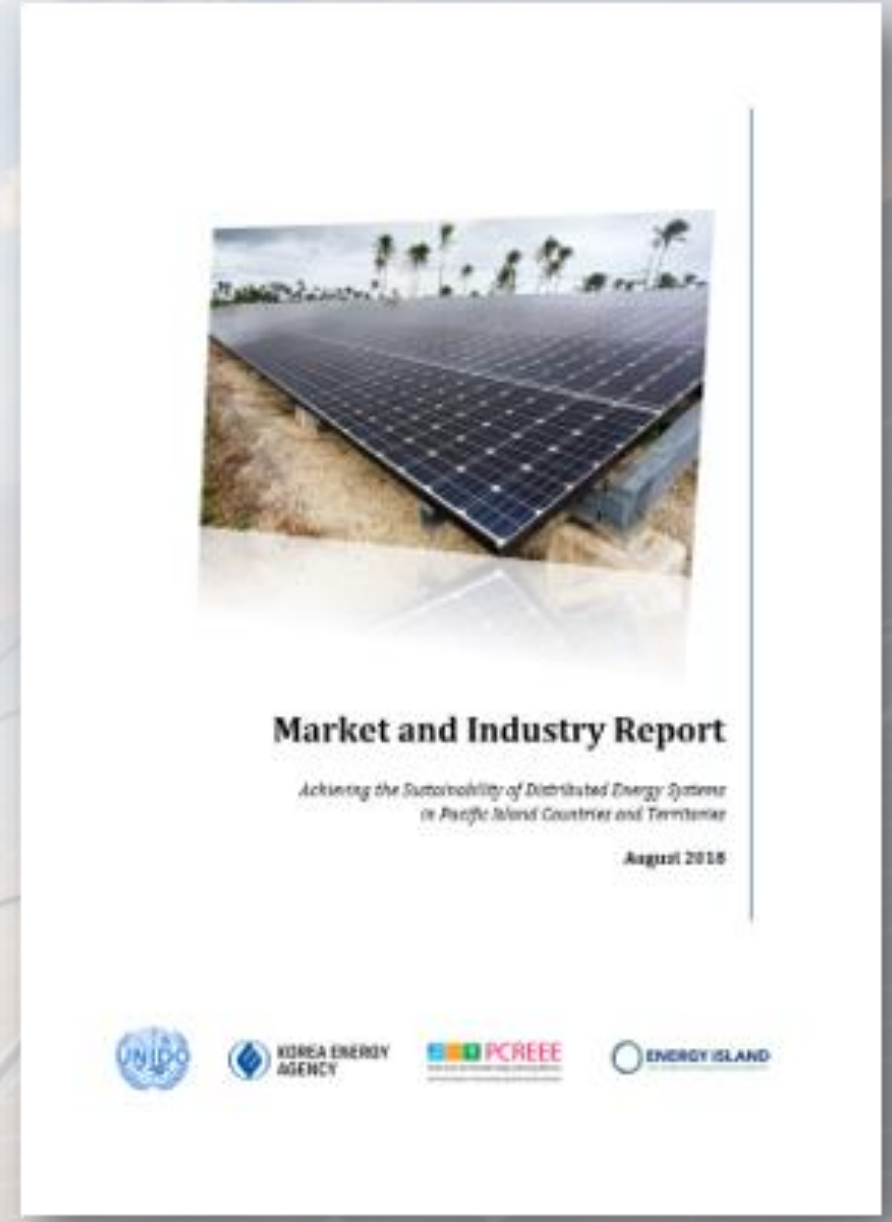
Assessment of Mini-grid Market and Industry in PICTs

Session 1
Thursday, November 22, 2018

Presenter:
Taeil Kang,
CEO, One Energy Island Co., Ltd.



Presenter: TAEIL KANG, CEO, One Energy Island Co., Ltd.

(Education)

- MBA, Rotman School of Management, University of Toronto, Canada
- BA, Business Administration, Seoul National University

(Professional Experience)

Founder and CEO, One Energy Island Co., Ltd.

- Responsible for Design and Feasibility Study of a solar PV, ESS and Diesel Hybrid System at Spansh Wells, Bahamas
- Responsible for Design and Feasibility Study of a Mini-grid Project in Palau
- Responsible for conducting Feasibility Study for Micro-grid in Santa Cruz and Baltra Islands, Galapagos,
- Responsible for Policy Research of Strategy of Renewable Energy Business Development in Overseas Small Island Countries, funded Ministry of Trade, Industry, and Energy, Republic of Korea
- Responsible for conducting Feasibility Study for Construction and Operation of Eco-Friendly Energy Town in Laos

Member of Working Group Committee, Green Energy Capacity Building and Industry Growth, Seoul Metropolitan Government

Senior Vice President, Renewable Energy Business Division , KC Cottrell Co. Ltd

- Responsible for development, construction, and operation of grid-tied solar PV projects in total more than 50MW capacity including a solar power IPP project at Renault Samsung Korea. The project covered 280,000 square meters factory roof-top and auto parking lots at the Renault Samsung Busan factory for construction and operation of a 20MW solar power system.

Chair of International Collaboration Committee, Korea Photovoltaic Industry Association

- Task force member for Korea-Uzbekistan Solar Test Bed Project, a joint project of the Government of Korea and Government of Uzbekistan (2014)
- Director of Asia Solar Energy Forum (2011~2012)

Introduction One Energy Island, Co., Ltd

Strategy Consulting and Project Development Specializing in RE-based Distributed Energy Projects

ENERGY ISLAND
Green Energy Business Strategy & Business Development

WHAT WE AIM TO DO

Design and implement a tailored strategy for building energy systems that provide;

GOAL

- Community or private owner of facility with stable supply of energy from sustainable energy sources at competitive cost
- Investor with stable rate of return on investment
- Global community with contribution to making a greener environment

CORE COMPETENCY

- Strategic approach in design of sustainable energy system for community
- Engineering expertise of optimization of grid with data-based dynamic grid analysis
- Team of knowledgeable business development experts in strategic markets

PROJECT REFERENCE

Project	Description	Employer
Design and Feasibility Study of Micro-grid in Santacruz & Baltra Islands, Equator	Optimization of integrated operation of 1.5MW solar PV, 2.25MW wind turbines, 4.3MW ESS, with 6.7MW diesel generators	Korea Energy Agency, Government of Ecuador
Design of solar PV, ESS and diesel hybrid system at Spanish Wells, the Bahamas	Solar PV 1MW, and ESS to be operated with existing diesel: targeting 30% to 50% of renewable energy contribution to existing 2MW average load	St. Georgy Cay Power Company, Bahamas
Design of Mini-grid in Pelleliu Island, Palau, South Pacific	Solar PV and ESS hybrid system to be operated with existing diesel generators, targeting 70% of renewable energy contribution to existing 200kW load	Palau Energy Administration, Palau Public Utility Corporation

PROJECT REFERENCE

Project	Description	Employer
Strategy of Utilization of MDB Financing for Development of Renewable Energy Projects in Overseas Market		Ministry of Trade, Industry, and Energy, Government of Korea
Design of solar PV, ESS and diesel hybrid system at San Cristobal Island, Galapagos, Ecuador	1MW solar PV with 1.5MWh ESS operating with existing diesel generators	Woojin Industrial Systems
Strategy of Mini-grid Business Development in Overseas Islands	•Study of mini-grid market in the Pacific, Caribbean, and Indian Ocean	Ministry of Trade, Industry and Energy, Government of Korea

CONTENTS

01 Introduction

02 Issues of RE-based Mini Grid Project : Under PICTs Environment

03 Mini-Grid Market and Industry

04 Major Findings and Take Outs

Introduction

001 Project Outline

002 Methodology

1. Project Outline

Project Outline

Project Title

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

Project Beneficiaries

Contractor

Consultancy

- PCREEE
- UNIDO
- One Energy Island Co., Ltd.

Project Period

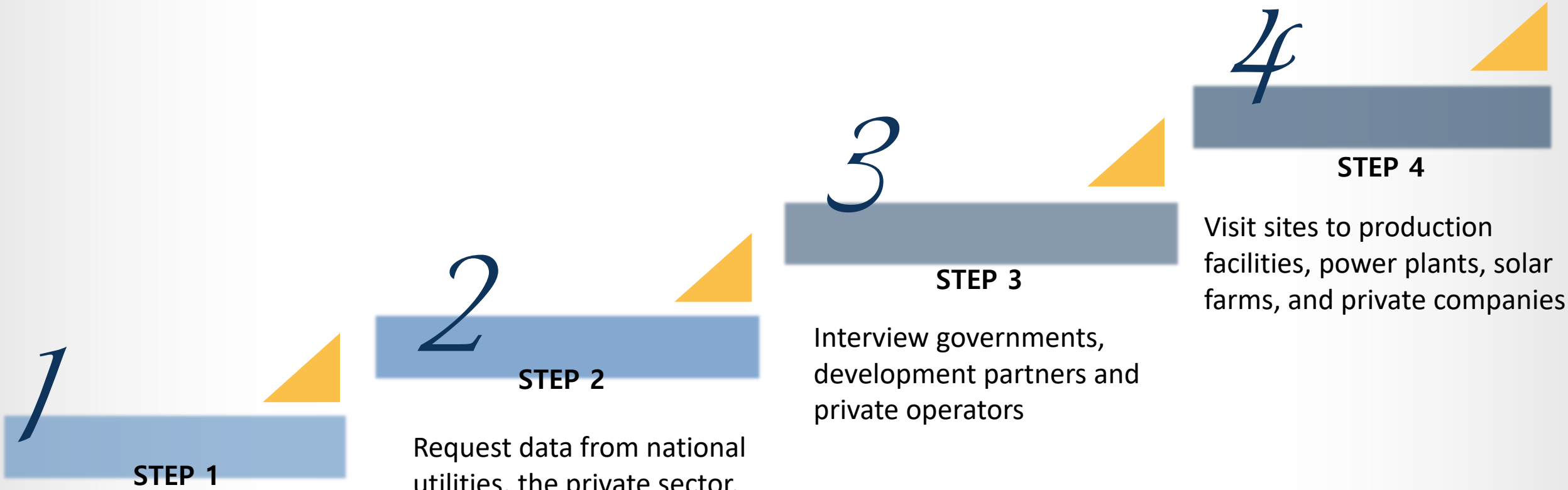
Project Activity

- January 2018 – August 2018
- 1. Market and Industry Report
  2. Design of Mini-grid
  3. Concept Note

The Consultancy Objective

To support the first operational phase of the Pacific Centre for Renewable Energy and Energy Efficiency (PCREEE) by proposing concrete recommendations concerning how PCREEE can promote a market for decentralized renewable energies, and facilitate innovation and capacity development for regional industry growth.

2. Methodology



Issues of RE-based Mini Grid Projects: PICTs Environment

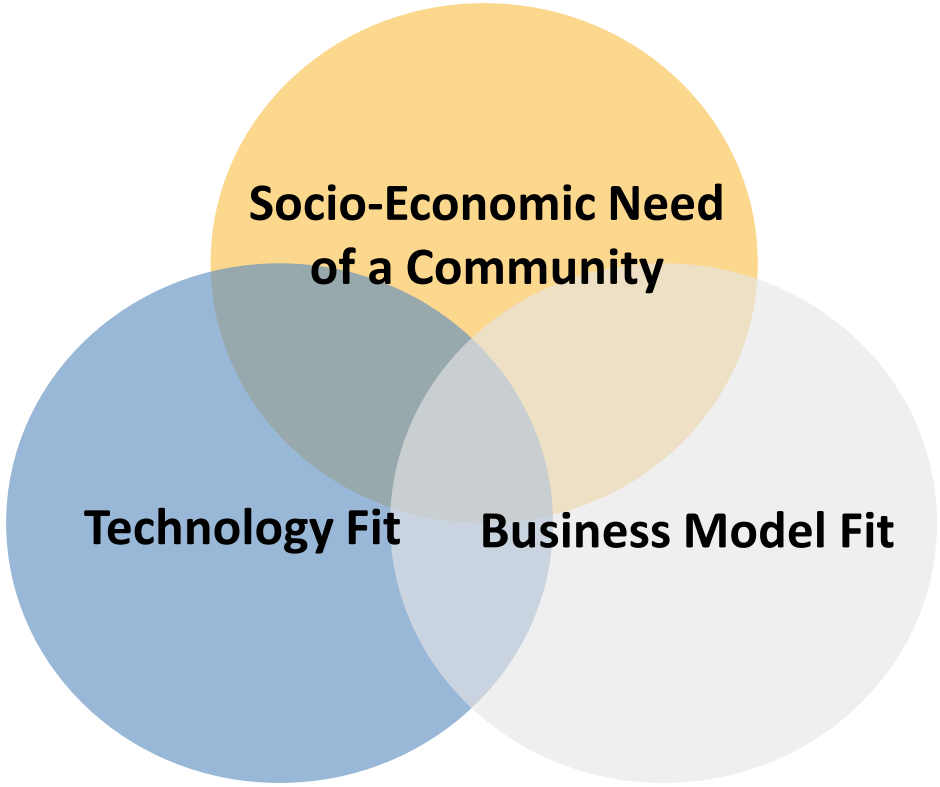
2

001 Conditions for Sustainable Mini-grid Project

- Socio-Economic Need
- Technology Fit Issues
- Business Model Fit Issues

1. Conditions for Sustainable Mini-grid Project

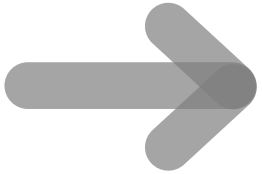
Sustainable Mini-grid Project



Sustainable Mini-grid Project

Socio-Economic Need

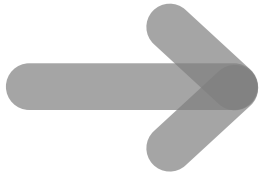
- Affordable, reliable energy supply
- Social development
- Local industry development



Agreed consensus on Socio-Economic Needs

Technology Fit Issues

- Emerging technologies
- Economies of scale requirement for production of key components
- High degree of complexity in design and operation of system



How to achieve fit between
- Standardization vs customization & localization
- Foreign technologies vs local contribution

Business Model Fit Issues

- Fragmented, under-developed market:
  - High perceived risks of doing mini-grid business in PICTs
- Donors Funding
- External leadership

How to design and implement a proper PPP (Public and Private Partnership) model toward the market-driven model

- How to attract participation of private companies
- How to share and reduce risks

Mini-Grid Market and Industry: Current Status

3

001 PICTs Energy Environment and RE

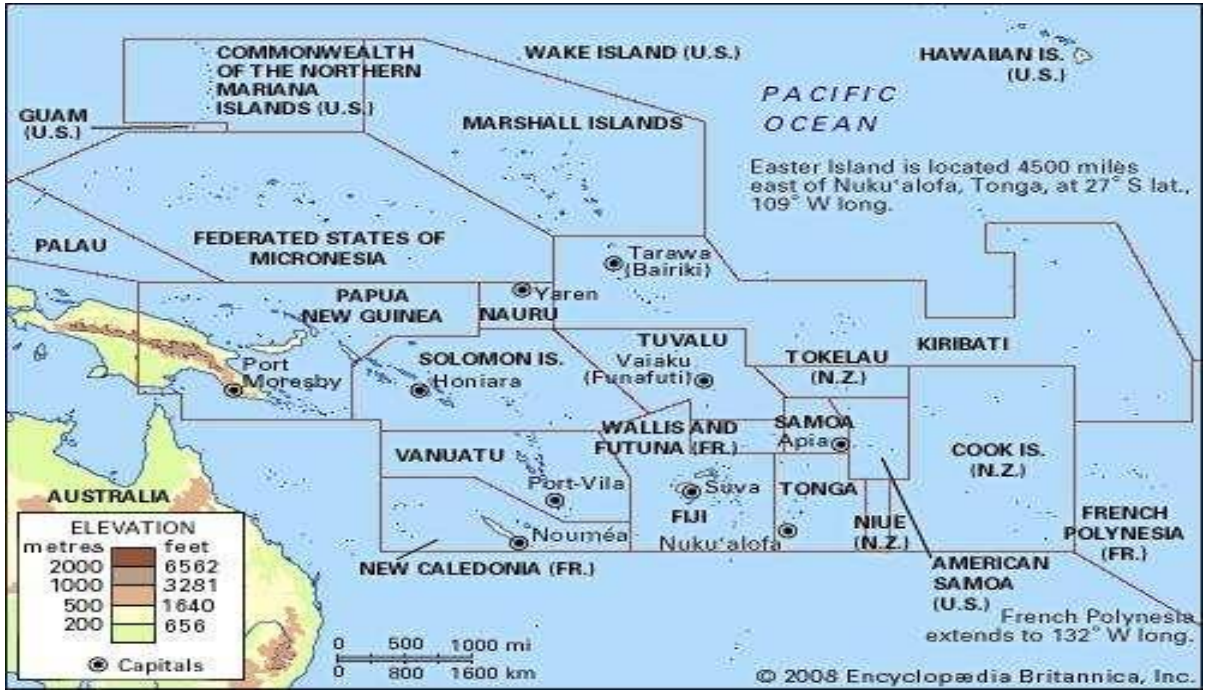
- PICTs Geography
- PICTs Demographics and Economy
- PICTs Energy as the Key Strategic Agenda

002 Country Level Market Analysis

003 Mini-grid System Case Studies

1. PICTs Energy Environment and RE

PICTs: Geography



22 Countries and Territories covering tens of millions square miles of the South Pacific Ocean

- The vastness of the coverage and remoteness of the locations shape the fundamental nature of doing business in PICTs, including mini-grids

1. PICTs Energy Environment and RE

PICTs: Demographics and Economy

Country	ODA US$ in millions	ODA Received per Capita	Population (2012)	Land area (km2)	GDP per capita (WB)		GDP growth rate per capita (WB)	
					US$	Year	%	Year
Cook Island	8.09	536.22	15,087	237	15,002	2014	6.2	2014
Fiji	102.48	114.87	855,545	18,273	4,922	2015	5.56	2015
Kiribati	64.95	577.81	106,886	811	1,424	2015	3.5	2015
Marshall Is.	57	1,076.72	53,679	181	3,386	2015	0.63	2015
Micronesia (F.S.)	81.39	779.35	102,948	701	3,016	2015	3.77	2015
Nauru	31.25	2505	10,292	21	8,053	2015	2.81	2015
Palau	13.93	654.36	17,445	444	13,501	2015	9.36	2015
PNG	589.74	74.46	7,229,077	462,840	2,183	2015	8.53	2014
Samoa	93.72	483.69	187,610	2,785	4,149	2015	1.63	2015
Solomon Is.	190	323.47	587,068	30,407	1,922	2015	3.73	2015
Tonga	68.4	643.1	103,276	650	4,094	2015	3.71	2015
Tuvalu	49.65	4,513.23	10,732	26	2,970	2015	2.64	2015
Vanuatu	186.56	705.06	257,031	12,281	2,806	2015	-0.8	2015
Average	118.24	999.03	-	-	5,187	-	3.94	-

Source: Aggregated data from Pacific Power Association. (2012), World Bank Data (2015), OECD (2015), UN data (2014).

Countries and territories with small size of population each and in the developing stage

1. PICTs Energy Environment and RE

PICTs:
Energy as the Key Strategic Agenda

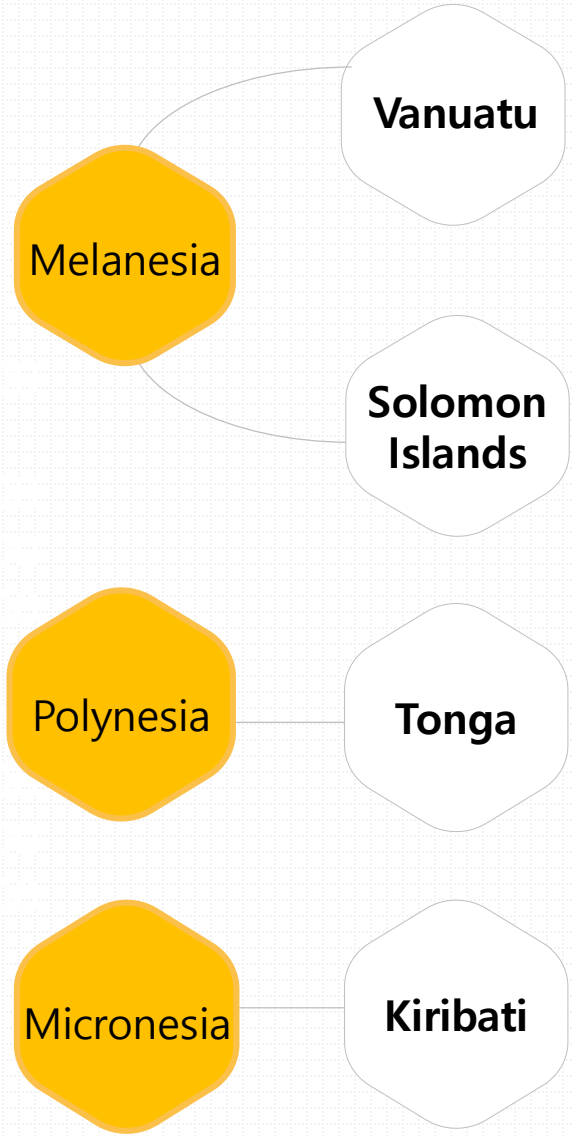
PICTs	Power Access (%)	Rate of RE (%)	CO2 emissions (metric tons per capita)	Renewable Electricity Targets by 2020 (%)
Cook Islands	85%	N.A.-	N.A.	100%
Fiji	100	59	1.3	100%
Kiribati	48.1	2.6	0.6	10%
Marshall Islands	90	<1	0.9	20%
Micronesia (F.S.)	71.7	-	1.4	30%
Nauru	99.2	<1	4	50%
Palau	99.8	<1	12.3	20%
Papua New Guinea	20.3	35	0.8	No Target
Samoa	97.9	41	1	+10%
Solomon Islands	35.1	<1	0.4	50%
Tonga	95.3	<1	1.1	50%
Tuvalu	98.5	3	1	100%
Vanuatu	34.5	19	0.6	65%

Source: World Bank Data (2014), Power Access and CO2 Emission. World Bank Data (2015), PPA (2011), RE rate, IRENA (2013), Pacific Lighthouses, French Development Agency (2014), Renewable Energy in Pacific Islands.

Sustainable energy supply is the key strategic agenda for PICTs;

- Increase energy access, and
- Reduce dependency on fossil fuel-based power generation

2. Country Level Market Analysis



- 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
- Limited financing resources
- Private sector engagement needs to be encouraged
- Low awareness from locals

- Lack of an energy database
- No policy framework for mini-grid development
- Financial and technological capacity issues
- Geographical characteristics increase cost of development

- Long-term financial instability in the energy sector
- Limited land availability
- O&M issues
- Scaling up from home solar systems to mini-grids
- Huddles for local businesses to participate

- Lack of policy framework to develop mini-grid development
- Inadequate capacity to manage grid stability.
- Inventory control is needed for spare parts
- Limited financing resources

3. Mini-grid System Case Studies

- 8 projects covered
- Mini-grid in remote villages or outer islands
- Hybrid system of solar PV and battery with diesel generators
- Funded as grant by international organization: no commercial IPP project
- Operational, but with some technical troubles

3. Mini-grid System Case Studies

Activity / Task	CASE 1	CASE 2	CASE 3	CASE 4
Project Type	Solar PV mini grid	Solar PV mini grid with Diesel back up	Solar PV/ Diesel hybrid mini grid	Solar PV/ Wind / Diesel hyb rid mini grid
Location	Kauma (Abemama), Kiribati	Kiritimati island, Kiribati	Kadavu island, Fiji	Nabouvalu, Fiji
Business Year	2014	2014	2015	1997
System	42.525 kW_p sola PV (18 0 x 235 W_p) + 3488.3AH C_{10} Battery + 18 kW inverter (3 phase) with Diesel backup	16.215 kW_p solar PV + 2150AH C_{10} battery + 12 kW inverter	249 kW_p solar PV + 2 x 23 kW Hatz twinpacks low load diesel generators	37.4 kW_p solar PV + 8 x 6.7 kW Bergey wind + 50 kW battery + 2 x 100 kVA diesel generators
Funding	A component of EU 10th European Development Funding (EDF)- Total 4.1 Million Euros	A component of EU 10th European Development Funding (EDF)- Total 4.1 million Euros	UAE Pacific Partnership Fund (Total 5 million US D for 3 projects in Fiji)	MOFA, Japan (F$ 800,000) + FDoE , Fiji F$ 230,000
Application	Off-grid in outer Islands, schools	Off-grid in outer Islands, schools	Solar PV and diesel hybrid mini-grid,	Solar PV, battery, and diesel hybrid mini-grid
Performance	Operational	Operational	Technical trouble in cont roller, damage caused by a recent cyclon	Non operational (lacking adequate O&M resource)

3. Mini-grid System Case Studies

Activity / Task	CASE 5	CASE 6	CASE 7	CASE 8
Project Type	Solar PV/ Diesel hybrid mini grid	Solar PV/ Diesel hybrid mini grid	Solar mini-grid	Solar PV/ Diesel hybrid mini grid OIREP
Location	Kadavu island, Fiji	Vava'u island, Tonga	Cook Islands	Islands of 'Eua, H'aapai and Vava'u , Tonga
Business Year	2017	2013	2016	2017 (Project agreement signed)
System	30 kW_p solar PV + 32 kVA diesel generators -	420 kW_p Solar PV+ 930 kW Diesel + 100 kW Battery	Solar Photovoltaic plants under Cook Islands Renewable Energy Sector Project(COO46453-002) Phase 1	9 islands, Solar PV 1.25MWp in total and ESS
Funding	Korea Government (1.5 M USD) + Fiji Government (500, 000 FJD)	UAE partnership Fund	NZD 30M(USD 20M), ADB Loan	ADB concessional lending
Application	Solar PV, battery, and diesel hybrid mini-grid in a remote village	Solar PV, battery, and diesel hybrid mini-grid	Solar PV and diesel hybrid mini-grid in outer islands	Solar PV, battery, and diesel hybrid mini-grid in outer islands
Performance	Operational (some technical troubles were solved)	Operational in supplying energy to fulfill 70% of electricity demand	Operational	Under-construction

Major Findings and Take Outs

4

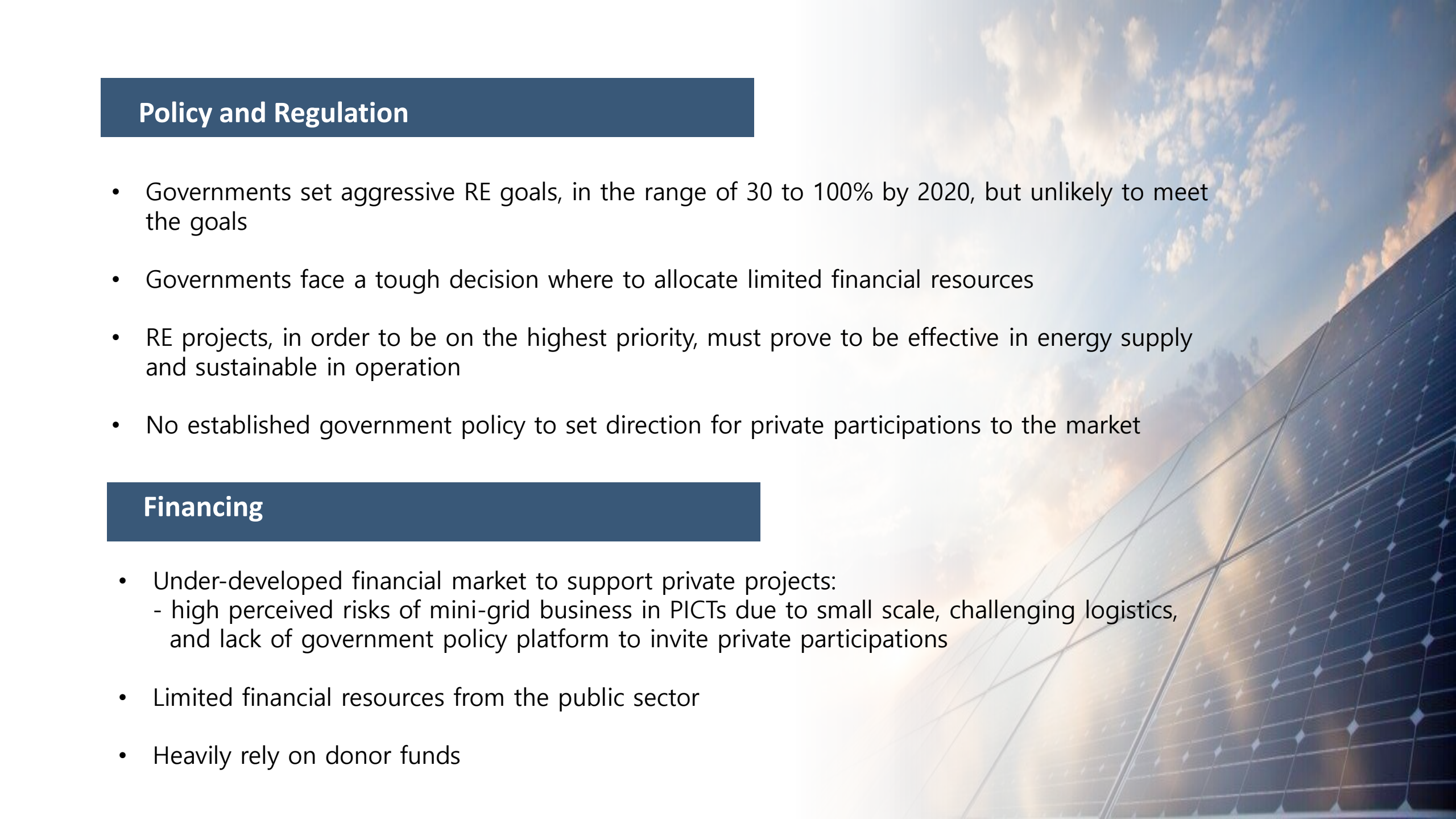
- Policy & Regulation
- Financing
- Technology
- Industry
- Key Challenged Identified in PICTs

Policy and Regulation

- Governments set aggressive RE goals, in the range of 30 to 100% by 2020, but unlikely to meet the goals
- Governments face a tough decision where to allocate limited financial resources
- RE projects, in order to be on the highest priority, must prove to be effective in energy supply and sustainable in operation
- No established government policy to set direction for private participations to the market

Financing

- Under-developed financial market to support private projects:
  - high perceived risks of mini-grid business in PICTs due to small scale, challenging logistics, and lack of government policy platform to invite private participations
- Limited financial resources from the public sector
- Heavily rely on donor funds



Technology

- Foreign technologies and products
- Weak connection with local contribution and fit with local conditions
- No appropriate resources and practices for sustainable operation

Industry

- Unfavored position of local companies in the industry value chain
  - Limited opportunity for value added contribution
- Limited financial resources from the public sector, and heavy dependency on donor funds
- Lack of opportunity of local industry growth and capacity building

Key Challenges Identified in the Pacific Community

Business Side

- High perceived risk in doing mini-grid business
- Limited market knowledge and data for private sector involvement
- Lack of opportunity for local companies to make value-added contribution

How to design and implement a program to facilitate move to the market-based mechanism driven by local industry and private participation

Key Challenges Identified in the Pacific Community

Technology Side

- Technologies and products which are new, foreign, and complicate to handle
- Limited capacity of local companies in project design and operation

How to design and implement a program to support local companies to be leading sustainable design and operation of mini-grid projects

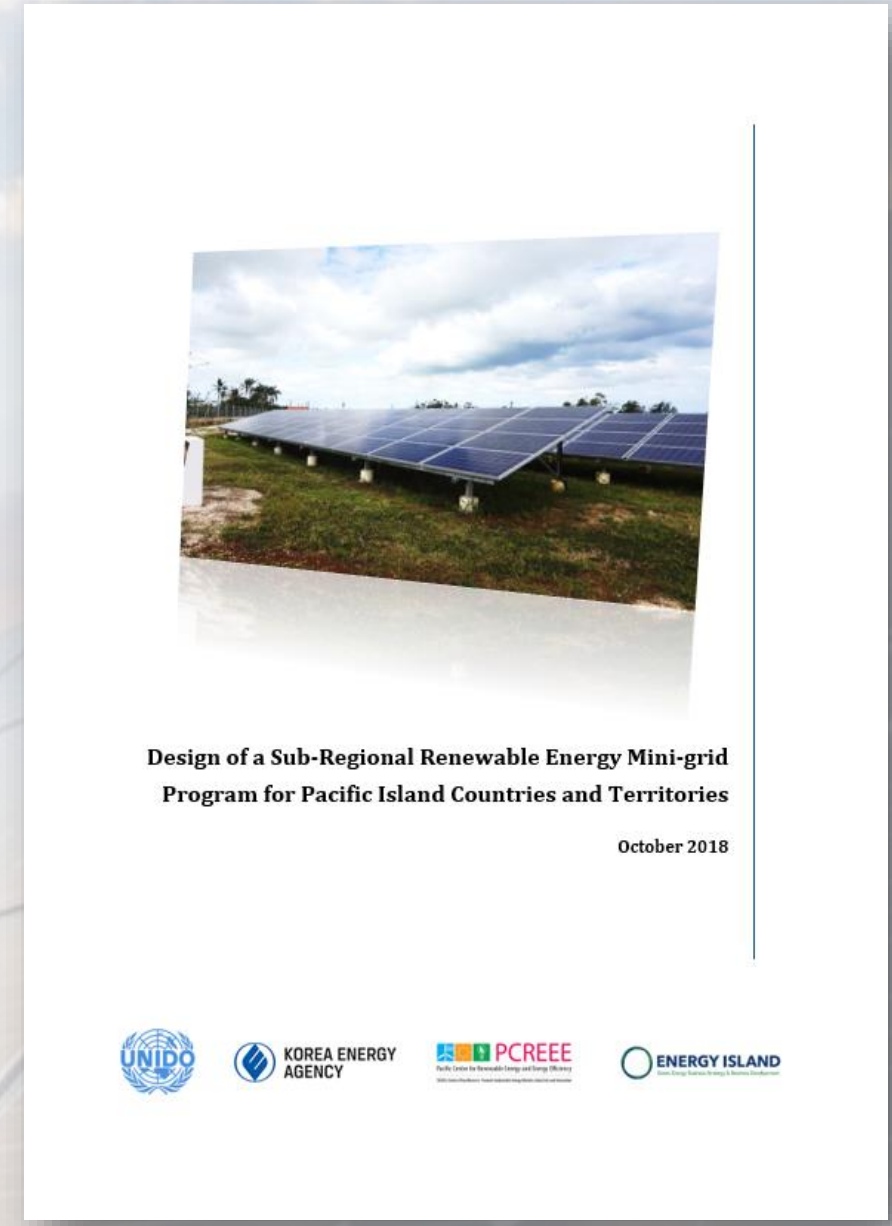
ENERGY ISLAND
Green Energy Business Strategy & Business Development

Design for a Mini-grid Program in PICTs

Session 2

Thursday, November 22, 2018

Presenter: Taeil Kang



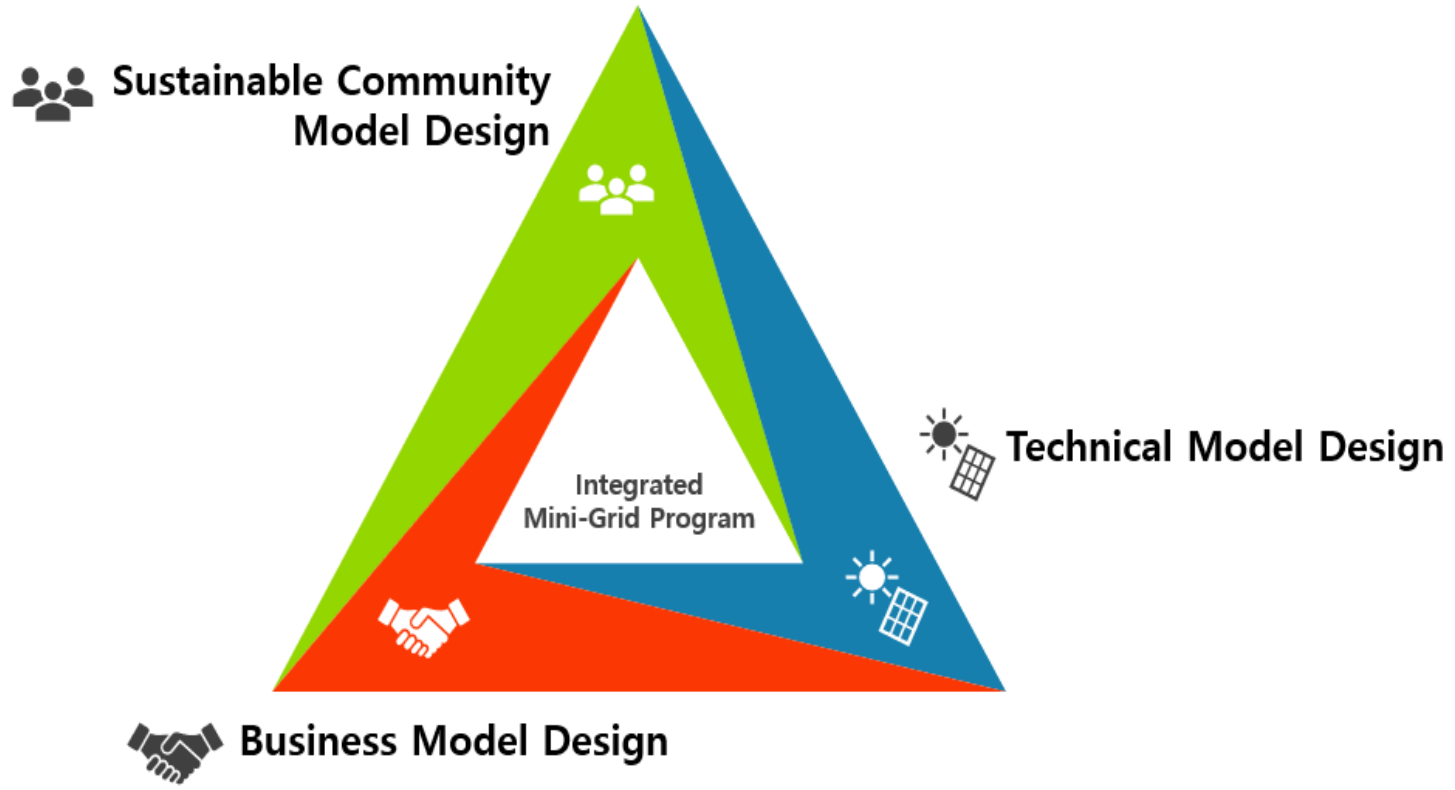
CONTENTS

Approach: Design of Sustainable Community Model

001 Design Approach of Mini-grid Programme

1. Design Approach of Mini-grid Programme

- **To take into account of the socio-economic needs and conditions of a community into the design of the mini-grid programme**
- **To contribute to sustainable development of community**
- **To fit into specific physical conditions and constraints of community**



1. Design Approach of Mini-grid Programme – Guideline

Principle of “Design for Social Good” by Emily Pilloton

- Simple
- Less use of material
- Aesthetic

Interpretation of “Design for Social Good” Into PICTs Mini-grid Design Context

Accessible

- Design of system which is “easy to deliver and assemble , easy to install, and simple and easy to operate”

Affordable

- Utilize locally available renewable energy resources.
- Utilize locally available materials and human resources.
- Proper funding and adaptable tariff schedules to make a mini-grid project financially affordable and sustainable

Reliable

- Empower community and/or a local enterprise to be an active agent and owner .
- Design business model that enables and fosters the participation of the local community and private enterprises.

Conflicting and challenging missions to be solved with “Win-Win” collaboration among key stakeholders

Categorization of Mini-grid Model

2

001 Categorization

- Background
- Main islands
- Outer islands
- Remote islands

1. Categorization

Background of Categorization

- Geographical characteristics of PICTs that shape the nature of mini-grid business
- Islands in PICTs that can be grouped in a different set of geographical conditions
- A different set of geographical conditions may require different set of technical and business model

Categorization

1. Categorization

Subject	Main Islands (group A)
Existing power system and environment	Centralized grid operated by a public utility corporation Size of average load larger than 10MW in most main Islands Still majority of power generation based on diesel
Constraints and conditions for commercial scale mini-grid projects	Dominant and monopolistic position of existing utility
Feasible Business model	IPP with private funding
Feasible Technical model	Grid tied RE systems utilizing local RE sources ESS for voltage support and frequency regulation as RE increases
Technical System Design	Diesel as the main power source responsible for energy supply with RE supporting diesel in saving peak load
Key problems	Grid stability as RE penetration increases

1. Categorization

Subject	Outer Islands (group B)
Existing power system and environment	Small grid operated by a public utility or a private company Size of average load varies in the range of several hundred kW to several MW Mostly diesel-based generation
Constraints and conditions for commercial scale mini-grid projects	High demand of mini-grid with RE and ESS Economies of scale needed to make a bankable commercial project
Feasible technical model	Hybrid of mini-grid systems with RE, ESS and diesel to reduce the dependency of diesel
Feasible business model	Community or private business model with a blended funding that includes concessional loan from public sector
Technical system design	RE as the main power source responsible for energy supply with diesel supporting as back-up function
Key problems and solutions	High level of engineering requirements for mini-grid design Effective O&M platform Incentives to attract private participation Innovative business model to achieve economies of scale of a project, and Blended financing model for risk sharing between public and private companies

1. Categorization

Subject	Remote Islands (group C)
Existing power system and environment	No reliable power system, or small independent power system on diesel base Size of average load in most cases less than one hundred kW
Constraints and conditions for commercial scale mini-grid projects	Challenging logistics conditions for delivery and construction Poor local capacity for construction and O&M
Feasible technical model	SHS (Small Solar Home System), or Hybrid mini-grid system
Feasible Business model	Public program
Technical System Design	Small solar home system, or RE based off-grid. Black out or supply interruption may be allowed
Key problems and solutions	Most remote islands with small populations do not have the required market demand for a proper mini-grid, and solar home system or small off-grid system are proper solution.

Technical Model Design

3

001 Database of Mini-grid Projects in PICTs

002 Integrated Mini-grid O&M Platform

003 Case: Wireless Monitoring of Mini-grid System

1. Database of Mini-grid Projects in PICTs

Concept

- Collect, accumulate and analyze of performance data and technical troubles of all existing and future mini-grid projects in PICTs
- Provide developers and operators with open-source knowledge for optimal design, and sustainable operation and maintenance of future mini-grid projects
- Provide manufacturers with knowledge for improvement and innovation of mini-grid system and components

Necessity

- Technical troubles and operational problems whose root causes can not be identified
- Risk of repetitive failures or under-performance from the same causes
- No reliable guideline to be referred to in design and operational improvement

1. Database of Mini-grid Projects in PICTs

Items to be Collected and Analyzed

- System configuration
- General information of community environment and conditions
- Status of system operation and performance
- Record of breakdowns or troubles by components and makers

Database Platform

- Upgrade of SPC's existing data repository is a feasible option
- Incentive program for voluntary participation and information sharing may be necessary

2. Integrated Mini-grid O&M Platform

Concept

- A central monitoring and control hub connected and communicating with local site operators on-line
- Professional O&M services or costly repairments by the hub and day-to-day routine operation and monitoring based on standard O&M manual by local operators or site managers
- Regular site tours and on site training from the hub experts

Necessity

- No proper resource and practice of mini-grid operation and maintenance of PICTs
- Lack of economies of scale of most of mini-grid programs in outer and remote islands where hiring professional, skilled operators or site managers are not feasible
- Challenging logistics conditions that makes timely response to technical trouble costly or impossible

2. Integrated Mini-grid O&M Platform

Key Component for Platform Design

- Standard O&M Manual
- Platform Structure Design
- On-line Monitoring and Data Communication Mode
- Spare-parts and Component Management
- Communication Infrastructure

Issues

- Limited on-line communication infrastructure
- Coverage of a hub: sub-regional or country?
- Funding for the platform construction and operation
- Entity to be responsible for the platform operation

2. Integrated Mini-grid O&M Platform

Existing Internet Infrastructure in PICTs

Protocols	Examples	Speeds
1G	brick phones, bag phones	2kbps
2G	GSM/CDMA/GPRS	14.4~64kbps
3G	WCDMA	2 Mbps~
4G	LTE	200Mbps ~ 1 Gbps

- The prevailing wireless protocol in PICTs is 2G to 3G
- Only limited size of data transmission is feasible
- Real-time data transmission is challenging

Approach

- Start on the existing wireless communication infrastructure
- Incorporate room for further improvement and upgrade along with advancement of wireless communication network in the future

3. Case: Wireless Monitoring of Mini-grid System

Fiji Namara Village Micro-grid Projects
EPC by Woojin Industrial Systems, Korea

FIJI NEWS

Solar power for Namara villagers soon

16:00 Sat Jun 03, 2017

Around two hundred and seventy people of Namara in Kadavu will soon have power supply.

Work on the over three million dollar Namara Village Solar Mini Grid Project has begun.

Infrastructure Minister, Parveen Kumar, says this is the first government co-financed solar project that is being installed with the Energy Saving System.

Kumar says the ESS will ensure enough power is stored to provide twenty-four hour services.

"This project has the potential to create new opportunities for the people of Namara, especially to our school children. The construction of this new infrastructure is the first ever in Fiji by the government of the Republic of Korea through the Korean Institute of Energy, Technology, Evaluation and Planning."

Taken from/By: FBC news
Report by: Ritika Pratap

Kumar says a better learning environment creates a better Fiji.

3. Case: Wireless Monitoring of Mini-grid System

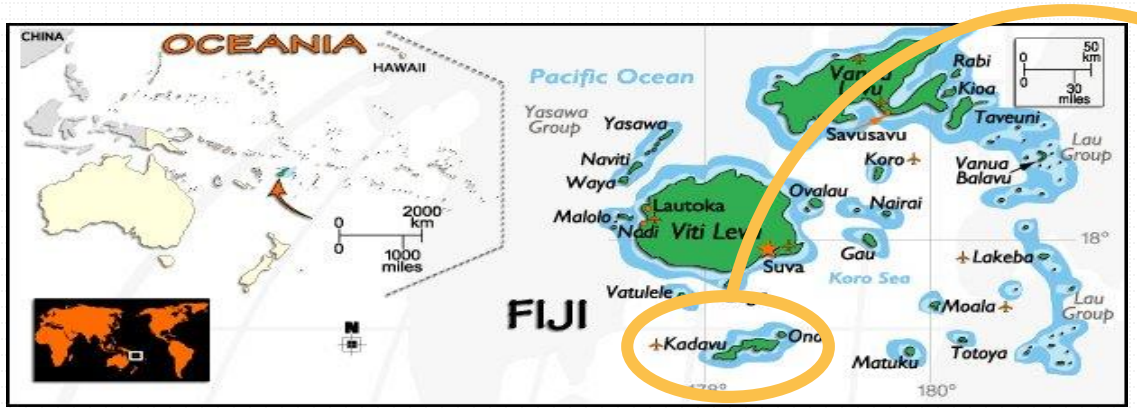
- Completed the F/S supported funded by the Korea Government in 2014
- As the result of the F/S, Village Micro-Grid(VMG) system was chosen as a suitable model for rural electrification project in Fiji

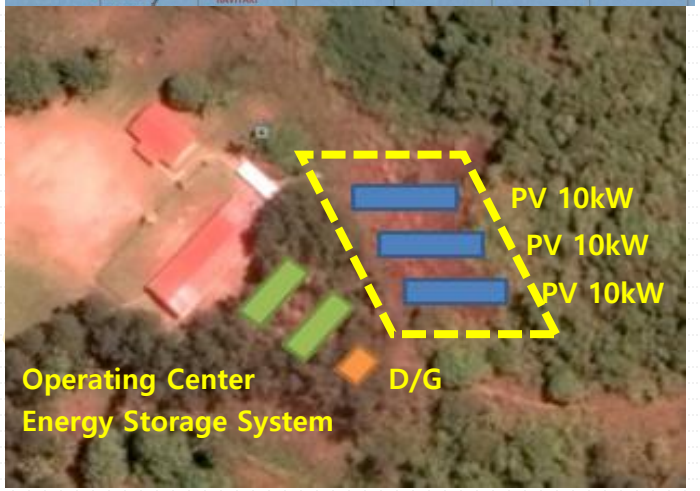
Project	• Establishment of Village Micro-Grid(VMG) system in Republic of Fiji islands
Purpose	• Supply 24/7 electric power by means of ESS and Solar system • PV 30kW, Battery 120kWh, EMS, AMI, D/G 50KVA(backup)
Period	• 1st January 2016 ~ 30th March 2018
Site	• Namara Village in Kadavu island, Republic of Fiji islands
Pacitipating Organization	• Fiji : DOE, CED, FEA, PA Kadavu, Korea Embassy in Fiji and relevant authorities • Korea : - Ministry of Trade, Industry and Energy - Fiji Embassy in Korea - Woojin'ndustrial Systems Co., Ltd.. • Financing : Korea Government

3. Case: Wireless Monitoring of Mini-grid System

Namara village, Kodavu Island

- Population : 170
- No. of buildings : 68 (houses/church/community hall : 67 & school : 1)
- Length of village : 800 m / - Wide of village : 180 m





3. Case: Wireless Monitoring of Mini-grid System

Login Window

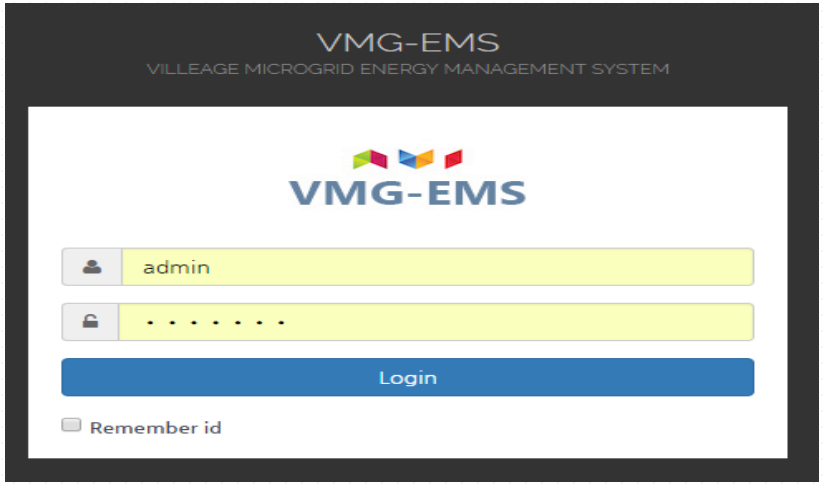
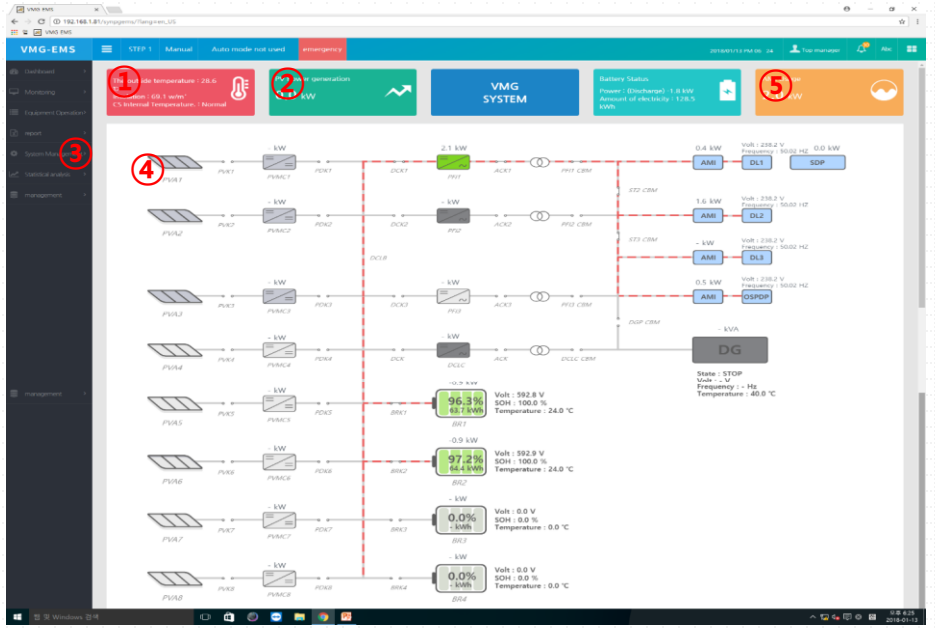


Image of System Monitoring



- Realtime monitoring and controlling of the system from Woojin Industrial System's office in Seoul
- Realtime access to operational data, and video streaming of system operation
- User ID authorization is categorized into controller, site operator, and general user.
- Quality of monitoring and communication varies day to day with internet communication line quality
- Mobile phone communication is available with additional application

3. Case: Wireless Monitoring of Mini-grid System

Design Concept of Integrated O&M for the Future

- **Multi-Micro-Grid Remote Control System**
  - ICT + Renewable energy + ESS + EMS

One central hub to monitor and control multiple systems on line

Business Model Design

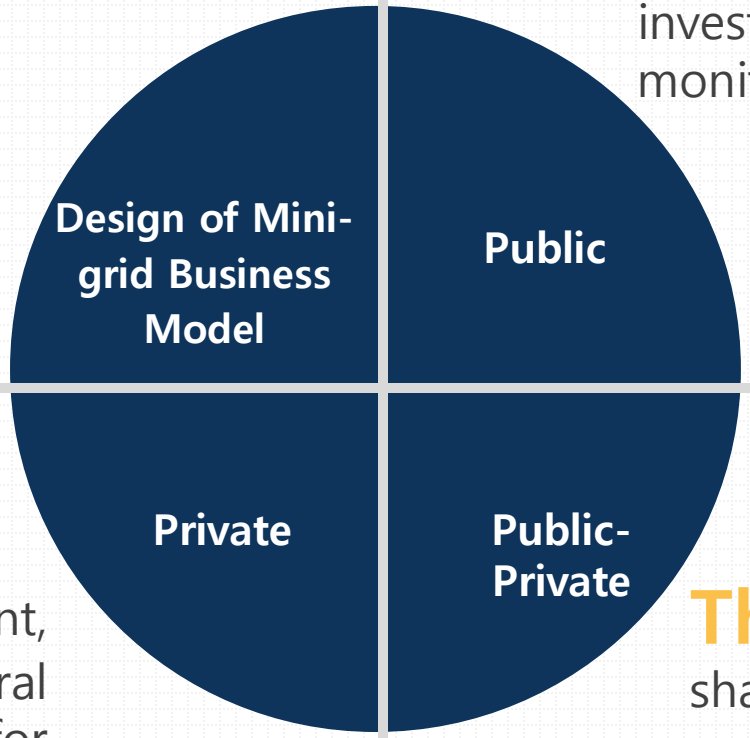
4

001 Application of 5Ps Model

002 Design of 5Ps Model in PICTs

1. Application of 5Ps Model

To accelerate electrification project in poor areas, a 5Ps model was created with focus on "Pro-Poor" to the Public and Private Partnership (PPP) model
(UNESCAP, 2004
Cinta Mekar Small Hydro Project, Indonesia)



To set the standards of quality of projects, provide funding for capital investment, promoting projects and monitoring the performance of projects

The entities of investment, ownership and operation of rural electrification projects, responsible for the operation of projects

The important role of public sector is sharing the business risks with private companies while supporting and monitoring the business performance

2. Design of 5Ps Model in PICTs

- 5Ps Model as transitional program to market driven model
- A Bridge model could be considered where a fully developed 5Ps model is not feasible

Task	Party	Public Model	Bridge Model	5Ps Model	Market-driven Model
Project Development	Public	Public, with foreign experts, leads project design and development	Public involvement in securing sites, and permit and license	Public involvement in securing sites, and permit and license	Public involvement in securing sites, and permit and license
	Private	No involvement	Private leads development	Private leads development	Private leads development
Operation	Public	Government responsible for operation	Monitoring Tariff scheduling and guarantee	Monitoring Tariff scheduling, and guarantee	No involvement
	Private	No involvement	Through training, transfer operation to professional local company and community	Private responsible for operation and maintenance	Private responsible for operation
Investment	Public	Provide ODA grant to beneficiary government	Provide concessional loan or grant to Projects (through a public intermediary)	Concessional loan or grant from public	No involvement
	Private	No involvement	Private participants generate cash income for operation and maintenance	Private participation in investment	Funding from financial market

Design of Mini-grid Programme

Development Objective: Increased clean energy access and improved livelihoods for communities through the promotion of a mini-grid projects to achieve the Sustainable Development Goals (SDGs) throughout the PICTs.

Outcome 1 (Market intelligence): Enhanced awareness of the mini-grid market and strengthened mini-grid market knowledge through market intelligence development

Outcome 2 (Capacity building, and Public and Private Partnerships): Empowered local institutions and private sector through targeted capacity building and reinforced public private partnerships

Outcome 3 (Technical advancement): Improved access to more reliable, cleaner and more affordable electricity services through the optimal design of mini-grid systems, and more effective practices of system operation

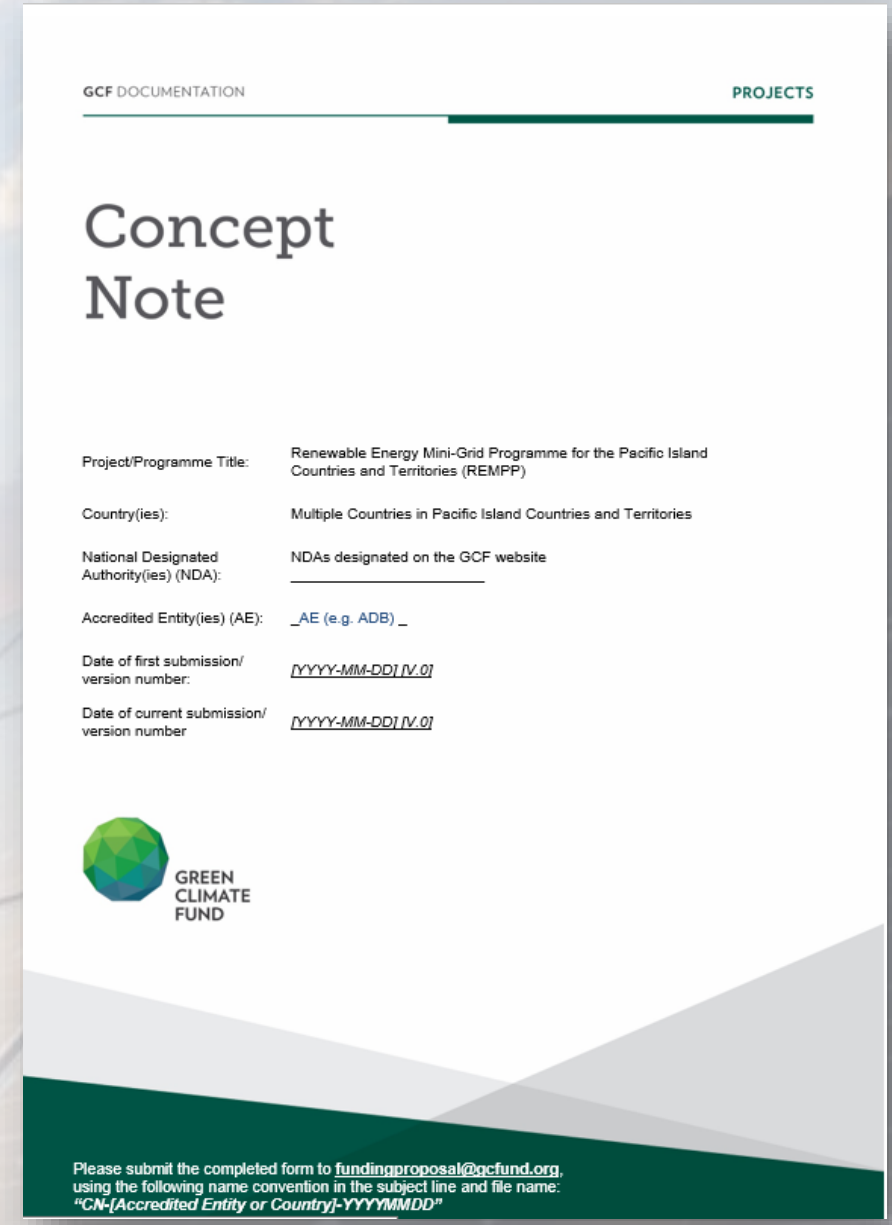
ENERGY ISLAND
Green Energy Business Strategy & Business Development

Concept Note
&
Question and Answer Session

Session 3

Thursday, November 22, 2018

Presenter: Jinkyung Oh



GCF DOCUMENTATION PROJECTS

Concept Note

Project/Programme Title:	Renewable Energy Mini-Grid Programme for the Pacific Island Countries and Territories (REMPP)
Country(ies):	Multiple Countries in Pacific Island Countries and Territories
National Designated Authority(ies) (NDA):	NDAs designated on the GCF website
Accredited Entity(ies) (AE):	_AE (e.g. ADB) _
Date of first submission/ version number:	*[YYYY-MM-DD] [V.0]*
Date of current submission/ version number	*[YYYY-MM-DD] [V.0]*

GREEN CLIMATE FUND

Please submit the completed form to fundingproposal@gcfund.org, using the following name convention in the subject line and file name: *"CN-[Accredited Entity or Country]-YYYYMMDD"*

Presenter: JINKYUNG OH, Consultant, One Energy Island Co., Ltd.

(Education)

- MA, Graduate School of Environmental Studies, Seoul National University
  (Thesis Title: Successful Factors of Offshore Wind Energy Development in Denmark: An Analysis of Collaborative Governance)
- BA, Business Administration, Ajou University

(Professional Experience)

Consultant, One Energy Island Co., Ltd.

- Consult for Feasibility Study for Micro-grid in Santa Cruz and Baltra Islands, Galapagos
- Research on Multilateral Development Bank Financing Model
- Research on Market Assessment for Small Island Countries and Territories

Economic Assistant, U.S. Embassy Seoul

- Managed research on Korea-U.S. Trade Agreement, Economic Trends
- Supported development policy research for USAID and bilateral cooperation between Korea and U.S.

(Honors)

- Excellent Thesis Award, Korea Environmental Policy and Administration Society, 2017
- Excellence Award, Urban Renewal Project in Ansan City, Seoul National University, 2016
- U.S. Embassy Franklin Award, 2014 (Excellence in Research)

CONTENTS

Introduction

1

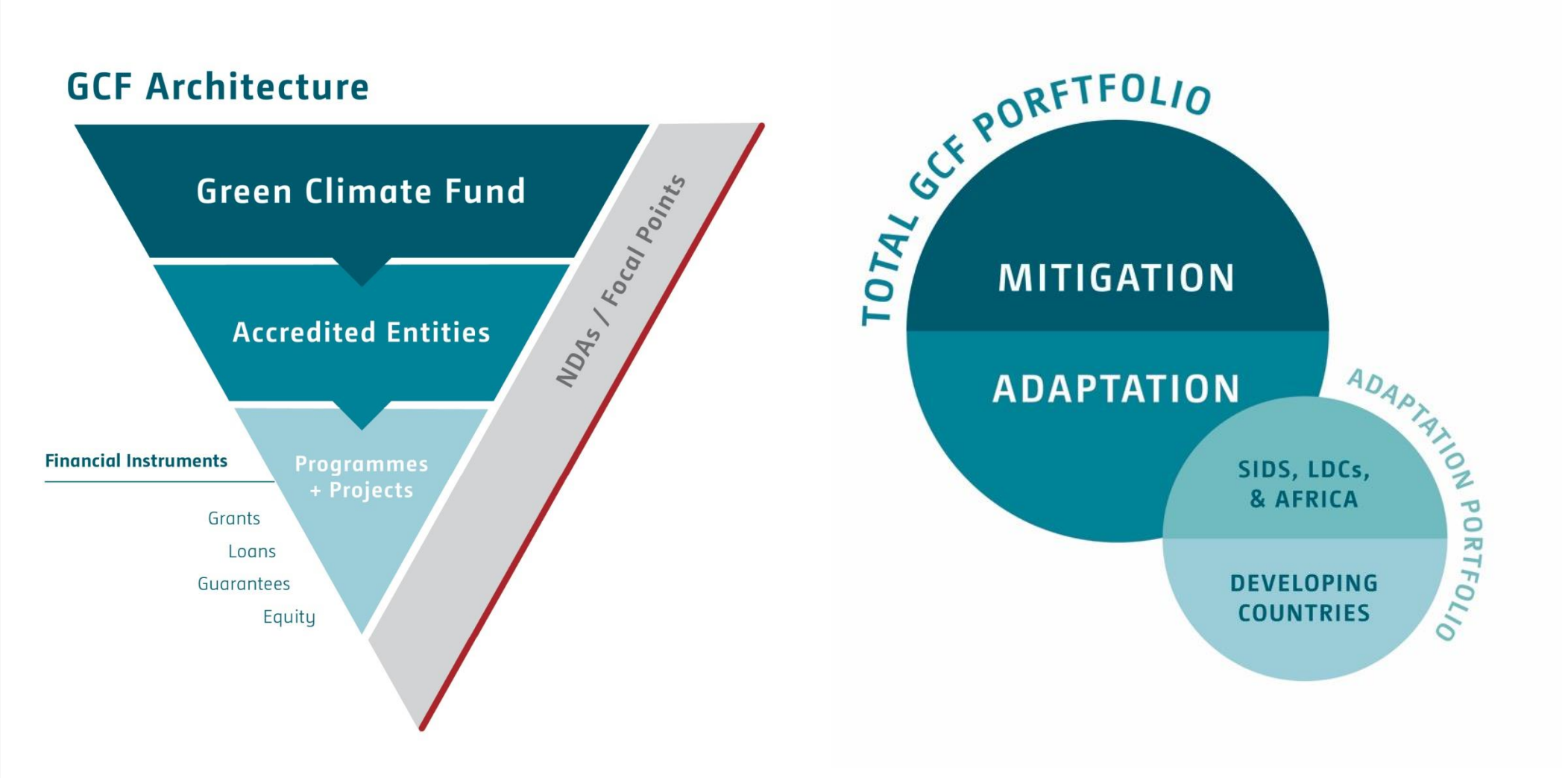
1. Introduction of GCF

NAME	**GREEN CLIMATE FUND**
TYPE	**Financial Mechanism of the Convention - UNFCCC**
ESTABLISHED	**11 December 2010 in Cancun, Mexico**
STAKEHOLDERS	**194 Countries** Signatories to the UNFCCC
GOVERNANCE	**Board + Secretariat + Independent Accountability Units** Equal Board members from developing and developed countries
MANDATE	**To promote low-emission and climate-resilient development in developing countries**
HEADQUARTERS	**Songdo, Republic of Korea**

Source: GCF

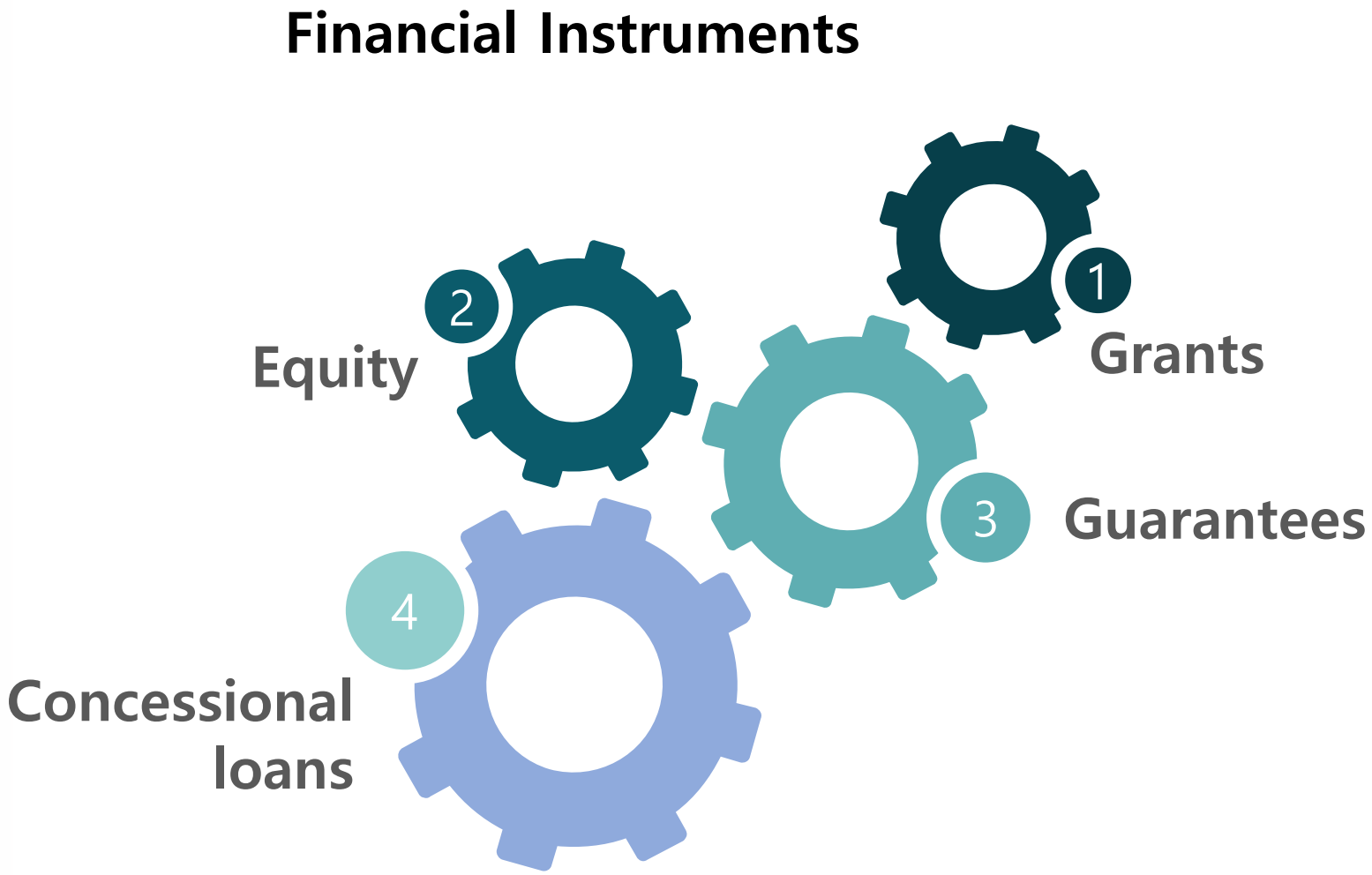
1. Introduction of GCF

GCF Architecture and Portfolio



Source: GCF

1. Introduction of GCF

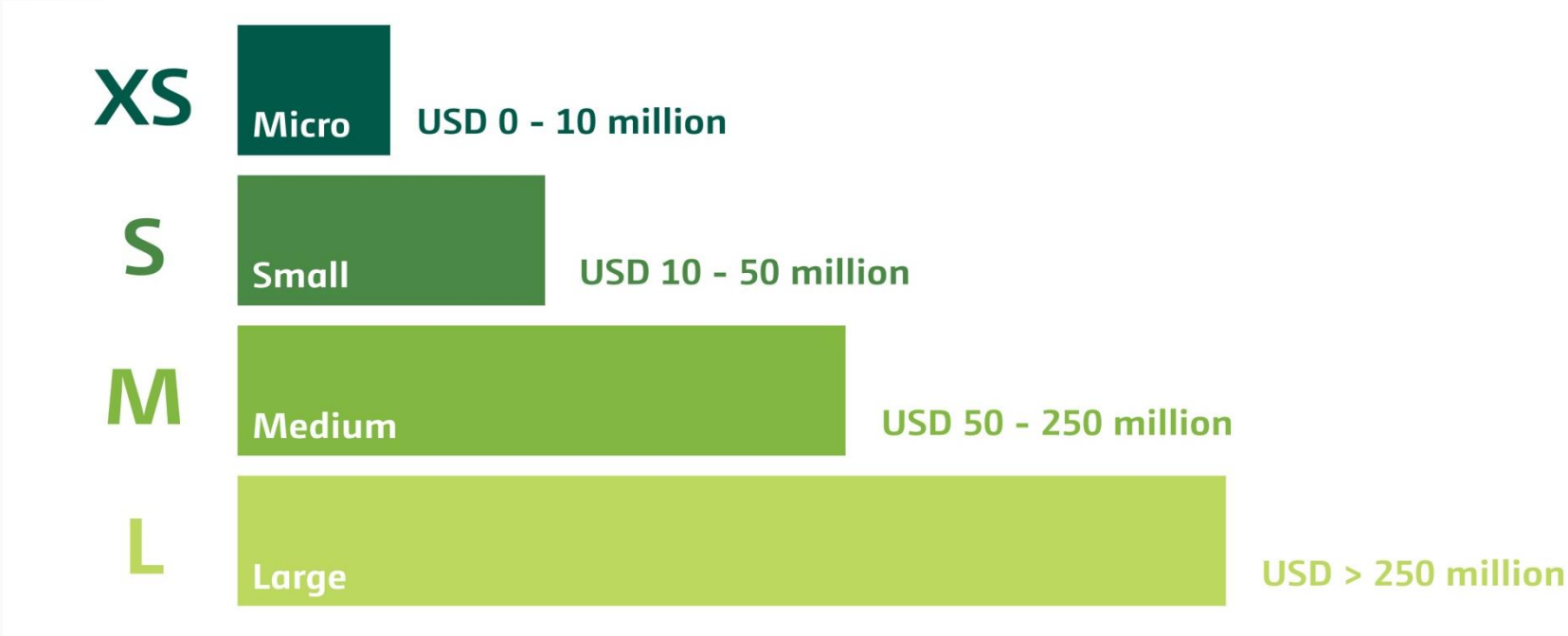


Source: GCF

1. Introduction of GCF

Size of project/activity within a programme

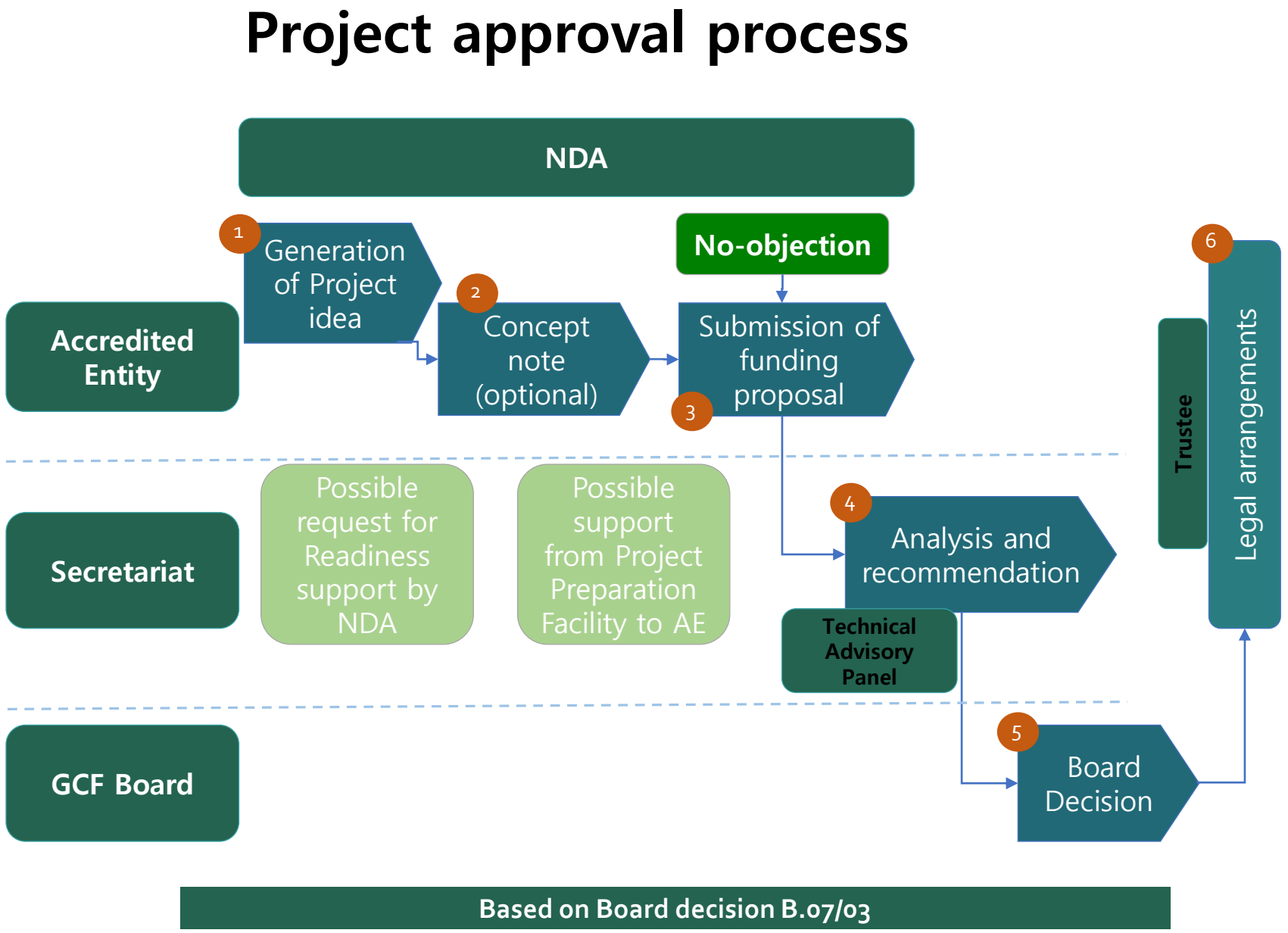
Total Projected Costs*



* At the time of application, irrespective of the portion that is funded by the Fund and, if applicable, other sources, for an individual project or activity within a programme.

Source: GCF

1. Introduction of GCF

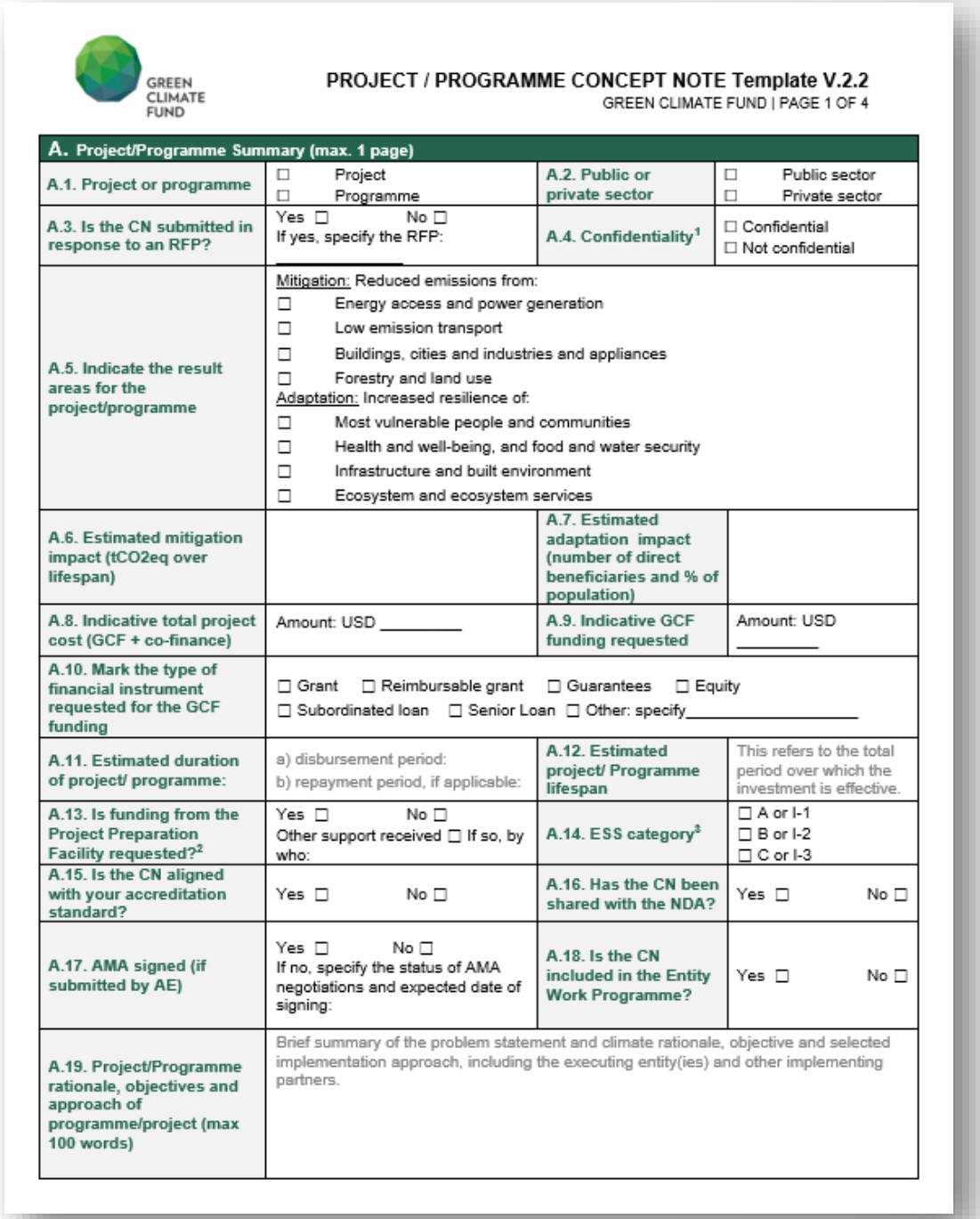


Source: GCF

2. GCF Concept Note

GCF Concept Note

A document which provides essential information about a proposal to seek feedback on whether the concept is aligned with the objectives, policies and investment criteria of the GCF.



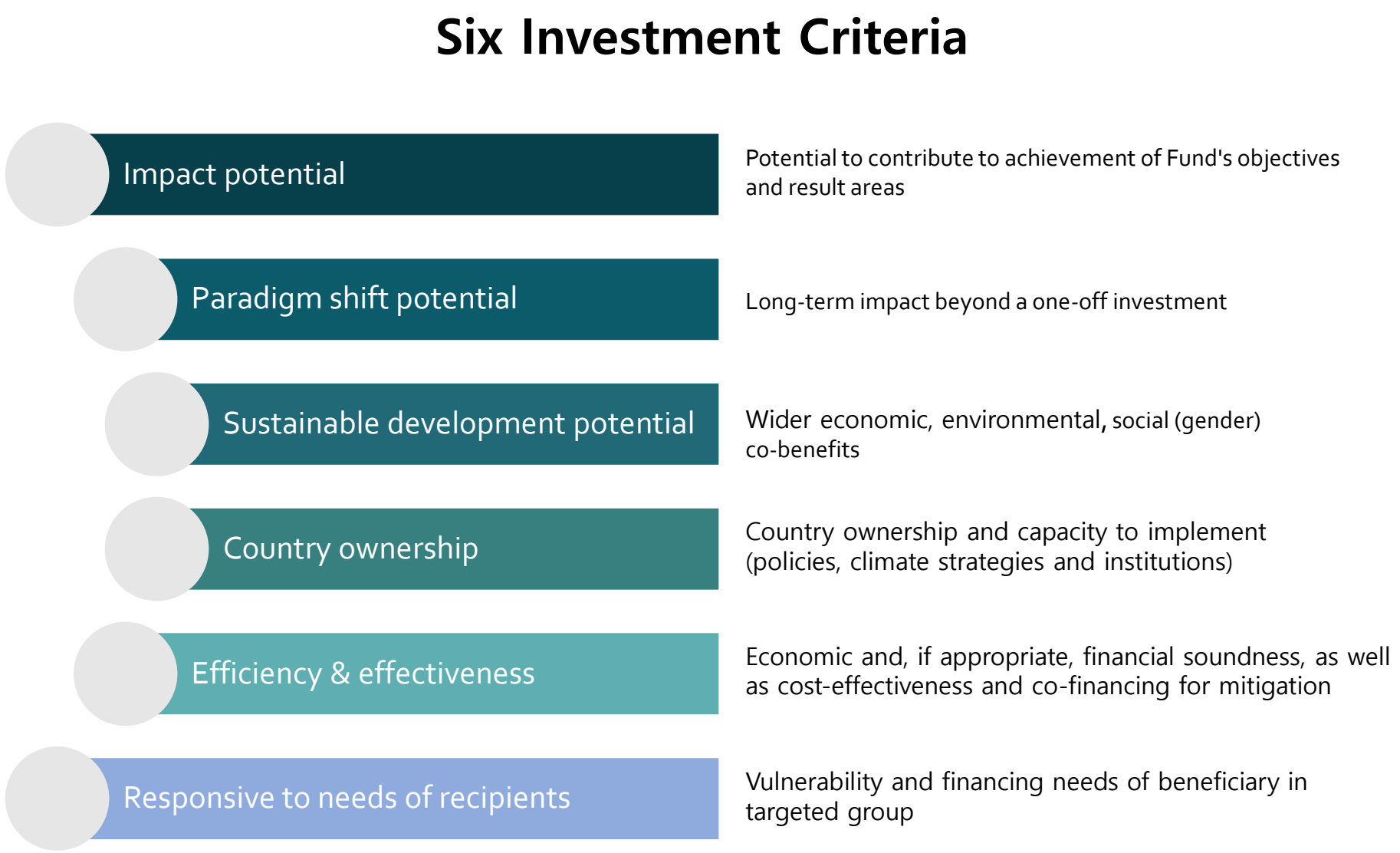
GREEN CLIMATE FUND

PROJECT / PROGRAMME CONCEPT NOTE Template V.2.2

GREEN CLIMATE FUND | PAGE 1 OF 4

A. Project/Programme Summary (max. 1 page)			
A.1. Project or programme	☐ Project ☐ Programme	**A.2. Public or private sector**	☐ Public sector ☐ Private sector
A.3. Is the CN submitted in response to an RFP?	Yes ☐ No ☐ If yes, specify the RFP: _____	**A.4. Confidentiality[1]**	☐ Confidential ☐ Not confidential
A.5. Indicate the result areas for the project/programme	Mitigation: Reduced emissions from: ☐ Energy access and power generation ☐ Low emission transport ☐ Buildings, cities and industries and appliances ☐ Forestry and land use Adaptation: Increased resilience of: ☐ Most vulnerable people and communities ☐ Health and well-being, and food and water security ☐ Infrastructure and built environment ☐ Ecosystem and ecosystem services		
A.6. Estimated mitigation impact (tCO2eq over lifespan)		**A.7. Estimated adaptation impact (number of direct beneficiaries and % of population)**	
A.8. Indicative total project cost (GCF + co-finance)	Amount: USD _____	**A.9. Indicative GCF funding requested**	Amount: USD _____
A.10. Mark the type of financial instrument requested for the GCF funding	☐ Grant ☐ Reimbursable grant ☐ Guarantees ☐ Equity ☐ Subordinated loan ☐ Senior Loan ☐ Other: specify_____		
A.11. Estimated duration of project/ programme:	a) disbursement period: b) repayment period, if applicable:	**A.12. Estimated project/ Programme lifespan**	This refers to the total period over which the investment is effective.
A.13. Is funding from the Project Preparation Facility requested?[2]	Yes ☐ No ☐ Other support received ☐ If so, by who:	**A.14. ESS category[3]**	☐ A or I-1 ☐ B or I-2 ☐ C or I-3
A.15. Is the CN aligned with your accreditation standard?	Yes ☐ No ☐	**A.16. Has the CN been shared with the NDA?**	Yes ☐ No ☐
A.17. AMA signed (if submitted by AE)	Yes ☐ No ☐ If no, specify the status of AMA negotiations and expected date of signing:	**A.18. Is the CN included in the Entity Work Programme?**	Yes ☐ No ☐
A.19. Project/Programme rationale, objectives and approach of programme/project (max 100 words)	Brief summary of the problem statement and climate rationale, objective and selected implementation approach, including the executing entity(ies) and other implementing partners.		

3. GCF Investment Criteria

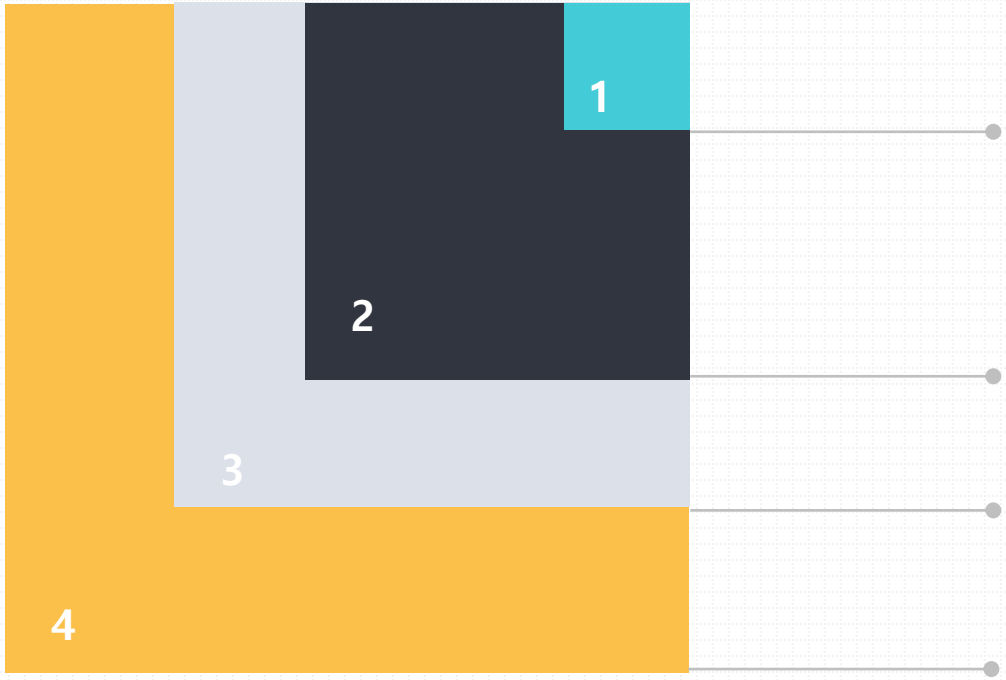


Source: GCF

Mini-grid Programme

2

1. Key Challenges Identified in PICTs



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

Existing Challenge 2: Limited financial allocation in energy sector

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

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

2. Mini-grid Programme

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

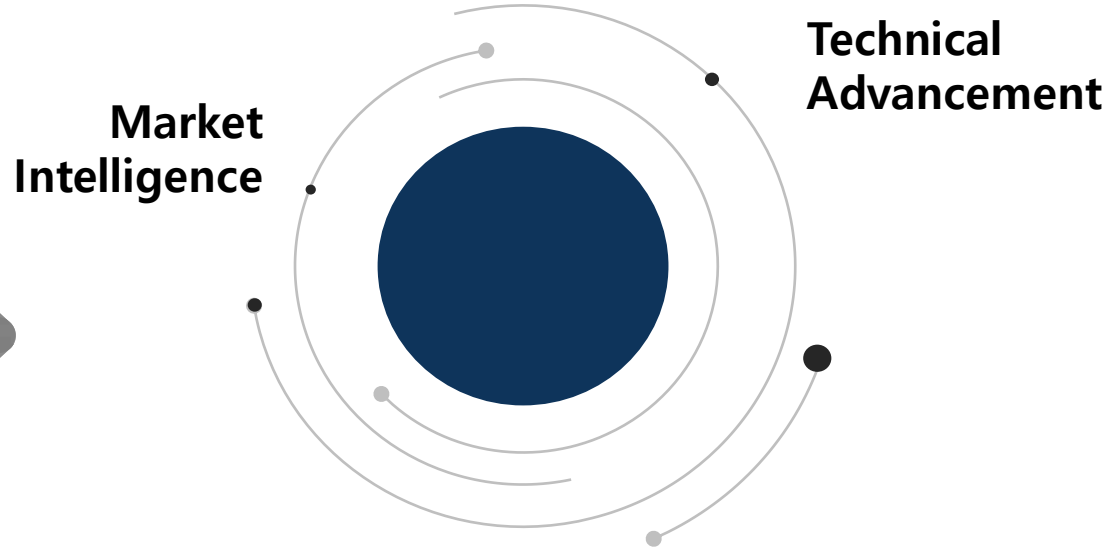
Component	Description
1. Market Intelligence	**Enhanced awareness of mini-grid market and strengthen market knowledge thr ough market intelligence development.**
	Activity 1: Web-based market knowledge platform Activity 2: Up-to date market information Activity 3: Data storage and GIS of mini-grid systems
2. Capacity Building and Public and Private Partnerships	**Empowered local institutions and private sector and increased project develop ments through capacity building and reinforced networks and partnerships bet ween stakeholders.**
	Activity 1: 5P business development model curriculum Activity 2: Capacity building program Activity 3: Promotion of mini-grid and public private partnerships Activity 4: Establishment of national sustainable energy industry associations
3. Technical Advancement	**Improved sustainability of mini-grid system and implemented standardized tec hnical equipment and design.**
	Activity 1: Guidelines for standardized mini-grid system Activity 2: Integrated Operations and maintenance (O&M) platform

2. Mini-grid Programme

Key Challenges Identified

- Limited Market Knowledge and Data
- Limited Financial Allocation
- High Risk and Limited Economic Scale
- Limited Capacity

Mini-grid Programme



Enabling Mini-grid Market

3. Risk Analysis

Type	RISK	Measures
Financial Risk	• Risk that the necessary fund for design and development may not be raised • Risk that expenditure for operation may exceed the budget • Risk that the fees for service to mini-grid systems may not be collected due to poor management of projects at sites	• Consult with international donor organizations on the programme to secure possibility of co-funding • Consult with international donor organizations, local mini-grid operators and stakeholders on key financial issues and variables and incorporate their inputs into the final plan of the project
Legal and Regulatory Risk	• Risk that each of PICTs may have different policies or regulatory practices which prevent coordinated and integrated regional information and O&M practices • Risk that may fail to acquire voluntary collaboration from governments to be involved in the practices	• Consult with key stakeholders including governments in PICTs from the early stage of project development and incorporate their inputs into the final plan of the project

3. Risk Analysis

Type	RISK	Measures
Environmental Risk (O&M)	• Risk that devastating environmental events may take place which fail or prevent scheduled services	• Consider contingency measures into the operational plan, for example, storing key parts and components at local sites in case of such emergency, and planning of emergency operation of mini-grid systems
Technical Risk	• Risk that lack of ICT connection may hinder access to the knowledge database • Risk that Integrated O&M standard may not apply to specific conditions or needs of each project site • Risk that in some remote islands, the existing wireless communication infrastructure may be underdeveloped and therefore not support necessary communication between TOC and local sites • Risk that a certain types of system troubles that exceed the coverage of TOC's regular or emergency repairs • Risk that no properly trained operators at project sites are available	• Supports from government are needed to have ICT connections to access the platform and monitor O&M issues • Conduct a thorough research about the condition of existing mini-grid projects and environment in collaboration with local partners including SPC (South Pacific Community) and PCREEE. • Prepare design and plan of the platform based on the research

4. GHGs Mitigation

Scenario 1 – 30% of RE Target

36,229 metric tons of CO2e

Scenario 2 – 60% of RE Target

1,076,067 metric tons of CO2e

Scenario 3 – 100% of RE Target

2,824,737 metric tons of CO2e

Country Name	RE target	RE 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 CO2 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 CO2 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 CO2 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)

5. GCF Investment Criteria

- **Impact potential** - *Mitigating climate change through enabling mini-grid development in the market.*
- **Paradigm shift potential** – *Suggested categorization of RE will bring a paradigm shift in clean energy transition of small island countries.*
- **Sustainable development potential** – *While it focuses on mitigation, a successful intervention will bring positive outcomes to meet existing needs and creating new services in need. Moreover energy access has the potential to alleviate poverty.*
- **Needs of recipient** – *The Pacific Small Island Developing States are countries most vulnerable to climate change due to sea level rise and unexpected weather events. The main beneficiaries of the project are the local population from the actual mini-grid development.*
- **Country ownership** –*The regional programme highly respects the opinions and comments from member countries to operate the program.*
- **Efficiency and effectiveness** – *As the programme is expected to support each country's RE development, it is expected to reduce 36,229 metric tons of CO2e (30% RE goal), 1,076,067 metric tons of CO2e (60% RE goal), and 2,824,737 metric tons of CO2e (100% RE goal) respectively.*

Programme Funding

3

001 Programme Funding

- Component1
- Component2
- Component3

002 Justification of GCF Funding Request

1. Programme Funding

Component	Budget (US$)
Market Intelligence	USD 2,195,000
Capacity Building and Public and Private Partnerships	USD 2,640,000
Technical Advancement	USD 3,605,000
Total	8,440,000

Component 1. Market Intelligence

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

Component 1. Market Intelligence

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

Component 2. Capacity Building and PPP

Activity / Task	2019	2020	2021	2022	2023
Activity 1: 5P business development model curriculum	275,000	25,000	25,000	25,000	25,000
a. Program design	150,000	0	0	0	0
b. Office and equipment for lecturing, discussion, and networking	100,000	0	0	0	0
c. Printing and textbook publication	25,000	25,000	25,000	25,000	25,000
Activity 2: Capacity building program	330,000	180,000	180,000	180,000	180,000
a. Training of key staff members and leadership	30,000	30,000	30,000	30,000	30,000
b. Training of local operating units	300,000	150,000	150,000	150,000	150,000
Activity 3: Promotion of mini-grid and public private partnerships	165,000	200,000	200,000	200,000	200,000
a. Support and training of government officers of member countries	50,000	50,000	50,000	50,000	50,000
b. Networking events and conference for private and public partnership	50,000	50,000	50,000	50,000	50,000
c. Monitoring and evaluation of public and private partnership practices	30,000	30,000	30,000	30,000	30,000
d. Staffing for networking and and program operation	35,000	70,000	70,000	70,000	70,000
Activity 4: Industry Association	50,000	50,000	50,000	50,000	50,000
a. Staffing	35,000	35,000	35,000	35,000	35,000
b. Operation cost	15,000	15,000	15,000	15,000	15,000
Total	820,000	455,000	455,000	455,000	455,000

Component 2. Capacity Building and PPP

Activity / Task	BUDGET	Budget comment
Activity 1: 5P business development model curriculum	375,000	
a. Program design	150,000	
b. Office and equipment for lecturing, discussion, and networking	100,000	To share existing PCREEE and SPC offices
c. Printing and textbook publication	125,000	
Activity 2: Capacity building program	1,050,000	
a. Training of key staff members and leadership	150,000	10 key staff members and program leaders
b. Training of local operating units	900,000	10 countries x 3 sub units
Activity 3: Promotion of mini-grid and public private partnerships	965,000	
a. Support and training of government officers of member countries	250,000	10 governments x 2 officers
b. Networking events and conference for private and public partnership	250,000	1 conference and 1 networking event each year
c. Monitoring and evaluation of public and private partnership practices	150,000	
d. Staffing for networking and and program operation	315,000	1 staff in year 2019, additional 1 staff in year 2020 and 2021
Activity 4: Industry Association	250,000	
a. Staffing	175,000	
b. Operation cost	75,000	
Total	2,640,000	

Component 3. Technical Advancement

Activity / Task	2019	2020	2021	2022	2023
Activity 1: Guidelines for standardized mini-grid system	200,000	150,000	150,000	50,000	50,000
a. Workshops for mini-grid technical standards	30,000	30,000	30,000	30,000	30,000
b. Task force team operation of public and private (locals and foreigners)	150,000	100,000	100,000	0	0
c. Guideline manual and publications	20,000	20,000	20,000	20,000	20,000
Activity 2: Integrated Operations and maintenance (O&M) platform	865,000	610,000	510,000	510,000	510,000
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
b. Upgrade of wireless communication network at TOC	250,000	0	0	0	0
c. Upgrade of wireless communication network between TOC and sites	N / A				
d. Staffing for design and test operation at TOC	70,000	100,000	100,000	100,000	100,000
e. Training of staffs in TOC	30,000	0	0	0	0
f. Training of local operators at sites	0	150,000	50,000	50,000	50,000
g. Inventory of key components and spare parts to be located at TOC	0	250,000	250,000	250,000	250,000
h. Regular site check-up and A/S	0	50,000	50,000	50,000	50,000
i. Emergency dispatch for A/S	0	30,000	30,000	30,000	30,000
j. Evaluation and knowledge sharing	15,000	30,000	30,000	30,000	30,000
Total	1,065,000	760,000	660,000	560,000	560,000

Component 3. Technical Advancement

Activity / Task	BUDGET	Budget comment
Activity 1: Guidelines for standardized mini-grid system	600,000	
a. Workshops for mini-grid technical standards	150,000	One event each year
b. Task force team operation of public and private (locals and foreigners)	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	100,000	
Activity 2: Integrated Operations and maintenance (O&M) platform	3,005,000	1 staffs in year 2019, additional 2 staff in year 2020 and 2021
a. Design of platform configuration and operational logics, on-line communication, operational manuals, and schedule of key parts and components	500,000	
b. Upgrade of wireless communication network at TOC	250,000	
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	470,000	2 staffs in year 2019, additional 1 staff in year 2020 and 2021
e. Training of staffs in TOC	30,000	Including overseas trip for training
f. Training of local operators at sites	300,000	
g. Inventory of key components and spare parts to be located at TOC	1,000,000	10 countries x 5 sites
h. Regular site check-up and A/S	200,000	solar modules, inverters and IGBT components, repair tools
i. Emergency dispatch for A/S	120,000	
j. Evaluation and knowledge sharing	135,000	2 times per year
Total	3,605,000	

2. Justification of GCF Funding Request

- GCF intervention is critical due to develop low carbon pathways
- GCF fund to overcome financial hardship
- GCF will serve mitigation benefits in PICTs
- Grant with repayment contingency is needed due to unstable economic conditions for Mini-grid development

Question and Answers


Thank you!