledge platform	150,000	0	0	0	0	150,000	
a. Design of Web-based knowledge platform	50,000	0	0	0	0	50,000	
b. Construction or overhaul of web-based platform	100,000	0	0	0	0	100,000	
Activity 2: Up-to date market information	95,000	250,000	100,000	100,000	100,000	645,000	
a. Reorganization of existing SPC data repository	30,000	0	0	0	0	30,000	
b. Collection and update of existing mini-grid projects in PICTs (including communication with member countries)	30,000	150,000	0	0	0	180,000	
c. Staffing of Web platform operation	35,000	100,000	100,000	100,000	100,000	435,000	1 staffs in year 2019, additional 2 staff in year 2020 and 2021
Activity 3: Database of Mini-grid projects in PICTs	400,000	700,000	100,000	100,000	100,000	1,400,000	
a. Design of data base, data format, data collection	150,000	0	0	0	0	150,000	
b. Training of operational staffs at project sites for data collection and communication	0	300,000	0	0	0	300,000	10 countries x 3 sub units
c. Construction and operation of web-based data communication platform	200,000	300,000	0	0	0	500,000	
d. Staffing of data base operation and update	50,000	100,000	100,000	100,000	100,000	450,000	1 staffs in year 2019, additional 1 staff in year 2020 and 2021
Total	645,000	950,000	200,000	200,000	200,000	2,195,000	

Component 2. Capacity Building and Public and Private Partnerships

Activity / Task	Projected Budget by Year					Budget	Budget comments
	2019	2020	2021	2022	2023	Total	
Activity 1: SP business development model curriculum	275,000	25,000	25,000	25,000	25,000	375,000	
a. Program design	150,000	0	0	0	0	150,000	
b. Office and equipment for lecturing, discussion, and networking	100,000	0	0	0	0	100,000	To share existing PCREEE and SPC offices
c. Printing and textbook publication	25,000	25,000	25,000	25,000	25,000	125,000	
Activity 2: Capacity building program	330,000	180,000	180,000	180,000	180,000	1,050,000	

a. Training of key staff members and leadership	30,000	30,000	30,000	30,000	30,000	150,000	10 key staff members and program leaders
b. Training of local operating units	300,000	150,000	150,000	150,000	150,000	900,000	10 countries x 3 sub units
Activity 3: Promotion of mini-grid and public private partnerships	165,000	200,000	200,000	200,000	200,000	965,000	
a. Support and training of government officers of member countries	50,000	50,000	50,000	50,000	50,000	250,000	10 governments x 2 officers
b. Networking events and conference for private and public partnership	50,000	50,000	50,000	50,000	50,000	250,000	1 conference and 1 networking event each year
c. Monitoring and evaluation of public and private partnership practices	30,000	30,000	30,000	30,000	30,000	150,000	
d. Staffing for networking and and program operation	35,000	70,000	70,000	70,000	70,000	315,000	1 staff in year 2019, additional 1 staff in year 2020 and 2021
Activity 4: Industry Association	50,000	50,000	50,000	50,000	50,000	250,000	
a. Staffing	35,000	35,000	35,000	35,000	35,000	175,000	
b. Operation cost	15,000	15,000	15,000	15,000	15,000	75,000	
Total	820,000	455,000	455,000	455,000	455,000	2,640,000	

Component 3. Technical Advancement of the Mini-grid System

Activity / Task	Projected Budget by Year					Budget	Budget comments
	2019	2020	2021	2022	2023	Total	
Activity 1: Guidelines for standardized mini-grid system	200,000	150,000	150,000	50,000	50,000	600,000	
a. Workshops for mini-grid technical standards	30,000	30,000	30,000	30,000	30,000	150,000	One event each year
b. Task force team operation of public and private (locals and foreigners)	150,000	100,000	100,000	0	0	350,000	10 to 15 T/F members x 3 meetings in 2019 and 2 meetings in 2020 and 2021
c. Guideline manual and publications	20,000	20,000	20,000	20,000	20,000	100,000	1 staffs in year 2019, additional 2 staff in year 2020 and 2021
Activity 2: Integrated Operations and maintenance (O&M) platform	865,000	610,000	510,000	510,000	510,000	3,005,000	
a. Design of platform configuration and operational logics, on-line communication, operational manuals, and schedule of key parts and components	500,000	0	0	0	0	500,000	
b. Upgrade of wireless communication network at TOC	250,000	0	0	0	0	250,000	

Design of a Sub-Regional Renewable Energy Mini-grid Program for PICTs

c. Upgrade of wireless communication network between TOC and sites	N/A						To be addressed by member countries
d. Staffing for design and test operation at TOC	70,000	100,000	100,000	100,000	100,000	470,000	2 staffs in year 2019, additional 1 staff in year 2020 and 2021
e. Training of staffs in TOC	30,000	0	0	0	0	30,000	Including overseas trip for training
f. Training of local operators at sites	0	150,000	50,000	50,000	50,000	300,000	10 countries x 5 sites
g. Inventory of key components and spare parts to be located at TOC	0	250,000	250,000	250,000	250,000	1,000,000	solar modules, inverters and IGBT components, repair tools
h. Regular site check-up and A/S	0	50,000	50,000	50,000	50,000	200,000	2 times per year
i. Emergency dispatch for A/S	0	30,000	30,000	30,000	30,000	120,000	
j. Evaluation and knowledge sharing	15,000	30,000	30,000	30,000	30,000	135,000	
Total	1,065,000	760,000	660,000	560,000	560,000	3,605,000	