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Report No: PAD2533

INTERNATIONAL DEVELOPMENT ASSOCIATION

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED GRANT

IN THE AMOUNT OF SDR24.3 MILLION
(US$34 MILLION EQUIVALENT)

TO THE

REPUBLIC OF THE MARSHALL ISLANDS

FOR A

SUSTAINABLE ENERGY DEVELOPMENT PROJECT

November 22, 2017

Energy and Extractives Global Practice
East Asia and Pacific Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective Oct 31, 2017)

Currency Unit =	United States Dollar (US$)
SDR 0.71190 =	US$1
US$1.40469 =	SDR 1

FISCAL YEAR
January 1 - December 31

Regional Vice President:	Victoria Kwakwa
Country Director:	Michel Kerf
Senior Global Practice Director:	Riccardo Puliti
Practice Manager:	Jie Tang
Task Team Leader(s):	Leopold Sedogo

ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
ADFD	Abu Dhabi Fund for Development
BESS	Battery Energy Storage System
BP	Bank Procedure
CEO	Chief Executive Officer
CER	Contingent Emergency Response
CFA	Compact of Free Association
CNO	Coconut Oil
CPF	Country Partnership Framework
CQS	Selection Based on the Consultants' Qualifications
CTF	Compact Trust Fund
DA	Designated Account
DIDA	Division of International Development Assistance
EIRR	Economic Internal Rate of Return
EPD	Energy Planning Division
EPC	Engineering, Procurement and Construction
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
EU	European Union
FIRR	Financial Internal Rate of Return
FM	Financial Management
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GoRMI	Government of the Republic of the Marshall Islands
GRS	Grievance Redress Service
ICDF	International Corporation and Development Fund Taiwan, China.
IDA	International Development Association
IFC	International Finance Corporation
IFR	Interim Financial Report
IMF	International Monetary Fund
IPF	Investment Project Financing
IRENA	International Renewable Energy Agency
JICA	Japan International Cooperation Agency
KADA	Kwajalein Atoll Development Authority
KAJUR	Kwajalein Atoll Joint Utility Resource
kW	Kilowatt
kWh	Kilowatt Hour
MEC	Marshalls Energy Company
MFBPS	Ministry of Finance, Banking and Postal Services
MRD	Ministry of Resources and Development
MW	Megawatt
MWh	Megawatt Hour
MWp	Megawatt Peak
MWSC	Majuro Water and Sewer Company

NCBP	Non-concessional Borrowing Policy
NEP	National Energy Policy
NGO	Non-governmental Organization
NOx	Oxides of Nitrogen
NPV	Net Present Value
O&M	Operations and Maintenance
OP	Operational Policy
PACC	Pacific Adaptation to Climate Change
PDO	Project Development Objective
PIC	Pacific Island Country
PIM	Project Implementation Manual
PIU	Project Implementation Unit
PPA	Project Preparation Advance
PPSD	Project Procurement Strategy for Development
PREP	Pacific Resilience Program
PSC	Project Steering Committee
PV	Photovoltaic
QCBS	Quality- and Cost-Based Selection
RFB	Request for Bidding
RFP	Request for Proposal
RFQ	Request for Quotation
RMI	Republic of the Marshall Islands
ROE	Return on Equity
RPF	Resettlement Policy Framework
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SCD	Systematic County Diagnostic
SDR	Special Drawing Right
SHS	Solar Home System
SOx	Oxides of Sulphur
STEP	Systematic Tracking of Exchanges in Procurement
TTL	Task Team Leader
U.S.	United States
WB	World Bank
WBG	World Bank Group

BASIC INFORMATION

Is this a regionally tagged project?	Country(ies)	Financing Instrument
No		Investment Project Financing

[ ] Situations of Urgent Need of Assistance or Capacity Constraints

[ ] Financial Intermediaries

[ ] Series of Projects

Approval Date	Closing Date	Environmental Assessment Category
15-Dec-2017	30-Dec-2022	B - Partial Assessment
Bank/IFC Collaboration		
No		

Proposed Development Objective(s)

The objective of the project is to increase the share of renewable energy generation in the Recipient's territory, and enhance the reliability of electricity supply and improve energy efficiency in the Project Areas.

Components

Component Name	Cost (US$, millions)
Renewable Energy Investments	28.63
Promotion of Energy Efficiency and Loss Reduction Program	2.45
Technical Assistance, Capacity Building, and Project Management	2.92

Organizations

Borrower : Republic of the Marshall Islands

Implementing Agency : Marshalls Energy Company (MEC)

PROJECT FINANCING DATA (US$, Millions)

[ ] Counterpart Funding	[ ] IBRD	[ ] IDA Credit	[✔] IDA Grant	[ ] Trust Funds	[ ] Parallel Financing

Total Project Cost:	Total Financing:	Financing Gap:
34.00	34.00	0.00
	Of Which Bank Financing (IBRD/IDA): 34.00	

Financing (in US$, millions)

Financing Source	Amount
IDA-D2610	34.00
Total	**34.00**

Expected Disbursements (in US$, millions)

Fiscal Year	2018	2019	2020	2021	2022	2023
Annual	0.40	10.50	15.00	4.75	2.00	1.35
Cumulative	0.40	10.90	25.90	30.65	32.65	34.00

INSTITUTIONAL DATA

Practice Area (Lead)

Energy & Extractives

Contributing Practice Areas

Climate Change and Disaster Screening

This operation has been screened for short and long-term climate change and disaster risks

Gender Tag

Does the project plan to undertake any of the following?

a. Analysis to identify Project-relevant gaps between males and females, especially in light of country gaps identified through SCD and CPF

Yes

b. Specific action(s) to address the gender gaps identified in (a) and/or to improve women or men's empowerment

Yes

c. Include Indicators in results framework to monitor outcomes from actions identified in (b)

Yes

SYSTEMATIC OPERATIONS RISK-RATING TOOL (SORT)

Risk Category	Rating
1. Political and Governance	Moderate
2. Macroeconomic	Moderate
3. Sector Strategies and Policies	Substantial
4. Technical Design of Project or Program	Substantial
5. Institutional Capacity for Implementation and Sustainability	Substantial
6. Fiduciary	Substantial
7. Environment and Social	High
8. Stakeholders	Moderate
9. Other	Substantial
10. Overall	Substantial

COMPLIANCE

Policy

Does the project depart from the CPF in content or in other significant respects?

[ ] Yes [✔] No

Does the project require any waivers of Bank policies?

[ ] Yes [✔] No

Safeguard Policies Triggered by the Project	Yes	No
Environmental Assessment OP/BP 4.01	✔	
Natural Habitats OP/BP 4.04	✔	
Forests OP/BP 4.36		✔
Pest Management OP 4.09		✔
Physical Cultural Resources OP/BP 4.11	✔	
Indigenous Peoples OP/BP 4.10		✔
Involuntary Resettlement OP/BP 4.12	✔	
Safety of Dams OP/BP 4.37	✔	
Projects on International Waterways OP/BP 7.50		✔
Projects in Disputed Areas OP/BP 7.60		✔

Legal Covenants

Sections and Description

Project Steering Committee (Legal Agreements-Schedule 2, Section I.A.1)

The Recipient shall, by no later than three (3) months after the Effective Date (or such other date which the Association has confirmed in writing to the Recipient as acceptable to the Association, as determined in its sole discretion, under the circumstances), establish and thereafter maintain until the Closing Date, the Project Steering Committee with mandate, composition and resources satisfactory to the Association, which shall be responsible for providing oversight and strategic guidance for Project implementation. Without limitation to the generality of the foregoing, the Project Steering Committee shall be chaired by the Chief Secretary of the Public Service (or such other person which the Association has confirmed in writing to the Recipient as acceptable to the Association, as determined in its sole discretion, under the circumstances), and be composed of representatives from, inter alia, MFBPS, Energy Planning Division, MEC, KAJUR, Ministry of Works, Infrastructure and Utilities, Kwajalein Atoll Development Authority, Combined Utilities Board, and Majuro Water and Sewer Company (MWSC).

Sections and Description

Project Implementation Unit (Legal Agreements-Schedule 2, Section I.A.2)

The Recipient shall maintain, until the Closing Date, the Project Implementation Unit within MEC, with a mandate, composition and resources satisfactory to the Association, which shall be responsible for coordinating the implementationof the Project by MFBPS, MEC, EPD, MWSC and KAJUR, in a manner set forth in the Memorandum of Understanding, in a form and substance acceptable to the Association. Without limitation to the generality of the provisions of Section I.A.2 of this Schedule 2, the Project Implementation Unit shall: (a) include the following minimum key staff, each with terms of reference, qualifications and experience satisfactory to the Association: (i) a Project manager; and (ii) a technical advisor; and (b) include the following minimum key staff or be supported by specialists from the MFBPS, each with terms of reference, qualifications and experience satisfactory to the Association, in the following roles: (i) an accountant; (ii) a procurement specialist; and (iii) a safeguards specialist.

Sections and Description

Project Implementation Manual (Legal Agreements-Schedule 2, Section I.B.1)

The Recipient shall prepare and adopt, by no later than three (3) months after the Effective Date, a manual, in form and substance acceptable to the Association, setting forth the arrangements and procedures for implementation of theProject, including: (a) the institutional arrangements for day to day execution of the Project; (b) the implementation arrangements for Safeguard Documents; (c) budgeting, disbursement, and financial management arrangements; (d) procurement arrangements; (e) Project monitoring, reporting, and evaluation arrangements; (f) performance indicators; (g) criteria and procedures to be used for the selection of energy efficiency investment activities undertaken under Part 2(b) of the Project; (h) the boundaries of Project Areas and the criteria and procedure for selecting additional Project Areas; and (i) criteria and procedures to be used for the selection of Outer Islands for activities undertaken under Part 3(b) of the Project (“Project Implementation Manual”).

Sections and Description

Operation and Maintenance Fund (Legal Agreements-Schedule 2, Section I.E.1)

The Recipient shall, by no later than twelve (12) months after the Effective Date, establish and thereafter maintain until the Closing Date, a fund for the operation and maintenance of the renewable energy investments supplied and installed under Part 1 of the Project (“O&M Fund”).

Conditions

Type	Description
Effectiveness	The Memorandum of Understanding, referred to in Section I.A.2 of Schedule 2 to the Financing Agreement, has been duly executed and delivered on behalf of the parties thereto.

PROJECT TEAM

Bank Staff

Name	Role	Specialization	Unit
Leopold Sedogo	Team Leader(ADM Responsible)	Senior Energy Specialist	GEE09
Dominic Reyes Aumentado	Procurement Specialist(ADM Responsible)	Senior Procurement Specialist	GGO08
Zhentu Liu	Procurement Specialist	Senior Procurement Specialist	GGO08
Stephen Paul Hartung	Financial Management Specialist	Financial Management Specialist	GGO20
Allison Berg	Team Member	Senior Operation Officer	GSDDR
Anuja Utz	Team Member	Senior Operation Officer	GED02
Audrey Marie Crochemar	Team Member	Consultant	GEE09
Caroline Bruton Adams	Team Member	Consultant	EACNQ
Cristina Hernandez	Team Member	Program Assistant	GEE09
Duangrat Laohapakakul	Counsel	Senior Counsel	LEGES
Fabrice Karl Bertholet	Peer Reviewer	Senior Financial Analyst	GEE03
Helle Buchhave	Team Member	Senior Social Specialist	GSU02
Juana Veronica Guillermi Mendizabal Joffre	Team Member	Gender Specialist	GTI02
Kim Dagmar Baverstock	Team Member	Program Assistant	EACNF
Loren Jayne Atkins	Counsel	Associate Counsel	LEGES
Maria Alexandra Planas	Team Member	Consultant	GEE01
Maria Isabel A. S. Neto	Team Member	Senior Energy Specialist	GEE09
Natsuko Toba	Team Member	Consultant	IEGSD
Pedro Antmann	Peer Reviewer	Lead Energy Specialist	GEE08
Penelope Ruth Ferguson	Environmental Safeguards Specialist	Environment	GENDR
Peter Mockel	Peer Reviewer	Principal Industry Specialist	CBDSB
Qingyuan Wang	Team Member	Consultant	GEE09

Rabin Shrestha	Peer Reviewer	Senior Energy Specialist	GEE06
Renee Berthome	Team Member	Operation Analyst	GEE09
Ross James Butler	Social Safeguards Specialist	Senior Social Development Specialist	GSU02
Sandra Walston	Team Member	Team Assistant	GEE09
Silvia Martinez Romero	Peer Reviewer	Senior Energy Specialist	GEE04
Takayuki Doi	Team Member	Senior Power Engineer	GEE09

Extended Team

Name	Title	Organization	Location

MARSHALL ISLANDS
SUSTAINABLE ENERGY DEVELOPMENT PROJECT

TABLE OF CONTENTS

I. STRATEGIC CONTEXT

A. Country Context

1. The Republic of the Marshall Islands (RMI) is one of the world's smallest, most isolated, and vulnerable nations. The country consists of 29 atolls and five isolated islands and has a total land mass of just 181 square kilometers (km^2) set in an area of over 1.9 million km^2 in the Pacific Ocean. The population of RMI is estimated at 53,066[1] in 2016 of which the two largest urban centers, Majuro (the capital atoll) and Ebeye (an islet on Kwajalein atoll with a land area of 40 hectares and home to local workers at the United States military base), have populations of 28,000 and 9,614, respectively.

2. RMI is a sovereign nation in a "Compact of Free Association" (CFA) agreement with the United States (U.S.). The first CFA was signed in 1983 and continued through 2003, while an amended CFA entered into force in 2004 and is in effect through 2023. The current CFA provides approximately US$70 million in grants per year. No CFA financing is assured beyond the life of the current arrangement, which presents a key challenge to the country´s fiscal sustainability. While a Compact Trust Fund (CTF) was established to replace CFA grants from 2024 onward, based on current projections CTF contributions are inadequate to ensure a smooth transition, and annual CTF income can be expected to fall short of what is needed to replace CFA grants.

3. RMI is a lower middle-income country with a 2016 Gross Domestic Product (GDP) of US$183 million, and a per capita GDP of $3,448.50.[2] GDP has grown at an average rate of around one percent per annum in real per capita terms since RMI established self-government in 1979.[3] However, foreign grants averaged 60 percent of GDP since access to sovereignty in 1986.[4] There is a subsistence economy in most outer islands.[5] The size and remoteness of RMI increases the costs of economic activity and make it unable to achieve economies of scale. With limited export and domestic production opportunities, public administration and social services constitute the largest share of the economy – approximately 45 percent of GDP. The fisheries sector comprises around 10 percent of GDP, while manufacturing makes up less than two percent. Copra and fisheries are the most significant exports, while the country is almost completely reliant on imports for food, fuel, and other basic needs. With substantial constraints to export-led growth, RMI is heavily dependent on aid and other fiscal transfers. Foreign aid funds a very large public sector that dominates the economy.

4. RMI is one of the most vulnerable countries to climate change and rising sea levels. A sea level rise of one meter could lead to a loss of 80 percent of the land in the capital city of Majuro. With average elevation of just two meters above sea level, inundations and large storms are already becoming an increasing threat to RMI, which is becoming more vulnerable to extreme weather events. The 2014 Intergovernmental Panel on Climate Change models suggest that the cost of sea level rise impacts as a percentage of GDP would be highest for the

[1] 2011 RMI census.
[2] Source: World Bank.
[3] In 1979, the Government of RMI was officially established and the country became self-governing.
[4] *The Republic of the Marshall Islands Renewables Readiness Assessment*, International Renewable Energy Agency (IRENA), 2015. In 1986, the CFA with the U.S. entered into force, granting RMI its sovereignty.
[5] *The Republic of the Marshall Islands Renewables Readiness Assessment*, IRENA, 2015.

Federated States of Micronesia, Palau, RMI, and Nauru in the Pacific. [6]

5. In the medium to long-term, RMI could face significant challenges arising from the scheduled decline in CFA grants, extreme weather-related events due to climate change, the impact of poorly performing state-owned enterprises, and limited private sector activity. In addition, RMI's reliance on expensive imported fuel will continue to impose severe fiscal challenges, with effects felt throughout the economy, if not properly addressed. In 2015 and 2016, Marshalls Energy Company (MEC), which is responsible for the country's fuel imports, sold 11.2 million and 9.4 million gallons of diesel fuel, respectively; in 2016, MEC and the Kwajalein Atoll Joint Utility Resource (KAJUR) consumed 3.9 million and 1.3 million gallons of diesel fuel for the power plants in Majuro and Ebeye, respectively.

B. Sectoral and Institutional Context

6. RMI's energy sector is led by the Ministry of Resources and Development (MRD), and energy policy is managed through MRD's Energy Planning Division (EPD). EPD has full responsibility over the national energy policy framework and its associated action plans; overseeing renewable energy and energy efficiency on both the power supply and demand sides; petroleum reform towards energy efficiency; and energy security. Electricity is provided mainly by the two public sector utilities: KAJUR and MEC. KAJUR only serves Ebeye in Kwajalein. MEC operates throughout the rest of the country. Staff and resources of EPD include just two full time staff and a part-time assistant.

7. MEC is a vertically integrated, state-owned utility established by charter in 1984 that oversees electric power generation and distribution in Majuro, Jaluit, and Wotje. It is responsible for urban and rural power supply, diesel fuel import, storage and bunkering, and rural photovoltaic (PV) programs. MEC is overseen by the Combined Utilities Board appointed by the Cabinet, and subject to Cabinet direction. The Board consists of three government and four private sector members. MEC's annual net generation is 51,147 megawatt hours (MWh) with a peak load of 8.2 MW and average load of 6.11 MW in 2016. Diesel generators account for 99 percent of electricity generation and only one percent of electricity is produced through renewable sources. MEC also imports and distributes petroleum products and is hierarchically under the Ministry of Works, Infrastructure and Utilities. MEC relies on 188 staff to supply 4,050 customers.

8. KAJUR is much smaller than MEC, responsible for providing power, water, sewer, and potable water for Ebeye atoll. KAJUR has an installed capacity of 4.8 MW, a peak demand of two MW, and about 1,300 metered customers. The annual net generation is 14,355 MWh, and diesel generators account for 100 percent of electricity generation, or about 4.2 million liters of fuel yearly. KAJUR was run by the Kwajalein Atoll Development Authority (KADA), but is now operated as a subsidiary of MEC, with the same Board of Directors and under the direction of the MEC Chief Executive Officer (CEO). MEC has the authority for the management of KAJUR based on the delegation resolution dated on September 5, 2007.

9. The Cabinet and Cabinet appointed Combined Utilities Board direct and authorize the operations and management of MEC, KAJUR, and EDP. The RMI Cabinet are responsible for regulating energy in RMI; there is no independent energy or utilities regulator.

[6] International Monetary Fund (IMF) staff report for the 2016 Article IV Consultation with the Republic of the Marshall Islands.

10. A 2008 fuel crisis pushed MEC towards insolvency with the company requiring continual cash transfers and advances from the national government, placing additional pressure on an already stressed fiscal system. In depth diagnoses of MEC's financial and operational performance revealed numerous long-standing problems, including a deteriorating financial situation, deficient asset management, and continuous operational losses. MEC adopted a series of reform measures and prepared a Comprehensive Recovery Plan aimed at achieving an improvement in its financial position. In response to the crisis, RMI also adopted in September 2009 a "National Energy Policy" (NEP), which it reviewed in 2015. The NEP was developed with the vision of "improved quality of life for the people of the Marshall Islands through clean, reliable, affordable, accessible, environmentally appropriate and sustainable energy services." It has the broad goals to: (i) strengthen financial, policy, and legislative frameworks for the energy sector; (ii) supply 100 percent of urban households with electricity by 2015; (iii) provide 95 percent of rural outer atoll households with off grid electricity by 2015; (iv) provide access to modern forms of cooking to 90 percent of all households by 2020; (v) make households and businesses 50 percent more energy efficient and government buildings 75 percent more energy efficient by 2020; (vi) achieve a 20 percent efficiency improvement in transport sector fuel use by 2020; (vii) reduce supply side energy losses from MEC by 20 percent by 2017; and (viii) provide 20 percent of power generation through indigenous renewable resources by 2020. The NEP also identified four priority outcomes: (i) improved enabling frameworks for reducing dependence on imported fossil fuel; (ii) all Marshallese have equitable access to modern energy services; (iii) smarter uses of energy in households, businesses, government, transport sector, and power utilities; and (iv) reliable, sustainable, and affordable energy supply.

11. *Consumption and Access.* RMI's imported fuel consumption breakdown is as follows: 68 percent for transportation, 30 percent for power generation, and the remainder for commercial enterprises and private homes. In 2014, estimated rates of access to electricity in RMI were 90 percent, or 81 percent in rural areas and 94 percent in urban areas. The rates of electrification in Majuro atoll and Ebeye are 93 percent and 97 percent, respectively.[7]

12. *Majuro Electricity System.* MEC operates two diesel power stations (adjacent to one another) on Majuro. The utility has four generators in operation, two decommissioned and one under repair. The total rated capacity on name plates is 19.4 megawatts (MW), but the available capacity is approximately 11.4 MW. The diesel power station is ageing and has been plagued with problems, including a major fire that permanently damaged two generators. Two waste-heat turbines installed at the Majuro power plant started to generate some 2,100 MWh of continuous renewable energy annually. Typical daytime loads are approximately six MW, with peaks up to eight or nine MW, resulting in limited reserve capacity. Loads have decreased over the last decade mainly due to tariff increases and the introduction of prepayment meters. Since the first prepayment meters were installed in 2010, there has been a steady decrease in electricity demand, averaging around 1.8 percent annually, consistent with the energy saving properties of prepayment meters. The first phase of the prepayment meter project concentrated on residential customers which, when completed in 2017, will be followed by a second phase that will concentrate on single-phase, commercial customers. The residential sector, which represents 86 percent of the customer base, accounts for 49 percent of the energy sold in 2016. The governmental and commercial sectors account for three and 11.6 percent in customer numbers, and 15 and 36 percent in electricity sales, respectively. Average monthly sold energy per customer is 537 kilowatt hours (kWh) for residential, 3,716 kWh for business, and 4,395 kWh for government in 2016.[8]

[7] Marshall Islands Project on the Formulation of a Self-Sufficient Energy Supply System Final Report, JICA, January 2015.
[8] Source: MEC data.

13. There are approximately 3,000 standalone solar home systems (SHS) and some small grid connected solar PVs in Majuro, including a 600 kW MASDAR system, located near the airport, a 209 kW Japan International Cooperation Agency (JICA) system on the hospital roof, a 111 kW system at the College of Marshall Islands (privately owned system), a 55 kW system at the University of South Pacific campus, and several small privately owned grid-connected PV systems (five to six kW each).[9] MEC's distribution network is aged (over 30 years old) and in need of significant reinvestment and modernization and was not designed to accommodate any distributed generation from intermittent renewable resources (i.e., solar). Preliminary findings of an analysis conducted by JICA reveal that the current system can accommodate no more than 890 kW of PV-grid connected energy without advanced control or storage and upgrades of its diesel generation system and distribution network. As the current amount on the grid is approximately one MW,[10] it is not recommended that any more grid-connected PV be installed without a proper countermeasure.

14. *Outer Islands*. MEC operates diesel mini-grids on the outer islands of Wotje and Jaluit, and also a small diesel mini-grid on Rongrong Island on the Majuro atoll. Wotje, with a population of 860, has two x 275 kW generators and a load of 70-110 kW that drops to 40 kW during school holidays. Jaluit has a population of 1,780 (890 served by mini-grid) and has two x 300 generators and a load of 80-100 kW that drops to 40 kW during school holidays. Rongrong, with a population of 60, has two x 60 kW diesel generators and a load of 10-15 kW. The mini-grids on the Jaluit and Wotje receive an annual subsidy of approximately US$800,000 as the tariffs do not cover true costs. The remaining islands are served by SHS supplied and maintained by MEC. When this program was first introduced, customers were charged a flat monthly fee of US$12 for servicing and replacement of parts. According to MEC, this fee adequately covered the cost to make service of the SHS sustainable. However, due to social considerations, there was a subsequent decision by the Government of RMI (GoRMI) to reduce the monthly fee to US$5, which does not cover the cost of replacement parts. This means that the program is likely to end once the batteries in the existing systems fail, without additional government action on monthly payments or further donor funds (which will not encourage the GoRMI to set appropriate fees).

15. *Ebeye Electricity System*. KAJUR has a generation capacity sufficient to meet the Ebeye population's demand. The power station houses four high-speed, diesel generators rated at 1,286 kW each (three online and one currently under repair). The total capacity is about five MW. The generators are manually operated and the total power demand fluctuates between 1.5 MW and 1.8 MW from midnight to about eight in the evening, after which it peaks at 1.9-2.1 MW for three to four hours. The last major upgrade of the generating plant was carried out in 2012. The engines are rundown and would need to be replaced as part of any new generation project implemented on the island. The last upgrade of the existing power distribution system was carried out in 2004/2005. During this upgrade, all high voltage overhead transmission lines within the village community on Ebeye Island were replaced with the underground cables and all pole mounted transformers replaced with the cubicle type units mounted on the concrete plinths on the ground. KAJUR receives annual operational subsidies, most recently over US$2.5 million in 2015 and US$1.8 million in 2014[11]as the tariffs do not cover costs and most of the water and sanitation services are free of charge. There is currently no solar PV or any other renewable energy on Ebeye, but JICA has planned a 600kW grid-connected PV system to be located on land behind the power station. A JICA grid study found that the maximum installed capacity for PV on Ebeye without additional

[9] MEC 2016 Power Report.
[10] MEC 2016 Power Report.
[11] KAJUR Financial Statement and Auditor's Report, Year ended September 2015 and 2014.

controls could only be about 270 kW. The new 600 kW JICA system near the Ebeye power station will likely include curtailment controls for the PV, which would require a new generator control system to facilitate this.

16. *Electricity Tariffs*. Financial recovery electricity tariffs are determined by MEC and approved by Cabinet and the President. Tariffs are adjusted based on imported diesel prices. On-grid tariffs are uniform across all grids supplied by MEC (Majuro, Jaluit, Wotje, Rongrong) and are relatively high, even for the Pacific region, at US$0.416 per kWh for government, US$0.406 for commercial, and US$0.346 for residential. There is also a lifeline tariff of US$0.326 for low-use customers with less than 500 kWh consumption per month. They constitute about 60 percent of total customers and the largest sales share at 38 percent in 2016. KAJUR has the same tariffs as MEC. According to a JICA study and MEC records, the tariff is high enough to achieve cost recovery on the commercial and government tariffs in Majuro, but not on residential tariffs, or in Ebeye or any of the outer islands. There are no direct subsidies to lower the electricity tariffs, but important governmental support to meet these shortfalls is provided, such as (i) no tax on MEC's imported fuel; and (ii) US$500,000-US$800,000 to MEC annually to supply fuel and power to Wotje and Jaluit atolls through the National Energy Support Fund, and about US$2-US$2.5 million for KAJUR. The subsidies are vulnerable to the volatile prices of diesel oil. GoRMI also provides all land owners (approximately 900) with 1,000kWh of electricity per month for providing their lands for various power equipment and distribution lines.

17. *Distribution Losses*. The only distribution loss study available was conducted in 2010 on MEC. Distribution losses are believed to be at least 26 percent; there is no segregation in technical losses and non-technical losses, but the latter is estimated to be higher than the former. One of the reasons behind those high losses pertains to the total capacity of the transformers as compared to the supplied load: the distribution network in Majuro has a total capacity of 43 MW of transformers that supply a peak load of only eight MW. There is no available figure for the level of losses in Ebeye, but they are generally believed to be higher than in Majuro even though the technical losses might be lesser because the network is relatively shorter in Ebeye.

18. *Potential for Renewable Energy.* Various studies have assessed the potential for renewable energy in RMI, concluding that solar PV is the most feasible and cost efficient technology as the country has about 2,480 hours of direct sunlight per year. In addition, there is a coconut oil (CNO) resource on the outer islands, and there is a mill on Majuro producing CNO (mostly for export but also for blending with diesel in one of the MEC generators). The Asian Development Bank (ADB) is funding a project to test the use of CNO in one of MEC's generators. Biomass energy in the country is produced from waste materials, coconut stalks, and copra (coconuts oil), and used for cooking and water heating in households.

19. In summary, the major issues faced in the power sector include: (i) high dependency on costly imported fuels; (ii) insufficient tariff revenue for MEC and KAJUR to meet operations and maintenance (O&M) costs (thus requiring government subsidies); (iii) high maintenance cost of generation and distribution systems in a marine environment; (iv) lack of capital to finance power infrastructure requirements; and (v) weaknesses in the sector regulatory framework. The country is trying to address these issues through implementation of the NEP and Action Plan. Various donors, including the European Union (EU), ADB, Taiwan, China, JICA, New Zealand, and IRENA/Abu Dhabi Fund for Development (ADFD), are preparing projects to support the sector based on a comprehensive approach developed by GoRMI to: (i) strengthen the financial, policy, and legislative frameworks for the sector; (ii) achieve 50 percent more energy efficient households and businesses and 75 percent more efficient government buildings by 2020; (iii) reduce supply side energy losses by MEC by 20 percent by 2020; and

(iv) provide 20 percent of power generation through indigenous renewable resources by 2020. These investments will complement the project objectives and also pave the way for its success.

C. Higher Level Objectives to which the Project Contributes

20. The project is consistent with (i) the recently approved World Bank Group's (WBG) Regional Partnership Framework (FY17-FY21)[12] that outlines the World Bank Group (WBG) strategic program for nine Pacific Island Countries (PICs), including RMI; (ii) the Small States[13] Roadmap, which underscores a number of key areas in which the WBG will support small states in seven priority action areas,[14] including multiple efforts to mobilize both concessional and private resources to serve small states clients' development finance needs, particularly addressing the vulnerabilities emerging from small populations, limited geography, and lack of diversified assets; and (iii) the Pacific Possible Report,[15] which explores transformative opportunities that exist for PICs over the next 25 years and identifies the biggest challenges that require urgent action. The proposed project forms an integral part of the Bank's overall energy sector engagement in the Pacific. Under Objective 4.2 of the Regional Partnership Framework: "*Increased access to basic services and improved connective infrastructure,*" the WBG will support increased access to renewable energy in RMI through the installation of solar PV systems and upgrades to electricity generation.

21. The project is also aligned with the WBG's twin goals of ending extreme poverty and promoting shared prosperity in a sustainable manner by facilitating RMI's efforts to provide cleaner and less expensive electricity, to reduce losses, and to improve the efficiency of electricity use. The proposed project will enable significant improvements in sector operational efficiency triggered by diesel fuel substitution and system loss reduction. This will have a positive impact by lowering generation costs, leading to an improved and more efficient cost structure, with resultant improved cash flows contributing to strengthened sector finances, thereby reducing the need for government subsidies to the sector. In addition, part of the resources made available through the reduction of government subsidies to the energy sector will become available to foster economic and social development through other national priorities, such as education and health.

22. Furthermore, beyond the grid connected solar PV installed capacity to be financed under this project, it is anticipated that the project will help strengthen the capacity of the country to mainstream and scale up efficient and cleaner generation technology, aspects needed to meet demand in the years ahead. This will support the sector to move toward a more sustainable operation. In addition, the project will finance strategic energy efficiency investments in the largest electricity-consuming sectors, which could significantly reduce the need for future investments on the generation side. Moreover, the increase in the share of renewable energy and a more efficient use of electricity will result in immediate fuel savings and reduced greenhouse gas (GHG) and other harmful gas emissions while enhancing the reliability of electricity supply, especially for the poor who are least able to protect themselves against outages.

[12] Report No. 120479.

[13] The Bank defines small states as countries that: (i) have a population of 1 .5 million or less; or (ii) are members of the Small States Forum hosted annual during the World Bank/IMF Annual Meetings. The 50 Small States Forum participating countries are quite diverse in land area, location, levels of income, and economy.

[14] At the 2015 Small States Forum in Lima, Peru, small states' representatives agreed on the following priorities: (i) inclusion of vulnerability as a criterion for concessional financing; (ii) predictability of affordable financing; (iii) debt sustainability; (iv) access to new and existing climate financing; (v) capacity building and technical assistance; (vi) diversification of small states' economies; and (vii) accessing financial markets.

[15] Report No. ACS22308, August 2017.

II. PROJECT DEVELOPMENT OBJECTIVES

A. PDO

23. The objective of the project is to increase the share of renewable energy generation in the Recipient's territory, and enhance the reliability of electricity supply and improve energy efficiency in the Project Areas.

B. Project Beneficiaries

24. Direct project beneficiaries include electricity consumers (residential, commercial, industrial, and government) in RMI who will benefit from an improved and more efficient and reliable electricity supply, and eventually from more affordable and sustainable tariffs. By reducing the dependence on imported fuel with volatile prices and supplies, the project will benefit the country as a whole by reducing subsidies to the sector, which can be used for other high priority sectors such as health, education, and other key infrastructure. Policy and decision makers, as well as planners and managers and technical staff of the utilities will also benefit from strengthened technical capacity. Finally, a cleaner energy mix will have global environmental benefits by contributing to the reduction of GHG emissions.

C. PDO-Level Results Indicators

25. Progress will be measured against the following PDO level results indicators:

- Share of renewable energy in the Recipient's territory (%).
- MEC and KAJUR System Average Interruption Duration Index (SAIDI, minutes).
- Distribution loss reduction in the project areas (%).

See Section VII for the full project results framework.

III. PROJECT DESCRIPTION

A. Project Components

26. The GoRMI formally requested the Bank´s support in advancing its NEP and energy sector objectives of (i) increasing the use of renewable energy to at least 20 percent by 2020 while reducing by 20 percent its GHG emissions; and (ii) reducing subsidies to the sector by lowering the operating costs (i.e., by reducing the share of expensive imported fuels in its generation mix and by increasing its energy sector utilities´ efficiency). In this context, the Bank commissioned a study to conduct a preliminary analysis of potential solutions that would increase the share of renewable energy in the country, thereby reducing the dependency on imported fuels. The study evaluated three solutions (all estimated monetary values are undiscounted, 2016 US$ prices):

- ***Solution 1 – Majuro – Centralized storage and control system***: This option would involve building (i) a centralized, open protocol Battery Energy Storage System (BESS) to be located at MEC power station and (ii) the installation of 3.4 MW to 6.8 MW[16] of solar PV to increase the share of renewable energy supply between 10-20 percent for Majuro. The associated solar PV panels could be installed at the existing Majuro Water Company´s (MWSC) water reservoir near the airport, on land leased by the GoRMI near the hospital, or on various recently built school rooftops. This solution would cost approximately US$19 million and save US$580,000 per year on fuel cost subsidies from avoided diesel oil consumption for power generation (based on 3.4 MW capacity).

- ***Solution 2 – Ebeye- Centralized storage and control system***: This option would involve (i) a centralized, open BESS to be located at KAJUR power station; and (ii) up to 3.4 MW of solar PV, located at different sites due to the limited land availability on Ebeye, to increase the share of renewable energy supply to approximately 30 percent for the atoll. This solution would cost approximately U$$19 million and would save approximately US$720,000 per year on fuel cost subsidies.

- ***Solution 3 – Outer islands - Mini-grids:*** This solution would support conversion of the existing diesel mini-grids on Wotje, Jaluit, and Rongrong atolls into solar hybrid mini-grid systems and establishment of one new solar-hybrid mini-grid in Santo (Kwajalein atoll). This solution would cost approximately US$10 million and would provide fuel cost savings to MEC of approximately US$700,000 per year.

27. For RMI to be able to reach its targets by 2020, and 100 percent renewable energy by 2050, approximately nine MW of solar PV needs to be installed. To this end, all three solutions should be implemented. With this aim, a phased approach to sustainable energy development in RMI is proposed. Through discussions with GoRMI and other stakeholders, solution 1 has been chosen as the priority in the first instance. The recommendation to commence with solution 1 on Majuro was made *inter alia* considering the level of investment intensity on the island of Ebeye in the coming years, the fact that Majuro offers more possibilities than Ebeye and the Outer Islands in terms of achieving the country's intended objectives and targets, particularly for 2020, and the lower unit costs of investment in Majuro.

28. The WBG strongly supports and is committed to the phased approach and looks forward to a long-term partnership in the sector with GoRMI. This commitment is reflected in the Regional Partnership Framework, which identifies the energy sector as a high priority for the WBG and the GoRMI. This proposed project is built around solution 1 on Majuro and will include the three components described below.

29. **Component 1: Renewable Energy Investments (IDA US$28.63 million).** This component will include the following two sub-components:

(i) ***Sub-component 1.1: Renewable Energy Development in Majuro (US$23.6 million).*** This sub-component will finance the design, supply, installation, and operational support for solar power generation, battery energy storage, and grid management equipment in Majuro. The activities to be supported include (i) conducting a detailed survey, preliminary design, cost analysis, preparation of bidding documents, and supervision of engineering, procurement, and construction (EPC) contractor; (ii) installation of an estimated three MW of

[16] The final capacity would depend on component financing, technology, and competitive bidding.

solar power-generation, inverters, battery storage, grid-connection, and other ancillary equipment needed to support the contribution of renewable energy in RMI's generation system and reduce diesel generation; and (iii) provision of assistance on operations and maintenance and capacity building activities to enhance knowledge transfer and sustainability of the technology supplied and installed. An initial assessment on potential sites (owned or leased by GoRMI) available to host the arrays of PV panels include MWSC´s water reservoir near the airport, some public schools and public buildings, the empty space adjacent to the Majuro hospital, and some basketball fields in the city. The water reservoir is the primary candidate for several reasons: it would serve both MWSC and MEC generation purposes in a situation of limited land availability; it would reduce evaporation currently experienced by MWSC; it concentrates half of the potential sites' total capacity; it avoids anticipated potential distribution constraints; and, due to its size and relative proximity with MEC's existing thermal generation facilities, a power distribution feeder can easily be erected to convey the generated RE from the reservoir site to the power plant. If the reservoir is used, this would involve installation of floating or fixed solar PV panels in the reservoir.[17] This component will also address the lining of the reservoir as needed during implementation. More information is provided in the Technical Assessment section below and in Annex 1. Site selection will be confirmed during the preparation of the bidding documents.

(ii) ***Sub-component 1.2: Supply and Installation of Gensets for Majuro and Ebeye (US$5.03 million).*** This sub-component will finance gensets (low/medium or high-speed depending on studies) for MEC's and KAJUR´s power plants in Majuro and Ebeye to help accommodate the planned grid solar capacity, and to improve fuel efficiency and system reliability.

30. **Component 2: Promotion of Energy Efficiency and Loss Reduction Program (US$2.45 million).** This component will provide technical and operational assistance and will complement Component 1 by reducing energy demand through improving the efficiency for both use and supply of electricity from MEC and KAJUR. It will include the following three sub-components:

(i) ***Sub-component 2.1: Loss Reduction Program in Ebeye (US$1.4 million).*** This sub-component will support design and implementation of a loss reduction program for KAJUR to address issues related to supply-side management. Current losses are estimated at approximately 30 percent in Ebeye. This is mostly caused by technical mismatches in facility configurations and operations. A loss reduction study will be prepared by external consultants to provide recommendations to achieve loss reduction. Recommendations from the study that are designed to increase the energy efficiency of essential energy infrastructure will also be supported under this sub-component, and may include activities such as downsizing transformers, upgrading distribution lines, and the installation of meters for monitoring usage.

(ii) ***Sub-component 2.2: Demand Side Energy Efficiency (US$1.05 million).*** This sub-component will support activities designed to enhance efficient use of energy. This could include such activities as enhanced insulation in buildings and replacement of inefficient lighting or appliances in said buildings. External consultants will provide recommendations to harness best available technologies. This sub-component will also support information awareness campaigns, workshops, training, and education on demand-side management and energy efficiency. It will also support development of policies and regulations for energy efficiency, as well as the development of standards and labeling for energy efficiency, including phasing out inefficient incandescent bulbs and more stringent standards for appliances. Activities aimed at raising

[17] There are existing PV arrays located on the left bank of the reservoir.

consumer awareness on energy efficiency and related capacity-building activities and training will also be supported under this sub-component.

31. **Component 3: Technical Assistance, Capacity Building and Project Management (IDA US$2.92 million).**

(i) ***Sub-component 3.1: Technical Assistance and Capacity Building (US$0.335 million).*** This sub-component will enhance the capacity of the Ministry of Finance, Banking and Postal Services (MFBPS), MEC, EPD, KAJUR, and MWSC to support efficient energy sector operation, including: (i) carrying out training and workshops on energy sector policies, regulatory framework, management, and planning; (ii) conducting studies and provision of technical assistance to enhance EPD's role in the sector; (iii) provision of technical assistance to establish an O&M fund to ensure sufficient funds for the operation and maintenance of the renewable energy investments supplied and installed under Component 1 of the project; and (iv) mainstreaming of gender dimensions into the project.[18]

(ii) ***Sub-component 3.2: Preparation of Renewable Energy Projects in Ebeye and the Outer Islands (US$0.6 million).*** This sub-component will support the preparation of studies to identify further assistance and investments needed on renewable energy in Ebeye and the Outer Islands (Wotje, Jaluit, Rongrong, and Santo), including the design of the potential renewable energy projects and preparation of related documents include design documents and the preparation of technical specifications.

(iii) ***Sub-component 3.3: Project Management (US$1.985 million).*** This sub-component will support MEC and MFBPS to manage and implement the project, including provision of support on project coordination, monitoring and evaluation, reporting, procurement, financial management, audit, safeguards management, and technical operation. The project's incremental operating costs will be financed as well as office equipment and project audits.

32. The project implementing agency is MEC, with support provided by KAJUR, EPD, MFBPS, DIDA, and MWSC in accordance with the provisions of a Memorandum of Understanding to be entered between the organizations that will define roles and responsibilities of each. MEC will be the focal point for the implementation Component 1, Sub-component 2.1, and Component 3 with support from KAJUR; MEC and KAJUR will support EPD which will be the focal point for the implementation of Sub-component 2.2.

Focal Point	Project Components	Support Entities
MEC	Sub-component 1.1	KAJUR, MFBPS/DIDA, EPD, MWSC
	Sub-component 1.2	KAJUR, MFBPS/DIDA, EPD

[18] This includes technical assistance to (a) conduct a gender assessment during implementation that explores the differentiated roles and responsibilities of men and women consumers, needs and knowledge gaps regarding energy efficiency, to inform the program of activities under Component 2 (energy efficiency consumer awareness campaign, and entry points for addressing gender in future interventions as part of the phased approach to increase the share of renewable energy in the country); and (b) assessment of community involvement/options for women's groups participation in basic maintenance. It will also support implementation of recommendations of the assessment, possibly including investments in skills development and organization; training for utility, contractors, and supervision on implementation of workforce codes of conduct; and as part of capacity development activities, implementation of specific recommendations provided under the on-going IDA-financed Regional Sustainable Energy Industry Development Project (P152653) to increase the participation of women in the energy sector workforce in both utilities, MEC and KAJUR.

	Sub-component 2.1	KAJUR, MFBPS/DIDA, EPD
	Component 3	KAJUR, MFBPS/DIDA, EPD
EPD	Sub-component 2.2	KAJUR, MFBPS/DIDA, MEC

33. The focal point role of MEC and EPD is to ensure that the Project Implementation Unit, consultants, and contractors receive the necessary support to successfully implement the project activities. This includes, but is not limited to, drafting/reviewing specifications, reviewing reports, participating in meetings, and generally ensuring all necessary support is made available.

B. Project Cost and Financing

34. The proposed lending instrument is investment project financing (IPF) funded by a grant from the International Development Association (IDA). The project cost and financing plan, including price, foreign exchange, and physical contingencies is presented in the table below.

Table 1: Project Financing by Component (US$ million)

Project Components	Project Cost	IDA Financing	Trust Funds	Counter-part Funding
Component 1: Renewable Energy Investments	28.63	28.63	..	..
Component 2: Promotion of Energy Efficiency and Loss Reduction Program	2.45	2.45	..	..
Component 3: Technical Assistance, Capacity Building, and Project Management	2.92	2.92	..	..
Total Costs	**34.00**	**34.00**	..	..
Total Financing Required	**34.00**	**34.00**	..	..

C. Lessons Learned and Reflected in the Project Design

35. The project design has benefited from the Bank's experience in designing and implementing renewable energy projects in other PICs, including Federated States of Micronesia, Kiribati, Solomon Islands, Tuvalu, and Vanuatu, as well as Papua New Guinea and other islands such as Comoros, Haiti, and Maldives. While RMI is generally aware of grid solar PV technology and for many years has operated solar PV technologies, PV systems with a relatively large battery storage have not yet been implemented and operated in the country. Lessons learned and incorporated in project design are summarized below.

- *Specific measures should be taken to address and mitigate slow implementation.* Slow implementation of energy sector projects in some PICs has been attributed to poor project design. The design of this project considers good practice, including: (i) a limited and modest set of initial objectives to create momentum; (ii) a deliberately lean program, with only three core project components closely tied to existing policy commitments; and (iii) close attention to implementation arrangements, including the project's readiness to implement these arrangements from day one. For these reasons, underlying technical assessments have

been conducted to inform project implementation to the extent possible and advance procurement has been undertaken with the support of a Project Preparation Advance (PPA). Terms of reference for the project manager, distribution engineer, and safeguard specialist were finalized at an early stage of preparation and each specialist has been evaluated and selected by MFBPS.

- *Targeted and flexible assistance*. The proposed project responds to GoRMI priorities regarding the critical need to improve the performance of power utilities and to diversify their energy mix in order to reduce reliance on expensive fossil fuel products. Project components have been designed to address sector needs in a targeted and flexible manner, including investments to address the most critical needs of the utilities, technical assistance for strengthening managerial and technical capacity, and targeted energy efficiency interventions to be identified with stakeholders.

- *Strengthening relationship with the client.* A well-designed and well-executed project that includes technical assistance offers the opportunity to conduct a continuous policy dialogue and strengthen the relationship between the GoRMI and development partners. The project can help build trust and pave the way for a sustained and larger collaboration by creating an enabling environment for further support to the country's energy sector. In that context, the project will not only finance the renewable energy investments in Majuro, but also finance specific activities in Ebeye (i.e., generator and energy efficiency and work with EPD on the formulation of national energy efficiency policies and measures.

- *Technical issues*. Based on the experience of other countries that are rapidly transitioning to very high penetration of renewables, the project design will ensure the maintenance of grid stability—voltage and frequency regulation—as generation from intermittent energy sources increasingly becomes the dominant portion of the power mix. Therefore, a sizeable portion of the project's investments is allocated to battery storage, inverters, and ancillary equipment needed to handle not only the impact of the proposed IDA-financed renewable energy investments, but also the impacts of upcoming solar PV investments by other donors. The project is designed as an integrated solution and the main component related to the solar PV+BESS is planned to be constructed through an EPC contract along with an international experienced firm, which will carry on supervision activities.

- *Sustainability*: Another lesson drawn from past infrastructure projects, particularly in the Pacific Region, is the critical role of maintenance in ensuring sustainability. Maintenance of PV installations will be facilitated by ensuring that all equipment and installations under the project conform to the set of standards that the New Zealand Ministry of Foreign Affairs and Trade has developed for the Pacific Region's PV systems and components, or other standards that promise at least substantial equivalence. In addition, an O&M fund will be set up within 12 months of effectiveness to ensure that O&M are available throughout the lifespan of the infrastructure.

- *Donor coordination*: The Pacific region is known to be a donor-crowded region with a high risk of duplicated activities or inefficiencies if coordination is not managed soundly, in particular during the early stage of project preparation. The Bank team has been continuously conducting consultations with other development partners involved in the energy sector, with a particular focus on planned renewable energy and energy efficiency investments. GoRMI also conducted a series of consultations with its partners in the sector before expressing requests for support. The risk of duplicating unnecessarily activities as well as the risk of technical and operational incompatibilities is therefore mitigated.

IV. IMPLEMENTATION

A. Institutional and Implementation Arrangements

36. MEC is responsible for overall project preparation and implementation, including procurement. A Project Implementation Unit (PIU) will be established within MEC and include a Project Manager, a Project Accountant, a Procurement Specialist, a Safeguards Specialist, and a Technical Advisor. The Safeguards Specialist, the Accountant, and the Procurement Specialist will be recruited by MFBPS/DIDA to support the implementation of various IDA-financed projects, including this one as well as the Pacific Resilience Program (PREP, P147839). The PIU will coordinate the implementation of the project between MFBPS, MEC, EPD, KAJUR, and MWSC in a manner that is to be set forth in a Memorandum of Understanding that outlines the roles of each organization. The Memorandum of Understanding will clarify, *inter alia*, the necessary intra-government cooperation and support necessary for the project.

37. The Project Manager will be responsible for overall project coordination and technical guidance and will support the procurement of the various packages and studies. Technical staff will be recruited as necessary to support the implementation of Component 3 at EPD. The Project Manager will report to the CEO of MEC and to the Project Steering Committee (PSC). MFBPS's DIDA, as the unit responsible for coordinating all international development assistance to RMI, will be responsible for the project´s fiduciary aspects. DIDA is currently responsible for fiduciary management of the PREP and other development partner-supported projects. DIDA will act as the focal point for the World Bank.

38. A PSC will be established and comprise representatives of the MFBPS/DIDA, EPD, MEC, KAJUR, KADA, MWSC, the Combined Utilities Board, the Ministry of Works, Infrastructure and Utilities, and others as needed. The PSC will provide oversight and strategic guidance for project implementation. The Chief Secretary of the Public Service will chair the PSC.

39. A Project Implementation Manual (PIM) is being prepared by DIDA and the PIU, and includes information such as: (i) the criteria and procedures to be used for the selection of energy efficiency investment activities undertaken under Sub-component 2.2; (ii) institutional arrangements for day-to-day execution of the project; (iii) the procurement plan and implementation arrangements; (iv) guidance on implementation of safeguard instruments; (v) budgeting, disbursement, and financial management processes; (vi) project monitoring, reporting, evaluation, and performance indicators including implementation of, and compliance with, Bank safeguard policies; (vii) the boundaries of defined Project Areas and the criteria and procedure for selecting additional Project Areas; and (viii) criteria and procedures to be used for the selection of Outer Islands for activities undertaken under Part 3.2 of the project.

B. Results Monitoring and Evaluation

40. MEC will conduct overall monitoring and coordination of project activities, with data and information provided by relevant agencies (KAJUR and EPD) in accordance with the indicators included in the Results

Framework (Section VII). No later than 45 days after each biannual period, MEC will submit biannual progress reports to the Bank, covering all project activities, including a procurement and financial summary report. Biannual reviews, the first one to take place six months after IDA grant effectiveness, will provide a detailed analysis of implementation progress toward achievement of the PDO, and will include an evaluation of financial management and a post review of procurement. Baselines when unavailable (e.g., losses in Ebeye) will be determined during the first year of implementation.

41. MEC will, not later than June 22, 2020 (or such other date as agreed with the Bank), carry out a mid-term review of the project, and prepare and furnish to the Bank a mid-term report documenting progress achieved in the implementation of the project during the period preceding the date of such report, taking into account the monitoring and evaluation activities performed and setting out the measures recommended to ensure the continued efficient implementation of the project and the achievement of its objectives during the period following such date. It will also review with the Bank said mid-term report, on or about one month after its submission, and thereafter take all measures required to ensure the continued efficient implementation of the project and the achievement of its objectives.

C. Sustainability

42. Sustainability of this project is supported by the GoRMI's strong commitment to the project objectives, the expected savings in fuel imports, the reduced electricity consumption due to the implementation of energy efficiency measures, and the technical assistance to be provided to MEC, KAJUR, and EPD. In line with the GoRMI's strategy, this project will consistently contribute to (i) securing the supply of electricity by using domestic potential; and (ii) limiting the exposure of RMI's economy to the volatility of oil prices and foreign exchange risks, therefore contributing to the sustainability of the sector and the country's economy.

43. *Commitment to the project objectives.* The GoRMI's commitment to the project´s objective is reflected by the adoption of the NEP in September 2009 and reviewed in 2015. Among others, the NEP's goals include to: (i) provide 20 percent of power generation through indigenous renewable resources by 2020 and 100 percent by 2050; and (ii) to make households and businesses 50 percent more energy efficient and government buildings 75 percent more energy efficient by 2020.

44. *Expected savings in fuel imports*. At projected fuel prices during the 2019–2038 period, annual average of avoided diesel oil would be an equivalent of a four percent reduction in diesel oil fuel usage in 2016 due to increased renewable energy penetration in Majuro and generation efficiency in Ebeye represents a cost saving of US$490,000 per year in present value of 2018 prices with a return on equity (ROE) of 3.3 percent, which provides a strong incentive for project implementation.

45. *Capacity building.* The project will build capacity within DIDA, MEC, KAJUR, and EPD. The increased capacity is expected to remain after the project ends. This project places significant emphasis on training so that staff is well equipped to deliver expected outcomes. Sustainability is also favored by the preparation and implementation of similar projects in Ebeye and the Outer islands on potential subsequent phases.

46. *EPC Contract.* MEC will enter an EPC contract with a seasoned contractor with sound experience in designing and developing solar power projects. This will mitigate the risks associated with construction. The Bank and the owner's engineer will further assist the project team in reviewing and clearing important technical

and contractual documents. The Bank team can rely on extensive technical experience within the Bank in this regard as a result of successful, recent, past projects.

47. *O&M.* The EPC contract will contain a provision for an O&M agreement, which means that experience in operating and maintaining such a project will be assessed during the recruitment of the contractor. MEC will handle O&M under the supervision of the contractor for delicate tasks. Some of the tasks to be performed include: (i) modules cleaning; (ii) inverters, batteries, transformers, and cables maintenance; (iii) managing operation and reporting; (iv) security and safety; (v) insurance and guarantee costs; and (vi) any other element to ensure the correct operation of the plant.

48. *O&M Fund.* Given the history of poorly maintained facilities in the region resulting in depleted infrastructure being decommissioned well before the lifespan of the equipment, with very high costs of replacement, and the innovative nature and specifics of PV solar plants with storage, there is a provision to create a dedicated account as early as one year following effectiveness to forestall any funding requirement for replacement (e.g., battery) and O&M. A consultant will be recruited to propose the rules, guidelines, and procedures regulating the funding and disbursement of this account.

49. *Disaster Risk Reduction.* Given that RMI is prone to natural disasters, including floods/storm surge and droughts, design of the power plant will include provisions for resilience as well as emergency response to assist MEC with post-disaster damage recovery. Risk-reduction/adaptation measures will be taken into account in project engineering, including robust design specifications able to cope with increased wind speeds, flood, high temperatures, corrosion, and ground shaking as applicable, and non-engineering options on O&M procedures.

D. Role of Partners

50. Many development partners are implementing or planning to engage with GoRMI in the short to medium-term to develop the energy sector and increase the share of renewable energy. Known interventions include JICA's planned 600 kW solar PV plant in Ebeye along with technical assistance (US$10-US$11 million); a Taiwan, China International Cooperation and Development Fund (ICDF) US$4 million financing for renewable energy products for home owners in Majuro and Ebeye; and an ongoing ADB project to refurbish the MEC fuel tank (US$4-US$6 million). Also under development is support from the New Zealand Government for solar PV in Majuro. The EU is providing US$8.5 million in budget support with triggers related to loss reduction and increased renewable generation. ADB is also initiating preparation of a Green Climate Fund project to upgrade the power system in Majuro. These partners' engagements will contribute to the achievements of NEP goals in the following ways:

- ***To strengthen financial, policy, and legislative frameworks for the energy sector.*** With the EU funding support, GoRMI is securing the necessary technical assistance to develop an energy sector management act to properly define the roles, responsibilities, and institutional arrangements of all energy sector actors. GoRMI is also working with New Zealand Government to develop an energy sector roadmap to serve as the high-level framework guiding the sector orientation towards renewable energy sources.

- ***To make households and business 50 percent more energy efficient and government buildings 75 percent more energy efficient by 2020.*** In 2016, GoRMI entered into a loan agreement with the Taiwan, China ICDF.

ICDF will provide a US$4 million loan to finance private sector actors who plan to make energy efficiency improvements and install solar PV systems connecting to the grid at household level.

- ***To reduce supply side energy losses from MEC by 20 percent by 2017.*** With ADB support, GoRMI is preparing a project to identify a near-term opportunity for a high-value investment in the MEC distribution network that will both provide for rapid reduction of physical and financial losses on the MEC system and inform investment decisions in further loss-reduction investments and siting of future RE assets. With JICA support, GoRMI is implementing a training program for utility engineers and staff to establish capacity in the areas of efficient control, maintenance, and operation of diesel engine generators in MEC and KAJUR.

- ***To provide 20 percent of power generation through indigenous renewable resources by 2020.*** With ADB support, MEC is developing a high-level master plan to review existing constraints to increasing renewable energy generation on the MEC power network and to identify and priority investments in support of the referenced renewable energy target.

51. In addition to the support described above, GoRMI applied for funds from IRENA for a Solar City proposal focusing on PV in outer islands and solar plus storage in Ebeye. The IRENA/ADFD application has been approved in the amount of US$11 million. GoRMI is currently assessing the terms and how these funds may be used. GoRMI was informed that IDA's policy on non-concessional borrowing (NCBP)[19] may apply to this loan. The Bank is ready to work with the GoRMI to ensure the procedures and processes in regards to the NCBP are followed, should GoRMI accept this loan.

52. Finally, as part of an ADB-funded Water Supply and Sanitation Project on Ebeye, power plant switchgear is being retrofitted, and under the IDA-funded PREP II Project a hazard and climate change vulnerability assessment will be conducted and investments in coastal protection works along much of the islet undertaken.[20] The Bank team is making sure that the proposed energy investments do not interfere with the implementation of these two infrastructure projects and surpass the capacity of the public infrastructure and community to cope with the workforce influx and the capacity of KAJUR and KADA.

53. DIDA has taken the lead is ensuring that regular donor coordination meetings are held and to keep the donor community abreast of new development in the sector. The Bank through the project will maintain its support to this strategy to guarantee that energy sector investments remain complementary.

V. KEY RISKS

A. Overall Risk Rating and Explanation of Key Risks

54. The overall risk rating is substantial due to the country´s lack of experience in implementing World Bank projects, MEC´s limited technical capacity in BESS, land availability issues, and the potential price premium due to the country's distance from major markets and the vulnerability of its economy to external shocks. More information on specific risks rated substantial or high are provided below.

[19] The NCBP was adopted by IDA's Executive Directors in July 2006 and applies to countries eligible for IDA grants and to IDA-only recipients of assistance under the Multilateral Debt Relief Initiative.
[20] See Report No: PAD2128 and Report No: PAD2400.

55. *Sector Strategies and Policies risks are considered substantial.* RMI is heavily dependent on imported petroleum fuels, making the country highly vulnerable to oil price volatility, including price shocks, resulting in increased subsidies, electricity prices and uncertainties involving planning. The development and utilization of renewable energy sources and improvements in energy efficiency will contribute to the mitigation of this risk.

56. *Technical design risks are considered substantial.* The project must be designed in close coordination with other projects of other development partners in the sector to avoid overlaps, ensure consistent or compatible technical designs, coordinate land requirements, and especially ensure manageable technical constraints on the grid due to the addition of intermittent renewable energy resources. Moreover, the installation of the solar PVs could involve the installation of floating or fixed panels in the MWSC water reservoir (see Technical Assessment section below), which will increase the risk related of cost overrun and could delay construction and operation of the PVs and reservoir. It is necessary to ensure proper coordination with water supply for Majuro. Capacity building on O&M for floating PV panels will be provided to MEC and MWSC. Moreover, the Environmental and Social Management Plan (ESMP) includes measures to mitigate any potential disruptions to water supply during installation and maintenance of the panels.

57. *Institutional capacity risk for implementation is substantial.* Given the limited capacity of the implementing entity and the lack of experience in implementing World Bank projects, the project is designed to be instrumental for broadening and strengthening implementation capacity by establishing a PIU that will finance a Project Manager and additional fiduciary and procurement capacity as needed. Safeguards support to the project will be provided by a safeguards specialist to be recruited under the PREP Project at DIDA. Additional technical capacity, especially for EPD, will also be financed by the project.

58. *Fiduciary risk is substantial*. MEC´s lack of procurement experience using Bank guidelines and standard bidding documents will be addressed through the assistance from consultants in all stages of the bidding process and support from the Bank team when necessary. Due to MEC's limited financial management (FM) resources and capacity, the FM risk will be mitigated in part by the employment of a part-time bookkeeper/accountant. Under the Bank's Directive: Investment Project Financing, with respect to projects financed by the Bank, the borrower and implementing agency are required to maintain adequate FM systems—including accounting, financial reporting, and auditing systems—to ensure that they can provide the Bank with accurate and timely information regarding the project resources and expenditures. Overall, the FM arrangements meet the FM requirement as stipulated in the Directive, subject to the successful implementation of agreed actions and mitigating measures.

59. *Environmental and social risk is high.* This is primarily due to the scarce land availability in the country. Risks associated with land ownership and rights are being mitigated by ensuring that the solar PV installations are on land leased by the GoRMI with facilities owned by the GoRMI (as is the case of the reservoir, the school rooftops, and the empty space by the hospital). Impacts from occupying scarce land is being mitigated by identifying and prioritizing multi-use locations. There will be no involuntary land acquisition, as this has proven extremely difficult in the past. Voluntary, negotiated leases for the use of private land is possible. During preparation, MEC has identified more than enough government-leased land to ensure that the total MW of solar generation on Majuro can be achieved in this project, and has held preliminary consultations. Therefore, the risk of not finding enough suitable sites is considered low. However, for the preparation of future solar investments on Ebeye, land availability will be a major issue. Despite the recent signing of a Master Lease

between KADA and the custom land owners for public infrastructure, concerns remain on the ability to find enough suitable land or rooftops for panel installation. Due to these constraints, options to be studied could include installing panels on the reef flats or on land on adjacent islets.

60. *Other - Operational risk is substantial*. The technical, operational, and maintenance capacity of MEC to operate and maintain the solar PVs and battery storage facilities financed under the project will be addressed by preparing a Monitoring and Maintenance Plan that will cover the proper O&M of generation, storage, and ancillary service equipment. Moreover, the project will support the establishment of an O&M fund to ensure adequate resources for O&M of the PV system and storage in the medium to long-term.

VI. APPRAISAL SUMMARY

A. Economic and Financial (if applicable) Analysis

61. The economic and financial analysis covers 64 percent of the total project cost. The capacity of the solar PV and diesel gensets needs to be consistent with the capacity targets of the result framework. The conservative target values are set compared to the base case unit equipment cost estimates, which are technically compatible to the level of detailed studies currently available that provide for a stable system. It is expected that the Owner's Engineer and the EPC contractor further assess this capacity. Thus, the economic analysis covers only part of the allocated cost of Component 1 in order to be consistent with the targeted capacity in the result framework. Sub-component 2.2 (Demand Side Energy Efficiency) is not covered as the activities are not yet defined in detail. Activities related to Sub-component 3.2 (Preparation of Renewable Energy Projects in Ebeye and the Outer Islands) are also not covered as the corresponding potential investments will not be financed under this project. Reflecting these omissions, the analysis reduced proportionally the project cost of the rest of the project's overarching activities (i.e., Sub-component 3.1, Technical Assistance and Capacity Building, and Sub-component 3.3, Project Management). Results are summarized in the following paragraphs and further details are presented in Annex 4.

Economic Analysis

62. The economic analysis shows that the project's activities and inputs would meet the PDO with a net present value (NPV) of US$27 million discounted by the economic opportunity cost of capital of 1.4 percent (US$ 2018 prices) pursuant to World Bank's guidance (2016), and an economic internal rate of return (EIRR) of 12 percent. The renewable energy generation from the IDA-financed solar power adds seven percent share of net renewable energy-based power generation in terms of the total net electricity generation in 2016. The new genset in KAJUR will be more efficient in diesel oil consumption. The project is expected to be environmentally sustainable. Globally, the proposed project is expected to avoid GHG emissions of about 82,000 tons CO_{2e} under Components 1 and 2. The PV covering water reservoir option will provide climate change mitigation and adaptation co-benefits of avoided global and local emissions and increased water availability. All values were converted to economic values, such as foreign exchange premium (shadow exchange rate), economic opportunity cost of labor (shadow wage rate), fuel inventory (working capital), etc. an estimated economic discount rate of 1.4 percent was used for the economic analysis as economic opportunity cost of capital.

Financial Analysis

63. The financial analysis used an ROE of 3.3 percent based on the cost of capital estimated from time certificates of deposit rate of the Bank of Marshall Island and an estimated inflation rate. The financial NPV is US$16 million. MEC and KAJUR could save about 11 percent and 6 percent of annual diesel oil costs they spent in 2016, respectively, as well as lube oils.

64. **Provision of Public-sector Financing.** Currently, the private sector is unlikely to take the risk of financing large-scale solar-battery systems in RMI. There is significant uncertainty of the operational costs of solar-battery and volatility of fuel prices and supply. This project will provide an opportunity to test such an operation and build requisite capacity in and define each role of the public and private sectors for such an operation. This "innovative" project is also likely to highlight the need for new, or updates to existing, power sector policy, laws, and regulations. If the project is successful, and recurrent costs including the required skill sets are found reasonable, private sector participation for scale-up could be a future option.

65. **World Bank Value Added.** The World Bank's value added is the scale of financing, the long-term partnership in the sector, and the building of the GoRMI's sector capacity. The technical assistance and capacity building aspects of the project are a key part of the Bank's value added and will help ensure sustainability of the project. This contrasts with simply providing a capital grant (or capital grant with all project procurement and management done by a grant provider or a third party). The World Bank Group, as a global organization, can draw on its global experience in the energy sector, including with renewable energy, that can be readily shared with RMI.

B. Technical

66. The proposed PV solar power plant will use a very well-known PV technology; crystalline silicon cell module is proposed. Although this would be the first utility-scale grid connected PV plant with battery system in RMI, the technology is in successful operation at utility-scale (>1 MWp) globally, including in some PICs. The proposed technical solution and technology have been prepared by the Bank project team supported by international experts in the field, with local contributions from MEC. Crystalline silicon modules are widely used for large scale solar farms in the world on a commercial basis and are expected to generate sufficient competition among suppliers across the world. The technology and technical solutions to be applied to the solar PV plant at the water reservoir will ultimately be determined during implementation at the time of EPC contract awarding. Nevertheless, the Bank has conducted thorough due diligence to ensure that this solution is viable and would not negatively impact MWSC's day-to-day operations and maintenance needs. At this stage, the technical assessment study identified three solutions, with the first likely to be recommended if the reservoir makes it to the list of final project sites:

- ***Rigid Steel Bracket***: the PV modules will be laid above the water pool and supported with rigid steel brackets composed of H-type steel as the main bearing components. Connection between the PV modules and H-type steel will be made with Z-type steel or C-type steel, and each PV module will be supported with two pieces of Z-steel or C-type steel underneath.

- **Space Frame Structure:** Space frame is a truss-like structure and can support PVs with few columns. Re-lining work can be eliminated unlike for the solution based on rigid steel bracket. Therefore, this solution would have less impact on operation of the reservoir during construction.

- ***Flexible Support***: flexible PV support eliminates the impact of PV cell module to daily operation of the impounding reservoir, which addresses the issue of long span and can also meet the requirement of wind load resistance. The flexible foundation solution is a patented technology owned by a company in Zhejiang Province, China and has been applied in domestic projects, such as sewage treatment plants (the first demonstration project with this solution was completed in Zhejiang Province in 2015). The flexible support solution can reduce steel consumption, but because of the use of steel wire ropes, corrosion is likely to occur in the hypersaline environment in the later stage.

67. In addition, the following steps have been taken to minimize technical risks: (i) a first general assessment on solutions to increase renewable energy share in RMI was conducted by an international firm; (ii) a second detailed assessment was conducted by another international firm to determine suitable sites for the PV plants in Majuro, including a proposed technical solution, particularly for the water reservoir option; (iii) an Owner's Engineer is being recruited to support MEC during the procurement process and supervision of the related works; (iv) detailed designs, civil works, equipment supply and installations, and commissioning of the solar farms will be carried out by an international EPC contractor to be competitively selected; (v) an O&M contract is planned between the contractor and MEC for a period up to two years; and (vi) an O&M fund is being designed in order to make sure that MEC will be able to provide for O&M expenses to ensure sustainability. Close consideration will also be paid to the project development model itself for the solar installation in Majuro to avoid early obsolescence and allow for sufficient and steady cash flow to support O&M.

C. Financial Management

68. An FM assessment of MEC, the implementing agency, and MFBPS/DIDA, which will be responsible for fiduciary aspects, was carried out in accordance with the "Principles Based Financial Management Practice Manual" effective March 1, 2010. Under the Bank's Directive: Investment Project Financing, the borrower and implementing agency are required to maintain financial management systems, including accounting, financial reporting, and auditing systems, adequate to ensure accurate and timely information regarding the project resources and expenditures. Overall, the assessment found that the FM arrangements satisfy the requirements as stipulated in Directive subject to implementation of agreed actions and mitigating measures. The main FM risk relating to the proposed project is the insufficient capacity within DIDA and MEC to meet the FM demands of the project. The recommended mitigating measure to be implemented is the employment of a Project Accountant to be located within DIDA and dedicated to carrying out the day-to-day FM functions of the proposed project along with the IDA-financed PREP. At present, there are no additional mitigating measures for MEC, which will rely on its Finance and Accounting Department to provide DIDA with necessary documentation and data.

D. Procurement

69. Procurement under this project will follow the World Bank Procurement Regulations for IPF Borrowers (July 2016, Procurement Regulations). Key risks relating to procurement include: (i) lack of experience of MEC with implementing procurement following the procedures in the Procurement Regulations; (ii) lack of experience of MEC with procurement of contracts for the nature and size under this project; (iii) limited staffing and capacity of MEC's procurement team; and (iv) delayed progress of procurement activities under the PPA for establishing the project implementation unit in MEC. Mitigation measures agreed are: (i) DIDA is speeding up

the selection of consultants under PPA - the Project Manager and the Safeguard Specialist have already been recruited while the Technical Advisor (distribution expert) and the Owner's Engineer are in process; (ii) procurement assistance is included in consulting services for preparing the procurement documents, including the Project Procurement Strategy for Development (PPSD) and procurement plan (finalized), and for implementing procurement processes; (iii) the Systematic Tracking of Exchanges in Procurement (STEP) system will be used for monitoring procurement process-an overview of the system has already been provided to the end-users while the implementing agency registration is on process; and (iv) the Bank team will provide necessary training and support at the early stage of project. The detailed procurement arrangements are in Annex 2.

E. Social (including Safeguards)

70. The project is classified as Category B for environmental and social safeguard purposes. The main social issue relates to land. All land in RMI is privately owned, under customary land ownership structures. Land is scarce and there are very few 'spare' lots where solar arrays could be installed without impacts on existing uses. There is a well-established legal process for the leasing of land. GoRMI leases land for public purposes. The rent payments vary depending on the use of the land, but typically range from US$3,000 to US$4,000 per acre per year. This may soon increase to US$6,000 per acre per year. The investment options for solar arrays on Majuro and the new genset in Ebeye are all proposed for land that is already under government lease. Negotiations are required with the relevant government agency or public corporation to allow for the use of the land, building, and/or water reservoir for solar arrays and energy infrastructure. Government-leased land will be prioritized for temporary work areas for the contractor; there are several options available on Majuro and Ebeye. OP/BP 4.12, Involuntary Resettlement, has been triggered and a Resettlement Policy Framework (RPF) has been prepared and disclosed on October 30, 2017, which provides the process for acquiring land via government leases; it also provides detailed guidance on the identification of people potentially affected by involuntary resettlement and the methods of assistance that will be used to resettle people and/or compensate for losses.

71. Site selection and land due diligence will be required as part of the work required to prepare the Ebeye solar project and Outer Islands energy investments during project implementation. If necessary, Resettlement Action Plans or RPFs will be prepared under this project for these future investments. However, the investments are not expected to be funded under this project.

F. Gender [21]

72. A desk review on gender aspects in RMI was conducted during project preparation. The review indicates that matrilineal land ownership has traditionally given women a position of influence, but population growth, urbanization and migration are eroding these customary rights. The proposed project will ensure that women's land rights are fully respected in the land leasing process under Components 1 and 3, if any. This will include the consideration of gender aspects in the preparatory studies for Ebeye and Outer Islands under Sub-component 3.2. Women in the country have in general limited job opportunities.[22] Both utilities, MEC and KAJUR, are

[21] Laqeretabua, A. 2014. Gender Profile, Marshall Islands.
[22] United Nations Women indicates that in 2012 about 66 percent of men were considered economically active, compared to 35 percent women. Female unemployment rates are much higher than male unemployment rates, with national averages of 37 percent and 28 percent, respectively (*http://asiapacific.unwomen.org/en/countries/fiji/co/republic-of-the-marshall-islands*).

working to increase the participation of women in the energy sector workforce.[23] Both are also part of an initiative in this regard under the IDA-financed Regional Sustainable Energy Industry Development Project. The proposed project provides an opportunity to ensure that specific recommendations from the Pacific Regional project will be implemented as part of capacity building activities under Sub-component 3.1.

73. Specific information regarding gender and energy in the country is limited. The project will conduct a full gender assessment during implementation that explores the differentiated roles and responsibilities of men and women consumers, needs and knowledge gaps regarding energy efficiency to inform the program of activities under Component 2, specifically the energy efficiency consumer awareness campaign, and to identify further entry points for addressing gender in future interventions as part of the phased approach to increase the share of renewable energy in the country. The project will also assess community involvement, potential options for existing women's groups participation in basic maintenance aspects as a way to resolve some of the risks and issues of remoteness, communication, and overall maintenance capacity by the utility, enhancing asset management. This may require investments in skills development and organization, and help support jobs creation.

74. Workforce Codes of Conduct for contractors covering Gender-Based Violence, communicable diseases and child protection, will be a contractual requirement, to reduce the risks (primarily to women and youth) of exploitation and abuse from foreign workers. This follows similar pilot projects in the World Bank funded Vanuatu, Tuvalu, and Samoa aviation projects. Consultations, citizen engagement, and public awareness campaigns will be gender-informed. The ESMP has a Stakeholder Engagement Plan that outlines the requirements for communication methods that engage both men and women. The Results Framework includes an intermediate level indicator that captures progress toward greater gender equality on energy efficiency awareness: "an energy efficiency campaign targeting female consumers is implemented (Yes/No)".

G. Environment (including Safeguards)

75. An ESMP has been prepared and disclosed in-country on October 30, 2017 and on the World Bank's website on November 2, 2017. The ESMP provides an assessment of potential impacts from the physical investments under Component 1 and the network efficiency, energy efficiency and energy policy activities. Because the sites are not yet confirmed, all solar investment options have been assessed in the ESMP, along with ancillary activities such as aggregate souring and waste management. The ESMP will guide the final design and site selection for the investments and, if new risks are identified, the Plan will be updated during project implementation and redisclosed prior to the start of installation. As discussed in Section E, an RPF has been prepared which will also influence final site selection (prioritizing existing government-lease land) and outlines the land lease arrangements for land acquisition and compensation entitlements for any involuntary resettlement impacts.

76. The project aims to avoid using high value and scarce land. Majuro solar options provide for multi-use sites to reduce the impacts of underutilizing land. The key environmental and social risks of the physical investments under Component 1 relate to minor disturbances during construction (noise, dust, occupational health and safety risks, a small imported labor force), demand for sand to make the concrete foundations and the disposal of waste from old equipment (light bulbs, waste oil and fuel, generation equipment). Sand will be

[23] KAJUR for example has a school outreach program to promote careers in the energy sector among male and female students.

imported, to avoid adverse impacts on the Majuro or Ebeye foreshore or nearshore seabed. All waste will be exported for safe disposal or recycling off shore. Based on experience with the construction of existing solar facilities, a small number of foreign technicians and laborers will form the workforce for civil works and equipment installation. A labor influx management plan is not required as the risks are low and the impacts will be managed under the ESMP. A Workers Codes of Conduct and workforce training will be a contractual requirement to reduce the risks of violence, harassment and transmission of communicable diseases with the local population. The ESMP highlights potential risks to drinking water from solar array placement in or on the water supply reservoir. The design, operational and maintenance requirements will be assessed during the detailed design phase to minimize contamination risks.

77. The project will also fund technical assistance for the preparation of an Environmental and Social Impact Assessment (ESIA) and/or an ESMP for the Outer Islands energy projects and solar generation on Ebeye. The investments are not expected to be funded under this project, however because the technical assistance activity is expected to lead to physical investments, the World Bank safeguards policies apply. Early screening of the projects has identified that there may be risks to the foreshore and seabed on Ebeye if reclamation or the use of reef flats are required for solar arrays. It may also cause land issues because the ownership and right to occupy the reef is not clear. Because this environment is already heavily degraded, the activity has been screened as Category B. Specialized mitigation may be required to mitigate impacts on natural habitats and maintain coastal protection.

78. Significant environmental risks should be avoided on the outer islands through good consultation, site selection, and selection of suitable technology. There may be social issues relating to the use of land and there are concerns that the frequency of shipping may be reduced if diesel shipments decline.

79. OP/BP 4.11, Physical Cultural Resources, has been triggered due to the possibility that issues may be identified during the ESIA/ESMP studies for renewable energy investments in the Outer Islands and Ebeye including graves and World War II relics. Should sites be discovered they will be avoided, or if that is not possible, the ESMP will include appropriate mitigation measures.

80. OP/BP 4.04, Natural Habitats, has been triggered due to the possibility that impacts may be identified during the ESIA/ESMP studies for renewable energy investments in the Outer Islands and Ebeye, particularly the reef flat option. Significant impacts can be avoided by screening out the option; otherwise the ESMP will include appropriate mitigation measures.

81. MEC and DIDA conducted stakeholder and community consultations during project preparation. Early consultations occurred in Majuro in March 2017, where the project concept was discussed with GoRMI and non-governmental organization (NGO) stakeholders. Details on the proposed project and the safeguards instruments were presented to GoRMI and NGO stakeholders on July 31, 2017. The question and answer sessions enabled stakeholders to raise issues such as waste management, land use and compensation rates, concerns with foreign labor, gender-based violence issues, maintenance and operational budgets, and the options for use of private buildings as well as public buildings. A stakeholder engagement plan and a grievance redress mechanism will be put in place under the project. They will be used to capture beneficiary feedback during project implementation.

H. Other Safeguard Policies (if applicable)

82. If the reservoir solar project is considered feasible by the engineering consultants, then OP/BP 4.37, Safety of Dams, will apply to the project. The policy has been triggered because the project may rely on the performance of an existing dam; the definition of dam includes 'low embankment tanks'. An assessment of the structural integrity of the embankments by a qualified engineer will be required, along with a review of the O&M, during the design process. The outcomes, including any necessary repairs or improvements to the reservoir, will be included in the final design. Any residual environmental or social risks (such as from leaks or catastrophic events) will be included in and updated version of the ESMP.

I. World Bank Grievance Redress

83. Communities and individuals who believe that they are adversely affected by a World Bank (WB) supported project may submit complaints to existing project-level grievance redress mechanisms or the WB's Grievance Redress Service (GRS). The GRS ensures that complaints received are promptly reviewed to address project-related concerns. Project affected communities and individuals may submit their complaint to the WB's independent Inspection Panel which determines whether harm occurred, or could occur, because of WB non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the World Bank's attention, and Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate Grievance Redress Service (GRS), please visit *http://www.worldbank.org/en/projects-operations/products-and-services/grievance-redress-service*. For information on how to submit complaints to the World Bank Inspection Panel, please visit www.inspectionpanel.org.

VII. RESULTS FRAMEWORK AND MONITORING

Results Framework
COUNTRY : Marshall Islands
Sustainable Energy Development Project

Project Development Objectives

The objective of the project is to increase the share of renewable energy generation in the Recipient's territory, and enhance the reliability of electricity supply and improve energy efficiency in the Project Areas.

Project Development Objective Indicators

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Name: Share of Renewable Energy in the Recipient's Territory		Percentage	2.00	9.00	Annual	MEC, KAJUR/	PIU, MEC, KAJUR
Description: Percentage of Renewable Energy Generated by MEC & KAJUR over a year							
Name: MEC & KAJUR Average Generation SAIDI		Minutes	3300.00	2400.00	Annual	MEC, KAJUR	PIU, MEC, KAJUR
Description: Weighted Average of the Generation SAIDI of MEC & KAJUR							

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Name: Distribution Loss Reduction in the Project Area		Percentage	0.00	2.00	Annual	MEC,KAJUR-Baseline to be determined at the end of 2018.	PIU, MEC, KAJUR
Description: Decrease in points of % of distribution losses in Ebeye							

Intermediate Results Indicators

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Name: Generation capacity of energy constructed or rehabilitated	✔	Megawatt	0.00	5.00	Annual	PIU, MEC, KAJUR	PIU, MEC, KAJUR
Thermal (conventional) power generation capacity constructed under the project	✔	Megawatt	0.00	2.00	Annual	PIU, MEC, KAJUR	PIU, MEC, KAJUR
Renewable energy generation capacity (other than hydropower) constructed under the project	✔	Megawatt	0.00	3.00	Annual	PIU, MEC	PIU, MEC

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Description:							
Name: Projected energy or fuel savings	✔	Mega Joules (MJ)	0.00	108000000.00	Annual	PIU, MEC, KAJUR	PIU, MEC, KAJUR
Projected lifetime fuel savings	✔	Mega Joules (MJ)	0.00	108000000.00	Annual	PIU, MEC, KAJUR	PIU, MEC, KAJUR
Description:							
Name: Study on loss reduction available for KAJUR and MEC		Yes/No	N	Y	Biannual	MEC, KAJUR and Project Reports	MEC, KAJUR, DIDA , EPD
Description: Study on loss reduction completed							
Name: Energy Efficiency campaign targeting female consumers		Number	0.00	5.00	Annual	PIU,MEC, KAJUR and Project Reports	MEC, KAJUR, DIDA , EPD
Description: Number of trainings on EE targeting female consumers							
Name: Annual report on grievances received under the grievance redress		Yes/No	N	Y	Annual	PIU, MEC and Project Report	PIU, MEC, DIDA, EPD

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
mechanism, including how feedback from the grievance redress mechanism has been taken into account under the project							
Description: A grievance Redress Mechanism is in place							

Target Values

Project Development Objective Indicators

Indicator Name	Baseline	YR1	YR2	YR3	YR4	YR5	End Target
Share of Renewable Energy in the Recipient's Territory	2.00	2.00	2.00	4.00	6.00	9.00	9.00
MEC & KAJUR Average Generation SAIDI	3300.00	3300.00	3200.00	3000.00	2700.00	2400.00	2400.00
Distribution Loss Reduction in the Project Area	0.00	0.00	0.50	1.00	1.50	2.00	2.00

Intermediate Results Indicators

Indicator Name	Baseline	YR1	YR2	YR3	YR4	YR5	End Target
Generation capacity of energy constructed or rehabilitated	0.00	0.00	2.00	4.00	5.00		5.00
Thermal (conventional) power generation capacity constructed under the project	0.00	0.00	1.00	2.00	2.00	2.00	2.00
Renewable energy generation capacity (other than hydropower) constructed under the project	0.00	0.00	1.00	2.00	3.00	3.00	3.00
Projected energy or fuel savings	0.00	0.00	15000000.00	46000000.00	77000000.00	108000000.00	108000000.00
Projected lifetime fuel savings	0.00	0.00	15000000.00	31000000.00	31000000.00	31000000.00	108000000.00

Indicator Name	Baseline	YR1	YR2	YR3	YR4	YR5	End Target
Study on loss reduction available for KAJUR and MEC	N	N	Y	Y	Y	Y	Y
Energy Efficiency campaign targeting female consumers	0.00	0.00	1.00	3.00	4.00	5.00	5.00
Annual report on grievances received under the grievance redress mechanism, including how feedback from the grievance redress mechanism has been taken into account under the project	N	Y	Y	Y	Y	Y	Y

ANNEX 1: DETAILED PROJECT DESCRIPTION

COUNTRY: The Marshall Islands
Sustainable Energy Development Project

Project Components

1. GoRMI formally requested World Bank support in advancing its energy sector objectives of increasing the use of renewable energy to at least 20 percent by 2020 while reducing by 20 percent its GHG emissions, and reducing subsidies to the sector by lowering the operating costs (i.e., by reducing the share of expensive imported fuels in its generation matrix and by increasing its energy sector utilities´ efficiency). In that context, the Bank commissioned a study to conduct a preliminary analysis of potential solutions that would increase the share of renewable energy in the country, thereby reducing the dependency on imported fuels.

2. The recommendations of the preliminary analysis were based on a technical mission to the country, a review of available studies in the energy sector, and a review of a proposal from a U.S. company - Solar City – submitted to the GoRMI for the development of a solar project on Ebeye and three outer islands. The study made by Solar City forms the basis of a US$11 million financial request (non-concessional funding at one percent interest rate) submitted by the GoRMI to the ADFD via IRENA and approved in March 2017. The Bank's preliminary analysis evaluated three solutions corresponding to the development of renewable energy in Majuro, Ebeye, and the outer islands as follows (all estimated monetary values are undiscounted, 2016 US$ prices):

- ***Solution 1 – Majuro – Centralized storage and control system***: This option would involve building (i) a centralized, open protocol BESS[24] to be located at MEC power station and (ii) the installation of 3.4 MW to 6.8 MW[25] of solar PV to increase the share of renewable energy supply between 10-20 percent for Majuro. The associated solar PV panels could be installed at the existing MWSC water reservoir near the airport, on land leased by GoRMI near the hospital or in various recently built school rooftops. This solution would cost approximately US$19 million and save US$580,000 per year on fuel cost subsidies from avoided diesel oil consumption for power generation (based on 3.4 MW capacity).

- ***Solution 2 – Ebeye- Centralized storage and control system***: This option would involve (i) a centralized, open BESS to be located at KAJUR power station ;and (ii) up to 3.4 MW of solar PV, located at different sites due to the limited land availability on Ebeye, to increase the share of renewable energy supply to approximately 30 percent for the atoll. This project would cost approximately U$$19 million and would save approximately US$720,000 per year on fuel cost subsidies.

- ***Solution 3 – Outer islands - Mini-grids:*** This solution would support conversion of the existing diesel mini-grids on three atolls, Wotje, Jaluit, and Rongrong, into solar hybrid mini-grid systems and the establishment

[24] The BESS should be of open-protocol so that it is open to expansion in the future and can communicate with devices from different manufacturers.
[25] The final capacity would depend on component financing, technology and competitive bidding.

of one new solar-hybrid mini-grid in Santo (Kwajalein atoll). The hybrid systems would use a well-proven Sunny Island type equipment, with which utility staff are already familiar and where at least 90 percent of the energy supply is through RE. The project would cost approximately US$10 million and would provide fuel cost savings to MEC of approximately US$700,000 per year. The development of new PV mini-grids on other atolls could also be included at an additional cost.

3. In February 2017, RMI´s Cabinet decided that all three solutions should be implemented in order to reach RMI's national goal on renewable energy share and reduce subsidies for KAJUR and MEC. It should be highlighted that to undertake all three solutions concurrently would be very expensive, between US$50-60 million, therefore a phased approach would be adopted for their construction over a period of five to seven years. The Cabinet further recommended that the implementation commence with solutions 1 and 3 on Majuro and/or the Outer Islands after considering the level of investments intensity on the island of Ebeye in the coming years, which includes the Bank-supported PREP, the ongoing ADB Water Supply and Sanitation Project, and the JICA solar PV project. This recommendation is consistent with the Bank's long-term engagement goals and commitment to RMI's energy sector.

4. A comparative assessment on the most efficient order of implementation led to the selection of the Majuro solution as the first candidate. The Majuro solution was selected to be financed in a first phase based on: (i) implementation capacity: various investments are concurrently being implemented in Ebeye and KAJUR´s capacity is overstretched; (ii) increased share of RE: Majuro alone offers more possibilities than Ebeye and the Outer Islands in terms of achieving the country's intended objectives and targets, in particular for 2020; (iii) donor coordination: the JICA 600kW project in Ebeye is ready to be implemented and would be at risk if the Ebeye Solution was selected to commence first; (iv) technical compatibility: it is better that JICA finalizes its project before implementing the Ebeye Solution to avoid the risk of both projects proceeding in parallel and not achieving integration; (v) land availability and social issues are potentially less risky in Majuro, in particular, if the reservoir, school buildings or other known public buildings or space are selected; (vi) O&M: MEC supports KAJUR with ongoing O&M, and both will better benefit if this new type of installation is implemented by MEC first; (vii) O&M fund: MEC has experience with the management of this sort of financing arrangement, which will ease preparation and implementation challenges.

5. The proposed project, with an estimated cost of US$34 million, is therefore built around solution 1 on Majuro and will include the three components described below.

Component 1: Renewable Energy Investments (IDA US$28.63 million). This component will include the following sub-components:

6. ***Sub-Component 1.1: Renewable Energy Development in Majuro (US$23.6million).*** This sub-component will finance the program of activities to supply and install solar power generation activities, including (i) conducting detailed survey, preliminary design and cost analysis, preparation of bidding documents and supervision of engineering, procurement and construction contractor; (ii) installation of an estimated three MW of solar power-generation, inverters, battery storage, grid-connection and other ancillary equipment needed to support the contribution of RE in RMI's generation system and reduce diesel generation; and (iii) provision of assistance on operations and maintenance and capacity building activities to enhance knowledge transfer and sustainability of the technology supplied and installed. Depending on the solar PV installation costs, this sub-component could finance up to 4.3 MW of solar PV generation capacity. An initial assessment on potential sites

able to host the arrays of PV panels, that are owned/leased by GoRMI, identified MWSC´s water reservoir near the airport, some of the public schools and public buildings and the empty space adjacent to the Majuro hospital, not to mention the many basketball fields in the city. A more detailed feasibility assessment of the potential of each site was further conducted in order to confirm their suitability to erect the PV plant by solar PV and civil engineering experts: MWSC 's water reservoir remains the main and preferred site. The water reservoir is the primary candidate for several reasons: it would serve both MWSC and MEC generation purposes in a situation of limited land availability; it would reduce evaporation currently experienced by MWSC; it concentrates half of the potential sites' total capacity; it avoids anticipated potential distribution constraints; and, due to its size and relative proximity with MEC's existing thermal generation facilities, a power distribution feeder can easily be erected to convey the generated RE from the reservoir site to the power plant. If the reservoir is used, this would involve installation of floating or fixed solar PV panels in the reservoir.[26] This component will also address the lining of the reservoir as needed during implementation: the implementation of this component is timely and will benefit MWSC and reduce overall investment costs for GoRMI; indeed, MWSC is currently looking for funds to cover the reservoir and retrofit the lining.

7. As the BESS will be a new and relatively complex technology, the project will include assistance in O&M and capacity building for at least two years. This could be in the form of a remote support arrangement supplemented by periodic visits by the installer. An O&M arrangement will be set up between MEC and the contractor to ensure knowledge transfer and sustainability.

8. ***Sub-component 1.2. Supply and installation of Genset(s) for Majuro and Ebeye (US$5.03 million).*** This sub-component will finance genset(s) (low/medium or high-speed depending on studies) for MEC and KAJUR´s power plant in Majuro and Ebeye to help accommodate the planned grid solar capacity, and to improve fuel efficiency and system reliability. Currently Ebeye has three high-speed gensets in operation and a fourth one is under maintenance but all four are almost towards the end of their useful life. A consultant will be recruited under the PPA to define what type of generator (low to medium speed or high speed) better suits the KAJUR operation. The preparation of the technical specifications for the genset(s) will be initiated as soon as the technical recommendation is ready so the procurement can start immediately.

Component 2: Promotion of Energy Efficiency and Loss Reduction Program (IDA US$2.45 million). This component will provide technical and operational assistance and will complement Component 1 by reducing energy demand through improving the efficiency for both use and supply of electricity from MEC and KAJUR. It will include the following sub-components:

9. ***Sub-Component 2.1: Loss Reduction Program in Ebeye (US$1.4 million).*** This sub-component will support design and implementation of a loss reduction program for MEC and KAJUR to address issues related to supply-side management. Current losses are at approximately 26 percent of 51,147 MWh in Majuro and believed to be higher percentage in Ebeye. This is mostly caused by technical mismatches in facility configurations and operations. A loss reduction study will be prepared by external consultants to provide recommendations to achieve loss reduction in the two utilities. Recommendations from the study that are designed to increase the energy efficiency of essential energy infrastructure will also be supported under this sub-component, and may include activities such as downsizing transformers, upgrading distribution lines, and the installation of meters for monitoring usage.

[26] There are existing PV arrays located on the left bank of the reservoir.

10. ***Sub-Component 2.2: Demand Side Energy Efficiency (US$1.05 million).*** This sub-component will support activities designed to enhance efficient use of energy. The program could include supply and installation of selected energy efficiency investments, such as enhanced insulation in buildings, and replacement of inefficient lighting or appliances in said buildings. External consultants will provide recommendations to harness best available technology. This sub-component will also support information awareness campaigns, workshops, training, and education on demand side management and energy efficiency. It will also support development of policies and regulations for energy efficiency, as well as the development of standards and labeling for energy efficiency, including phasing out inefficient incandescent bulbs and more stringent standards for appliances. Activities aimed at raising consumer awareness on energy efficiency and related capacity-building activities and training will also be supported under this sub-component.

Component 3: Technical Assistance, Capacity Building, and Project Management (IDA US$2.92 million).

11. ***Sub-component 3.1. Technical Assistance and Capacity Building (US$0.335 million).*** A program of activities designed to enhance the capacity of MFBPS, MEC, KAJUR, MWSC, and EPD will be carried out. These activities will support MFBPS, MEC, KAJUR, MWSC, and EPD to operate efficiently in the energy sector. A training needs assessment will identify specific training and skills-enhancement activities. Accordingly, a training plan will be prepared and implemented. Contractors/equipment providers will deliver several essential training activities as part of their contractual requirements. This sub-component will also support a study to assert EPD's role in the sector, defines its needs as one of the key actors and further provide means for EPD to undertake a few studies essential to the energy sector development as well as potential support for staffing. This subcomponent will also support the establishment of an O&M mechanism and related operational procedures (US$0.03 million) aims at setting up of O&M fund (i.e., Sinking Fund/Escrow Account) to maintain the PV solar plant equipment and ensure sustainability. Provision of technical assistance, training and workshops to support mainstreaming of gender dimensions in the project will also be financed under this sub-component.

12. ***Sub-component 3.2. Design of Renewable Energy Projects in Ebeye and the Outer Islands (US$0.6 million).*** This sub-component will support the preparation of studies for the subsequent phases of the project, including the design and safeguard instruments (up to the preparation of bidding documents along with the safeguard instruments) for renewable energy projects for Ebeye and the Outer Islands (Wotje, Jaluit, Rongrong, and Santo).

13. ***Sub-component 3.3: Project Management. (US$1.985 million).*** This component will support and strengthen MEC´s and MFBPS's capacity for project management and implementation, coordination, monitoring and evaluation, and reporting. It will support the establishment of a PIU in MEC including the recruitment of a Project Manager, procurement, financial management, social and environmental safeguards capacity as needed. It could also include an energy specialist to support EPD on the technical supervision of relevant studies. The project's incremental operating costs will also be financed through this component as well as office equipment and project audits.

14. MEC is responsible for the implementation of Component 1, Sub-component 2.1, and Component 3. EPD will lead the implementation of Sub-component 2.2.

Solar PV Erection Sites and PV Structure at the Water Reservoir under Component 1

15. A detailed assessment of potential sites able to host the solar panel arrays identified nine locations with up to a total installed capacity of about 4.13 MW as shown in the table below.

Site	Estimated Capacity (kW)
Water Reservoir	2,236
Airport Parking	513.5
School Building Roof	123.5
Nitijela Building Roof	182
ICC Roof	266.5
ECC Roof	208
Hospital Playground	455
Basketball Field	97.5
Public Parking	45.5
Total	**4,127.5**

16. The water reservoir is a primary candidate site for the following reasons: (i) it would serve both MWSC and MEC generation purposes in a situation of limited land availability; (ii) it would reduce evaporation currently experienced by MWSC; (iii) it concentrates half of the potential sites total capacity; (iv) it avoids anticipated potential distribution constraints—thanks to its size and relative proximity with MEC's existing thermal generation facilities, a power distribution feeder can easily be erected to convey the generated energy from the reservoir site to the power plant.

17. However, co-operations and co-maintenance considerations between MEC and MWSC should not be neglected, in addition to the fact that the reservoir is the main potable water supplier of Majuro.

18. The technology and technical solutions to be applied to the solar PV plant at the reservoir will ultimately be determined during implementation at the time of EPC contract awarding. Nevertheless, the Bank has conducted a thorough due diligence at this stage to ensure that this solution is viable and would not negatively impact MWSC's day-to-day operations and maintenance needs. To this end, three solutions have been identified:

- ***Rigid Steel Bracket Solution***: the PV modules will be laid above the water pool and supported with rigid steel brackets composed of H-type steel as the main bearing components. Connection between the PV modules and H-type steel will be made with Z-type steel or C-type steel, and each PV module will be supported with 2 pieces of Z-steel or C-type steel underneath.

- ***Space Frame Structure Solution***: Space frame is a truss-like structure and can support PVs with few columns. Re-lining work can be eliminated unlike rigid steel bracket. Therefore, this solution would have less impact on operation of the reservoir during construction.

- ***Flexible Support Solution***: flexible PV support eliminates the impact of photovoltaic cell module to daily operation of the impounding reservoir, which solves the issue of long span and can also meet the requirement of wind load resistance. The flexible foundation solution is a patented technology owned by a

company in Zhejiang Province in China and currently has been applied in domestic projects, such as sewage treatment plants, etc. The first demonstration project with this solution was completed in Zhejiang Province in 2015.

19. ***Analysis of Merits and Demerits of the three Solutions.*** All solutions are suitable for the PV modules at the reservoir. The rigid steel bracket solution uses a lot of steel, needs two columns to be set on the pool bottom which will affect normal operation of the reservoir during construction, but it has simple and well-proven structural form, extensive engineering application, and high reliability. The space frame structure solution will have less impact on operation of the reservoir. However, cost-benefit performance should carefully be confirmed before the selection of the solution. The flexible support solution can reduce steel consumption, but because use of steel wire ropes, corrosion is likely to occur in the hypersaline environment in the later stage. Currently, there are only a few projects having employed the flexible support solution, only one company in China has the ability to independently undertake the design and construction of this solution, and there may also arise the issue regarding intellectual property right protection.

20. Therefore, at this stage, and pending further consideration during implementation, it is the rigid steel bracket solution or the space frame structure solution that would be recommended if the reservoir makes it to the final list of project sites.

21. Finally, the proposed technical solution will not negatively Impact the operation of the existing photovoltaic arrays located on the left bank of the reservoir.

ANNEX 2: IMPLEMENTATION ARRANGEMENTS

COUNTRY: The Marshall Islands
Sustainable Energy Development Project

Project Institutional and Implementation Arrangements

1. The planned implementation period for the Sustainable Energy Development Project is five years. The proposed closing date is December 30, 2022.

2. A PIM is being prepared and include information such as: (i) institutional arrangements for day-to-day execution of the project; (ii) the procurement plan and implementation arrangements; (iii) guidance on implementation of safeguards instruments; (iv) budgeting, disbursement, and FM processes; and (v) project monitoring, reporting, evaluation, and performance indicators, including implementation of, and compliance with, Bank safeguards policies; (vi) the criteria and procedures to be used for the selection of energy efficiency investment activities undertaken under Sub-component 2.2; (vii) the boundaries of defined Project Areas and the criteria and procedure for selecting additional Project Areas; and (viii) criteria and procedures to be used for the selection of Outer Islands for activities undertaken under Sub-component 3.2 of the project.

Steering Committee

3. A PSC will provide oversight and guidance for the project. The PSC will comprise representatives of the MFBPS/DIDA, EPD, MEC, KAJUR, KADA, MWSC, the Combined Utilities Board, the Ministry of Infrastructure and Works, and others as needed. The Chief Secretary of the Public Service will chair the PSC.

Implementation Agencies

4. The project implementing agency is MEC, with support provided by KAJUR, EPD, MFBPS, DIDA, and MWSC in accordance with the provisions of a Memorandum of Understanding to be entered between the organizations that will define roles and responsibilities of each. MEC will be the focal point for the implementation Component 1, Sub-component 2.1, and Component 3 with support from KAJUR; MEC and KAJUR will support EPD which will be the focal point for the implementation of Sub-components 2.2.

Focal Point	Project Components	Support Entities
MEC	Component 1.1	KAJUR, MFBPS/DIDA, EPD, MWSC
	Component 1.2	KAJUR, MFBPS/DIDA, EPD
	Subcomponent 2.1	KAJUR, MFBPS/DIDA, EPD
	Component 3	KAJUR, MFBPS/DIDA, EPD
EPD	Subcomponent 2.2	KAJUR, MFBPS/DIDA, MEC

5. MEC is responsible for overall project preparation and implementation, including procurement. A PIU will be established within MEC and include a Project Manager, a Project Accountant, a Procurement Specialist, a Safeguards Specialist, and a Technical Advisor. The Safeguards Specialist, the Accountant, and the Procurement Specialist will be recruited by MFBPS/DIDA to support the implementation of various IDA-financed projects, including this one and the PREP. The PIU will coordinate the implementation of the project between MFBPS, MEC, EPD, KAJUR, and MWSC in a manner that is to be set forth in a Memorandum of Understanding that outlines the roles of each organization. The Memorandum of Understanding will clarify, *inter alia*, the necessary intra-government cooperation and support necessary for the project.

6. MFBPS's DIDA, as the unit responsible for coordinating all international development assistance to the RMI, will oversee the project´s fiduciary aspects. DIDA is currently responsible for fiduciary management of the World Bank PREP and Pacific Islands Regional Ocean scape Project, and other development partner-supported projects. DIDA will act as the focal point for the World Bank.

Project Management

7. The Project Manager will be responsible for overall project coordination and technical guidance and will support the procurement of the various packages and studies, together with the Procurement Specialist. Technical staff will be recruited as necessary to support the implementation of Component 3 at EPD. The Project Manager will report to the CEO of MEC and to the PSC. The PIU will also be responsible for preparing and implementing the project in accordance with annual work plans and budgets, which will detail the project activities and eligible expenditures.

8. Technical staff and specialized firms will be recruited, as necessary, to support implementation. These recruitments include staffs for the PIU as well as EPD to support implementation of the related components. Specialized firms will also be recruited to provide studies, technical, and strategic recommendations to design and implement some of the activities.

Financial Management

9. DIDA within MFBPS maintains the financial accounts and provides FM support to donor-funded projects and hence will be responsible for the fiduciary aspects of this project. As this project will allocate sufficient funds to employ a Project Accountant as a mitigating measure, who will be located in DIDA, the FM arrangements satisfy the requirements as stipulated in Bank Directive: Investment Project Financing subject to implementation of agreed actions and mitigating measures. The FM risk of the project is assessed as "substantial" primarily because there are two agencies providing FM support and the FM capacity of the RMI unit is unknown until finance staff are appointed.

10. **Budgeting Arrangements.** RMI has a Budget Coordinating Committee which develops, formulates, and coordinates the government budget process. This committee is made up primarily of MFBPS staff who have strong skills in budget preparation and monitoring of the budget. Project funds will be included in the estimates and in-year reporting subject to the timely notification to the government. The budget section of the MFBPS is responsible for the monitoring of the government budget throughout the year and will be requested to work closely with DIDA fiduciary staff to assist in the budget preparation and monitoring of this project. The government accounting system has the capacity to compare actual costs to budget, which will assist in the monitoring of the

budget. Budgeting will be on an activity basis summarized by component and should be reviewed at least every six months by both the budget section of the MFBPS and the project team.

11. **Accounting Arrangements**. RMI uses the accounting system 4Gov developed by a U.S.-based software company. The system has a comprehensive chart of accounts, and transactions or line items can be further classified by cost center, organization (department/division), and geography if required. This system can maintain accounting records that meet the Bank's reporting requirements for this project. The project accounts will be maintained on the government system. As there is a likelihood the government will replace 4Gov during the life of this project, interim project accounting arrangements may be needed during the transition which could require additional FM support. DIDA has recently employed their first Project Accountant to maintain the accounts for current and future donor funded projects, which are implemented by government. This position is funded through the PPAs for the PREP and an information communications technology project; as the demand within DIDA grows, additional fiduciary staff will be needed. Hence, provision has been made within the project budget for the employment of a Project Accountant who will be employed when demand within DIDA necessitates the additional position. It is yet to be established if the Project Accountant will be able to input directly into 4Gov and what access this officer will be provided.

12. **Internal Controls.** GoRMI uses a Standard Operations Procedure Manual, which outlines the internal controls and procedures. However, compliance within agencies has often been poor. This risk should be mitigated by ensuring the Project Accountant is aware of the Standard Operations Procedure Manual requirements, and that compliance to the manual is included in the terms of reference of the position. To enhance the controls, all project Purchase Orders will be approved by the Secretary of Finance prior to release. There is currently no Internal Audit Service within the MFBPS/DIDA**.** Generally, project payments will be authorized by MEC, however DIDA will ensure compliance with the internal controls and authorizations and as part of the checking process prior to finalization of the payment.

13. **Flow of Funds.** Funds will flow from the World Bank directly into a designated account (DA). Project expenditures will be tracked through the government accounting system and paid from the treasury account. Prior to completing a replenishment Withdrawal Application, the equivalent funds expended from the treasury account will be transferred from the DA into the treasury account, hence the DA will be replenished by that amount. Adequate documentation will be required to be maintained to ensure easy reconciliation of payments made from the treasury account to payments authorized by the project. For larger payments, direct payments can be used where funds will flow directly from the World Bank to the supplier. Where direct payments are used as the disbursement method, the transactions must be incorporated into the project accounts.

14. **Financial Reporting.** Financial reporting will be fully integrated into the government accounting system. The project will be allocated a cost center, and sub accounts will be created to reflect the specific activities. Reports will be generated from the 4Gov accounting system. The financial reports will include an analysis of actual expenditure for the current period, year to date and for the cumulative to date, plus outstanding commitments, compared against total project budget. The project will be required to prepare half-yearly (semester) Interim Financial Reports (IFRs) in a format agreed with the Bank. The IFRs will be prepared by the Project Accountant in consultation with MFBPS and will be required to be submitted not later than 45 days after the end of the reporting period.

15. **Audit.** The audit of project funds will be incorporated in the National Accounts and hence will be disclosed

as a note to the accounts of the National Accounts, with submission due nine months after the end of the fiscal year. There is a risk that through an oversight the project information is not included in a note to the accounts. To reduce the risk, each year the Bank will formally write to MFBPS advising them of the projects that need to be included in the disclosed World Bank project note. Currently, the audit of the National Accounts is sub-contracted by the Public Auditor to a private contractor. MFBPS, the Public Auditor, and the Bank will agree on the information required to be disclosed.

16. That National Accounts will be published on the Office of the Auditor General's web site.

Disbursements

The project will use four Disbursement Methods: (i) Advance; (ii) Reimbursement; (iii) Direct Payment; and (iv) Special Commitment.

17. A DA will be opened for this project. The documentation required for the replenishment of the advance will be by Statement of Expenditure. While supporting documentation will not be required to be sent, except for those contracts subject to prior review, the project will be expected to retain documentation for audit and review by World Bank staff.

18. The Project Accountant will prepare all Withdrawal Applications and send the Withdrawal Applications along with accompanying documentation to DIDA/MFBPS for checking, signing and submission to the World Bank.

19. The disbursement tables showing categories of expenditure and amounts eligible for financing are shown below, and are also to be found in the legal agreement. Please note in the case of discrepancy, the version referred to in the legal agreement takes precedence over the tables shown below.

Table A2-1: Financing Agreement Disbursement Categories and Amounts

Category	Amount of the Financing Allocated (expressed in SDR)	Percentage of Expenditures to be Financed (inclusive of Taxes)
(1) Goods, works, non-consulting services, consulting services, Training and Workshops, and Operating Costs for the Project	23,850,000	100%
(2) Refund of Preparation Advance	450,000	Amount payable pursuant to Section 2.07 of the General Conditions
TOTAL AMOUNT	**24,300,000**	

Procurement

20. Procurement under this project will follow the World Bank Procurement Regulations for IPF Borrowers (July 2016), Procurement Regulations.

21. **Risks and Mitigation Measures.** The procurement risk is assessed as high. Key procurement risks emanate

from: (i) lack of experience of MEC with implementing procurement following the procedures in the Procurement Regulations; (ii) lack of experience of MEC with procurement of contracts for the nature and size under this project; (iii) limited staffing and capacity of MEC's procurement team; (iv) limited supply capacity in the national market; and (v) delayed progress of procurement activities under the PPA for establishing the project implementation unit in MEC. Mitigation measures agreed are: (i) DIDA is speeding up the selection of consultants under PPA - the Project Manager and the Safeguard Specialist have already been recruited while the Technical Advisor (distribution expert) and the Owner's Engineer are in process; (ii) the Procurement Specialist will be recruited, while additional procurement assistance will be included in consulting services, for preparing the procurement documents and implementing procurement process; (iii) STEP will be used for monitoring procurement process-an overview of the system has already been provided to the end-users while the implementing agency registration is in process; and (iv) the Bank team will provide necessary training and support at the early stage of project. Procurement will be carried out in accordance with the World Bank's "Procurement Regulations for IPF Borrowers" dated July 2016 and the specific provisions stipulated in the legal agreement.

22. A procurement plan has been prepared and agreed with the World Bank. The procurement plan will be published on the World Bank website and is summarized as follows:

Table A2-2: Procurement of Goods, Works and Non-Consulting Services

Description	No.	Category	Method	Amount (US$)	Review	Start Date
S&I of Integrated Solar PV-Storage-Control System - O&M Support-Feeder	C1.1	Work	RFB	22,600,000	Prior	2018/05/01
S&I of Majuro Diesel Generators	C1.3	Work	RFB	3,000,000	Prior	2018/05/01
S&I of Ebeye Diesel Generators	C1.3	Work	RFB	2,000,000	Prior	2018/12/01
Implementation of Supply Side Management	C2.1	Work	RFB	1,200,000	Prior	2018/05/01
Demand Side Management Energy Efficiency Equipment	C2.2	Goods	RFB	750,000	Prior	2018/05/01
Office Equipment	C3.3	Goods	RFQ	50,000	Post	2017/09/01

Table A2-3: Procurement of Consulting Services

Description	No.	Method	Amount (US$)	Review	Start Date
Design of solar plants erection	C1.1	CQS	400,000	Post	2017/10/31
Supervision of solar plants erection	C1.1	QCBS	600,000	Prior	2018/08/01
Technical study for Majuro Diesel Generators	C1.3	INDV	30,000	Post	2017/11/15
Design of Future Generation Mix Projects in Ebeye, the Outer Islands	C3.2	CQS	500,000	Prior	2018/07/01
Safeguard study for Future RE Projects in Ebeye, the Outer Islands	C3.2	CQS	100,000	Post	2018/07/01
Setup of O&M Mechanism and Implementation Arrangements	C3.1	INDV	30,000	Post	2018/05/01
Supply Side Management Loss Reduction Study	C2.1	CQS	200,000	Post	2017/11/15
Demand Side Management Energy Efficiency Study	C2.2	INDV	50,000	Post	2017/11/15
Institutional Strengthening, Regulatory Mechanism & Policy Framework for Energy Efficiency	C2.2	CQS	250,000	Post	2018/03/31
Project Manager	C3.3	INDV	750,000	Prior	2017/04/01
Procurement Specialist	C3.3	INDV	150,000	Post	2017/10/31
Safeguard Advisor/Studies	C3.3	INDV	250,000	Prior	2017/10/31

Financial Management Officer	C3.3	INDV	100,000	Post	2017/01/31
Energy Advisor	C3.1	INDV	300,000	Prior	2019/01/31
Audit Services	C3.3	LCS	50,000	Post	2018/01/05

23. Procurement risks were identified and mitigation measures were agreed per the following table.

Table A2-4: Procurement Risks and Mitigation Measures

Risk Identified	Mitigation Measures
Limited capacity of DIDA and MEC	• The World Bank Procurement Regulations for IPF Borrowers and related guidance notes will be disseminated to concerned agencies early on in project preparation. • A full-time Procurement Specialist will be hired under the PPA. • The Procurement Specialist will work with DIDA to: o conduct procurement of consulting services; o finalize/update the PPSD and procurement plan for the whole project when necessary; o prepare a detailed procurement manual as a part of the PIM.
Limited capacity of local market	• The project will invite international consultants and contractors to ensure the required capacity and quality are achieved. • The national contractors may also participate (as contractor or sub-contractor subject to meeting the qualification requirements) so that their capacity will also be strengthened.
Criticality of selecting the right Project Manager, and Key Experts	• Seek international applications. • Rigorous selection process, with strong emphasis of track-record and referee checks. • Interactive, evidence-based, face-to-face interviews. • Apply a probation period under the contracts – be prepared to change consultant(s) early if recruited experts are not performing to a high standard.
Criticality of selecting a capable Contractor for the solar PV plants	• EPC contract to be signed. • Ensure the contract package sizes are sufficiently large to attract interest. • Clear functional and performance requirements in the RFP. • Effective supervision and quality oversight by the design and supervision firm.
Criticality of selecting the right design and construction supervision firm	• Seek international applications. • Rigorous selection process, with strong emphasis of track-record, experts' qualifications, and referee checks.

24. A PPSD has been prepared. Summary points from the PPSD are:

- Procurement of Works: Based on the analysis of works required, equipment needed, capacity of the national contractors, as well as potential alternative technical solutions, it is recommended that: (i) open international competitive approach will be used to attract contractors from all over the globe; and (ii) an EPC contract will be signed through RFP selection method.

- Selection of Consultants: There are not qualified consulting firms or individuals in RMI for the services of

technical design and construction supervision, environmental and social impact assessment, etc. The project will approach international consulting firms and/or individual consultants. For firms, quality and cost based selection (QCBS), quality-based selection (QBS) or Selection based on Consultants' Qualifications (CQS) will be used. For individual consultants, candidates will be identified through public advertisement or information from other projects and the consultants will be selected by comparing the qualifications in the CVs.

- Procurement of Goods: the simple requirements will be acquired through Request for Quotations while the more sophisticated goods will be procured through Request for Bidding.

- Procurement Implementation Support: It is expected that substantial procurement implementation support will be needed from the World Bank for the first year of implementation. In addition, the World Bank task team will provide initial procurement training and regular advice at the early stage of project implementation. This arrangement will be reviewed in the first 12 months of implementation.

25. **Procurement Supervision.** In addition to prior review of procurement transactions, at least two procurement missions will be fielded annually to support implementation. Procurement post reviews will be conducted annually.

Environmental and Social (including safeguards)

26. MEC has no experience with World Bank safeguards and does not have any environmental or social specialists in the team. The staff and consultants in the PIU will require training and support from the World Bank safeguards specialists and the DIDA-based Safeguards Specialist to ensure that their responsibilities are understood and safeguards are integrated into the project work plan. The DIDA-based Safeguards Advisor will have overall responsibility for the implementation of the safeguards instruments, screening of projects, consultations, assisting with land leases, preparing ESMP and permit applications, managing consultants for the preparation of safeguards instruments as part of the outer islands and Ebeye studies and supervising contractors. This person will be highly qualified and experienced in World Bank or similar safeguards policies and environmental impact assessment and management.

27. The ESMP will be included in the bid documents and contractors will be expected to have the personnel and resources available to comply with the ESMP. Contractors will be required to prepare contractors ESMP outlining environment, social, health and safety policies and practices.

28. Consultants undertaking technical assistance will be required to comply with the project's safeguards instruments and World Bank policies more generally, and the DIDA-based Safeguards Advisor will review their outputs.

Monitoring and Evaluation

29. Overall monitoring and coordination of project activities will be performed by the implementing agency, MEC, which will have overall responsibility for monitoring and evaluating the different components/activities in accordance with the indicators included in the Results Framework. The Project Manager will be responsible for gathering data for monitoring and evaluation. No later than 45 days after each biannual period, the project will

submit biannual progress reports to the Bank, covering all project activities, including procurement and financial summary reports. Biannual reviews (the first one to take place six months after effectiveness) will provide a detailed analysis of implementation progress toward achieving the project development objectives and will include an evaluation of financial management and a post-review of procurement aspects.

ANNEX 3: IMPLEMENTATION SUPPORT PLAN

COUNTRY: The Marshall Islands
Sustainable Energy Development Project

Strategy and Approach for Implementation Support

1. The strategy for implementation support has been developed based on the nature of the project and its risk profile. The aim is to make implementation support to the client flexible and efficient.

2. The Bank Task Team Leader will provide ongoing support by coordinating with the client and among World Bank staff who will provide implementation support on technical, fiduciary (FM and procurement), and safeguards aspects.

3. The Bank will field twice-yearly supervision missions, and in conjunction with government counterparts, monitor progress against the monitoring indicators in the Results Framework. The Bank will flexibly conduct additional missions when a need arises especially at early stage. The Bank will also monitor risks and update the risk assessment and risk management measures, as needed.

4. A mid-term review would encompass a more in-depth stock taking of performance under the project and will take place starting on June 22, 2020, or other date as agreed with the project entities. Based on the assessment of progress at the mid-point of the project, recommendations for improvements/changes to the project would be considered by government counterparts and the Bank.

5. Tables A3-1 and A3-2 below map out the proposed implementation support plan, skills mix, and other inputs required.

I. Implementation Support Plan and Resource Requirements

Table A3-1: Implementation Support Plan and Resource Requirements

Time	Focus	Resource	Time (staff weeks)	Budget (US$)
First 12 months	Team leadership	Task Team Leader/Co-Task Team Leader based in DC	25	150,000
	Procurement & FM Specialists	Manila & Sydney	15	
	Safeguards Specialists	Sydney & Auckland	5	
	Implementation Support Officers	DC & FSM	4	
	Technical Specialist	DC	2	
Year 2 to 5	Team leadership	TTL/Co-TTL based in DC	10	100,000
	Procurement & FM Specialists	Manila & Sydney	8	

	Safeguards Specialists	Sydney & Auckland	2	
	Implementation Support Officers	DC & FSM	2	
	Technical Specialist	TBD	1	

II. Skill Mix Required

Table A3-2: Implementation Support Plan and Resource Requirements

Skills Needs	Number of Staff Weeks/year	Number of Trips/year	Comments
Co-Task Team Leaders (2)	13	2	DC
Implementation Officer	2.4	2	DC/Federated States of Micronesia
Financial Management	3	2	Australia
Procurement	11	2	Manila
Safeguards	2.6	2	Australia/New Zealand
Technical Specialists	1.2	2	TBD

ANNEX 4: ECONOMIC AND FINANCIAL ANALYSIS

COUNTRY : The Marshall Islands
Sustainable Energy Development Project

1. The economic and financial analysis followed World Bank guidance documents (2001, 2014a, 2014b, 2016 and 2017) and Bank Directive: Investment Project Financing.[27] Following the guidance note (2014a), this analysis addressed (i) the project's development impact, (ii) the public-sector provision or financing as the appropriate vehicle, (iii) the World Bank's value added, (iv) financial, fiscal and environmental sustainability and (v) the project justification nexus — results, risks, and economic rationale. This nexus is explained as follows. The PDO is to increase the share of renewable energy generation in the Recipient's territory, and enhance the reliability of electricity supply and improve energy efficiency in the Project Areas. The analysis examined the causal chain that links project activities and inputs to these objectives in the section VII. Results Framework and Monitoring. The risk and sensitivity analysis to those results included those in the Section V., Key Risks. This analysis is preliminary. Hence, the analysis may be updated when detailed designs are available or change, as well as at the mid-term review, project restructuring (if happens) and completion.

2. The preliminary analysis covered 64 percent of the total project cost. The analysis could not cover the remainder of the project cost due to the following reasons. The capacity of the solar PV and diesel gensets needs to be consistent with the capacity targets of the result framework. The conservative target values are set compared to the base case unit equipment cost estimates, which are technically compatible to the level of detailed studies currently available that provide for a stable system. It is expected that the Owner's Engineer and the EPC contractor further assess this capacity. Thus, the economic analysis covers only part of the allocated cost of Component 1 in order to be consistent with the targeted capacity in the result framework Sub-Component 2.2 (Demand Side Energy Efficiency) is not covered as the activities are not yet defined in detail. Activities related to Sub-component 3.2 (Preparation of Renewable Energy Projects in Ebeye and the Outer Islands) are also not covered as the corresponding potential investments will not be financed under this project. Reflecting these omissions, the analysis reduced proportionally the project cost of the rest of the project's overarching activities (Sub-component 3.1, Technical Assistance and Capacity Building, and Sub-component 3.3, Project Management). Major data sources for the analysis comes from MEC, KAJUR, ADB, the IMF, the World Bank Group, and other secondary sources. Key assumptions are summarized in Table A4-1.

[27] Operations Policy and Quality (OPSPQ). 2014a. Investment Project Financing Economic Analysis Guidance Note; Belli P., J. R. Anderson, H. N. Barnum, J. A. Dixon, and J-P Tan. 2001. Economic Analysis of Investment Operations: Analytical Tools and Practical Applications; P. Meier. 2017. Power Sector Investment Projects: Guidelines for Economic Analysis; and Fay, M., S. Hallegate, A. Kraay, and A. Vogt-Schilb. 2016. Discounting Costs and Benefits in Economic Analysis of World Bank Projects; World Bank 2014b. Guidance note on social value of carbon in project appraisal September 2014.

Table A4-1: Summary of Key Assumptions

PLANT CHARACTERISTICS					TIMING				
					Base year			2018	
PV (MWp)			3		Start of generation:			Availability at start:	
Battery (MWh)			3		Solar PV system and battery		2020	72%	
IDA Majuro Diesel genset name plate (MW)			1.0		Diesel gensets		2020	100%	
IDA Ebeye Diesel genset name plate (MW)			1.0		Plant availability at replacement (%)			67%	
International Organization for Standardization (ISO) factor (%)			5%		Project operational life (years)			19	
Capacity factor IDA Majuro Diesel genset (%)			95%		Residual year			2039	
Capacity factor Ebeye Diesel genset (%)			95%		IDA years			5	
Auxiliary consumption Majuro (%)			10%		IDA Commitment Charge (%) per year (0.5% each for			1%	
Auxiliary consumption Ebeye (%)			15%						
Annual reduction of plant utilization (%)			0.5%		NEW EQUIPMENT COST			US$	
PV Degradation Rates (%) Year 1, 2-10, 11-20	2.5%	0.7%	1%		Medium speed diesel power plant		kW	1,500	
Battery Degraration rate (%)			4%		PV (roof)		kW	2,000	
PV Inverter Output			19%		PV (ground)		kW	2,500	
Direct PV power to load			19%		PV (reservoir)		kW	3,100	
Battery Storage to load (MWh)			389		Battery energy storage system (BESS)		kWh	800	
Loss IDA Majuro genset to Battery			90%		Transimission Line		Km	300,000	
Loss battery to Load			90%		Booster Station		set	3,000,000	
Loss through PV to Load			98%						
					REPLACEMENT COST		Year	Cost	
Total system loss of gross generation (%)			15%		Majuro solar inverter replacements cost (		2029	180,674	
Technucal loss reduction KAJUR (%)			2%		Majuro Battery replacements cost (US$)		2029	603,465	
MEC system loss of net generation (%)			17%						
KAJUR system loss of net generation (%)			18%		ECONOMIC LIFE (years):				
KAJUR transformer technical system loss reduction of gross generation			2%		PV System				19
					Civil Works				19
MEC Improved electricity supply security consumers US$/kWh			0.537		Battery energy storage system (BESS) and Booster Station,				10
KAJUR Improved electricity supply security consumers US$/kWh			0.544		with a capacity maintenance contract with the battery vendor				
					Diesel gensets High speed				15
Average crude oil price (US$/bbl)	78				Diesel gensets Medium speed				19
Diesel:					Health expenditure (%GDP)	public	14%	private	3%
Net IDA Majuro Medium Speed Diesel consumption (gallon/kWh)			0.0725						
Net IDA Ebeye Medium Speed Diesel consumption (gallon/kWh)			0.0725		MEC Total avoided outage (MWh/year)		112		
Net Non IDA Majuro system average Med Speed Diesel consumption (ga			0.0763		KAJUR Total aovided outage (MWh/year)		9		
Net Non IDA Ebeye system average High Speed Diesel consumption (gall			0.0843						
Net New Non IDA Ebeye system average High Speed Diesel consumption			0.0757		O&M COSTS				
Net New Non IDA Majuro system average Med Speed Diesel consumptio			0.0725		Fixed:				
					Majuro IDA Medium Speed Diesel gensets fixed cost (US$/year)				12,434
Heat rate degradation factor		Year 1 up	5%		Ebeye IDA Medium Speed Diesel gensets fixed cost (US$/year)				12,434
		Thereafter u	0.5%		PV General maintenance and spare parts (US$/kW/year)				56
					Variable:				
Cost of diesel (US$/gallon)			3.2		Medium Speed Diesel gensets variable costs (US$/MWh)				14
Ebeye Cost of diesel (US$/gallon)			3.6						
Transport cost of diesel to KAJUR US$/gallon			0.4		Periodic (major maintenance and overhaul):				
					IDA Majuro Medium speed Diesel genset 25% of gensets cost (US$/5th ye				375,000
International price of diesel (US$/gallon)			2.8		IDA Ebeye Medium speed Diesel genset 25% of gensets cost (US$/5th ye				375,000

Lube Oils:					WORKING CAPITAL AND INVENTORY							
Majuro Medium Speed Lubes Cost US$ / USG			19.5		MEC Accounts Payable (weeks)					14.6		
Majuro Medium Average Lube Cost US$ / KWh			0.01		MEC Cash Balance (weeks)					4.8		
Majuro Medium Speed System Average Lubes Gallon/kWh			0.0004		KAJUR Accounts Payable (weeks)					0.2		
Ebeye Non IDA High Speed System Average Lubes Cost US$ / USG			6.3		KAJUR Cash Balance (weeks)					15		
Ebeye Non IDA System Average Gross High Speed Lube Cost US$ / K			0.001		With Project Majuro Inventory of diesel (gallons)					1,200,000		
Ebeye Non IDA Lubes Gross System Average High Speed Gallon/kWh			0.0002		With Project Ebeye Inventory of diesel (gallons)					1,500,000		
Ebeye IDA Med Speed Lubes Cost US$ / USG			19.8		Without Project Majuro Inventory of diesel (gallons)					1,800,000		
Ebeye IDA Gross Med Speed Lube Cost US$ / KWh			0.01		Without Project Ebeye Inventory of diesel (gallons)					1,500,000		
Ebeye IDA Lubes Gross Med Speed Gallon/kWh			0.0004									
					WAGE							
Economic Oportunity Cost of Labor (EOCL), Shadow Wage	Conversion Factor (CF)				Annual wage growth rate, real (%)					0.5%		
Projecr Manager		0.89			Annual growth rate of labor productivity, real (%)					1.07%		
Procurement advisor		0.87										
Financial management advisor		0.92			Effective Tariff, averge 2018 (US$/kWh)			Sales Share		Elasticity		
Social and environmental safeguards advisor		0.92			Government	MEC Majur	0.45	15%		0.93		
Energy advisor		0.92			Commercial	MEC Majur	0.44	36%		-0.05		
Design and Supervision Consultants		0.92			Residential	MEC Majur	0.38	11%		-0.47		
O&M contractor		0.91			Life Line	MEC Majur	0.36	38%		-0.53		
Supply side Management consultant		0.93			System average weighted		0.40	100%				
O&M Mechanism and Implementation Arrangements		0.93										
PV installation technician and labor		0.93			Effective Tariff, averge 2018 (US$/kWh)			Sales Share		Elasticity		
Battery system installation technician and labor		0.93			Government	KAJUR	0.45	16%		0.93		
Safeguard studies		0.93			Commercial	KAJUR	0.44	47%		-0.05		
PV Support contract, Annual visit and training refresher		0.93			Residential	KAJUR	0.38	2%		-0.47		
Audit		0.93			Life Line	KAJUR	0.36	35%		-0.53		
Non-IDA finaced MEC full time solar engineers		0.84			System average weighted		0.41	100%				
Local employees for public sector, MEC/KAJUR		0.64										
Local employees for private sector, including transport		1.75			TAXES							
					Sales tax Majuro (%)		Sales price					4%
PV's annual water surface evaporation reduction (meter)		2			Sales tax Ebeye (%)		FOB price					2%
Reservoir size (m2)	30,000				Fuel tax (MEC/KAJUR exempt)		US$ Per gallon				$	0.08
Assumed volume reduction by slope	25%				Social security (7%) and Health Insurance (3.5%) contribution (employer)					11%		2100
Residential water tariffs		1.06			Social security (7%) and Health Insurance (3.5%) contribution (employee)					11%		2100
Market price of reverse osmosis-purified water US$/m3		276			Imports (%) with some exceptions as foods stuffs, vehicles, tobacco, wine, etc.							12%
Water supply expected to be consumed in drought periods		4%			Motor Vehicles Import (whose values can be determined in the Kelly's Blue Book)							15%
					Foodstuff							5%
DISCOUNT RATES, FEP					Personal income tax rate (%) annual income US$					Exemption		
Target return on equity, real (%)		3.3%			Annual	0	5,200			-1,040		8%
Economic cost of capital, real (%)		1.4%			Annual	5,201	10,400					8%
Foreign exchange premium (FEP) (%)		6.4%			Annual	10,401						12%
					National Government Gross Revenue Tax (doing business)							
INFLATION AND EXCHANGE RATES						0	10,000			80		
Inflation rate (RMI)		2.10%				10,000						3%
Inflation rate (US)		2.03%										
Exchange rate, 10/31/2017 (US$/SDR)		1.4047										
Eimssions												
CH4 Global Warming Potential for 100 years	21	N2O Global	310									
							Health dama	Ebeye		Majuro		
	CO2kg /TJ	CH4 kg /T.	N2O kg /TJ	NOx, ton/gal	PM10, ton/gallon	SOx, ton/g	NOX	0.004		0.0004		
Diesel	74,100	3.0	0.6	0.2	0.004	0.003	PM-10	0.017		0.002		
Per Gallon	10.74	0.00	0.00				SOx	0.005		0.0005		
CO2e ton /gallon	0.01	0.00001	0.00003									
Social Values of Carbon recommended for the WBG in US$ per 1 metric tonne of CO2 equivalent												
Year		2018	Annually increased to		2038							
Base case in 2018 US$		35			66							

PV Option Assessment – Climate Change Mitigation and Adaptation

3. The feasibility study included three types of PV installations: covering water reservoir, covering roof, and on ground. During the early stage of preparation, pre-screening economic and financial analyses were conducted for each option, assuming the same capacity and output of PV given the IDA allocation of the PV sub-component of US$22.6 million. The water reservoir option is the most expensive but could provide climate change mitigation and adaptation co-benefits of avoided global and local emissions and increased water availability. The covering water reservoir is one of the options under the Pacific Adaptation to Climate Change (PACC) Programme. [28] The water reservoir option with this climate change adaptation impacts, is about 20 percent of the total IDA financing (i.e., about US$7 million was allocated for the PV covering reservoir option of the IDA total US$34 million). Rooftop

[28] "Buncle, Aaron. 2013. Informing-climate resilient development: the application of cost-benefit analysis (CBA) in the Pacific Adaptation to Climate Change (PACC) Programme: experiences and lessons learned in the application of CBA to PACC demonstration projects / Aaron Buncle – Apia, Samoa: SPREP, 2013. p. cm. (PACC Technical Report No.2). Secretariat of the Pacific Regional Environment Programme (SPREP).

option is the least cost option. It was found that the project can maximize the benefits by choosing the water reservoir and roof options. The summary of PV option assessment presented in Table A4-2.

Table A4-2: PV Option Assessment[29]

PV (reservoir), US$3,000/kW	Cost Overun	877,500	3%
NPV, real (US$) @ EOCK:		1.4%	16,512,017
EIRR:			8.7%
Levelized Energy Cost, real (US$/kWh)			0.49
FNPV, real (US$) @ ROE:		3.3%	6,667,924
FIRR:			Not available (grant)
Levelized Energy Cost, real (US$/kWh)			0.58
PV (roof), US$2,000/kW	Cost savings	-2,236,000	-7%
NPV, real (US$) @ EOCK:		1.4%	7,963,902
EIRR:			5.6%
Levelized Energy Cost, real (US$/kWh)			0.43
FNPV, real (US$) @ ROE:		3.3%	6,667,924
FIRR:			Not available (grant)
Levelized Energy Cost, real (US$/kWh)			0.50
PV (ground), US$2,500/kW	Cost savings	-679,250	-2%
NPV, real (US$) @ EOCK:		1%	6,549,899
EIRR:			4.6%
Levelized Energy Cost, real (US$/kWh)			0.45
FNPV, real (US$) @ ROE:		3%	6,667,924
FIRR:			Not available (grant)
Levelized Energy Cost, real (US$/kWh)			0.53
PV (Project - Reservoir + Roof), US$2,718/kW			
NPV, real (US$) @ EOCK:		1%	17,265,005
EIRR:			9.2%
Levelized Energy Cost, real (US$/kWh)			0.48
FNPV, real (US$) @ ROE:		3%	6,667,924
FIRR:			Not available (grant)
Levelized Energy Cost, real (US$/kWh)			0.57

Economic Analysis

4. All values were converted to economic values and conversion factors were estimated, such as foreign exchange premium (shadow exchange rate),[30] economic opportunity cost of labor (shadow wage rate),[31] fuel inventory (working capital), etc. Pursuant to the World Bank's guidance (2016) noted above

[29] Net present values (NPVs) and internal rate of returns (IRRs) in the table do not reflect the final economic and financial analysis because after the pre-screening analysis, other project design details and assumptions had been revised. However, the relative ranking of solar-battery options were valid.

[30] Estimated based on the methodology by Glenn P. Jenkins, 2008. Program on Cost-Benefit Analysis on Economic Analysis/Project Appraisal; and Graham Glenday, 2011. Program on Project Appraisal and Risk Management May 15-June 10, 2011, Economic Opportunity Cost of Foreign Exchange, Duke Center for International Development.

[31] Estimated based on the methodology by Jenkins, G. and A. Klevchuk. 2006. Appraisal of El-Kureimat Combined Cycle Power

and guided by the country economist of the World Bank, an estimated economic discount rate of 1.4 percent was used for the economic analysis as economic opportunity cost of capital as presented in Table A4-1 above.[32] The analysis is presented in US$ 2018 prices.

5. The project objective of promoting renewable energy and energy efficiency supports the NEP. The key driver of development of NEP in 2009 was the country's declaration of the State of Economic Emergency on July 3, 2008 due to the unprecedented increases in the costs of imported petroleum fuel and foods. On May 13 2008, the power rationing began on Jabor, Jaluit. The country's electrical power was threatened to switched off in September in 2008 when its fuel supplies were expected to run out. It was double threats of soaring fuel prices and the fuel supply disruption due to a weather-delayed fuel tanker. The financial shortfall by MEC and KAJUR was estimated to be US$18 million or 20 percent of the total national budget.[33] The above background was the basis of the cost and benefit analysis and the counterfactual scenario.

The counterfactual scenario and the expected benefits

6. The analysis was conducted for each utility, i.e., MEC in Majuro and KAJUR in Ebeye. In the counterfactual scenario for MEC, as happened in 2008, MEC's customers would have to be prepared to pay for increased power prices and the society would risk the power cut due to the lack of fuel supply. Historically, the changes in fuel prices and supply were extremely volatile and stochastic. On the other hand, the project's solar power could mitigate these risks and improve the energy security. Hence, these avoided costs of potential electricity price and supply shock (i.e., loss of consumer surplus and cost to the society) were the main benefits for MEC. As a proxy, the avoided increased electricity tariff was based on the actual tariff increases in the 2008 crisis. The avoided electricity supply disruption cost was based on the public and private health expenditures due to the disruption in the hospital operation and water and sanitation services. RMI's health expenditure is above the average among the PICs.[34] As fuel tank delivery was expected to arrive in about 12 days from Korea, this supply disruption was assumed to be only once a year, for two weeks. The project financing of battery, though charged by only diesel gensets, will add economic value by enabling additional PV in the Majuro system. Covering water reservoir with PV will provide increased water availability, which is getting even more scarce due to the climate change. The project is also expected to reduce the power interruption and outages at the generation level [35]. In 2014, MEC's System Average Interruption Duration Index (SAIDI) was 4,175

Plant; Jenkins G. P, C. Y. K Kuo and A.C. Harberger, 2011. The Economic Opportunity Cost of Labor" Chapter 12. Cost-Benefit Analysis for Investment Decisions. (2011 Manuscript).

[32] Data source for this estimate was provided by the World Bank Country Economist and the Debt Sustainability Analysis by World Bank and IMF.

[33] Source: Radio New Zealand: *http://www.radionz.co.nz/international/pacific-news/175108/marshalls-face-possible-power-cuts*; Renewable Energy and Energy Efficiency Partnership (REEEP) *http://www.reegle.info/policy-and-regulatory-overviews/MH*, the Republic of the Marshall Islands National Energy Policy and Energy Action Plan. Volume 1: National Energy Policy. Majuro, September 2009, Space Daily *http://www.spacedaily.com/reports/Marshall_Islands_declares_economic_emergency_over_energy_crisis_999.html*. Pacific Islands Report. http://www.pireport.org/articles/2009/06/01/micronesia-review-issues-and-events-1-july-2007-30-june-2008-marshall-islands

[34] IMF 2016. IMF staff report for the 2016 Article IV Consultation with the Republic of the Marshall Islands.

[35] SAIDI = System Average Interruption Duration Index = the total duration of interruption for the average customer during a predefined period of time. SAIFI = System Average Interruption Frequency Index = how often the average customer experiences a sustained outage over a predefined period of time.

minutes (69.6 hours) and System Average Interruption Frequency Index (SAIFI) was 11, which mean an average interruption was 6.6 hours. The project is expected to reduce SAIDI to about 3,000 minutes. The value of lost load (VOLL) estimate was not available. As a proxy, the same value used for the avoided potential high electricity price was used for VOLL. MEC also needs urgent replacement of aging diesel genset are the expected funding was not materialized. The project will finance the new diesel genset that will reduce the MEC's fuel expenditure. The technical specification details will be determined at early stage of the project. At appraisal, the economic analysis assumed the medium speed diesel genset, which will be more efficient than the high speed to run as a baseload. In the counterfactual scenario, MEC is assumed to obtain funding to run the new medium genset in 2022.

7. For KAJUR, due to its commitments to urgently providing power to the water and sanitation project, KAJUR would need to replace a new diesel genset anyway. Funding may not be always available when needed. Even when an informal approval of funding was obtained, the actual decision for the funding availability could be overturned as it happened to MEC this year 2017. As same as in the MEC case, the appraisal analysis assumes that the project will finance a medium speed diesel genset, but the detailed designs will determine the most appreciate technology and specification during the early stage of the project. Therefore, in the counterfactual scenario, KAJUR was assumed to run their existing high speed gensets, though not efficient as the new ones until 2026. By 2026, the funding was assumed to be available for the replacement of new efficient gensets (for comparison, high speed genset was assumed in the analysis). Hence, the reduced diesel oil consumption is considered as the main benefit to KAJUR. The project is also expected to reduce he technical loss of transformers, which would reduce the amount of the power generation required by two percent, and SAIDI at generation level. KAJUR's generation level's SAIDI in 2014 was 831 minutes and SAIFI was 26, or about 32 minutes per interruption. The project is expected to reduce SAIDI to about 484 minutes. The same methodology was used for the VOLL as MEC.

8. **PDO Achievements.** The summary results Table A4-3 shows that the project's activities and inputs would meet the PDO with an NPV of US$27 million, or about 14 percent of GDP in 2016, and an EIRR at 12 percent. The renewable energy generation from the IDA financed solar power adds seven percent share of net renewable energy based power generation in terms of the total net electricity generation in 2016. The new genset in KAJUR would be more efficient in diesel oil consumption.

Table A4-3: Economic Analysis Results Summary

Summary of Economic Analysis at economic opportunity cost of capital (EOCK) at 1.4 percent (in 2018 US$)

	Total Project Costs	Economic Analysis Conducted (%)	Total ENPV	Total EIRR	Total ENPV with CO2e	Total EIRR with CO2e	Total ENPV with CO2e, NOx, PM10, SOx	Total EIRR with CO2e, NOx, PM10, SOx	Solar-Battery Levelized costs, real (US$/kWh)
	34,000,000	64%	26,955,975	12%	30,648,752	13%	30,650,078	13%	0.28
Percent of GDP in 2016	18%	12%	14%		16%		16%		

Net Benefit Distribution

			100% Total ENPV @ EOCK							
FNPV @ EOCK				Externalities Stakeholders @ EOCK						
				Electricity Customers					Majuro Population	MWSC
MEC	KAJUR	Government	Local Labor	Government agencies	Commercial	Residential	Lifeline	Fuel Transport Labor	Drinking Water	Reservoie r Cover
60%	13%	-47%	0.2%	4%	9%	4%	15%	0.05%	37%	5%

Avoided Fuel Import for Diesel Power Generation for 2019-2038			Avoided Emissions for 2019-2038				
	Diesel oil	Lube oil		CO2e	NOx	PM10	SOx
Total Gallon (undiscounted)	7,604,118	9,479	(undiscounted)	81,946	1,516,320	27,152	23,929
Total US$ PV @ EOCK	22,064,018	1,318,451	US$ PV @ EOCK	3,579,842	1,212	90	25
Total Percent of GDP in 2016	12%	0.7%	Abatement Cost (US$/CO2e t)	374			
Annual Gallon (average, undiscounted)	380,206	474					
Annual US$ PV @ EOCK (average)	1,103,201	65,923					

			Potential Water Saving using Water Reservoir for PV 2,236kWp			
Percent of imports of goods, f.o.b, of current account balance in 2014	0.89%	0.053%	US$ PV@EOCK for 2019-2038	Annual Saving (gallons)	Equivalent Majuro Water Drinking Volume/Days/Yea r	Equivalent Storage Capacity (volume)
Percent of official capital grants in 2014	58%	3%	10,040,136	14,330,671	14	39.3%

IDA's Renewable Energy Share (net, average) in terms of 2016 Net Total Electricity Generation								
	IDA Solar average per year	Total	MEC total net generation Majuro in 2016	KAJUR total net generation in 2016	Outer islands estimates		Project beneficiaries (% of which female)	% of RMI total population (2016)
MWh	4,399	67,171	51,147	14,355	1,670		32,137	61%
Percent	7%	100%	76%	21%	2%		49%	

9. **Development Impacts.** The main development impacts are the mitigation of risk to the security of electricity supply due to the increased RE and energy efficiency under this project. The distribution analysis showed that MEC will benefits the most for the fuel saving, followed by residents in Majuro for the availability of drinking water equivalent of 14 days per year, and electricity customers. MWSC will save expenditure for reservoir cover. GoRMI's public expenditure using IDA grant with commitment charges on the project was demonstrated its role to improve social welfare. Local labor could benefit for contributing to the civil work for the solar and battery system construction because the public sector's wage is higher than that of the private sector. According to a 2014 report, more women were employed in the private sector but in low paying positions and constrained by limited opportunities in both the private and the public sector.[36] The local fuel transporter could lose marginally because of the reduced fuel needed for KAJUR.[37] Majuro society at large would benefit in drinking water availability and water conservation, over US$ 0.7 million per year in 2018 prices.[38] In RMI, water is very scarce. For example,

[36] Laqeretabua, A. 2014. Gender Profile, Marshall Islands.

[37] The reason of positive sign of 0.2 percent benefit of local transporter (the private sector) is due to the private sector's wage is much lower than the public sector. Hence, the less work means that they are released from the work that pays less than their labor supply price. However, unless they find a better paying work, they will lose from the loss of the work even if they are underpaid. See further information: Jenkins G. P, C. Y. K Kuo and A.C. Harberger, 2011. The Economic Opportunity Cost of Labor" Chapter 12. Cost-Benefit Analysis for Investment Decisions.

[38] Water benefits are estimated based on the methodology by "Buncle, Aaron. 2013. Informing-climate resilient development: the application of cost-benefit analysis (CBA) in the Pacific Adaptation to Climate Change (PACC) Programme: experiences and lessons learned in the application of CBA to PACC demonstration projects / Aaron Buncle – Apia,

in 2013, the northern atolls experienced serious drought, resulting in the U.S. President declaring an emergency that activated US$5.5 million (three percent of GDP) of drought relief from the CFA. In February 2016, GoRMI declared a state of emergency, citing severe drought conditions, consequence of a protracted El Niño system that started building up in early 2015, which was followed by a declaration of emergency by the U.S. President, activating support from the U.S. Federal Emergency Management Agency.[39] Freshwater systems on small Pacific islands are fragile, and highly vulnerable to climate change. The islands need resilient freshwater systems to ensure water security for their people into the future.[40]

Financial Analysis

10. The financial analysis used an ROE of 3.3 percent based on the cost of capital at 5.5 percent estimated from time certificates of deposit rate of the Bank of Marshall Islands and an estimated inflation rate. Financial NPV was US$16 million. The results summary Table A4-4 shows that MEC and KAJUR could save about 11 percent and 6 percent of diesel oil costs, respectively. KAJUR could spend more on lube oils because the medium speed genset's lube oils are costlier and more amount required per electricity generation than the high speed genset. However, the data of lube oils for KAJUR were in 2013 and thus updated data may result differently.

Table A4-4: Financial Analysis Results Summary

Summary of Financial Analysis at return on equity (ROE) at 3.3 percent (in 2018 US$)						
Total Project Costs	Financial Analysis Conducted (%)	Total FNPV	MEC FNPV	KAJUR FNPV	Solar-Battery Levelized costs, real (US$/kWh)	
34,000,000	64%	16,345,229	13,320,748	2,917,666	0.30	
Avoided Fuel Cost for Diesel Power Generation for 2019-2038						
	Total		MEC		KAJUR	
	Diesel oil	Lube oil	Diesel oil	Lube oil	Diesel oil	Lube oil
Total Gallon (undiscounted)	7,604,118	9,479	6,492,396	38,245	1,111,723	-28,766
Total US$ PV @ ROE	17,493,311	401,432	14,579,469	530,219	2,913,842	-128,787
Annual Gallon (average, undiscounted)	380,206	474	324,620	1,912	55,586	-1,438
Annual US$ PV @ ROE (average)	874,666	20,072	728,973	26,511	145,692	-6,439
Percent of Fuel Costs in MEC and KAJUR 2016	8%	7%	11%	10%	6%	-27%
KAJUR MEC diesel oil 2016 gallon		5,008,416				
Avoided diesel gallon		7.6%				
% of capital grant in 2014		45%				
% of annual capital grant in 2019-21(estimates)		6%				

Sensitivity Analysis

Samoa: SPREP, 2013. p. cm. (PACC Technical Report No.2). Secretariat of the Pacific Regional Environment Programme (SPREP).

[38] IMF 2016. IMF staff report for the 2016 Article IV Consultation with the Republic of the Marshall Islands.

[38] The Secretariat of the Pacific Regional Environment Programme (SPREP). 2014. Building resilient freshwater systems. The Pacific Adaptation to Climate Change (PACC) Programme.

[39] IMF 2016. IMF staff report for the 2016 Article IV Consultation with the Republic of the Marshall Islands.

[40] The Secretariat of the Pacific Regional Environment Programme (SPREP). 2014. Building resilient freshwater systems. The Pacific Adaptation to Climate Change (PACC) Programme.

11. A number of sensitivity tests were carried out to identify critical parameters affecting the project's performance. The sensitivity analysis addressed some of the risks in the Section V., Key Risks, which includes technical design, operation, institutional capacity, fiduciary, and environmental and social risks. Tables below show the summary of the results. In the summary, Table A4-5, sensitivity indicators show the ratio of the percentage change in the NPV to the percentage change in the parameter tested. Sensitivity indicators in Table A4-5 show the bars indicating the level of negative or positive sensitivity.

12. The bar charts in the sensitivity indicators in the tables indicate the levels of sensitivity to the results. Regarding the macroeconomic risks (moderate), inflation rates in RMI and the U.S., and manufacturing unit value index showed relatively less sensitivity to the results compared to SDR exchange rate. Regarding the technical design and operational risk, the lack of expertise may require hiring new staff for solar and battery system operation. Although the analysis did not include the hiring experts due to high uncertainties on the actual costs, the sensitivity analysis assessed hiring experts based on the MEC's anticipation. The results indicated hiring up to six experts could be still financially viable. Although Table A-5 in the base case indicates one expert, the actual base case in the analysis was zero expert. This sensitivity analysis put one expert to be able to compute the results. The actual base case assumes hiring a contractor for remote support with annual visits, which has been used in other PICs Investment cost overrun is sensitive to the economic results. Diesel and crude oil prices are also sensitive to the results.

13. Related technical issues are that system loss from PV to load is relatively sensitive to the results. Since the IDA financed-solar power system and diesel gensets will be used to replace power generation from diesel gensets, -efficiency of diesel oil consumption of the IDA financed genset is very sensitive to the results. This indicates that it is crucial that the detailed design and procurement will select the most efficient genset with the lowest life cycle cost and that the stringent O&M practices are applied.

Table A4-5: Sensitivity Analysis Results Summary

Majuro	**Economic sensitivity analysis**					
Parameters	Base case	Change	ENPV (US$)	EIRR (%)	Sensitivity Indicator	SwitchingValue
Investment Cost Overrun Factor (%)	0%	20%	20,863,324	9%	-0.7	147%
Utilization Factor (%)	100%	85%	23,670,790	12%	0.129794	-670%
Inflation Rate, RMI (%)	2.1%	6%	24,143,263	12%	0.0001	-38067%
Inflation Rate, USA (%)	2.03%	6%	24,635,335	12%	0.0105	-192%
SDR Exchange Rate	1.42	1.46	24,542,860	12%	0.66	-0.74
Cost of Diesel (US$/Gallon)	2.8	4.5	20,774,777	10%	-0.2	15
Manufactures Unit Value (MUV) Index	1	1.2	24,706,404	12%	0.1	-7.5
Increased Generation IDA Genset to Battery due to System Loss (Index = 1)	1	1.4	23,325,591	11%	-0.1	12.8
Loss through PV to Load	98%	94%	22,952,931	11%	1.2	17%
Growth Rate of Real Labor Wages (%)	0.5%	0.7%	24,128,831	12%	-0.001	440%
Solar and Battery Operation and Maintenance Costs (US$)	56	100	22,353,331	11%	-0.09	650
Hiring Solar Battery Experts (actual base case is zero expert)	1	3	18,113,750	9%	0	12.0
Battery Replacement Costs	603,465	1,200,000	23,595,144	12%	0.0	26,995,733
Battery Degraration Rate (%)	4%	7%	24,252,951	12%	0.01	-642%
Photovoltaic Degradation Rate (%)	1%	3%	23,151,043	12%	-0.03	38%
Net Non IDA Majuro System Average Med Speed Diesel Consumption (Gallon/kWh)	0.08	0.07	17,375,805	9%	1.89	0.036
Oil Prices, Real	78	70	24,578,966	12%	-0.2	542
MEC IDA diesel genset cost	2,500	1,000	25,608,585	11%	-0.1	27,170

Ebeye	Economic sensitivity analysis					
Parameters	Base case	Change	ENPV (US$)	EIRR (%)	Sensitivity Indicator	SwitchingValue
Investment Cost Overrun Factor (%)	0%	20%	2,450,811	11%	-0.5	155%
Utilization Factor (%)	100%	85%	2,426,712	12%	0.9	-9%
Inflation Rate, RMI (%)	2.1%	8%	2,877,971	14%	No change	Not relevant
Inflation Rate, USA (%)	2.03%	8%	2,891,023	14%	0.009	-220%
SDR Exchange Rate	1.42	1.47	2,854,834	13%	0.4	-1.845724794
Cost of Diesel (US$/Gallon)	2.8	4.5	4,572,205	21%	1.0	0.1
Manufactures Unit Value (MUV) Index	1	1.2	2,805,451	13%	No change	Not relevant
Net IDA Ebeye High Speed Genset Diesel Oil Consumption (gallon/kWh)	0.076	0.080	-271,336	0%	-19	0.080
Oil Prices, Real	78	65	2,450,559	12%	0.8	-25
Growth Rate of Real Labor Wages (%)	0.5%	0.8%	2,816,793	14%	0.001	-556%
KAJUR IDA Genset Cost	2,500	1,000	4,214,785	19%	-1	5,517
Variable O&M cost of IDA genset (US$/MWh)	14	16	2,511,356	13%	-1	36

Majuro	Financial sensitivity analysis				
Parameters	Base case	Change	FNPV (US$)	Sensitivity I	SwitchingValue
Utilization Factor (%)	100%	85%	13,154,340	0.13565	-637%
Inflation Rate, RMI (%)	2.1%	6%	13,435,956	0.000	-6237%
Inflation Rate, USA (%)	2.03%	6%	13,355,128	-0.003	738%
SDR Exchange Rate	1.42	1.47	14,106,370	1.56	0.5
Cost of Diesel (US$/Gallon)	2.8	4.5	22,448,859	1.10	0.3
MUV Index	1	1.2	13,862,986	0.16	-5.2
Increased Generation IDA Genset to Battery due to System Loss (Index = 1)	1	1.4	12,809,421	-0.12	9.7
Loss through PV to Load	98%	94%	12,802,243	1.14	12%
Growth Rate of Real Labor Wages (%)	0.5%	0.7%	13,427,562	No change	Not computable
Accounts Payable (Weeks)	15	17	13,402,228	-0.01	1,292
Cash Balance (Weeks)	5	12	13,503,234	0.00	-1,272
Solar and Battery Operation and Maintenance Costs	56	100	11,909,018	-0.14	445
Hiring Solar Battery Experts (actual base case is zero expert)	1	3	11,449,408	-0.17	6.8
Battery Replacement Costs	603,465	1,200,000	12,961,590	-0.04	17,793,353
Battery Degraration Rate (%)	0.04	0.07	13,504,772	0.01	-518%
Photovoltaic Degradation Rate (%)	1%	3%	13,007,819	-0.02	49%
Net Non IDA Majuro System Average Med Speed Diesel Consumption (Gallor	0.08	0.07	8,398,620	2.52	0.046
Oil Prices, Real	78	70	12,253,201	0.81	-18
MEC IDA diesel genset cost	2,500	1,000	14,254,591	-0.10	26,854

Ebeye	Financial sensitivity analysis				
Parameters	Base case	Change	FNPV (US$)	Sensitivity I	SwitchingValue
Utilization Factor (%)	100%	85%	2,608,716	0.7	-42%
Inflation Rate, RMI (%)	2%	8%	2,956,951	0.0048	-436%
Inflation Rate, USA (%)	2%	8%	2,957,076	0.005	-440%
SDR Exchange Rate	1.42	1.47	3,011,906	1.0	0
Cost of Diesel (US$/Gallon)	3	5	4,302,568	0.8	-1
MUV Index	1	1	2,958,899	0.1	-13
Net IDA Ebeye High Speed Genset Diesel Oil Consumption (gallon/kWh)	0.08	0.08	579,767	-14	0.08
Accounts Payable (Weeks)	0.2	2	2,921,090	0.0001	-1,569
Cash Balance (Weeks)	15	19	2,910,858	-0.01	1,584
Oil Prices, Real	78	65	2,630,264	0.6	-58
Growth Rate of Real Labor Wages (%)	0.5%	0.8%	2,918,345	0.0004	-14
KAJUR IDA Genset	2,500	1,000	4,036,139	-1	6,413
Variable O&M cost of IDA genset (US$/MWh)	14	16	2,656,986	0	41

Risk Analysis

14. Based on the above sensitivity analyses, the key variables were identified. An appropriate probability distribution and the likely range of values for each risk variable were estimated, based on a historical observation of those variables. Even if an independent variable in the sensitivity analysis may indicate an insignificant impact on the result, it could be possible that multiple variables' interactions could result in significant impacts. Therefore, the following variables have been selected from different risk categories (e.g., operational, technical, etc.): annual utilization factor, crude oil prices (which is linked to diesel oil prices), battery replacement cost, Ebeye genset periodic maintenance cost, fuel efficiency of gensets, capital cost of gensets, Ebeye genset variable O&M cost, PV power system loss to the load, battery replacement cost, increase of diesel genset supply to battery due to the battery system loss, SDR exchange rate, manufacturing unit value index, U.S. and RMI inflation rates. Monte-Carlo risk

simulation was carried out over 10,000 trials with the help of Crystal Ball™ software. The results suggested a high risk of financial outcome of the project (Figures A4-1 and A4-2).

15. The Tornado analysis of Crystal Ball was also conducted to analyze the critical variables. This high risk was due to the historically extremely volatile oil prices in 1960-2016, which was the base for the probability distribution. In fact, originally, more recent historical prices of 1980-2016 was used for the probability distribution but that was also very volatile and uneven. Then, a longer period back to 1960 was used but still it was very volatile. But this stochastic nature of the oil price is the very reason that the RMI would like to avoid. The economic analysis assumed the benefit of avoided risk to the volatility oil price and supply shock and water availability. Hence, the NPV was positive as Figure A4-1 below showed. But financial analysis, without these economic benefits, showed a lower NPV than that of the base case as presented in Figure A4-2 below. This result was due to the Majuro's solar and battery system because it was very sensitive and complicated relationship with oil prices, efficiency and costs of the technology options (i.e., solar PV, battery and diesel gensets). . Ebeye's genset was immune to the oil prices and supply because the counterfactual was also the diesel power plant and the benefit was diesel fuel efficiency. Both with and without project scenarios, KAJUR is expected to use diesel gensets.. This reiterates the crucial need for the most efficient diesel genset with the lowest life cycle costs, and stringent O&M practices.

Figure A4-1: Probability Distributions of Economic Outcomes

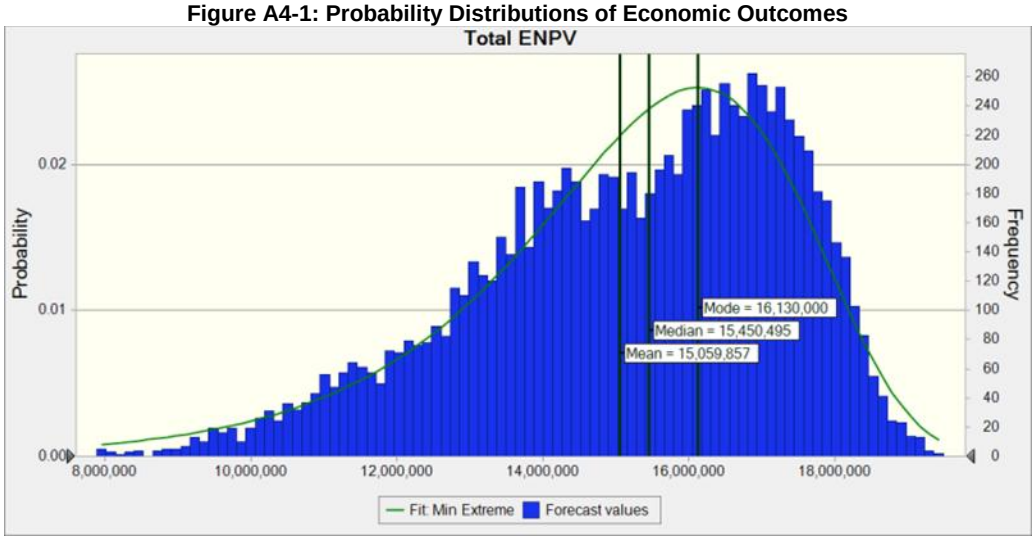
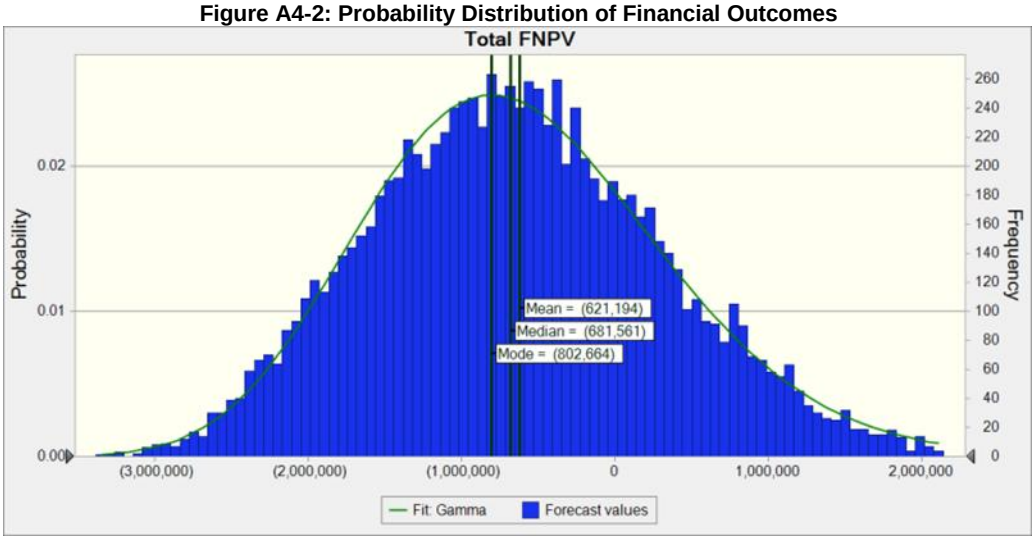


Figure A4-2: Probability Distribution of Financial Outcomes



16. **Financial Sustainability.** The solar-battery system would be financially sustainable based on the following two conditions. The capital cost is financed as a grant. Second, the O&M costs including the labor and the replacement of battery and inverters would not be much higher than those estimated in the analysis. Recent Bank and non-Bank financed projects, cost estimates by the International Finance Corporation, and studies and proposals for RMI were reviewed.[41] The review and the consultation with MEC found a large uncertainty of the actual O&M costs including the labor, battery, and inverter replacement costs. For example, MEC planned to hire three international staff members to operate the solar and battery system as they had no staff experienced in operating solar system at the proposed scale. On the other hand, in American Samoa, incumbent local diesel power generation engineers were trained to operate solar-battery system. Despite these uncertainties, the solar power would mitigate volatile diesel price and supply shock. The 2008 fuel crisis pushed MEC towards insolvency.[42] Majuro has repeatedly faced the threat of fuel shortages because of its debt coupled with rising prices. An inability to generate adequate revenues from its customers has forced it to reduce orders of diesel to minimum amounts. Before the 2008 crisis, the utility was also nearly running out of diesel on several occasions in 2006 and 2007.[43] Therefore, this project will provide an important opportunity to test the viability of this type of project in RMI. Financial sustainability of the project for KAJUR is minimal even though the project is expected to finance a more efficient diesel genset. The is because most of KAJUR's water and sanitation customers are not required to pay for the services. Hence, KAJUR needs to allocate revenues from electricity sales to both electricity and water and sanitation services.

[41] Key examples of reviewed documents are the following. World Bank Haiti: Renewable Energy for All Project (P156719), background document for the Solomon Islands: Tina River Hydropower Development Project (P161319). Non-World Bank American Samoa Solar Battery Project by Solar city, Solar battery projects in Hawaii, JICA and Okinawa Enetech Co., Inc. 2015. Marshall Islands Project on the Formulation of a Self-Sufficient Energy Supply System Final Report January, 2015, Solar city proposal presentation for Ebeye and outer islands 2016. Clean and Resilient Power for Small Islands, a Global Workshop on Renewable Energy Microgrids.

[42] Asian Development Bank. 2010. Marshalls Energy Company Analysis. (Republic of the Marshall Islands: Public Sector Program). (RRP RMI 43321-01).

[43] Source: Radio New Zealand: *http://www.radionz.co.nz/international/pacific-news/175108/marshalls-face-possible-power-cuts*.

17. **Fiscal Substantiality.** An estimated avoided diesel and lube oil import per year is nearly one percent of imports of goods (free on board) of current account balance of the government in 2014. Yet, this annual avoided diesel and lube oil import is over 61 percent of official capital grants in 2014. [44] Hence, the project could mitigate potential risk to the diversion of emergency official capital grant to fuel expenditures in the event of the fuel price and supply shocks. The reduced diesel fuel costs will reduce government subsidies to KAJUR.

18. **Environmental Sustainability.** The project is expected to be environmentally sustainable. The project would reduce emissions of particulate matter 10 micrometers or less in diameter (PM10), oxides of nitrogen (NOx), and oxides of Sulphur (SOx) from diesel oil fired power plants.[45] In particular, Ebeye's population density is very high.[46] Although there was no available data for emissions and impacts, black smoke was frequently found emitted from the smokestack from KAJUR's Unit 1.[47] Therefore, it can be assumed that the project's more efficient and new genset could mitigate the harmful emissions. Globally, the proposed project is expected to avoid GHG emissions (about 82,000 tons CO_{2e}). The PV covering water reservoir option will provide climate change mitigation and adaptation co-benefits of avoided global and local emissions and increased water availability.

19. **Provision of Public-sector Financing.** As of 2017, the private sector is unlikely to take the risk of financing large-scale solar-battery systems in RMI. There is significant uncertainty of the operational costs of solar-battery and volatility of fuel prices and supply. This project will provide an opportunity to test such an operation and build requisite capacity in and define each role of the public and private sectors for such operation. This "innovative" project is also likely to highlight the need for new or updates to existing power sector policy, laws, and regulations. If the project is successful, and recurrent costs including the required skill sets are found reasonable, the private sector participation for scale-up could be a future option.

20. **World Bank Value Added.** The World Bank's value added is the scale of financing, the potential longer term partnership in the sector, and the building of the GoRMI's sector capacity. The technical assistance and capacity building aspects of the project are a key part of the Bank's value added and will help ensure sustainability of the project after the IDA grant closure. This contrasts with simply providing a capital grant (or capital grant with all project procurement and management done by a grant provider or a third party). The World Bank Group, as a global organization, can draw on its global experience in the energy sector, including with renewable energy, that can be readily shared with RMI.

Conclusion

21. Overall, the analysis demonstrates the project's potential achievement of PDO. The economic NPV was equivalent of 14 percent of GDP in 2016. However, there are considerable financial, technical,

[44] IMF 2016. IMF staff report for the 2016 Article IV Consultation with the Republic of the Marshall Islands.
[45] Local emissions costs were estimated based on the methodology advised in P. Meier. 2017. Power Sector Investment Projects: Guidelines for Economic Analysis.
[46] Sources: Economic Policy, Planning, and Statistics Office, Office of the President, 2012. RMI's 2011 Census of Population and Housing. Cleary, C.R. et al. 2012. Ebeye 2023: Comprehensive Capacity Development Master Plan. Report 2012-4 DTIC: ADA576906. United States Military Academy.
[47] JICA and Okinawa Enetech Co., Inc. 2015. Marshall Islands Project on the Formulation of a Self-Sufficient Energy Supply System Final Report January, 2015.

and operational risks due to the innovative nature of the main component. In late 1990 and 2000, there were high expectation of cost reduction of solar power, which did not materialize. Recently, solar and battery prices have finally declined but based on the experience, the forecasted further declines were not fully assumed in this project. Similar expectations relate to oil prices and supply (historically stochastic) and plant equipment costs and supply (e.g., around 2004-2007). However, a small and remote island, mostly dependent on grants, cannot afford to cope with stochastic fuel supply and prices. That promoted the state of emergency in 2008 and was the very nature for the country to develop energy policy with the aims to promote renewable energy and energy efficiency. Also, the past well-intended donor support to solar home system in many small islands had uneven success mainly due to lack of capacity building especially regarding O&M. If successful and actual costs are identified, both the government and private sector could be confident in the private sector participation in scaling up the solar-battery system.