THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP

FOR OFFICIAL USE ONLY

Report No: PAD2931

INTERNATIONAL DEVELOPMENT ASSOCIATION

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED GRANT

IN THE AMOUNT OF SDR 21.6 MILLION
(US$30 MILLION EQUIVALENT)

TO THE

FEDERATED STATES OF MICRONESIA

FOR A

SUSTAINABLE ENERGY DEVELOPMENT AND ACCESS PROJECT

November 13, 2018

Energy and Extractives Global Practice
East Asia And Pacific Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective September 30, 2018)

Currency Unit =	United States Dollar (US$)
SDR 0.71672 =	US$1
US$1.39525 =	SDR 1

FISCAL YEAR
January 1 – December 31

ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
BESS	Battery Energy Storage System
CERC	Contingency Emergency Response Component
CIU	Centralized Implementation Unit
COFA	Compact of Free Association
CPF	Country Partnership Framework
CPUC	Chuuk Public Utility Corporation
CRISP	Capitalization, Recovery, and Institutional Strengthening Program
CTF	Compact Trust Fund
DA	Designated Account
DoFA	Department of Finance and Administration
DoR&D	Department of Resources and Development
EA	Energy Adviser
ED/DoR&D	Energy Division of the Department of Resources and Development
EDF	European Development Fund
EIRR	Economic Internal Rate of Return
ESDP	Energy Sector Development Project
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
EU	European Union
FEP	Foreign Exchange Premium
FHH	Female-Headed Household
FIRR	Financial Internal Rate of Return
FM	Financial Management
FNPV	Financial Net Present Value
FOCC	Financial Opportunity Cost of Capital
FSM	Federated States of Micronesia
GAO	Government Accountability Office
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GoFSM	Government of Federated States of Micronesia

GRM	Grievance Redress Mechanism
GRS	Grievance Redress Service
HIES	Household Income and Expenditure Survey
IAP	Indoor Air Pollution
IFR	Interim Financial Report
IMF	International Monetary Fund
INDC	Intended Nationally Determined Contribution
IPP	Independent Power Producer
JICA	Japan International Cooperation Agency
KSI	Key Sector Issue
KUA	Kosrae Utilities Authority
LCOE	Levelized Cost of Electricity
LED	Light-Emitting Diode
M&E	Monitoring and Evaluation
MFD	Maximizing Finance for Development
MoU	Memorandum of Understanding
MP	Master Plan
MUV	Manufacturing Unit Value
NEP	National Energy Policy
NEW	National Energy Workgroup
NPV	Net Present Value
NREL	National Renewable Energy Laboratory
O&M	Operations and Maintenance
PC	Performance Contract
PICs	Pacific Island Countries
PIM	Project Implementation Manual
PIU	Project Implementation Unit
PPA	Power Purchase Agreement
PSC	Project Steering Committee
PUC	Pohnpei Utilities Corporation
PV	Photovoltaics
RE	Renewable Energy
REC	Regional Energy Committee
RPF	Regional Partnership Framework
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SDP	Strategic Development Plan
SEDAP	Sustainable Energy Development and Access Project
SEP	Stakeholder Engagement Plan
SHS	Solar Home Systems
SMO	Supplemental Management and Operation
SoR&D	Secretary of Resources and Development
SPC	Secretariat of the Pacific Community
SV	Switching Value
TA	Technical Assistance
UNFC	United Nations Framework Convention
YSPSC	Yap State Public Service Corporation

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, Takayuki Doi

TABLE OF CONTENTS

DATASHEET

BASIC INFORMATION

Country(ies)	Project Name	
Micronesia, Federated States of	SUSTAINABLE ENERGY DEVELOPMENT AND ACCESS PROJECT	
Project ID	Financing Instrument	Environmental Assessment Category
P165183	Investment Project Financing	B-Partial Assessment

Financing & Implementation Modalities

[ ] Multiphase Programmatic Approach (MPA)	[ ] Contingent Emergency Response Component (CERC)
[ ] Series of Projects (SOP)	[✓] Fragile State(s)
[ ] Disbursement-linked Indicators (DLIs)	[✓] Small State(s)
[ ] Financial Intermediaries (FI)	[ ] Fragile within a non-fragile Country
[ ] Project-Based Guarantee	[ ] Conflict
[ ] Deferred Drawdown	[ ] Responding to Natural or Man-made Disaster
[ ] Alternate Procurement Arrangements (APA)	

Expected Approval Date	Expected Closing Date
06-Dec-2018	30-Nov-2023

Bank/IFC Collaboration

No

Proposed Development Objective(s)

To improve reliability of electricity supply, expand access to electricity, and scale up renewable energy generation.

Components

Component Name	Cost (US$, millions)
Improving Reliability of Electricity Supply in Pohnpei State	11.80

Expanding Access to Electricity in Chuuk State	3.45
Scaling up Renewable Energy Generation in Chuuk, Yap and Kosrae States	9.90
Institutional Strengthening and Capacity Building in the Energy Sector	1.90
Technical Assistance and Project Management	2.95

Organizations

Borrower:	Federated States of Micronesia Department of Finance and Administration (DoFA)
Implementing Agency:	Department of Resources and Development (DR&D)

PROJECT FINANCING DATA (US$, Millions)

SUMMARY

Total Project Cost	30.00
Total Financing	30.00
of which IBRD/IDA	30.00
Financing Gap	0.00

DETAILS

World Bank Group Financing

International Development Association (IDA)	30.00
IDA Grant	30.00

IDA Resources (in US$, Millions)

	Credit Amount	Grant Amount	Total Amount
National PBA	0.00	30.00	30.00
Total	**0.00**	**30.00**	**30.00**

Expected Disbursements (in US$, Millions)

WB Fiscal Year	2019	2020	2021	2022	2023	2024

Annual	0.66	2.25	3.36	6.46	9.88	7.39
Cumulative	0.66	2.91	6.27	12.73	22.61	30.00

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	Substantial
2. Macroeconomic	Moderate
3. Sector Strategies and Policies	Substantial
4. Technical Design of Project or Program	Substantial
5. Institutional Capacity for Implementation and Sustainability	High
6. Fiduciary	Substantial
7. Environment and Social	Moderate
8. Stakeholders	Moderate

9. Other	
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	✓	
Performance Standards for Private Sector Activities OP/BP 4.03		✓
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

o Section I.A.1 of Schedule 2 to the Financing Agreement:

The Recipient shall maintain, throughout the Project implementation period, the Energy Division within the Department of Resources and Development with resources, staffing and mandate satisfactory to the Association and with responsibility for implementation of the Project.

Sections and Description

o Section I.A.2 of Schedule 2 to the Financing Agreement:

The Recipient shall establish, by no later than three (3) months after the Effective Date, and thereafter maintain until the Closing Date, a Steering Committee.

Sections and Description
- Section I.A.3 of Schedule 2 to the Financing Agreement:

The Recipient shall maintain, until the Closing Date, the Project Implementation Unit within the Energy Division.

Sections and Description
- Section I.A.4 of Schedule 2 to the Financing Agreement:

The Recipient shall maintain until the Closing Date the Central Implementation Unit.

Sections and Description
- Section I.A.5 of Schedule 2 to the Financing Agreement:

The Recipient shall, in accordance with the Recipient's laws, take all reasonable steps to ensure the State Power Utilities to maintain, throughout the Project implementation period, an engineering unit within each State Power Utility.

Sections and Description
- Section I.C.1 and 2.

The Recipient shall prepare and, through the Project Steering Committee, adopt a Project Implementation Manual, and shall carry out, and in accordance with the Recipient's laws take all reasonable steps to ensure the State Governments and State Power Utilities to carry out, the Project in accordance with the Project Implementation Manual.

Sections and Description
- Section I.D

The Recipient shall prepare and furnish to the Association Annual Work Plans and Budgets not later than four (4) months after the Effective Date (or such later date as the Association may agree); and then August 31 of each year for every subsequent year during the implementation of the Project (or such later date as the Association may agree).

Sections and Description
- Section I.E

The Recipient shall, by no later than eighteen (18) months after the Effective Date, establish and thereafter maintain until the Closing Date, a fund for the operation and maintenance of the Pohnpei Utilities Corporation's energy generation investments supplied and installed under Part 1 of the Project ("Operations and Maintenance Fund").

Sections and Description
- Section I.F.

The Recipient shall ensure that the Project is carried out with due regard to appropriate health, safety, social, and environmental standards and practices, and in accordance with the Safeguards Instruments.

Sections and Description
- Section II.B

The Recipient shall carry out, jointly with the Association, not later than July 1, 2021, or such other date as may be agreed with the Association, a mid-term review of the Project (the "Mid-Term Review").

Conditions

Type	Description
Disbursement	o Section IV.B.1(b) No withdrawal for payments shall be made under Category (1) unless and until the Recipient has: (i) executed the Memoranda of Understanding in accordance with Section I.B of Schedule 2 to the Financing Agreement, to the satisfaction of the Association; (ii) adopted the Project Implementation Manual in accordance with Section I.C of Schedule 2 to the Financing Agreement, to the satisfaction of the Association; and (iii) the Project manager has been recruited and commenced, in accordance with Section I.A.3 to Schedule 2 of the Financing Agreement, to the satisfaction of the Association.

I. STRATEGIC CONTEXT

A. Country Context

1. **The Federated States of Micronesia (FSM) is a small, remote, geographically dispersed Pacific Island Country (PIC).** Similar to many PICs, the FSM faces significant inherent structural challenges to developing an economy that can sustain government functions and effective service delivery. The FSM has a population of approximately 102,453 scattered over an ocean area of 3.0 million km^2. The country is heavily reliant on external assistance, with on-budget grant income estimated to account for 47.4 percent of total revenues (32.6 percent of gross domestic product [GDP]) in 2016. The FSM has few resources, and exports are heavily concentrated on fish. High import dependency exposes the country to global economic shocks and price spikes. The FSM is particularly vulnerable to accelerated sea-level rise and is prone to natural hazards.

2. **A sovereign country since 1986, the FSM is a federation that gives significant power to the four state governments—Pohnpei, Chuuk, Kosrae, and Yap.** Each state has its own executive and legislative bodies and exercises considerable autonomy to manage its domestic affairs. Most public services are delivered at the state level. The FSM maintains deep ties and a cooperative relationship with the United States through the Compact of Free Association. Due to the federal structure and large geographical distances, accomplishing policy decisions at the national level is complex, as consensus across the national and the state governments is required.

3. **While domestic revenue has grown in recent years, mainly driven by higher fishing royalties, the FSM remains heavily dependent on aid—primarily through the Compact of Free Association—to meet both recurrent and development financing needs.** As mentioned earlier, grants contributed 47.4 percent of total revenue in 2016. By comparison, they contributed 55.6 percent in 2004. Since 1986, the Compact has provided large external financial transfers to support the Government in delivering key services, particularly education and health and substantial public sector investment at the state level. Under an Amended Compact Agreement, the FSM has been receiving payments of an inflation-adjusted US$92.7 million per year starting in 2004, with US$76.2 million in the form of grants, US$16.0 million to be placed in a Compact Trust Fund, and US$0.5 million for an annual audit. After the Amended Compact Agreement expires in 2023, investment income from the Compact Trust Fund is expected to replace the grants.

4. **The Government of the Federated States of Micronesia (GoFSM) is currently facing a challenging socioeconomic and fiscal situation.** This is characterized by a decreasing population due to out-migration, which has had an impact on the supply of a skilled labor force; limited economic growth prospects; and real reductions in the Amended Compact Grant fund flows, culminating in limited opportunities for domestic revenue generation. Even under optimistic growth projections, the FSM will still face a significant shortfall in public finances from FY24 due to reduced funding of the Compact Trust Fund. An additional fund, the FSM Trust Fund, was created by Congress in 1999. The National Government has made significant contributions to the FSM Trust Fund over the last three years because it has become clear that the Compact Trust Fund will not provide sufficient income in FY24 to replace the Compact Sector Grant funding levels. Helping address this situation through strengthening public financial management and increasing domestic revenues will be crucial for the FSM's long-term fiscal sustainability.

5. **The FSM's heavy dependence on imported petroleum fuels makes the country highly vulnerable to petroleum price volatility and shocks.** The country currently spends about US$40 million annually on imported fuels, which represents over 50 percent of the aggregate sectoral grants that the nation receives from the United States under the Amended Compact Agreement, and nearly 15 percent of nominal GDP, making energy the costliest sector of its fragile economy. The nation's fuel storage and wholesale distribution facilities are operated by the state-owned enterprise FSM Petroleum Corporation (referred to as PetroCorp and commercially known as 'Vital').

6. **Climate change represents a serious threat for the FSM because of rising air and ocean temperatures, changing rainfall patterns, sea-level rise, and ocean acidification.** Ocean acidification and increased sea-surface temperatures directly harm marine ecosystems, especially coral reefs, having negative consequences for fisheries. The Pacific Ocean has experienced some of the highest rates of sea-level rise which drives coastal erosion, increases the risk of flooding and salinization, and limits the availability of food and water. In addition, the western edge of the Micronesia Region is the most active tropical cyclone basin in the world: on average, 28 tropical storms and typhoons occur annually, causing damage to infrastructure, flooding, and drainage complications. Climate projections indicate that droughts will occur less frequently; however, the incidence of extreme rainfall events is expected to increase.

7. **Gender inequality is pronounced in the FSM—the country ranks 124 out of 187 countries in the United Nations Gender Inequality Index.**[1] Two gender gaps are specifically relevant for the electricity sector and the Sustainable Energy Development and Access Project (SEDAP). First, in terms of access to jobs and promotions, men surpass women in all fields of employment. According to the last available data (2007), nationwide only 38 percent of employees in the private sector are female, and in the public sector only 29 percent of employees are women.[2] Not only are women less represented in the paid workforce, they are concentrated at the lower levels of the hierarchy, with comparatively lower pay. This is also reflected in the energy sector in the FSM. The second gender gap relevant to the project relates to the health consequences of open fire as a primary means of household energy for cooking. Women—whether employed or not—continue to be responsible for most of the burden of household labor, including the preparation and cooking of food. Preliminary data indicate that around 90 percent[3] of non-urban households in Chuuk cook predominantly on open fires, exposing all household members—but primarily women—to toxic particulate matter.

8. **The joint IBRD/IDA/IFC/MIGA[4] Regional Partnership Framework (RPF) for FY17–FY21 outlines the World Bank Group's strategic program for nine Pacific Island Countries (PIC9),[5] including the FSM.**

[1] A composite measure reflecting inequality in achievements between women and men in three dimensions: reproductive health, empowerment, and the labor market. Sourced from the United Nations Development Programme's Human Development Report Office, 2013. http://hdr.undp.org/en/content/gender-inequality-index.

[2] SPC (Secretariat of the Pacific Community). 2012. *Stockage of the Gender Mainstreaming Capacity of Pacific Island Governments - Federated States of Micronesia*. New Caledonia. ISBN: 978-982-00-0524-2. While there is considerable variation across the states, a 2012 gender stock-taking carried out by the SPC reported that male employment levels surpassed women in all fields of work.

[3] This figure is from a rapid assessment made during the Gender Mission to the FSM in June 2018 where 18 households in Chuuk were interviewed on cooking practices.

[4] International Finance Corporation (IFC) and Multilateral Investment Guarantee Agency (MIGA).

[5] Report No. 120479, January 1, 2017. PIC9 include Kiribati, the Marshall Islands, the FSM, the Republic of Nauru, the Republic of Palau, Independent State of Samoa, Kingdom of Tonga, Tuvalu, and Vanuatu. Eight of these countries are IDA eligible and have seen a substantial increase in World Bank Group presence and engagement in recent years.

Adopted in 2017, the RPF focuses on World Bank Group interventions to support the efforts of PIC9 in strengthening macroeconomic management, improving access to basic services and connective infrastructure, and addressing knowledge gaps. The RPF builds upon the deepening engagement with Samoa, Tonga, and Kiribati and the ability to channel significantly more resources to the FSM, the Marshall Islands, Vanuatu, and Tuvalu. This framework has been established at a time when IDA support to the PICs is rising to unprecedented levels. The unique features that define PIC9, and which consequently have a direct bearing on their development agendas, are their small size (they are among the 25 smallest independent states on earth), remoteness, geographic dispersion, environmental fragility, and high degree of exposure to a volatile mix of economic shocks, climate change, and natural disasters. The FSM is ranked 122nd worldwide for hazards and exposure.

B. Sectoral and Institutional Context

9. **Government vision and objectives - National Energy Policy (NEP) and Energy Master Plan (MP).** The FSM's NEP was developed in 2012, setting the country's energy policy framework and actions at the national and state level to achieve its objectives regarding four primary components: Policy and Planning, Conventional Energy (fossil fuel), Energy Efficiency and Conservation, and Renewable Energy (RE). The MP, financed by the ongoing World Bank Energy Sector Development Project (ESDP), was recently completed and adopted by the Government in April 2018. The MP sets out a technically feasible, financeable, and implementable pathway for each state to provide a reliable and environmentally sustainable electricity service to all residents. The plan's target is providing electricity access to more than 80 percent of FSM households by 2020 and to almost every household by 2023. The plan seeks to achieve the FSM's objectives to deploy RE, decrease diesel consumption, and reduce greenhouse gas (GHG) emissions.

10. **Sector institutions.** The Department of Resources and Development (DoR&D) is responsible for assisting the states of Chuuk, Kosrae, Pohnpei, and Yap to develop their economies by focusing on the four priority sectors: energy, fisheries, agriculture, and tourism. The Energy Division of the DoR&D (ED/DoR&D) oversees the energy sector and includes the assistant secretary and a part-time energy adviser and project implementation officer funded through the ESDP. The ED/DoR&D performs the following functions: policy formulation, research on RE potential, coordination among state governments on sustainable use of fuel, and coordination with regional and international counterparts.

11. A National Energy Workgroup (NEW) oversees the activities in the energy sector, especially the implementation of the NEP. The NEW comprises members of key departments in the National Government and interacts closely with the state power utilities. The NEW also interacts with the four State Energy Workgroups[6] responsible for (a) overseeing and coordinating all state efforts in the energy sector, (b) implementing State Energy Action Plans aligned with the NEP, (c) advising the state governments on energy issues, and (d) assisting in the design and development of energy efficiency and RE projects for the consideration, funding, and implementation of development partners.

12. The states' autonomy to manage domestic affairs has resulted in four different public utilities responsible for power generation, transmission and distribution, and water and wastewater systems. The utilities are the Pohnpei Utilities Corporation (PUC), Chuuk Public Utility Corporation (CPUC), Yap State

[6] State Energy Workgroups comprise three or four people: one from the state government, one from the utility, the state energy officer or an energy expert, and one from the private sector or a nongovernmental organization.

Public Service Corporation (YSPSC), and Kosrae Utilities Authority (KUA). These four utilities are autonomous and report to their respective state governors. Each utility has its own tariff structure and is regulated by the Utility Board at the state level.

13. The presence of independent power producers (IPPs) in the FSM is currently limited to Vital's 2 MW power purchase agreement (PPA) with PUC in Pohnpei. The existing PPA does not bring any competitive advantage in the region. The country suffers from high electricity costs on the main islands and even higher costs on the outer islands due to a geographically scattered territory and sector fragmentation that typically preclude economies of scale.

14. **Demand and supply.** Currently, RE (small hydro and solar photovoltaics [PV]) constitutes 9.33 percent of the FSM's electricity generation mix, while petroleum-based fuels account for 81 percent. In the first semester of 2018, the commercial and industrial end-use sector was the largest consumer of electricity (35 percent), followed by the Government (28 percent) and the residential sector (20 percent). The remaining 17 percent was attributed to system's losses. The largest uses of electricity are air conditioning and lighting. Energy demand in rural areas reflects basic needs, such as lighting (often with kerosene, oil lamps, and flashlights) and cooking (wood and other biomass, such as coconut husk, and kerosene with dropping consumption due to cost increases). This is reflected in the monthly expenses in electricity, at US$35 in the main island and only US$15.37 in the outer islands. Specific information on 2017 demand and supply in each of the four federated states is presented in table 1.

Table 1. Electricity Demand and Supply

States	Peak Load (MW)	Growth (%)	Installed Capacity (MW)	RE (%)
Pohnpei	6.6	4.50	13.93	7
Chuuk	2.7	1.61	8.04	3
Yap	2.3	1.49	7.23	22
Kosrae	1.2	1.78	6.15	8

15. **The key sector issues (KSIs) are the following:**

- **Reliability of supply (KSI 1).** PUC's installed capacity is superficially higher than the peak demand. Due to deterioration of unit conditions and maintenance needs, the actual supply capacity is way below the installed capacity. In fact, PUC is experiencing frequent and unscheduled generator shutdowns. As a result, PUC's performance in delivering electricity services is currently well below the standards achieved by CPUC, YSPSC, and KUA. The Pohnpei thermal power plant is equipped with high-speed gensets that are being operated for base load. This leads to the deterioration of the diesel units and their frequent breakdown.[7] The plant will need medium-speed gensets, as confirmed by the MP and Pohnpei energy assessment, to take the base load and reduce the breakdown and damage to the existing high-speed units.

- **Low electricity access rate in Chuuk (KSI 2).** The electricity access rate is about 62 percent of all households in the FSM. Chuuk, where 47 percent of the population resides, lags the other states with the lowest access rate at 27 percent (see table 2). The MP and the Whole

[7] Units purchased under emergency characterized by stringent load shedding which resulted in rating incompatibility with the load profile.

of State Electrification Outline Plan prepared by CPUC seek to address this major issue. However, there is a major lack of funding to expand access to electricity. Where the grid is accessible, the one-off cost of connection (US$40) remains one potential barrier prohibiting poorer households from gaining access.

Table 2. FSM Population, GDP, and Electrification Rate by State, 2018

State	Population (%)	GDP (%)	Electrification Rate (%)
Pohnpei	35	47	95
Chuuk	47	28	27
Yap	11	17	87
Kosrae	7	8	95

- **Financial and system constraints to develop RE investments (KSI 3).** The four utilities are currently expanding RE generation capacity mainly through external assistance from development partners. Although some RE-based solutions are already a cost-competitive alternative to diesel generation, CPUC does not have enough financial capacity to scale up RE generation, whereas solar and wind power plants in YSPSC and KUA are occasionally curtailed due to system constraints, thus the need for solutions such as battery storage and high-speed gensets to accommodate existing wind and solar capacity in Kosrae and Yap. Extension of main grids through undersea cables to nearby islands in Chuuk could foster RE development; however, this option would require a high up-front capital investment.

- **Overdependence of electricity sector on imported fuels (KSI 4).** The FSM is heavily dependent on imported petroleum fuels, resulting in (a) high generation costs of electricity in the FSM compared to an international benchmark for island utilities (Figure 1 shows that for all four utilities, fuel cost is the largest component of cost per unit of electricity sold) and (b) high vulnerability to oil price volatility in the country, including price shocks that would result in higher electricity prices. Such vulnerability adds uncertainty in the energy sector, complicating long-term planning. The deployment of RE technology and improvements in energy efficiency can reduce the fossil fuel dependence, increasing the energy security in the country.

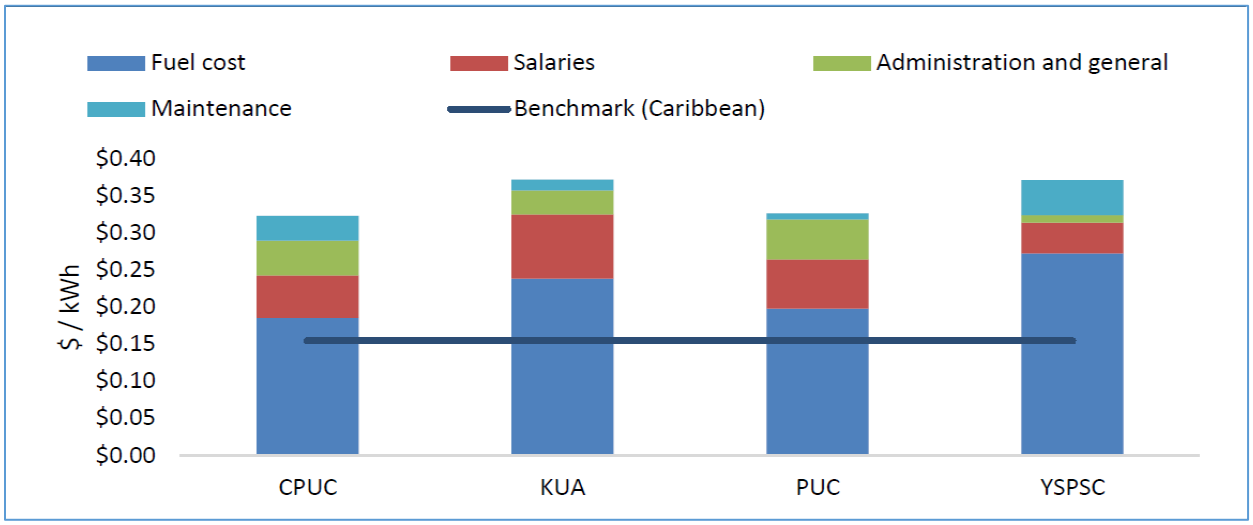
- **High cost of electricity supply (KSI 5).** In the four states, tariffs are relatively high compared to international standards, mainly due to the high cost of fuel. In spite of this, the states' utilities do not fully recover their operation and maintenance (O&M) costs and, consequently, have difficulties financing new power infrastructure. These challenges are particularly acute for PUC, which has higher investment needs due to the large size of generation assets and their deficient maintenance so far. Current average electricity costs and tariffs in the FSM are presented in table 3. The available cost of electricity supply in table 3 reflects total operating expenses divided by electricity sold. These figures do not account for revenue gap due to cross-subsidy between electricity and water and sewage.

Table 3. FSM Average Electricity Costs and Tariffs, 2016

States	Residential Tariff (US$)	Commercial and Industrial Tariff (US$)	Government and Public Authorities Tariff (US$)	Weighted Average Electricity Tariffs (US$/kWh)	Weighted Average Revenue Collected[a] (US$/kWh)	Cost of Electricity Supplied (US$/kWh)
Pohnpei	0.39	0.39	0.39	0.39	0.31	0.32
Chuuk	0.41	0.44	0.46	0.44	0.36	0.33
Yap	0.41	0.49	0.77	0.63	0.58	0.38
Kosrae	0.44	0.48	0.52	0.48	0.43	0.37

Note: **a. Inclusive of collection and distribution losses (distribution losses: PUC-21 percent, CPUC-17 percent, YSPSC-8 percent, and KUA-10 percent).**

Figure 1. Utilities' Costs of Electricity Supplied[b]



Source: MP.

Note: b. For all four utilities, fuel cost is the largest component of cost per unit of electricity sold (electricity costs are without provision for investments). YSPSC and KUA are particularly vulnerable to fuel cost compared to the other utilities; fuel cost correction is not built into tariffs.

- **'Build-neglect-replace' paradigm (KSI 6).** These weaknesses, combined with the lack of spare parts inventory and asset management systems, proper cost accounting, recurrent budget planning, and allocations for regular maintenance, have resulted in a 'build-neglect-replace' paradigm, in which generation infrastructure is inadequately maintained and must be replaced before the end of its normal operating life, though the recent trend is encouraging for some of the utilities. In addition, particularly for PUC, the relative abundance of donor financing for new capital purchases drives the recurrence for this approach.

- **Low representation of women in technical roles within the sector's workforce (KSI 7).** State utilities face acute challenges in recruiting, training, and retaining qualified technical staff. At the same time, there is a perception that women in the FSM have not considered these types of roles as viable career options nor have they been encouraged to pursue these roles by family or potential employers. For example, PUC and CPUC do not have technical roles

undertaken by women. In general, women present an untapped labor pool for utilities. Most roles in utilities are filled by employee referral or word of mouth, neither of which is effective in reaching women as they are not part of the workforce.

- **About 42 percent of the FSM's population is affected by household indoor air pollution (IAP) (KSI 8).** Only 10.6 percent of the population uses electricity for cooking. A significant amount of the population uses kerosene (44.1 percent) or wood (41.5 percent) and a few use liquid petroleum gas (3.6 percent) and other fuels (0.2 percent). Burning solid fuels in traditional stoves emits smoke that contains large quantities of particulate matter and gaseous pollutants. Switching to clean fuels has been identified as the most effective way of reducing IAP. More efficient stoves and improved ventilation conditions can also considerably reduce IAP. Inefficient combustion of traditional biomass results in high levels of IAP due to the particulate matter and carbon monoxide, hydrocarbons, formaldehyde, and benzene released.

16. **Private sector participation.** Both the NEP and the MP recognize private sector participation as an important driver for financing the sector, including the deployment of RE technology. However, none of the four states has yet been able to attract private sector investment to develop renewable generation at a reasonable cost. Moreover, the private sector faces many challenges in the energy sector and, generally, is weak in the region. Table 4 shows the percentage of IPP generation for 22 utilities in 2015. The proposed project will therefore also support the GoFSM in assessing and identifying challenges that are preventing private sector participation to maximizing financing for development (MFD).

Table 4. Percentage of IPP Generation in the PICs[8]

EEC	HECO	GPA	PPL	PUC	EDT	FEA	Others
95	47	41	37	11	1	1	0

17. **Provision of public sector financing.** As of 2018, the marginal productivity of capital in the private sector in the FSM is extremely low. This is due to the islands' remoteness, their small size, and geographic dispersion, which hinder economies of scale and the development of profitable private enterprises. In this environment, public investment in basic infrastructure can improve business conditions and ease constraints to private sector development. Such is the need for additional investments, that it is unlikely that public investments displace private funds. In fact, public investments are likely going to catalyze private investments in the FSM.

18. **World Bank Group support.** The World Bank Group is one of the key partners supporting the GoFSM in its efforts to establish conditions for sustainable and reliable energy provision for economic growth and poverty alleviation. The World Bank currently implements the ongoing ESDP to help the country achieve its long-term sector goals. This project is aligned with the four state MPs, which identified various investments and options to increase electricity access and improve quality of electricity service in each state. Approved in 2014, the ESDP's goal is to increase available generation capacity and efficiency of electricity supply and strengthen the technical capacities of the National Government and the state power utilities.

[8] EEC-Electricité et Eau de Calédonie; HECO- Hawaiian Electric; GPA-Guam Power Authority; PPL-PNG Power Ltd.; EDT-Electricité de Tahiti ; FEA-Fiji Electricity Authority

19. **World Bank Group value added.** The value added does not only lie in the financing and the convening power to mobilize funds from donors and leverage private investments but also in the provision of technical assistance (TA) and capacity building, which are key components of the World Bank's support to, and partnership with, the FSM and which help ensure the sustainability of projects. The World Bank Group, as a global organization, can also apply the global and regional knowledge and experiences to support the energy sector development in the FSM.

20. **Donor support and coordination.** Other donors are actively supporting the FSM's energy sector development strategy and goals generally through investment projects: the World Bank Group, the Japan International Cooperation Agency (JICA), the European Union (EU), the Asian Development Bank (ADB), and the New Zealand Government. The World Bank Group is maintaining close coordination with the Government and consultations with these development partners to avoid overlap and duplication. Tables 5 and 6 present the donors' investments and areas of cooperation in the country.

Table 5. Energy Sector Financing (US$, millions)

Development Partner	World Bank	EU	ADB	United States	JICA	Global Environment Facility	New Zealand	All
Ongoing	14.4	—	9.0	1.2	10	—	1	35.6
Planned 2019	30.0	12	12.5	—	—	2	—	56.5
Total	44.4	12	21.5	1.2	10	2	1	92.1

Table 6. Donors' Involvement

Development Partner	World Bank	EU	ADB	United States	JICA	Global Environment Facility	New Zealand
Thermal generation	X	—	X	X	X	—	—
Access	X	X	X	—	—	—	—
RE	X	X	X	—	—	—	X
Governance and reform	X	X	X	X	—	—	—
Energy efficiency	X	X	—	—	—	X	—
Capacity building	X	X	X	X	X	X	—

21. A Working group of donors and investors was formed to secure the financing needed to start the implementation of the MP in 2019. In April 2018, the ESDP supported a round table with the Working Group, which currently includes the World Bank Group, ADB, the United States, the Bank of Guam, SPC, Secretariat of R&D, Division of Energy, Vital (IPP in Pohnpei), Castalia, PUC, CPUC, KUA, and YSPSC. The MP tracks the development of the FSM energy sector over the next 20 years, with close to US$300 million of investments. The MP estimates that approximately US$100 million of investments will be required in the next 5 years.

C. Relevance to Higher Level Objectives

22. **The proposed project is aligned with the World Bank Group's FY17–FY21 RPF for PIC9, including the FSM.** This RPF's focus areas are (a) fully exploiting the available economic opportunities, (b) enhancing access to employment opportunities, (c) protecting incomes and livelihoods, and (d) strengthening the enablers of growth and opportunities. With the proposed project, the World Bank Group will support

Objective 4.2 of the RPF, "increased access to basic services and improved connective infrastructure," through the installation of solar PV systems and upgrades to electricity generation.

23. **The proposed project is consistent with the Pacific Possible Report.**[9] The report explores transformative opportunities that exist for PICs over the next 25 years and identifies the biggest challenges that require urgent action. It calls for access expansion to remote islands and the development of alternative sources of energy including solar to foster economic development opportunities just like fisheries. The proposed project forms an integral part of the World Bank's overall energy sector engagement in the Pacific.

24. **The proposed project is in line with the World Bank Group's corporate twin goals to end extreme poverty and promote shared prosperity in a sustainable manner by facilitating the FSM's efforts to improve the energy sector performance and access rate, including through increased use of RE in the long term.** This project will (a) improve the energy supply reliability that affects not only households and businesses but also all goods and services linked to electricity, (b) strengthen utilities' financial sustainability, and (c) increase access to electricity in line with the development of state energy MPs. A strong and lasting correlation exists between access to electricity and core human development measures, including poverty reduction, improved health and education, and gender equality.

25. **The project is also aligned with the research findings of the National Renewable Energy Laboratory (NREL) report** 'Electricity Sector Analysis for Federated States of Micronesia Intended Nationally Determined Contribution',[10] which states that electricity generation accounts for 42 percent of the total CO_2e emissions in the country. The FSM's intended nationally determined contribution (INDC), which relates to 80 percent of the country's GHG emissions, commits the country to unconditionally reduce its GHG emissions by 28 percent compared to 2000 levels by 2025. The country also has a conditional target to reduce emissions by up to 35 percent in 2025, compared to 2000 (subject to the availability of additional financial, technical, and capacity-building support from the international community).

II. PROJECT DESCRIPTION

A. Project Development Objective

PDO Statement

26. The Project Development Objective is to improve reliability of electricity supply, expand access to electricity, and scale-up renewable energy generation.

PDO Level Indicators

[9] World Bank. 2017. "Pacific Possible: Long-Term Economic Opportunities and Challenges for Pacific Island Countries (English)." Report No. ACS22308, World Bank, Washington, DC. http://documents.worldbank.org/curated/en/168951503668157320/Pacific-Possible-long-term-economic-opportunities-and-challenges-for-Pacific-Island-Countries.

[10] http://www4.unfccc.int/ndcregistry/PublishedDocuments/Micronesia%20First/Micronesia%20First%20NDC.pdf.

27. PDO indicators are included in table 7.

Table 7. PDO Indicators

PDO Indicators	Unit of Measure
PUC System Average Interruption Duration Index (SAIDI) in Pohnpei	Minutes
People newly provided with access to electricity under the project by household connections to grid/off-grid/mini-grid in Chuuk	Number of people
Annual generation output of renewable energy (other than hydropower) in Chuuk, Yap, and Kosrae	MWh

B. Project Components

28. The proposed project will address the eight KSI identified above by (a) improving reliability of electricity supply in the state of Pohnpei; (b) expanding access to electricity in the state of Chuuk; (c) scaling up RE generation in Chuuk, Yap, and Kosrae; (d) supporting institutional strengthening and capacity building in the energy sector; and (e) providing TA and project management.

29. The project will comprise the five components listed in table 8 with their respective budget allocation (including contingencies).

Table 8. Project Components and Budget

No.	Component	KSI to be addressed	Budget (US$, millions)
1	Improving Reliability of Electricity Supply in Pohnpei State	KSI 1	11.80
2	Expanding Access to Electricity in Chuuk State	KSI 2	3.45
3	Scaling up Renewable Energy Generation in Chuuk, Yap, and Kosrae States	KSI 3	9.90
4	Institutional Strengthening and Capacity Building in the Energy Sector	KSI 4–8	1.90
5	Technical Assistance and Project Management	All the above	2.95
Total			**30.00**

30. **Component 1: Improving Reliability of Electricity Supply in Pohnpei State (IDA US$11.8 million).** This component will address PUC's challenges with insufficient available generation capacity, which is way below the installed capacity, to cover peak demand in a stable manner and reduce unscheduled shutdowns of power supply and unsecure waste oil storage. The component will finance (a) medium-speed diesel gensets of about 7.5 MW total, which will serve base load and provide appropriate redundancy; (b) consultancy for technical specifications and analytical work, maintenance and supervision of works; (c) associated grid facilities in Pohnpei to improve the operational performance and generation capacity of PUC; (d) waste oil storage tank and spill containment; (e) removal of obsolete generation equipment; and (f) electromechanical and electronic equipment, such as a power system supervisory control and data acquisition (SCADA), measuring, monitoring, and protection devices, and converters to help PUC improve its operational performance.

31. **Component 2: Expanding Access to Electricity in Chuuk State (IDA US$3.45 million).** This component will support CPUC to expand access to electricity in Chuuk State, where the access rate is the lowest in the country (27 percent) due to the remoteness of several islands. Specifically, this component will finance (a) the construction of mini-grid systems in the islands of Udot and Satowan; (b) the installation of solar home systems (SHS) in off-grid project areas; the criteria and procedures for selecting

the homes to be fitted with SHS are provided in the MP; and (c) consultancy work for analytical work on power grid and supervision of works. Udot and Satowan are prioritized based on their high population with underserved energy needs, the cost-effectiveness of the investments, customers' affordability, and the alignment with other donors' programs and the Energy MP for the FSM.

32. **Component 3: Scaling up Renewable Energy Generation in Chuuk, Yap, and Kosrae States (IDA US$9.9 million).** This component will support CPUC to install the state's first utility-scale solar power plant to reduce fuel cost of diesel-based power generation and relieve CPUC from the financial burden incurred by access expansion on the outer islands. The component will also support YSPSC and KUA to significantly mitigate the curtailment of the existing RE output and enable the integration of more variable RE through storage capacity and high-speed gensets.

33. The component will finance (a) a 2 MW solar PV power plant in Weno,[11] (b) the installation of about 1 MWh[12] of battery capacity and energy management system for KUA, and (c) the installation of an 830 kW[13] high-speed genset and related ancillary facilities in the existing diesel power plant in Yap. For each of these investments, the component will also finance consultancy work for analytical work on power grid and for supervision during the project implementation.

34. **Component 4: Institutional Strengthening and Capacity Building in the Energy Sector (IDA US$1.9 million).** This component aims at reinforcing the sector's operational and environmental sustainability by improving institutional capacities for governance, identifying strategies to attract private sector investments, and exploring access to other efficient energy solutions.

- **Subcomponent 4.1: Sector Governance.** This component is designed to improve sector governance and financial performance, achieve self-sustainability, and improve assets maintenance strategies. Specifically, this subcomponent will support the following activities:

  (a) **PUC's O&M fund and Performance Contract (PC).** [14] PUC's O&M capacity and corporate functions will be reinforced through the establishment of an O&M fund that will ensure sustainability. The O&M fund shall cover, at least, PUC's generation assets financed by the ESDP and the SEDAP and be set up within 18 months of project effectiveness. A consultant will be recruited to propose the rules, guidelines, and procedures regulating the funding and disbursement of this account; project fund cannot be deposited into this fund. This subcomponent will also include the signature, implementation, and monitoring of a PC. Once the O&M fund and PC are established in PUC, similar schemes in each utility will be expected. Further information about the O&M fund and the PC is available in section III.C. Sustainability.

  (b) **Analytical work and TA.** An assessment on the energy sector readiness for private sector participation will be conducted under this subcomponent. Among other

[11] CPUC has already identified the land for 2 MW scale solar PV.
[12] KUA has already experienced the curtailment of solar power but has an intention to overcome this issue and scale up RE. The battery size will be designed to accommodate the existing solar power and the foreseeable future solar power. The size will further be refined after detailed study is completed.
[13] YSPSC has recently installed wind turbines and has a plan to install further RE systems. However, this could cause some difficulties in frequency control. The MP suggests adding 830 kW scale high-speed genset for stable power supply.
[14] A PC, agreed by relevant parties (PUC, Pohnpei State, and others) to be implemented and monitored based on the recommendations provided by the Graduates School United States' report on PUC.

strategies, the assessment will explore the potential of private-public partnerships to enable solutions to maximize finance for development for future projects. Some recommendations arising from this assessment may also be financed under this component. A preliminary identification of other potential themes to cover through this TA include (a) instruments to create an institutional, legal, and regulatory framework conducive to a self-sustained sector; (b) assessments for competitive and gender-neutral selection of key management positions and the participation of independent administrators in the Board; (c) a collaboration program with local schools, colleges, and media that encourages increasing the numbers of female candidates who apply for technical vocational roles; and (d) utility financial recovery plans, if needed.

- **Subcomponent 4.2: Efficient and Clean Cookstoves.** This subcomponent will finance (a) a detailed household survey assessment of the challenges and opportunities for intervention in selected islands of the FSM to address health (gender-disaggregated), environmental, livelihood, gender, and climate change issues associated with household energy for cooking; the criteria and procedure for selecting islands for the cookstoves survey assessment will be specified in the PIM; (b) awareness campaigns through (i) social mobilization to ensure that potential users are aware of the fuel-saving and health benefits associated with efficient and clean cooking and (ii) potential cooking demonstration workshops using different types of efficient and clean cookstoves and fuels to test consumer preferences and willingness to adopt and to purchase them; and (c) preparation of documentation necessary to identify and design a large-scale intervention on household energy for cooking in the FSM, which considers women's health benefits and employment opportunities, that may support an operation for the dissemination of clean cookstoves in the future.

35. **Component 5: Technical Assistance and Project Management (IDA US$2.95 million).** This component will finance (a) contract staffing for the project, including a project manager, consultancies and non-consultancies, office and other equipment, travel, and operational costs; (b) training and workshops; (c) recruitment of a full-time energy adviser to assist and support the Secretary of Resources and Development (SoR&D) on energy sector policy matters and development strategy; (d) support to utilities on respective activities implementation, including support on coordination, monitoring and evaluation (M&E), and reporting; and (e) capacity building for local experts through technical transfer and on-the-job training with international consultants.

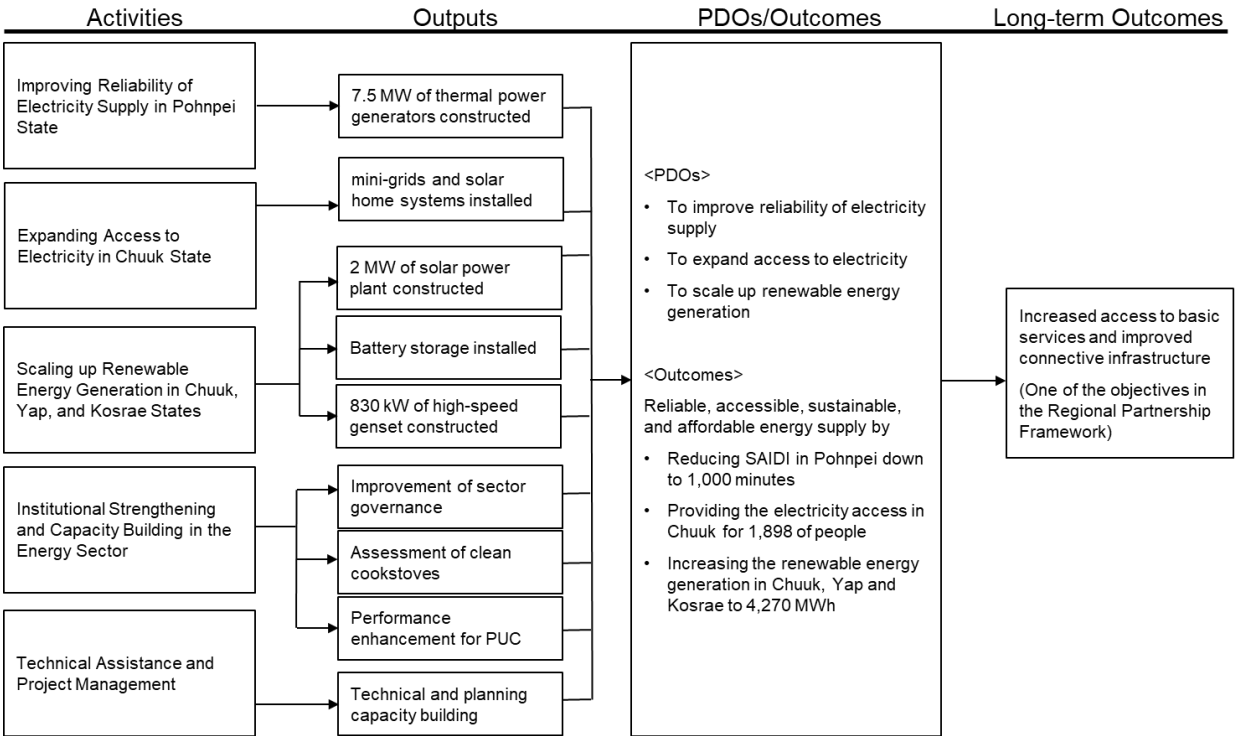
C. Project Beneficiaries

36. Direct project beneficiaries include FSM electricity consumers (residential, commercial, industrial, and the Government) who will benefit from an improved and more efficient and reliable electricity supply (sixty two percent of the population or about 63,685 peoples). In the long term, this could contribute to more affordable and sustainable tariffs. Over time, by reducing the dependence on imported fuel with volatile prices and supplies, the project will benefit the country 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, managers, and the utilities' technical staff 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.

D. Results Chain

37. The proposed activities are designed to achieve the practical outcomes of improving the reliability of electricity supply, expanding access to electricity, and scaling up RE generation. At the same time, these outcomes contribute toward achieving the long-term goal of increasing access to basic services and improving connective infrastructure, as specified in the RPF FY17–FY21. Figure 2 represents this theory of change.

Figure 2. Theory of Change



38. In broader terms, the project is also expected to significantly and positively affect (a) productivity due to improved access to modern electricity services and reliable electricity supply, (b) the economic activities and growth of the outer islands of the FSM, and (c) environmental externalities.

E. Rationale for World Bank Involvement and Role of Partners

39. Improving electricity supply and access is one of the FSM's most pressing development issues, as identified in the RPF FY17–FY21. Given the country's lack of private sector interest and absence of economies of scale and scope, public sector intervention is needed at least in the short to medium term to improve the sector's performance and efficiencies and the electricity services and access rate.

40. The rationale for public sector financing of thermal electricity rests primarily on the following factors: (a) low income levels of the target population, (b) an inadequate enabling environment, (c) the high up-front costs of alternative technologies in some contexts, (d) the limited experience with solar technologies and private provision of electricity services, and (e) the need for development of the

investment climate in the FSM. Low incomes and low electricity consumption levels create unattractive conditions for the private sector. Outer island remoteness and access solutions associated with solar technologies have high capital costs, which makes it more difficult to attract commercial financing.

41. The participation of an IPP in Pohnpei has improved the reliability of supply to some extent. However, existing PPAs do not bring any competitive advantage in the region due to the absence of economic scale, and public sector intervention is still needed. The proposed financing for the diesel generators (a) is part of the least-cost option in the FSM Energy MP, (b) will help resolve the energy crisis materialized by frequent load shedding, (c) will reduce the operation of inefficient diesel generators, and (d) enable more RE integration.

42. The World Bank's involvement is critical for MFD and development impact by (a) stimulating a sound donor coordination process that avoids replication, creates synergies among projects, and ensures a coherent approach for the sector's investments and (b) addressing binding constraints (operational, regulatory, and enabling environment) to unlock private solutions for IPPs in the future. To achieve this, the project will support the Donors and Investors Working Group, which includes actors from the private sector and aims to foster private sector participation in the energy sector.

43. There seems to be no sustainable private sector solutions that would limit public intervention in the sector, owing in part to policy or regulatory gaps and weaknesses. Therefore, the SEDAP scope and interventions are designed to assist the GoFSM to explore private sector participation in the energy sector under Subcomponent 4.1, in alignment with the corporate requirement for projects to support policy and regulatory reforms for MFD.

44. Public resources will be used to assess private sector interest and potentially create appropriate incentives to mitigate the risks of doing business in the FSM that was deemed commercially unattractive by the private sector. Increasing the share of RE will have an impact on the development of the solar market, which may require concessional financing in the early stage of the market development to attract the private sector and banks to take risks and invest in the supply and distribution chains. This type of concessional financing could enable the transition from pure public sector initiatives to a sustainable, commercially viable market for solar products in the FSM.

45. In addition, the World Bank will consider possible interventions for gender equality, citizen engagement, climate co-benefits, and climate and disaster risk mitigation during project preparation.

- **Gender equality.** By helping to meet the FSM's electricity needs, the project will enable social development and economic growth, contributing to the World Bank Group's twin goals of reducing extreme poverty and promoting shared prosperity. This project will pay attention to the needs of women and young people, in line with country priorities on gender and youth (cross-cutting themes throughout the RPF pillars). Specifically, the project will address inequalities between men and women in the following two areas: (a) access to paid work and (b) exposure to health risks. The following paragraphs explain these gender gaps, the project's actions to reduce them, and how progress will be measured.

(a) **Women are employed at a far lower rate than men in the power sector, specifically in technical roles.** The proportion of women in technical and managerial positions is particularly low. In power utilities across the Pacific, only around 30 percent of senior staff

and 4 percent of technical staff are women. In CPUC, only 10 out of the 80 people employed are women and all work in administration and finance. In PUC, only 10 of its 156 employees are women, who work in administration and finance. At the same time, utilities across the region struggle to identify and retain competent staff. Tapping into the potential female workforce offers the opportunity for utilities to expand their talent pool. While redressing the gender gap in engineering roles requires a longer lead time (to develop a pipeline of university-qualified female candidates), both utilities found it easily feasible in principle for women to carry out technical jobs such as meter reading, power system monitoring, and line crewing. The investments made in the power sector through this project and others over the coming years are expected to require more technical skilled staff. To enable staffing needs to be met while addressing the gender gap, the project will design and implement a collaborative outreach program with local schools, colleges, and media, aimed at increasing the numbers of female candidates who apply for technical vocational roles. The project will furthermore support the Chief Executive Officers and HR officers of CPUC and PUC power utilities to establish gender-responsive HR practices and will fund internships and on-the-job training for selected female candidates in technical vocational roles. The progress in reducing the gender gap will be measured with an indicator for the increased share of women employed by CPUC and PUC in technical roles in the power sector.

(b) **Cooking practices put women's health at risk.** Gendered division of labor at home and the culture of cooking with open fires result in women's health risks due to inhalation of toxic particulate matter. A preliminary gender assessment indicates that these risks are higher for women than men.[15] The introduction of cookstoves has the potential to increase opportunities for women to paid work related to manufacturing. Thus, the project will fund a cookstoves assessment, to gather more reliable data on cooking methods in the FSM and inform the design of a clean cookstoves solution and supply arrangements. The project will work with Chuuk Women's Council to employ members to facilitate the assessment and data gathering.[16]

- **Citizen engagement.** During the preparation of the safeguards instruments, a Stakeholder Engagement Plan (SEP) and Grievance Redress Mechanism (GRM) was prepared. The SEP together with the GRM consider gender aspects and support the engagement of and benefits for vulnerable and marginalized groups and are integral to address social issues. This approach facilitates continuous and meaningful engagement with affected communities and other stakeholders by allowing people to submit their views throughout project preparation and implementation. These tools introduce new behavioral insights and improve project efficiency by facilitating transparency

[15] Non-urban women spend on average around 3 hours per day directly over the cooking fire versus 0 on average for men. Average PM 2.5 readings in cooking fire areas in Chuuk were 700–800 micrograms per cubic meter of air, far in excess of recognized 'safe' levels for human health. For context, the U.S. Environmental Protection Agency (EPA) rates the 'safe' level of PM 2.5 exposure at a maximum of 35 in any single 24-hour period and 12 as an annual average. Given women's domestic role, the preliminary gender assessment suggests exposure to toxic smoke is a higher health risk for women compared to men. However, there is currently a lack of relevant sex-disaggregated public health data in the FSM.".

[16] The assessment will gather data on the number of hours weekly that women spend time on: (a) collecting firewood, (b) directly cooking over the fire, (c) self-reported incidences of health problems women associated with cooking, and (d) establish statistically representative average for PM2.5 levels in cooking areas while the fire is lit; identify options for targeting female employees in the supply of cookstoves in Chuuk. Progress to reducing the gender gaps will be measured by employment opportunities and through the Clean Cooking Assessment that considers women's health benefits.

and accountability. Overall, GRMs increase trust between citizens and governments, helping to build social cohesion.

- **Climate co-benefits.** The FSM's INDC to the 2015 Global Climate Agreement set a target to reduce GHG emissions by 28 percent by 2025. This project contributes to achieving this target by allowing the substitution of traditional energy in Chuuk, Yap, and Kosrae where more RE will be deployed and the reduction of fuel consumption in Pohnpei where higher efficient generators will be dispatched.

  (a) **Climate adaptation and disaster risk mitigation.** Although the FSM's contribution to climate change has always been marginal, climate adaptation is one of its priorities. Efforts are being made in the formulation and implementation of transformational adaptation investment plans to protect the country against climate change hazards. Various funding sources finance these efforts, including the United Nations Framework Convention on Climate Change (UNFCCC) financial mechanisms such as the Green Climate Fund.[17] As outlined in its first national communication to the UNFCCC in 1997, the FSM's major concerns as a coastal nation are vulnerability to sea-level rise and to more frequent, intense, or long-lasting El-Niño droughts and La Niña floods and storms. By presenting an ambitious INDC in the context of the Paris Agreement, the FSM realizes that the very survival of many small islands developing states is at stake without ambitious global emission reductions. This project aims to reduce the FSM's reliance on wood; it will thus contribute to decreasing deforestation and destruction of mangroves, resulting in fewer flashfloods and, respectively, less coastal erosion.

F. Lessons Learned and Reflected in the Project Design

46. **Design.** The World Bank's experience in implementing energy projects in the PICs (including in the Marshall Islands, Tuvalu, Vanuatu, Solomon Islands, and Papua New Guinea), as well as in other small islands (such as Maldives and Comoros, among others) and the current FSM SEDP project has been applied in the design of the SEDAP. Due to the small scale of power systems in the PICs, mini-grids and integrated RE have to be carefully designed to stabilize the system operation and mitigate the curtailment of RE. In addition, utilities have encountered difficulties in O&M caused by salt damage, high tide, wind gust, and lack of spare parts and skills at site.

47. **Targeted and flexible assistance.** The proposed project responds to the FSM priorities regarding the critical need to improve the performance of power utilities and diversify their energy mix 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, TA for strengthening managerial and technical capacity, and targeted energy efficiency interventions to be identified with stakeholders.

48. **Technical challenges.** The project has been designed to consider challenges regarding mini-grid formulation, RE management, tropical weather conditions and climate resilience, and O&M in remote small islands. Logistics, grid-connected facilities, and capacity building will be designed, prepared, and

[17] Lima Call for Climate Action, 2014; https://unfccc.int/files/meetings/lima_dec_2014/application/pdf/auv_cop20_lima_call_for_climate_action.pdf.

implemented under Component 5 of this project to address these challenges. In addition, institutional arrangements have been designed to reflect lessons learned from the World Bank's practice and experience in the FSM, as well as other PICs. Previously, each project had its own implementation unit. This required many different part-time advisers and caused delays, inefficient communications, and additional travel costs. In this project, the Centralized Implementation Unit (CIU) handles the fiduciary matters of multisectoral pooled projects, and the ED/DoR&D is primarily responsible for preparation and implementation of this specific project. The utilities cover technical aspects with the ED/DoR&D.

49. **Sustainability.** Another lesson drawn from past infrastructure projects, particularly in the Pacific Region, is the critical role of maintenance in ensuring sustainability. Maintenance of the power plant and the PV installations will be facilitated by ensuring that all equipment and installations under the project conform to the standards that the World Bank Sustainable Energy Industry Development Project (SEIDP[18]) has developed for the Pacific Region's PV systems and components or other compatible standards. In addition, an O&M fund and a PC will be set up for PUC to ensure that O&M services are available throughout the life-span of the infrastructure and improve corporate functions. Once the O&M fund and the PC are established in PUC, a similar scheme will be expected for each utility. Finally, maintenance contracts will be signed with suppliers to guarantee sound maintenance of the equipment purchased under the project and O&M knowledge transferred to FSM operators. If needed, the SEDAP's provisions for capacity-building activities could cover training for FSM power system operators on O&M related to the technology acquired under the project.

50. **Duplication risks.** 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 World Bank team has been continuously conducting consultations with other development partners involved in the energy sector. The FSM also conducted a series of consultations, including the 2018 donor round table, with its partners in the sector before expressing requests for support. The risk of unnecessarily duplicating activities as well as the risk of technical and operational incompatibilities is therefore mitigated.

III. IMPLEMENTATION ARRANGEMENTS

A. Institutional and Implementation Arrangements

51. R&D is responsible for overall project preparation and implementation. A Project Implementation Unit (PIU) will be established within the ED/DoR&D and include a project manager and support staff and will be supported by CIU staff including a financial management (FM) specialist, a procurement specialist, and a safeguards specialist. The procurement specialist, FM specialist, and the safeguards specialist are the CIU's personnel and support the implementation of various IDA-financed projects, including this one. The PIU will coordinate the implementation of the project with the ED/DoR&D, the states, and the utilities in a manner that is to be set forth in the Memorandum of Understanding (MoU) that outlines the roles of each organization. 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. The MoUs will clarify, among others, the necessary state and intra-government cooperation and support necessary for the project.

[18] Project ID: P152653

52. The project manager will be responsible for overall project coordination and technical guidance and will support the procurement of the various procurement packages and studies. The project manager will report to the assistant secretary at the ED/DoR&D and to the Project Steering Committee (PSC). The CIU, as the unit coordinating all related procurement and financial matters, will be responsible for the project's fiduciary aspects. The CIU will be a functional unit within the DoFA and support the implementation of the Bank's portfolio. Additional procurement and safeguards support may also be considered, if needed.

53. A PSC will be established and comprise, among others as may be required, the Secretary of DoFA, the SoR&D, a representative of the PIU, a representative of the CIU, ED/DoR&D, the CEOs of each of the state utilities, and the chairs of the state energy working groups. The PSC will be established within three months of effectiveness and will provide oversight and strategic guidance during project implementation, in accordance with the terms of reference of the PSC. The SoR&D will chair the PSC.

54. A Project Implementation Manual (PIM) will be prepared by the PIU and the CIU and adopted by the PSC not later than three months after effectiveness and will include (a) institutional arrangements for day-to-day execution of the project; (b) the Procurement Plan and implementation arrangements; (c) guidance on implementation of safeguard instruments and GRM; (d) budgeting, disbursement, and FM processes; and (e) project monitoring, reporting, evaluation, and performance indicators including implementation of, and compliance with, World Bank safeguard policies.

55. An Engineering Unit will be created within each utility to provide daily support to the implementation of the SEDAP. These units will be composed of the utility's owner's engineer, as well as dedicated staff who will support construction and supervision. The project manager will work with the Engineering Unit to coordinate and ensure sound project implementation according to the role's scope of work.

56. Table 9 lists the units involved in implementation and supervision; the CIU will provide support through the recruited procurement specialist, FM specialist, safeguards specialist, monitoring and evaluation officer, and communication staff.

Table 9. Implementation and Supervision Units

Unit	Staff
PIU	Project Manager, support staff
PUC-Engineering Unit	Owner's Engineer, PUC-SEDAP dedicated staff
CPUC-Engineering Unit	Owner's Engineer, CPUC-SEDAP dedicated staff
YSPSC-Engineering Unit	Owner's Engineer, YSPSC-SEDAP dedicated staff
KUA-Engineering Unit	Owner's Engineer, KUA-SEDAP dedicated staff

B. Results Monitoring and Evaluation Arrangements

57. The PIU will conduct overall monitoring and coordination of project activities with data and information provided by the relevant agencies in accordance with the indicators included in Section VI - Results Framework. No later than 45 days after each biannual period, the PIU will submit biannual progress reports to the World Bank, covering all project activities, including a procurement and financial summary report in accordance with the PIM. The biannual progress reports will also reflect monitoring of training (training session details, attendants' names and roles) and GRM (whether grievances are received

and if/how feedback is used). 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 FM and a post procurement review. The CIU will further reinforce monitoring capacity of the PIU for matters including, but not limited to, training, citizen engagement, gender, and capacity-building activities.

58. The PIU will, no later than July 2021 (or such other date as agreed with the World Bank), carry out a midterm review of the project and prepare and provide the World Bank a report documenting the progress achieved in the implementation of the project. During the period preceding the date of this report, the PIU will consider the M&E activities performed and set 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. The midterm report will also be reviewed with the World Bank, on or about one month after its submission, and thereafter the project and the World Bank will take all measures required to ensure the continued efficient implementation of the project and the achievement of its objectives.

C. Sustainability

59. Sustainability of this project is supported by the GoFSM's strong commitment to the project objectives, PUC's PC and O&M fund setup, and the expected savings in fuel consumption by all four utilities and the reduced electricity consumption due to the TA. In line with the GoFSM's strategy, this project will consistently contribute to (a) securing the supply of electricity by using domestic potential and (b) limiting the exposure of the FSM'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.

60. **Commitment to the project objectives.** The GoFSM's commitment to the project's objective is reflected by the adoption of the NEP in 2012 and the MP. Among others, the NEP's goals include increasing (a) the share of electricity generated from renewable sources to 30 percent by 2020, (b) energy efficiency by 50 percent as part of the 'Green Micronesia Initiative', (c) the average energy generation efficiency of conventional generating units by 20 percent by 2015, and (d) rural electrification rate to 90 percent by 2020.

61. **Expected savings in fuel consumption for the sector.** At projected fuel prices during 2019–2023, annual average of avoided diesel oil would be an estimated equivalent of a 7 percent reduction in diesel oil fuel usage in 2018 due to increased RE penetration and diesel plant efficiency improvement, representing a cost saving of US$0.8 million per year in present value in real 2018 prices with a financial opportunity cost of capital (FOCC) of 4 percent,[19] which provides a strong incentive for project implementation.

62. **Capacity building.** The project will build capacity within the energy sector, through structured capacity-building programs and by funding specialist advisers who will work alongside the existing staff, and the increased capacity is expected to remain after the project ends. Sustainability is also favored by the lessons learned during the preparation and implementation of the ESDP.

[19] For an estimation of FOCC, see annex 4.

63. **Design, procurement, and construction.** The SEDAP's main activities[20] will be developed by seasoned contractors with sound experience in project design and development and mitigation of construction risks. An owner's engineer will be recruited by each utility to support and assist in the preparation of technical aspects of the procurement document, evaluation of proposals, design review and supervision. The World Bank, the PIU, and the CIU will further assist, providing guidance on key activities such as citizen engagement, reviewing and clearing important technical and contractual documents, and ensuring that safeguards activities are fully integrated during design and implementation.

64. **PC.** PUC's struggle to effectively fulfil its public service missions stem in part from its inability to implement a cost recovery tariff and other issues, all under the authority of the state of Pohnpei. By setting the obligations of each party to the contract, the PC will contribute to secure SEDAP's sustainability.

65. **O&M fund.** A dedicated account with sufficient funds will be created within 18 months following the effectiveness date to anticipate and guarantee funding requirement for major overhaul and O&M for PUC's energy generation investments supplied and installed under the project. This is expected to ameliorate poor facilities maintenance and depleted infrastructure decommissioned well before the life-span of the equipment and diminish the very high costs of replacement. The project may support the creation of similar O&M funds for CPUC, YSPSC, and KUA, as needed.

66. **Disaster risk reduction.** Given that the FSM is prone to natural disasters, risk-reduction measures and climate resilience will be considered during project engineering, including robust design specifications able to cope with increased wind speeds, floods, high temperatures, corrosion, and ground shaking as applicable, and non-engineering options on O&M procedures. The Pacific Power Association will provide the support on the disaster preparedness for the Pacific utilities that includes FSM, and a separate technical assistance to support the FSM's utilities is currently under preparation. In addition, the GoFSM has requested to include a Contingency Emergency Response Component (CERC)[21] within the scope of the maritime project planned to be approved by the end of 2018.

IV. PROJECT APPRAISAL SUMMARY

A. Technical, Economic and Financial Analysis

Technical

67. **Technology assessment.** Technology choice was determined by the MP and the Pohnpei Energy Assessment based on the least-cost investment plan and various factors including sector readiness to comply with O&M requirements. The project presents common construction and operational challenges. The technical parameters and estimated project costs were established by detailed feasibility and engineering studies, including land surveys, carried out by internationally recognized consultants and

[20] PUC's diesel power plant, CPUC's PV solar plant and network construction in Satawan and Udot, battery storage facility in Kosrae, and YSPSC's diesel genset.

[21] The CERC is designed to provide swift response in the event of an eligible crisis or emergency, defined as "an event that has caused, or is likely to imminently cause, a major adverse economic and/or social impact associated with natural or manmade crises or disasters." Including a CERC in a project minimizes the time and effort needed to make available uncommitted funds from a project to finance urgent needs in the event of a crisis or emergency.

corroborated with actual unit costs for similar undertakings in the Pacific Region. The diesel gensets and mini-grids, including solar PV and electrical distribution lines, are well-known and proven technologies. The technology that will be procured under the project will have accessible spare parts markets and will not require highly qualified technical profiles for O&M.

Economic and Financial Analysis

68. The preliminary analysis covered 93 percent of the total project cost. The analysis could not cover the remainder of the project cost due to the following reasons. Component 4: Institutional Strengthening and Capacity Building in the Energy Sector is not covered as the component is not yet defined in detail and most activities covered are studies and assessments. Reflecting these omissions, the analysis also reduced proportionally the project cost of the rest of the project's overarching activities. Results are further detailed in annex 4.

Economic Analysis

69. The economic analysis shows that the project's activities and inputs would meet the PDO with a net present value (NPV) of US$38 million at an estimated social discount rate of 1.3 percent, or about 8 percent of 2018 estimated GDP, an economic internal rate of return (EIRR) of 16 percent, and the levelized cost of electricity (LCOE) of US$0.26 per kWh. LCOE of different technologies ranges between US$0.10 per kWh and US$1.46 per kWh. Results by technology are summarized in table 10. The high LCOE and low return in Satowan are the consequence of fuel transportation costs.

Table 10. Economic Analysis Results Summary

	PUC	CPUC				KUA	YSPSC	Total
	Gensets	Solar Weno	Udot Mini-grid	Satowan Mini-grid	Udot SHS	Battery Storage	Genset	
ENPV (US$, millions)	27.1	4.6	2.9	0.5	1.3	1.4	0.4	38.4
EIRR (%)	21	9	16	5	51	15	9	16
LCOE excluding TA, real (US$/kWh)	0.26	0.14	0.93	1.86	0.40	0.82	0.14	0.26

Note: ENPV = Economic Net Present Value.

Financial Analysis

70. Following the World Bank guidance, the financial analysis of the entire project was undertaken from an implementing agency perspective. Because each utility will carry out the project-funded activities, the financial analysis from a utility perspective was also conducted. As the project is fully financed by one financial source (IDA grant), the cost of the grant was assumed to be the cost of equity or the Government's economic cost of capital (the Government's cost of raising capital). Thus, the financial analysis used an estimated FOCC of about 4 percent, real.[22] The financial net present value (FNPV) is US$37 million and results by technology are presented in table 11. As the IDA grant (cash inflow) entirely

[22] This estimate is based on the historical return and long-term outlook of the International Monetary Fund (IMF) of nominal 5 percent return of the Compact Trust Fund (CTF) and FSM Trust Fund, adjusted with an expected 0.9 percent inflation rate.

offsets the investment cost (cash outflow), a meaningful financial internal rate of return (FIRR) could not be computed for most of the subcomponents.

Table 11. Financial Analysis Summary

	PUC	CPUC				KUA	YSPSC	Total
	Gensets	Solar Weno	Udot Mini-grid	Satowan Mini-grid	Udot SHS	Battery Storage	Genset	
FNPV (US$, millions)	24.8	8.7	0.3	0.1	0.2	1.5	1.8	37.4
FIRR (%)	—	—	168	59	—	-—	—	—
LCOE excluding TA, real (US$/kWh)	0.27	0.19	1.17	2.36	0.49	0.91	0.15	0.27

Environmental Sustainability

71. The project is designed considering the best practices in environmental sustainability. 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 while the impacts are not significant.[23] Globally, the proposed project is expected to avoid about 137,000 tons CO_2e of GHG emissions. Under the World Bank guidance, total ENPV with CO_2e low value[24] is US$44 million and EIRR is 18 percent. With a CO_2e high value, the NPV is US$50 million and the EIRR is 20 percent. The switching value of US$ per CO_2e ton is −US$259 per CO_2e ton.

B. Fiduciary

(i) Financial Management

72. An FM assessment was conducted in accordance with the 'Principles-Based Financial Management Practice Manual' issued by the Board on March 1, 2010. The assessment found that the proposed project FM arrangements meet the FM requirements stipulated in OP/BP 10.00 (Investment Project Financing). The FM risk is reduced as the DoFA has gained some experience with managing World Bank projects and the recent establishment of the CIU with experienced and qualified staff has reduced the assessed FM risk for FSM projects. The only mitigating measure would be that the project would finance a project accountant or equivalent position to meet the needs of the CIU to enable it to maintain adequate resources to meet the FM requirements of all the projects under its umbrella.

73. **Budgeting arrangements.** The CIU will provide support to staff from the ED/DoR&D and the project manager in the preparation and regular reviews of the project budget. Foreign-assisted projects greater than US$50,000 are reviewed by Congress for approval by resolution, if they are not included in the Appropriation Bill. When the Appropriation Bill or a resolution is passed, allotments against appropriations are entered into the Government accounting system.

[23] Local emissions costs were estimated based on the methodology advised in P. Meier. 2017. Power Sector Investment Projects: Guidelines for Economic Analysis.
[24] The World Bank guidance increases the constant U.S. dollar 2017 prices by 2.25 percent per year. These prices were adjusted to real prices in 2018 FSM U.S. dollar 2018 prices, a low value starting from US$40 per ton and a high value starting from US$80 per ton from 2019 and increasing thereafter.

74. **Accounting arrangements.** The Government currently maintains financial accounts in FundWare, a software with the following fully integrated modules: accounts payable, accounts receivable, payroll, and general ledger. The chart of accounts enables segregation of the project transactions and classification by component. While it is envisaged that a new financial reporting system will be introduced by the Government during the life of this project, this will not reduce the capacity of the current reporting requirements. Project transactions will be entered by the CIU directly into the Government accounting system. The current staff resources in the CIU are a program manager, finance officer, finance assistant, and a finance graduate. The expansion of the portfolio of World Bank-financed projects in the FSM means that the CIU will require additional staff over time. The project will finance additional staff, which may include an additional project accountant or equivalent position to enable the CIU to meet all its FM obligations. The accounting arrangements proposed for this project meet the World Bank's requirements.

75. **Internal controls.** The Financial Management Regulations of the FSM dictate the Government's internal control framework and provide adequate segregation of duties, asset controls, and approval and authorization controls. The PIM will provide guidance on project internal controls either specifically required for the project or not covered in sufficient detail in the regulations. The CIU is also preparing a guidance note on the role and responsibilities of the CIU for the areas of FM and procurement to ensure consistency across the portfolio on processes and understanding the CIU which will be included in future PIMs. For the FM section, this will include a template for performance reviews, process for approving incremental operating costs, monitoring, and management of travel advances as well as general processes for transactions.

76. **Financial reporting.** The project will prepare interim financial reports (IFRs) in U.S. dollars and in the format agreed with the World Bank, to be submitted no later than 45 days after the end of each semester. The reports will initially be produced from the existing FundWare system and will ultimately be generated from the new Financial Management Information System. The IFR will report by funds received from the World Bank, expenditure by component, and have accurate encumbrance balances that will be reconciled back to a more detailed commitment register maintained on a spreadsheet. Reports should show activity for the reporting period, year to date, and cumulative.

77. **External audit.** Audit of project funds will be part of the auditing of National Government accounts as project funds will be fully integrated therein. Audited National Government accounts will be submitted to the World Bank within nine months of the end of each fiscal year. Subject to the inclusion of the note below in the national accounts produced during the life of the project, no separate project audit will be required. The World Bank reserves the right to request additional information to supplement information provided in the National Government accounts and to request a project audit if the required note is not included in the National Government accounts.

Table 12. Template - Summary Information on Transactions Taking Place during the Year

	Current Year	**Preceding Year**	**Cumulative**
	US$	**US$**	**US$**
Amounts received during the year	X	X	X
Expenditures during the year	(X)	(X)	(X)

Note: X: World Bank Financing.

(a) The GoFSM received financial support from the World Bank IDA Grant No. XX dated mm/dd/yy to support implementation of [describe].

(b) The total amounts received from World Bank IDA Grant No. [xx] since its commencement were [xx] as at

September 30 [xx].

(c) The proceeds of the World Bank grant have been expended in accordance with the intended purposes as specified in the Grant Agreement.

Disbursements

78. **Flow of funds.** Disbursements under the project may be under any of the following methods: (a) advances into and replenishment of the Designated Account (DA), (b) direct payment, (c) reimbursement, and (d) special commitment. Direct payments will be used solely for large contracts.

79. A DA will be established in U.S. dollars at a commercial bank acceptable to the World Bank. The DA will be operated on an advance basis and the initial advance will be made through the completion and submission of a withdrawal application. The DA will be held in U.S. dollars. Subsequent replenishments will be made through the submission of withdrawal applications, along with details on the use of funds previously advanced, based on statements of expenditures and bank reconciliation of the DA.

80. Table 13 shows categories of expenditure and amounts eligible for financing, also found in the legal agreement. Note that, in the case of discrepancy, the version referred to in the Legal Agreement takes precedence over table 13.

Table 13. Financing Agreement Disbursement Categories and Amounts

Category	Amount of the Financing Allocated (US$)	Amount of the Financing Allocated (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 Parts 1, 2, 3, and 4 the project	26,140,000	18,800,000	100%
(2) Goods, non-consulting services, consulting services, training and workshops, and operating costs for Part 5 the project	3,460,000	2,500,000	100%
(3) Refund of Preparation Advance	400,000	300,000	Amount payable pursuant to Section 2.07 of the General Conditions
TOTAL AMOUNT	**30,000,000**	**21,600,000**	

81. The Preparation Advance amounts to US$0.4 million and covers consultancy works, aims to progress project readiness by the recruitment of the project manager, the energy adviser, and a safeguard specialist; and for PUC, the design and specification of the power plant and the preparation of the PC.

82. No withdrawal shall be made (a) for payments made before the signature date or (b) under Category (1) unless and until the recipient has (i) executed the MoU in accordance with Section I.B of Schedule 2 to the Financing Agreement, to the satisfaction of the Association; (ii) adopted the PIM in accordance with Section I.C of Schedule 2 to the Financing Agreement, to the satisfaction of the Association; and (iii) the project manager has been recruited and commenced, in accordance with Section I.A.3, to the satisfaction of the Association.

(ii) Procurement

83. Procurement under this project will follow the World Bank Procurement Regulations for IPF Borrowers (July 2016, revised November 2017 and August 2018, Procurement Regulations).

84. Key risks relating to procurement include (a) lack of experience of the PIU in implementing procurement following the procedures in the Procurement Regulations, (b) inadequate experience of the utilities with procurement of contracts for the nature and size under this project, (c) limited staffing and capacity of the utilities to provide technical inputs to procurement undertakings, and (d) delays associated with multiple-agency reviews. Key risks relating to procurement will be largely mitigated with the support of the international procurement specialist from the CIU, the project manager of the PIU, and the owner's engineers from the utilities.

85. The World Bank task team will provide implementation support and relevant procurement training, including on the use of the new Procurement Implementation Guidance and the Systematic Tracking of Exchanges in Procurement (STEP). This application will be used to prepare, clear, update, and monitor Procurement Plans and conduct all procurement transactions for the project. The PIM will be prepared and will include a Procurement Module which will expound on the procurement arrangements to implement the Procurement Plan and guide the project in its procurement operations.

C. Safeguards

(i) Environmental Safeguards

86. OP/BP 4.01 on Environmental Assessment is triggered on the basis that the installation and use of diesel and solar electricity generation infrastructure can have low to moderate impacts on people, land, water, and vegetation. For mini-grids, environmental risks come from the clearance of land for infrastructure and the ongoing risk of fuel and oil spills. Increasing the diesel generation capacity at PUC and YSPSC provides an opportunity to increase fuel efficiency and improve the handling of waste oil through investments in waste oil infrastructure and O&M training. Overall, the environmental risk is considered moderate and the project is classified Category B. Impacts are preventable and/or readily mitigatable using good industry practice. The location of 2 MW of solar investments in Weno, Chuuk, is yet to be confirmed. There are risks related to the clearance of vegetation and/or reclamation of land, depending on the nature of land parcels that become available for lease.

87. An Environmental and Social Management Plan (ESMP) has been prepared to manage the environmental and social risks of all activities except the solar investments on Chuuk, for which an Environmental and Social Management Framework (ESMF) has been prepared. The impact management measures are standard for most sites and are prescribed under the ESMP. Site-specific impacts for the solar investments on Chuuk will be screened and assessed during project implementation. Once installed, RE investments will avoid additional air emissions from diesel and reduce the risk of oil and fuel spills and contamination. Supporting the increased use of clean cookstoves is likely to result in minor improvements in mangrove and forest health from decreased fuelwood harvesting.

88. Environmental management measures from the ESMP, ESMF, and Stakeholder Engagement Plan (SEP) will be integrated into the site selection, design, tendering process, and the installation and operation of equipment. Environmental and social management, including GRM and consultations, will

be supported by the CIU environmental and social adviser. This person will be responsible for ensuring full compliance with the safeguards policies and safeguards instruments for SEDAP. This will be done through the review of documents, training, and capacity building for utility staff and consultants and taking responsibility for tasks such as supervision of works or developing consultation campaigns. The ESMP, ESMF and SEP instruments were disclosed on the Bank's website on October 17, 2018 and in-country on October 17, 2018.

89. The Policy on OP/BP 4.11 (Physical Cultural Resources) is triggered. The site screening and selection process in the ESMF will allow CPUC to avoid disturbances and other impacts on physical cultural resources as much as possible. However, due to the limited land availability on the small island of Weno, and the other variables such willing landowners, flat sites, good access to the grid, there is the possiblity that impacts on physical cultural resources may not be avoidable, and mitigation measures will be required.

90. The Policy on OP/BP 4.04 (Natural Habitats) is triggered. Small areas of land (a total of approximately 2-3ha) will be required in Chuuk for solar investments, and the location of infrastructure is flexible. The site screening and selection process in the ESMF will allow CPUC to avoid disturbances and other impacts on natural habitats as much as possible. However, due to the limited land availability on the small island of Weno, there is the possibility that impacts on natural habitats may not be avoidable, and mitigation measures will be required. The ESMF requires an ESIA to be completed where there will be moderate to significant impacts on ecological services, natural habitats or threatened species.

(ii) Social Safeguards

91. Almost the entire population of each State is indigenous. The policy OP4.10 Indigenous Peoples is triggered because the beneficiaries are overwhelmingly indigenous and as such the principles of the policy have been integrated into project design and the safeguards instruments. A Stakeholder Engagement Plan incorporates the elements of an Indigenous Peoples Plan reflecting free, prior and informed consultation approaches.

92. Land acquisition requirements are expected to be minimal. Notwithstanding this, OP/BP 4.12 Involuntary Resettlement is triggered to ensure land-related issues are managed in accordance with World Bank requirements.

93. Where generators are being replaced, existing landholdings will be used. Similarly, the mini-grids to improve energy access in Chuuk are expected to be carried out within public road reserves. Depending upon the final layout and design, some land may be required for essential equipment; however, it is expected that most impacts can be avoided by good design. In Chuuk, approximately 2 ha will be required for 2 MW of solar generation equipment. Chuuk has an established process for land-related issues for utilities under the CPUC Act 1996 (amended in 2007) which requires, among other things, that if the landowner can demonstrate loss of value by having assets on/under their land, CPUC must compensate for these losses. CPUC also uses voluntary land donations where the impact is very minor and the donor is a direct beneficiary and enters into leases to access land. The law only allows for the eminent domain taking of land if a lease cannot be agreed. An important element of the project from a social perspective will be effectively integrating citizen engagement into the subproject design. A Resettlement Policy Framework has been prepared to document the voluntary land acquisition and land lease arrangements

and the compensation arrangements. The RPF was disclosed on the Bank's website on October 17, 2018 and in-country on October 17, 2018.

94. Specific gender-focused work is being undertaken during design to ensure that gender-disaggregated data is captured to allow for effective design. This work will also assess risks associated with gender-based violence and sexual exploitation and assault. Meaningful consultation will be carried out during subproject design and an SEP has been prepared to guide ongoing engagement during implementation. These activities will inform the social assessment to be prepared during design.

95. Environmental and social management, including GRM and consultations, will be supported by the CIU environmental and social adviser.

(iii) Grievance Redress Mechanisms

96. In terms of citizen engagement, this project will use findings from technical studies to prepare an SEP and further develop GRMs. The GRMs, which consider gender aspects and support vulnerable and marginalized groups, are integral to address social issues. This approach can improve citizen engagement as it facilitates continuous and meaningful engagement with affected communities and other stakeholders by allowing people to submit their views throughout project preparation and implementation. These tools introduce new behavioral insights and improve project efficiency by facilitating transparency and accountability. Overall, the GRMs increase trust between citizens and governments; they build social cohesion.

97. Communities and individuals who believe that they are adversely affected by a WB supported project may submit complaints to existing project-level GRMs 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, as a result of WB non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the WB'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*.

V. KEY RISKS

98. **The overall risk rating is rated Substantial** due to institutional arrangements, the country's limited technical capacity in the energy sector, potential land availability issues, unanticipated costs overrun due to the country's market size and distance from major markets, and the vulnerability of its economy to external shocks. More information on specific risks rated Substantial or High are provided in the following paragraphs.

99. **Political and governance risks are considered Substantial.** The lack of capacity and decentralization at ED/DoR&D coupled with the fragmentation of the energy sector, utilities' autonomy and institutional anchoring to states, and coordination challenges on sector policy and strategy inherent to the multitude of partners drive these risks. As the country is working to improve access, increase the share of RE, and achieve a more sustainable energy sector, donor coordination is key to fulfilling these

objectives effectively through least-cost, complementary, and integrated solutions. The Government and the donor community will maintain an intensive dialogue on the energy sector, including its financial situation, through a common platform built around the MP, relevant economic and sector work, and the FSM energy sector strategy.

100. **Institutional capacity for implementation and sustainability risks is rated High.** Despite the PIU's experience in implementing World Bank-funded ESDP, given its limited capacity, the project is designed to be instrumental for broadening and strengthening implementation capacity by recruiting a project manager and relying on the CIU for all fiduciary, safeguards, and communication matters. Additional part-time technical capacity will also be financed as needed. Sustainability is built upon the choice of technology and instruments such as the PC and the O&M funds for the utilities.

101. **Sector strategies and policies risks are considered Substantial.** The FSM 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 RE sources and improvements in operations will contribute to the mitigation of this risk.

102. **Technical capacity and design risks are considered Substantial.** Though no common construction and operational challenges are expected, logistics and costs escalations will remain risks that need to be mitigated during implementation due to the remoteness of the outer islands, insufficient capacity and experience to develop solar PV projects, and PUC's struggles with thermal power plant O&M. Mitigation measures include recruitment of seasoned owner's engineers to support each utility and international consultants on a part-time and need basis. The energy adviser at the DoR&D and capacity building activities will also contribute to this strategy of mitigation.

103. **Fiduciary risks are considered substantial.** Implementation arrangements have been designed based on lessons learned in implementing the ESDP, as well as other projects in the FSM and the PICs. However, this project will be the first investment project financing managed by the CIU. Fiduciary risks pertain to the multitude of stakeholders involved (CIU, PIU, PUC, CPUC, YSPSC, and KUA) in implementation of the project as well as the sectoral fragmented share of responsibilities and may materialize in (a) a lack of coordination among entities, (b) noncompliance, and (c) implementation delays. Mitigation measures include the PIM, the MoUs, the Steering Committee, and capacity building activities.

VI. RESULTS FRAMEWORK AND MONITORING

Results Framework
COUNTRY: Micronesia, Federated States of
SUSTAINABLE ENERGY DEVELOPMENT AND ACCESS PROJECT

Project Development Objectives(s)

To improve reliability of electricity supply, expand access to electricity, and scale up renewable energy generation.

Project Development Objective Indicators

Indicator Name	DLI	Baseline	Intermediate Targets				End Target
			1	2	3	4	
Improving Reliability of Electricity Supply in Pohnpei State							
PUC System Average Interruption Duration Index (SAIDI) (Minutes)		4,000.00	4,000.00	2,500.00	1,500.00	1,000.00	1,000.00
Expanding Access to Electricity in Chuuk State							
People newly provided with access to electricity under the project by household connections Grid/Off-grid/mini-grid in Chuuk (Number)		0.00	0.00	1,898.00	1,898.00	1,898.00	1,898.00
Scaling up Renewable Energy Generation in Chuuk, Yap and Kosrae States							
Annual Generation Output of Renewable Energy (other than hydropower) in Chuuk, Yap and Kosrae (Megawatt		1,930.00	1,930.00	2,500.00	3,500.00	3,750.00	4,270.00

Indicator Name	DLI	Baseline	Intermediate Targets				End Target
			1	2	3	4	
hour(MWh))							

Intermediate Results Indicators by Components

Indicator Name	DLI	Baseline	Intermediate Targets				End Target
			1	2	3	4	
Component 1: Improving Reliability of Electricity Supply in Pohnpei State							
Generation capacity of energy constructed or rehabilitated (CRI, Megawatt)		0.00	0.00	7.50	7.50	7.50	7.50
Thermal (conventional) power generation capacity constructed under the project (CRI, Megawatt)		0.00	0.00	7.50	7.50	7.50	7.50
Component 2: Expanding Access to Electricity in Chuuk State							
Number of households receiving new connections (Number)		0.00	0.00	272.00	272.00	272.00	272.00
Component 3: Scaling up Renewable Energy Generation in Chuuk, Yap and Kosrae States							
Battery Storage Capacity in Kosrae (Megawatt hour(MWh))		0.00	0.00	1.00	1.00	1.00	1.00
Generation capacity of energy constructed or rehabilitated (CRI, Megawatt)		0.00	0.00	0.83	2.83	2.83	2.83
Thermal (conventional) power generation capacity constructed under the project (CRI, Megawatt)		0.00	0.00	0.83	0.83	0.83	0.83

Indicator Name	DLI	Baseline	Intermediate Targets				End Target
			1	2	3	4	
Renewable energy generation capacity (other than hydropower) constructed under the project (CRI, Megawatt)		0.00	0.00	0.00	2.00	2.00	2.00
Component 4: Institutional Strengthening and Capacity Building in the Energy Sector							
Clean Cooking Assessment available, which consider women's health benefits and employment opportunities (Yes/No)		No	No	Yes	Yes	Yes	Yes
Number of women employed by CPUC and PUC in technical roles in the power sector (Number)		0.00	0.00	1.00	2.00	3.00	4.00
Performance contract in effect for PUC (Yes/No)		No	No	Yes	Yes	Yes	Yes
Component 5: Technical Assistance and Project Management							
Project-supported organization(s) publishing periodic reports on GRM and how issues were resolved [including resolution rates] (Yes/No) (Yes/No)		No	Yes	Yes	Yes	Yes	Yes

Monitoring & Evaluation Plan: PDO Indicators					
Indicator Name	**Definition/Description**	**Frequency**	**Datasource**	**Methodology for Data Collection**	**Responsibility for Data Collection**
PUC System Average Interruption Duration Index (SAIDI)	This indicator measures the average total duration of electricity outages over the course of a year for each PUC customer(minutes).	Annual	PUC/PIU reports	In the absence of accurate data to determine the baseline for PUC, the baseline is estimated by extrapolating the SAIFI difference beteween YSPS and PUC to their SAIDI. The target is the current average SAIDI of other electrical utilities in the country, namely, CPUC, KUA and YSPSC.	PUC/PIU
People newly provided with access to electricity under the project by household connections Grid/Off-grid/mini-grid in Chuuk	This indicator measures the number of people that will receive or improved electricity service through operations supported by the World Bank in Chuuk.	Annual	CPUC report	This indicator aggregates the number of people provided with access to electricity services under the project by household connections (grid or off-grid). The number of people is estimated based on an average of 7 people per household according to the last census	/CIU

				available[1]. [1] Government of the Federated States of the Micronesia, 2003: http://www.fsmgov.org/press/pr05300b.htm	
Annual Generation Output of Renewable Energy (other than hydropower) in Chuuk, Yap and Kosrae	This indicator measures in megawatts-hour (MWh) grid connected RE generated by KUA, CPUC and YSPSC.	Annual	KUA, CPUC, YSPSC reports	This indicator will be measured by totalizing RE generated (MWh) by KUA, CPUC and YSPSC by grid connected PV and Wind plants.	PIU/CIU

Monitoring & Evaluation Plan: Intermediate Results Indicators					
Indicator Name	**Definition/Description**	**Frequency**	**Datasource**	**Methodology for Data Collection**	**Responsibility for Data Collection**
Generation capacity of energy constructed or rehabilitated		This indicator provides the capacity of thermal diesel unit installed in Ponhpei by the project.	PUC	PUC reports	PUC, PIU, CIU

Thermal (conventional) power generation capacity constructed under the project		Annual	PUC's and YSPSC's reports	PUC and YSPSC installed capacity of thermal generation by the project	PIU/CIU
Number of households receiving new connections	This indicator aggregates the number of households provided with access to electricity services under the project by household connections (grid or off-grid).	Annual	CPUC 's reports	Number of households provided with access to electricity services under the project by household connections (grid or off-grid) in Chuuk.	PIU/CIU
Battery Storage Capacity in Kosrae	This indicator provides the capacity of battery storage installed in Kosrae by the project.	Annual	KUA/PIU reports	KUA reports	KUA/PIU
Generation capacity of energy constructed or rehabilitated		Annual	KUA, CPUC, YSPSC	KUA, CPUC, YSPSC reports	KUA, CPUC, YSPSC, PIU, CIU
Thermal (conventional) power generation capacity constructed under the project		This indicator provides the capacity of the diesel engine unit installed by the project	YSPSC	YSPSC report	YSPSC, PIU, CIU

Renewable energy generation capacity (other than hydropower) constructed under the project		Anuual	CPUC	CPUC reports	CPUC, PIU, CIU
Clean Cooking Assessment available, which consider women's health benefits and employment opportunities	This indicator measures whether the detailed household assessment has been completed.	Annual	PIU reports	PIU	
Number of women employed by CPUC and PUC in technical roles in the power sector	This indicator measures the number of women conducting technical qualified jobs at CPUC and PUC.	Annual	This indicator is a composite of the women, in number, conducting technical qualified jobs at PUC and CPUC.	PUC's and CPUC's reports	PIU/CIU
Performance contract in effect for PUC	Performance Contract to be established with the support of a consultant, based on the US Graduates Scholl report and the ADB assessment.	Annual	PUC report	Starting date of the performance contract must be included in the semi-annual progress report.	PIU/CIU
Project-supported organization(s) publishing periodic reports on GRM and how issues were resolved [including resolution rates] (Yes/No)	This indicator measures whether functional mechanisms are available during the project implementation to receive feedback from beneficiaries and how feedback has been addressed/used.	Annual	PIU/PUC/CPUC/KUA/YSPSC reports	Confirmation that the mechanisms are maintained functional during the implementation must be included in the semi-annual progress report, stating if/how feedback	PIU/PUC/CPUC/KUA/YSPSC

	Mechanism can include, but do not need to be necessarily limited to telephone numbers, email addresses, visiting hours to utilities' officials or mail addresses, amongst others. This is a yes/no indicator			has been used.	

ANNEX 1: Implementation Arrangements and Support Plan

COUNTRY: Micronesia, Federated States of
SUSTAINABLE ENERGY DEVELOPMENT AND ACCESS PROJECT

I. Project Institutional and Implementation Arrangements

1. The planned implementation period for the Sustainable Energy Development and Access Project is five years. The proposed closing date is November 30, 2023.

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 the targets for the clean and efficient cookstoves assessment; and (vii) the boundaries of defined Project Areas and the criteria and procedure for selecting additional Project Areas.

Steering Committee

3. A PSC will be established and comprise, among others, as may be required, the Secretary of DoFA, the SoR&D, a representative of the PIU, a representative of the CIU, ED/DoR&D, the CEOs of each of the state utilities, and the chairs of the state energy working groups. The PSC will oversee and provide strategic guidance during the project implementation. The SoR&D will chair the PSC. The PSC will be established within three months of project effectiveness.

Implementation Agencies

4. R&D is responsible for overall project preparation and implementation. A Project Implementation Unit (PIU) will be established within the ED/DoR&D and include a project manager and support staff and will be supported by CIU staff including a financial management (FM) specialist, a procurement specialist, and a safeguards specialist. The procurement specialist, FM specialist, and the safeguards specialist are the CIU's personnel and support the implementation of various IDA-financed projects, including this one. The PIU will coordinate the implementation of the project with the ED/DoR&D, the states, and the utilities in a manner that is to be set forth in the Memorandum of Understanding (MoU) that outlines the roles of each organization. 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. The MoUs will clarify, among others, the necessary state and intra-government cooperation and support necessary for the project.

5. The table below lists the units involved in implementation and supervision; the CIU will provide support through the recruited procurement specialist, FM specialist, safeguards specialist, monitoring and evaluation officer, and communication staff.

. Implementation and Supervision Units

Unit	Staff
PIU	Project Manager, support staff
PUC-Engineering Unit	Owner's Engineer, PUC-SEDAP dedicated staff
CPUC-Engineering Unit	Owner's Engineer, CPUC-SEDAP dedicated staff
YSPSC-Engineering Unit	Owner's Engineer, YSPSC-SEDAP dedicated staff
KUA-Engineering Unit	Owner's Engineer, KUA-SEDAP dedicated staff

Project Management

6. The project manager will be responsible for overall project coordination and technical guidance and will support the procurement of the various procurement packages and studies. The project manager will report to the assistant secretary at the ED/DoR&D and to the Project Steering Committee (PSC). The CIU, as the unit coordinating all related procurement and financial matters, will be responsible for the project's fiduciary aspects. The CIU will be a functional unit within the DoFA and support the implementation of the Bank's portfolio. Additional procurement and safeguards support may also be considered, if needed.

7. An Engineering Unit will be created within each utility to provide daily support to the implementation of the SEDAP. These units will be composed of the utility's owner's engineer, as well as dedicated staff who will support construction and supervision. The project manager will work with the Engineering Unit to coordinate and ensure sound project implementation according to the role's scope of work.

II. Financial Management

1. An FM assessment was conducted in accordance with the 'Principles-Based Financial Management Practice Manual' issued by the Board on March 1, 2010. The assessment found that the proposed project FM arrangements meet the FM requirements stipulated in OP/BP 10.00 (Investment Project Financing). The FM risk is reduced as the DoFA has gained some experience with managing World Bank projects and the recent establishment of the CIU with experienced and qualified staff has reduced the assessed FM risk for FSM projects. The only mitigating measure would be that the project would finance a project accountant or equivalent position to meet the needs of the CIU to enable it to maintain adequate resources to meet the FM requirements of all the projects under its umbrella.

2. **Budgeting Arrangements.** The CIU will provide support to staff from the ED/DoR&D and the project manager in the preparation and regular reviews of the project budget. Foreign-assisted projects greater than US$50,000 are reviewed by Congress for approval by resolution, if they are not included in the Appropriation Bill. When the Appropriation Bill or a resolution is passed, allotments against appropriations are entered into the Government accounting system.

3. **Accounting Arrangements**. The Government currently maintains financial accounts in FundWare, a software with the following fully integrated modules: accounts payable, accounts receivable, payroll, and general ledger. The chart of accounts enables segregation of the project transactions and classification by component. While it is envisaged that a new financial reporting system will be introduced by the Government during the life of this project, this will not reduce the capacity of the current reporting requirements. Project transactions will be entered by the CIU directly into the Government accounting system. The current staff resources in the CIU are a program manager, finance officer, finance assistant, and a finance graduate. The expansion of the portfolio of World Bank-financed projects in the FSM means that the CIU will require additional staff over time. The project will finance additional staff, which may include an additional project accountant or equivalent position to enable the CIU to meet all its FM obligations. The accounting arrangements proposed for this project meet the World Bank's requirements.

4. **Internal Controls.** The Financial Management Regulations of the FSM dictate the Government's internal control framework and provide adequate segregation of duties, asset controls, and approval and authorization controls. The PIM will provide guidance on project internal controls either specifically required for the project or not covered in sufficient detail in the regulations. The CIU is also preparing a guidance note on the role and responsibilities of the CIU for the areas of FM and procurement to ensure consistency across the portfolio on processes and understanding the CIU which will be included in future PIMs. For the FM section, this will include a template for performance reviews,

process for approving incremental operating costs, monitoring, and management of travel advances as well as general processes for transactions.

5. **Flow of Funds.** Funds Disbursements under the project may be under any of the following methods: (a) advances into and replenishment of the Designated Account (DA), (b) direct payment, (c) reimbursement, and (d) special commitment. Direct payments will be used solely for large contracts.

6. A DA will be established in U.S. dollars at a commercial bank acceptable to the World Bank. The DA will be operated on an advance basis and the initial advance will be made through the completion and submission of a withdrawal application. The DA will be held in U.S. dollars. Subsequent replenishments will be made through the submission of withdrawal applications, along with details on the use of funds previously advanced, based on statements of expenditures and bank reconciliation of the DA.

7. **Financial Reporting.** The project will prepare interim financial reports (IFRs) in U.S. dollars and in the format agreed with the World Bank, to be submitted no later than 45 days after the end of each semester. The reports will initially be produced from the existing FundWare system and will ultimately be generated from the new Financial Management Information System. The IFR will report by funds received from the World Bank, expenditure by component, and have accurate encumbrance balances that will be reconciled back to a more detailed commitment register maintained on a spreadsheet. Reports should show activity for the reporting period, year to date, and cumulative.

8. **Audit.** Audit of project funds will be part of the auditing of National Government accounts as project funds will be fully integrated therein. Audited National Government accounts will be submitted to the World Bank within nine months of the end of each fiscal year. Subject to the inclusion of the note below in the national accounts produced during the life of the project, no separate project audit will be required. The World Bank reserves the right to request additional information to supplement information provided in the National Government accounts and to request a project audit if the required note is not included in the National Government accounts.

III. Disbursements

9. A DA will be established in U.S. dollars at a commercial bank acceptable to the World Bank. The DA will be operated on an advance basis and the initial advance will be made through the completion and submission of a withdrawal application. The DA will be held in U.S. dollars. Subsequent replenishments will be made through the submission of withdrawal applications, along with details on the use of funds previously advanced, based on statements of expenditures and bank reconciliation of the DA.

10. The Preparation Advance amounts to US$0.4 million and covers consultancy works, aims to progress project readiness by the recruitment of the project manager, the energy adviser, and a safeguard specialist; and for PUC, the design and specification of the power plant and the preparation of the PC.

11. The table below shows categories of expenditure and amounts eligible for financing, also found in the legal agreement. Note that, in the case of discrepancy, the version referred to in the Legal Agreement takes precedence over the table.

Financing Agreement Disbursement Categories and Amounts

Category	Amount of the Financing Allocated (US$)	Amount of the Financing Allocated (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 Parts 1, 2, 3, and 4 the project	26,140,000	18,800,000	100%
(2) Goods, non-consulting services, consulting services, training and workshops, and operating costs for Part 5 the project	3,460,000	2,500,000	100%
(3) Refund of Preparation Advance	400,000	300,000	Amount payable pursuant to Section 2.07 of the General Conditions
TOTAL AMOUNT	**30,000,000**	**21,600,000**	

IV. Procurement

12. Procurement under this project will follow the World Bank Procurement Regulations for IPF Borrowers (July 2016, revised November 2017 and August 2018, Procurement Regulations).

13. Key risks relating to procurement include (a) lack of experience of the PIU in implementing procurement following the procedures in the Procurement Regulations, (b) inadequate experience of the utilities with procurement of contracts for the nature and size under this project, (c) limited staffing and capacity of the utilities to provide technical inputs to procurement undertakings, and (d) delays associated with multiple-agency reviews. Key risks relating to procurement will be largely mitigated with the support of the international procurement specialist from the CIU, the project manager of the PIU, and the owner's engineers from the utilities.

14. The World Bank task team will provide implementation support and relevant procurement training, including on the use of the new Procurement Implementation Guidance and the Systematic Tracking of Exchanges in Procurement (STEP). This application will be used to prepare, clear, update, and monitor Procurement Plans and conduct all procurement transactions for the project. The PIM will be prepared and will include a Procurement Module which will expound on the procurement arrangements to implement the Procurement Plan and guide the project in its procurement operations. A PPSD has been prepared.

V. Strategy and Approach for Implementation Support

15. 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.

16. 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.

17. 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.

18. A mid-term review would encompass a more in-depth stock taking of performance under the project and will take place starting on July 21, 2021, 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.

VI. Implementation Support Plan and Resource Requirements

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

Table 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	

Table 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 2: Detailed Project Description

COUNTRY: Micronesia, Federated States of
SUSTAINABLE ENERGY DEVELOPMENT AND ACCESS PROJECT

Project Components

1. The proposed project will address the eight key sector issues identified in section I: B. Sectoral and Institutional Context by (a) improving reliability of electricity supply in the state of Pohnpei; (b) expanding access to electricity in the state of Chuuk; (c) scaling up RE generation in Chuuk, Yap, and Kosrae; (d) supporting institutional strengthening and capacity building in the energy sector; and (e) providing TA and project management.

2. The project will comprise the five components listed in table 2.1 with their respective budget allocation (including contingencies).

Table 2.1. Project Components and Budget

No.	Component	Key Sector Issues (to Be Addressed)	Budget (US$, millions)
1	Improving Reliability of Electricity Supply in Pohnpei State	KSI 1	11.80
2	Expanding Access to Electricity in Chuuk State	KSI 2	3.45
3	Scaling up Renewable Energy Generation in Chuuk, Yap and Kosrae States	KSI 3	9.90
4	Institutional Strengthening and Capacity Building in the Energy Sector	KSI 4–8	1.90
5	Technical Assistance and Project Management	All the above	2.95
Total			**30.00**

3. **Component 1: Improving Reliability of Electricity Supply in Pohnpei State (IDA US$11.8 million).** This component will address PUC's challenges with insufficient generation capacity to cover peak demand and unscheduled shutdowns of the power supply. Superficially, the installed generation capacity seems higher than the peak demand. Due to deterioration and maintenance needs, the actual supply capacity is way below the installed capacity. PUC owns seven gensets. Three gensets out of seven are second-hand, and there have been a range of maintenance issues because these gensets were commissioned, including an inability to fund the procurement of spare parts on time. Two gensets out of seven are containerized mobile generators, which are well suited to short-term deployments rather than continuous and permanent use. In this manner, most of the generators that PUC owns are not suitable for base power source, and the customers of PUC suffer from frequent power outages. Without an additional stable generation source, the reliability of electricity supply is expected to keep going down. Both the MP and Pohnpei Energy Assessment have concluded that diesel technology remains the most appropriate technology to address these challenges. The component will finance (a) medium-speed diesel gensets of about 7.5 MW total, which will serve the base load and provide appropriate redundancy; (b) consultancy for technical specifications and analytical work, maintenance and supervision of works; (c) associated grid facilities in Pohnpei to improve the operational performance and generation capacity of PUC; (d) electromechanical and electronic equipment, such as a power system Supervisory Control And Data Acquisition (SCADA), measuring, monitoring, and protection devices, and converters to help PUC improve its operational performance; (e) waste oil storage tank and spill containment; and (f) removal of obsolete generation equipment.

4. Medium-speed diesel gensets of 7.5 MW (2.5 MW x 3) will be reliable and efficient base power source for PUC and will allow PUC to achieve and maintain N-2 criteria[25] together with TA and adequate relay protection systems. The MP and the Pohnpei Energy Assessment study show that conventional feeder faults are causing total power station outages due to insufficiently coordinated genset protection systems. A well-coordinated protection system will be installed under the project. It will only isolate the faulted feeder and not cascade to a total power station black out. The average outage duration for each customer is expected to improve significantly. The outcome of this component will be measured by SAIDI.

5. While all four states' electricity utilities struggle to some degree to ensure full cost recovery, sustain sound O&M, and implement investment strategies that will foster economic development in the FSM, PUC faces these challenges most acutely. Pohnpei has the largest economy, is second in population, and has the highest rate of electrification; however, PUC is struggling to meet the demand and needs support in improving its electricity supply and reliability. In Pohnpei, the grid is mostly diesel based, with some hydro and existing solar funded by other development partners.

6. PUC has been operating since 2009 under an official declaration of emergency. While there have been brief periods of relief, the entire operations of PUC in providing power, water, and sewerage services to the people of Pohnpei are at risk of extended periods of service disruption. The financing of approximately US$10.8 million of capital contributions from FY12 to FY15 and subsidies in excess of US$2.8 million from FY09 to FY15 have not resulted in an improvement in the financial status of PUC. The net position of PUC has declined by over US$1.7 million during the period since FY09. The unrestricted net position of PUC fell into deficit in FY15 for the first time since FY07; the ratio of current assets to current liabilities has deteriorated to its worst level as well, with PUC holding just 0.62 in current assets for every US$1.00 of current liabilities, a sign of severe illiquidity. Bad debt allowances have also peaked, with 78 percent of PUC's accounts receivable deemed uncollectible. Pohnpei's residential and commercial power consumers who had once relied upon nearly fault-free and continuous power are now subject to frequent planned and unplanned outages, reducing total demand and creating knock-on expenses that typically remain uncompensated.

7. The Graduate School United States Pacific Islands Training Initiative recently supported a management and operation review study for the state of Pohnpei called the Capitalization, Recovery and Institutional Strengthening Program (CRISP).[26] The CRISP study is endorsed by the state of Pohnpei and based on the assessment, the PUC Board initiated the Framework for a Multi-Donor Funded Capitalization, Recovery and Institutional Strengthening Program Concept Note made available to the donor community. The CRISP approach includes three major axes: (a) capitalization - investment in power, water, and sewage infrastructure at US$24 million costed and more than US$60 million un-costed; (b) recovery support - rehabilitate existing facilities, enhance operation at US$5.8 million; and (c) institutional strengthening - fund for two to three years for a Supplemental Management and Operation team (SMO) at US$2.65 million.

8. The project will support the implementation of CRISP and complement and align with the ongoing ESDP, which already covers part of the recovery support axis. From an institutional perspective, a return

[25] N-2 is the redundancy criteria that PUC aims to obtain. N-2 means that PUC can supply electricity even under the situation that two generators suddenly become nonfunctional at the same time.
[26] This initiative previously supported the state of Chuuk to improve CPUC's management and operation performances; www.econmap.org.

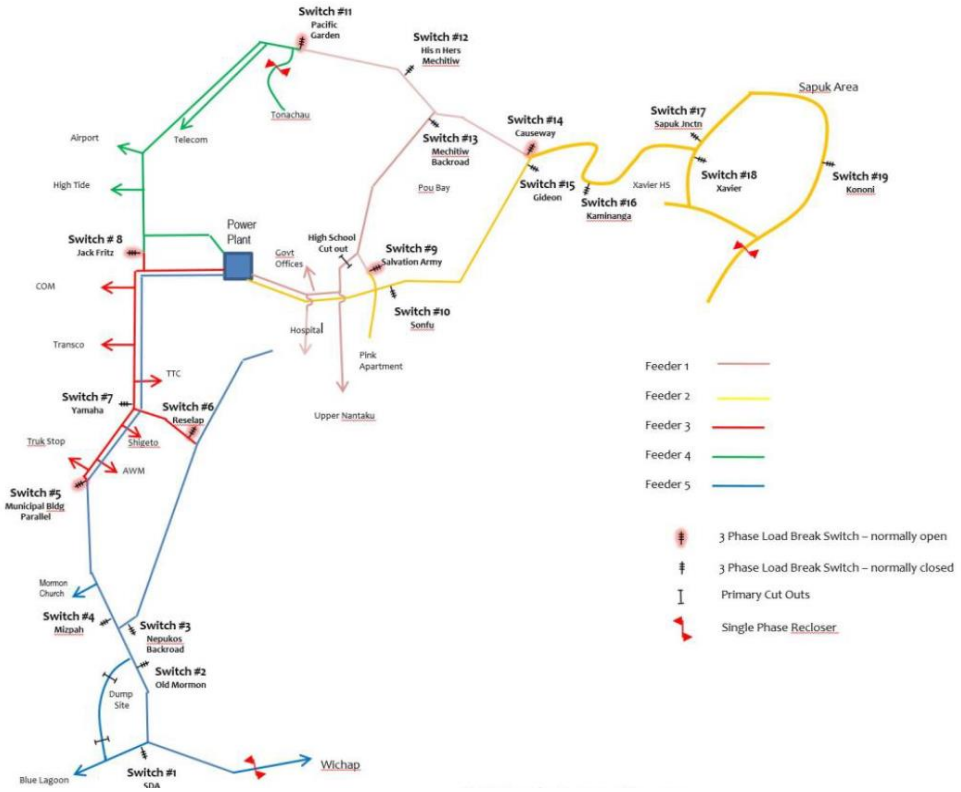
to true best practice in the areas of overall management, FM, power generation installation and management, water supply, and sewer rehabilitation and expansion will be achieved through the temporary use of externally sourced, highly skilled, and experienced professionals (SMO project) which ADB intends to fund.

9. **Component 2: Expanding Access to Electricity in Chuuk State (IDA US$3.45 million).** This component will support CPUC to expand access to electricity in Chuuk, where the access rate is only 27 percent due to the remoteness of several islands. To enhance the access rate, several approaches and areas have been considered. Specifically, this component will finance (a) the construction of mini-grid systems on the islands of Udot and Satowan, (b) the installation of SHS in off-grid areas; the criteria and procedures for selecting the homes to be fitted with SHS are provided in the MP; and (c) consultancy work for analytical work on power grid and supervision of works. Udot and Satowan are prioritized on the basis of population, needs, cost-effectiveness, customers' affordability, and other donor programs.

10. **Mini-grids in Udot and Satowan.** Although there are a 3.4 kW solar PV system with a 48 kWh battery for a local elementary school and several private generators for households, no electricity grid exists in Udot. Satowan is also in a similar state. Most households on Udot and Satowan are clustered in a series of villages with some scattered in more remote areas of the islands. Due to its geography and the distribution of households, the MP recommended providing a mini-grid with the hybrid or renewable energy generation system. The major components include (a) solar PV and inverters, (b) batteries, (c) diesel generators, (d) hybrid system controller, and (e) a 480 V underground distribution network with 120 V local distribution to houses.

11. **SHS in off-grid areas.** As shown in figure 2.1, Weno is almost covered by the well-developed distribution network with five feeders. However, there are still remote areas where these feeders cannot be extended economically. SHS will provide the electricity access to these areas efficiently. Udot also has remote and clustered areas where the mini-grid is not an economical option. The project will alleviate the financial burden that has prevented CPUC from expanding the electricity access by providing SHS.

Figure 2.1. Weno Distribution System



Source: CPUC.

12. Chuuk has the largest population share and is second in economy, but Chuuk State has the lowest electricity coverage ratio of all four FSM states, with only 27 percent of the population receiving electricity service. CPUC currently only provides grid service to Weno, the main municipality of Chuuk and largest town in the FSM. The total installed capacity of stand-alone systems is 90.5 kW. Given the scale of the electricity expansion challenge,[27] the Chuuk State Energy Master Plan, completed in April 2018 as part of the ongoing ESDP, recommends that an additional 12 MW of solar PV capacity be installed on the main island of Weno. The main island has a well-maintained power plant that has a modern grid providing power from diesel generation. The plan recommendation will help reduce the overall cost of generation by decreasing the use of diesel, help meet electricity demand on the island up to 2037, and significantly decrease electricity sector carbon emissions. The estimated costs of the project are in line with the cost estimates included in the MP. The plan's analysis determined that these investments can be fully funded at current tariffs by the savings from lower fuel costs, although, in the short term, tariffs may need to increase to cover the costs of the electrification program outside Weno.

[27] EDF11 (European Development Fund) under the European Union (EU) support program to the FSM is also targeting access increase in Chuuk. The EU's assistance to the FSM is currently focused on RE and is managed by the local office of the SPC Economic Development Division, North Pacific ACP Renewable Energy and Energy Efficiency Project (North-REP). EDF 11 (2016–2020) is programmed for village access to electricity/solar for Chuuk, solar and transmission line upgrading for Pohnpei, proper sizing transformers on Kosrae, and improving the efficiency and reliability of electricity of the outer islands of Yap. Out of €12 million allocated to energy, around €7 million is anticipated for access in Chuuk.

13. Within the lagoon, a massive area of more than 2,073 km^2 enclosed by a reef, there are dozens of islands with tiny villages, most of which have no electrical power whatsoever. Outside the lagoon, are even more isolated islands referred to as 'outer islands'. Developing entirely off-grid microgrid solutions for these small islands in this area is a big challenge. For instance, Udot is a heavily wooded minor island, one of 42 islands of Chuuk State intended to be provided with electricity access between 2019 and 2023 under the new Chuuk State Energy Master Plan. This municipality of only 10 km^2 is located in the Chuuk Lagoon, about 14 km from Weno (a 30–60-minute boat ride) and has a population of 1,680 and 240 households. The Chuuk State Energy Master Plan recommends that Udot consumers be provided with electricity access through a combination of a mini-grid[28] (480 V with aluminum/copper cable) that would cover 180 households and stand-alone solar systems or SHS for the remaining 60 households.

14. **Component 3: Scaling up Renewable Energy Generation in Chuuk, Yap, and Kosrae States (IDA US$9.9 million).** This component will support CPUC to install the state's first utility-scale solar power plant. The component will also support YSPSC and KUA to significantly mitigate the curtailment of the existing RE output and enable the integration of more variable RE through storage capacity and high-speed gensets. For each of these investments, the component will also finance consultancy work for analytical work on power grid and supervision of works during the project implementation.

15. **Chuuk 2 MW solar PV power plant in Weno.** The MP recommended additional 12 MW of solar PVs in Weno, which will reduce the overall cost of generation by reducing the use of diesel. The solar PVs are expected to alleviate the financial burden upon CPUC resulting from access expansion on the outer islands while increasing the share of RE. CPUC has already identified several potential lands for utility-scale solar PVs. The project will support the first utility-scale PV project of 2 MW-class capacity. The MP proposed both an on-water and land-based option. The installation cost for a floating PV array is estimated to be almost the same as that of a ground-mounted system. This cost includes the solar PV modules and mounting, the associated inverters and balance of system components, grid connection, and installation and logistics. The most appropriate option will be determined in the detailed feasibility study.

16. **Kosrae battery storage.** KUA's peak, average, and minimum demands are approximately 1.2 MW, 0.6 MW, and 0.4 MW, respectively. KUA currently has 0.35 MW of grid-connected solar PVs and plans to install additional 0.5 MW solar PV in the foreseeable future. KUA has already experienced the unwilling curtailment of output from solar PVs. The additional solar PVs could increase the RE curtailment. To mitigate the curtailment and make the best use of KUA's power supply infrastructure, a battery storage system will be deployed under the project. The battery size of 1 MWh will be able to accommodate the existing solar and the foreseeable future solar. The size will further be refined after a detailed study is completed.

17. **Yap 830 kW high-speed genset.** YSPSC has recently installed wind turbines and has a plan to install further RE power plants. YSPSC reported that the existing 830 kW generator is currently being run hard in response to fluctuations in wind farm generation, and it is not expected to last long. The second 830 kW will allow YSPSC to reduce the run hours on the existing generator so that it will not require RE curtailment

[28] According to the Energy Feasibility Studies for the Udot mini-grid, the initial capital cost estimation is US$1.48 million, with O&M expenses of US$21,876 per year.

for at least 10 years. Although this component will install a genset, the expected outcome is to scale up the RE. The result will be monitored and measured by the volume of RE output (GWh).

18. **Component 4: Institutional Strengthening and Capacity Building in the Energy Sector (IDA US$1.9 million).** This component aims at reinforcing the sector's operational and environmental sustainability by improving institutional capacities for governance, identifying strategies to attract private sector investments, and exploring access to other efficient energy solutions.

19. **Subcomponent 4.1: Sector Governance:** This component is designed to improve sector governance and financial performance, achieve self-sustainability, and improve assets maintenance strategies. Specifically, this subcomponent will support the following activities:

(a) **PUC's O&M fund and PC.** PUC's O&M capacity and corporate functions will be reinforced through the establishment of an O&M fund to cover, at least, all generation assets financed by the World Bank in Pohnpei. The O&M fund will be set up within 18 months of project effectiveness. A consultant will be recruited to propose the rules, guidelines, and procedures regulating the funding and disbursement of this account; project fund cannot be deposited into this fund. This subcomponent will also include the signature, implementation, and monitoring of a PC.[29]. Once the O&M fund and PC are established in PUC, similar schemes in each utility will be expected. Further information about the O&M fund and the PC is available in section III.C. Sustainability.

(b) **Analytical work and TA**. An assessment on the energy sector readiness for private sector participation will be conducted under this subcomponent. Among other strategies, the assessment will explore the potential of private-public partnerships to enable solutions to maximize finance for development for future projects. Some recommendations arising from this assessment may also be financed under this component such as, for example, consultancy support of a policy expert on enabling regulatory frameworks for the private sector. A preliminary identification of other potential areas to research through TA include (a) instruments to create an institutional, legal, and regulatory framework conducive to a self-sustained sector; (b) assessments for competitive and gender-neutral selection of key management positions and the participation of independent administrators in the Board; (c) a collaboration program with local schools, colleges, and media that encourages increasing the numbers of female candidates who apply for technical vocational roles; and (d) utility financial recovery plans, if needed.

(c) Key investments are necessary to increase revenues, reduce operational losses, and finance specific studies related to improving access and RE penetration (prefeasibility/feasibility). The FSM needs support to achieve a sustainable energy sector, rely on self-supporting utilities and more private sector participation, and cover infrastructure investment and rehabilitation needs. Indeed, private sector participation could meet the growing absorptive capacity of the sector and improve utility performance. Sector governance and financial

[29] A PC, agreed by relevant parties (PUC, Pohnpei State, and others) to be implemented and monitored based on the recommendations provided by the Graduates School United States' report on PUC.

performance will determine its ability to finance and develop new electricity infrastructure.[30] Private sector participation does exist in the electricity sector in the FSM through IPPs with limited scope of being scaled up in a competitive and transparent way. Management contracts have seldom delivered on expected results, especially in complex sector contexts. In addition, a series of governance actions will be taken in parallel, for instance, a competitive selection of key management position and the participation of independent administrators in the Board. Given that these options depend closely on the political economy of the country, the project will assess their pertinence and feasibility as part of the project TA (see Component 5).

20. **Subcomponent 4.2: Efficient and Clean Cookstoves.** This subcomponent will finance (a) a detailed household survey assessment of the challenges and opportunities for intervention in selected islands of the FSM to address health (gender-disaggregated), environmental, livelihood, gender and climate change issues associated with household energy for cooking; the criteria and procedure for selecting islands for the cookstoves survey assessment will be specified in the PIM; (b) awareness campaigns through (i) social mobilization to ensure that potential users are aware of the fuel-saving and health benefits associated with efficient and clean cooking and (ii) potential cooking demonstration workshops using different types of efficient and clean cookstoves and fuels to test consumer preferences and willingness to adopt and to purchase them; and (c) preparation of documentation necessary to identify and design a large-scale intervention on household energy for cooking in the FSM, which considers women's health benefits and employment opportunities, that may support an operation for the dissemination of clean cookstoves in the future.

21. Even though IAP studies were not specifically performed, because of which, data are unavailable for the FSM, household air pollution is one of the world's biggest and least-known killers. Daily exposure to toxic smoke from traditional cooking practices[31] is responsible for a staggering number of preventable illnesses and deaths each year, as well as environmental issues (deforestation and land degradation).[32] The World Health Organization (WHO) estimates that exposure to smoke from the simple act of cooking constitutes the fourth leading risk factor for disease in developing countries and causes over 4 million premature deaths per year, exceeding deaths attributable to malaria or tuberculosis. In addition, tens of millions more fall sick with illnesses that could readily be prevented with improved adoption of clean and efficient cookstoves and fuels. For an affordable investment, improved cookstoves have shown significant

[30] For instance, because about 35 percent of energy is consumed by commercial and industrial users, it would make sense to deploy a revenue protection program to focus on high-revenue clients and explore further the sustainability of such measures, especially in relation to the utility corporate governance.

[31] According to the Global Alliance for Clean Cookstoves: Smoke from traditional cooking penetrates deep into the lungs of the victims, causing a range of deadly chronic and acute health effects such as child pneumonia, lung cancer, chronic obstructive pulmonary disease, heart disease, and low birth weights in children born to mothers whose pregnancies are spent breathing toxic fumes from traditional cookstoves.

[32] About 42 percent of the FSM's total population is affected by household IAP while only 10.6 percent of the population uses electricity for cooking, 44 percent use kerosene, 41.5 percent use wood, 3.6 percent use gas, and 0.2 percent use other fuels. Women and children are often responsible for most household chores, including cooking and fuel collection, which places them at greater health risks due to poor ventilation, increased drudgery, and time loss. Source: Global Alliance for Clean Cookstoves, http://cleancookstoves.org/home/index.html.

measurable impact on health, the environment, family livelihood, climate change, and gender.[33] Exposure to these toxic fumes is greatest among women and young children who spend a disproportionate amount of time near open fires or traditional cookstoves or school children who may study by the low light of an open flame. In the FSM, poor access to electricity does not necessarily result in health problems associated with IAP because low-income households in the PICs do not generally cook using electricity even when it becomes available. However, clean cookstoves and fuels have the potential to reduce deaths from smoke-related illnesses, mitigate climate change, and lower air pollution. They can provide new sources of livelihoods for women while reducing the risk and drudgery of fuel collection and lower household expenditures on cooking fuel. Therefore, the World Bank is recommending that a proper assessment of the situation be conducted and an activity to disseminate clean cookstoves and address these challenges be considered in the SEDAP's scope.

22. **Component 5: Technical Assistance and Project Management (IDA US$2.95 million).** This component will finance (a) contract staffing for the project, including a project manager, consultancies and non-consultancies, office and other equipment, travel and operational costs, and training and workshops; (b) recruitment of a full-time energy adviser to assist and support the SoR&D on energy sector policy matters and development strategy; and (c) support to utilities on respective activities implementation, including provision of support on coordination, M&E, and reporting.

23. **Energy adviser.** The energy adviser will (a) assist and advise the SoR&D on policy, regulatory issues, planning, and sectoral strategy; (b) advise on improvement and harmonization of sector performance in terms of managerial capacities and capabilities; (c) advise on the FSM's energy efficiency and RE goals and the implementation of the NEP; (d) provide guidance on cutting-edge and disruptive energy technology; (e) monitor the implementation of the Energy MPs; (f) design and monitor the FSM energy dashboard; (f) propose an action plan conducive to private sector participation through IPP and PPP; and (g) assist on requests to the department on any energy-related work. The energy adviser will also support the technical implementation of the project and other energy-related activities within the FSM.

[33] Women in developing countries are at risk of head and spinal injuries and pregnancy complications from the strenuous task of carrying heavy loads of firewood or other fuels and may also suffer from gender-based violence, animal attacks, dehydration, and skin disorders. Source: Global Alliance for Clean Cookstoves, http://cleancookstoves.org/home/index.html.

ANNEX 3: FSM Energy Master Plan Summary of Recommendations by State

1. The FSM Energy MP has been developed during the period of unprecedented technological change. The last few years have seen remarkable and disruptive improvements in RE technologies and battery storage. Further expected reductions in the costs of these technologies provide the FSM with an opportunity to combine achievement of its environmental targets while ensuring that electricity production remains affordable. At the same time, the FSM faces a substantial challenge of delivering electricity to people living on outer islands. At present, there is significant social and economic divide; people living on the four main islands enjoy almost universal access to the main electricity grids. By contrast, people on the outer islands and in outlying communities have almost no access to electricity. The MP is designed to address this divide in a financially and socially sustainable way. The MP will provide electricity access, at good-quality service standards, to more than 80 percent of FSM households by 2020 and almost every household by 2023. Access is defined as the practical ability of each household to be able to receive affordable electricity. The plans achieve the FSM's RE, diesel reduction, and emissions reduction objectives.

Table 3.1. FSM National-Level Outcomes of MP

	2018	2020	2027	2037
Electricity access (%)	67	82	100	100
RE percentage (%)	19	44	63	84
Diesel use (million gallons)	4.2	2.9	2.1	1.5
Electricity CO_2 emissions (tons)	43,490	21,980	21,980	15,769

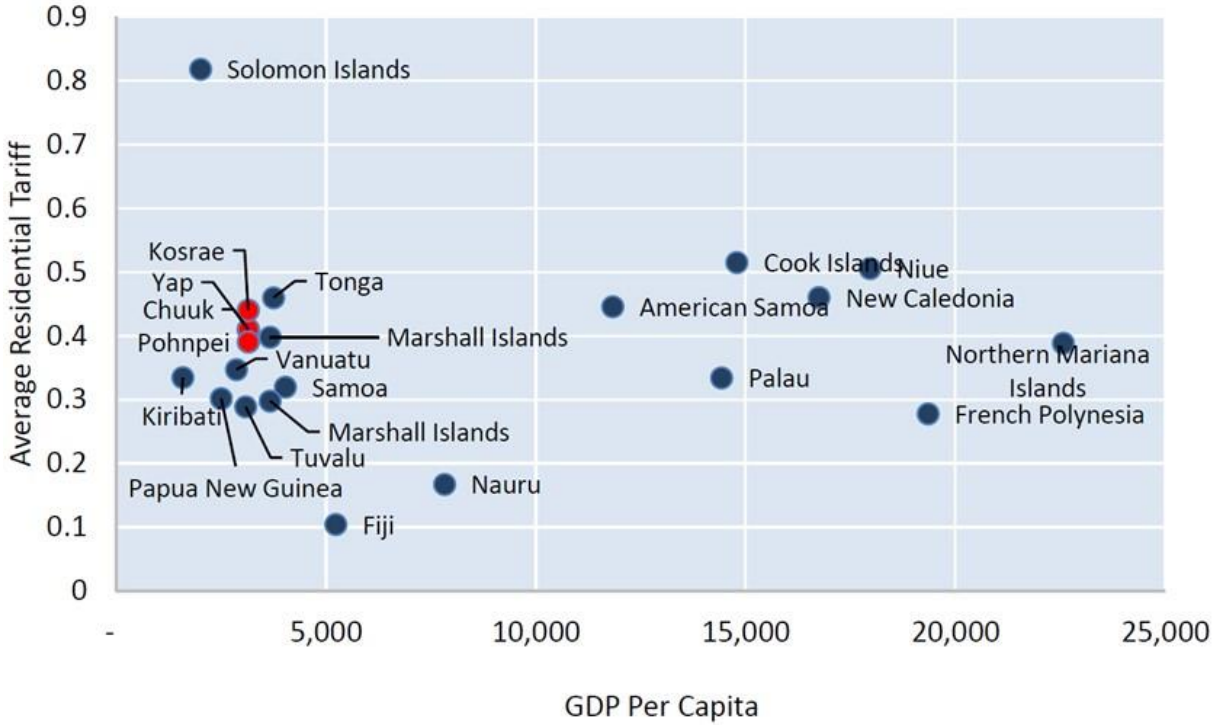
2. There is no consensus on affordable electricity. One of the recognized approaches is to measure affordability as the percentage share of the household expenditures. Based on experience with actual household expenditure patterns and results of willingness-to-pay surveys, certain thresholds are widely used by practitioners.

Table 3.2. Threshold of Affordability

	Measure of Ability to Pay	Threshold of Affordability
Off-grid energy	Monthly bill as % of household income	20% of per capita household income
On-grid energy	Monthly bill as % of household income	5% of per capita household income

3. The MP indicates that high-quality universal access electricity services can be provided at tariffs that are similar to the tariffs that the utilities are currently charging in each state. As shown in figure 3.1, FSM tariffs are within the range of tariffs being charged by the electricity utilities in countries with similar GDP per capita level.

Figure 3.1. Comparison of Residential Tariffs for Pacific Island Nations



Source: Energy MPs for the FSM.

4. The following is a state-by-state summary of the recommendations for 2019–2023 provided in the Final Report of the Energy Master Plan for the Federated States of Micronesia and published in April 2018.

Pohnpei

(a) Three 2.5 MW medium-speed diesel gensets should be brought online. This will allow for the aging CAT C-18 units to be retired and the Vital IPP to be retired or released by 2021. The new units will increase fuel efficiency and reduce O&M costs compared to the existing units.

(b) A total of 3 MW of solar PV capacity should be developed at the Pohnlangas solar site.

(c) The 2.7 MW Lehnmesi hydropower scheme should be developed. This scheme incorporates storage to provide firmer capacity to the mix.

(d) Energy storage should be deployed at the Pohnpei power station, providing 1 MW of capacity and 1 MWh of storage to manage integration of the PV plants.

(e) The recommended investments in solar and storage will meet a large proportion of Pohnpei Proper's demand in 2023, reducing the use of diesel and therefore the cost of electricity. However, diesel-off mode is not allowed, that is, at least one genset must run at all times.

Chuuk

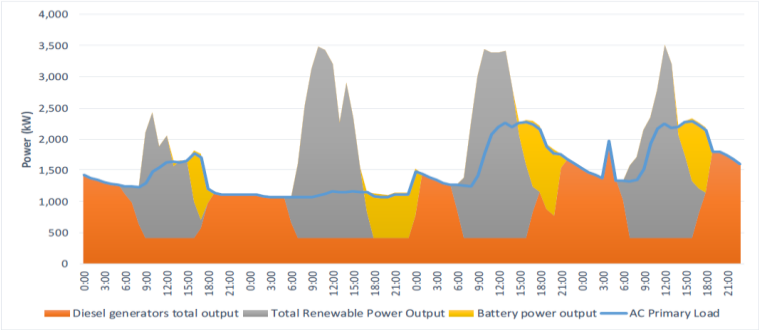
(a) There should be a major overhaul of the existing diesel gensets #4 and #5.

(b) A total of 4 MW of solar PV capacity should be developed. This will help reduce the cost of energy by reducing the use of diesel. The feasibility study on integrating new solar PV to the grid on Weno will review possible locations for this and the other solar PV capacity recommended on Weno (below) and the commercial arrangements that might be used.

(c) Energy storage should be deployed at the Weno power station, to provide 1 MW of capacity and 7 MWh of storage to manage integration of the PV plants and increased use of RE. The battery energy storage system (BESS) can be used for spinning reserve, stability management, and additional security (n-2) 5, as well as load shifting.

(d) The recommended investments in solar and storage will meet a large proportion of Weno's demand in 2023, reducing the use of diesel, and therefore the cost of electricity (figure 3.2). However, the system is set to keep one genset running at all times, that is, there is no diesel-off mode in this period.

Figure 3.2. Weno Load Duration Curve and Contribution of Generation Sources, 2023



Source: Energy MPs for FSM.

Kosrae

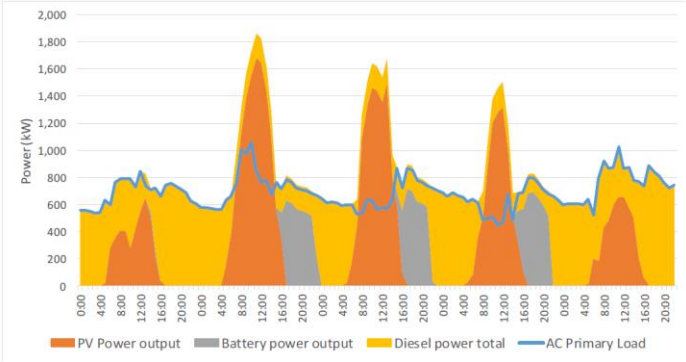
(a) A total of 2 MW of PV should be developed at one or more solar sites. Some of the capacity could be deployed behind the meter in government or commercial buildings.

(b) Energy storage should be deployed at the Kosrae power station, providing 1.25 MW of capacity and 5 MWh of storage to manage integration of the PV plants and increased use of RE.

(c) The recommended investments in solar and storage will meet a large proportion of Kosrae's demand in 2023, reducing the use of diesel, and therefore the cost of electricity (Figure 3.3).

(d) Genset #4 should be retired in 2020.

Figure 3.3. Kosrae Load Duration Curve and Contribution of Generation Sources, 2023



Source: Energy MPs for FSM.

Yap

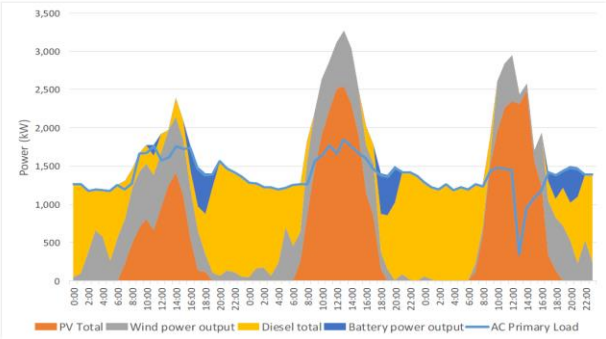
(a) A second 830 kW diesel generator should be added. This has been included at YSPSC's request, to allow the power station operators to manage the run hours on smaller generators better and extend their lives. YSPSC reported that the existing 830 kW generator is currently being run hard in response to fluctuations in wind farm generation, and it is not expected to last more than 5 years. The second 830 kW will allow YSPSC to reduce the run hours on the existing generator so that it will not require replacement for at least 10 years. This may defer the need for a new 830 kW generator later in the MP period.

(b) At least 2 MW of solar PV capacity should be developed at one or more sites. Some of the capacity could be deployed behind the meter in government or commercial buildings, but additional options such as ground-mounted and floating systems may also be needed.

(c) Energy storage should be deployed at the Yap power station, providing 0.5 MW of capacity and 3 MWh of storage to manage integration of the wind turbines and PV plants and increased use of RE.

(d) The recommended investments in solar and storage will meet a large proportion of Yap Proper's demand in 2023, reducing the use of diesel and therefore the cost of electricity (Figure 3.4).

Figure 3.4. Yap Load Duration Curve and Contribution of Generation Sources, 2023



Source: Energy MPs for the FSM.

ANNEX 4: Economic and Financial Analysis

1. The economic and financial analysis followed World Bank guidance documents (2001, 2014, 2016, 2017a, and 2017b) and World Bank Directive: Investment Project Financing.[34] Following the Guidance Note (2014),[35] this analysis addressed (a) the project's development impact; (b) the public sector provision or financing as the appropriate vehicle; (c) the World Bank's value added; (d) financial, fiscal, and environmental sustainability; and (e) the project justification nexus—results, risks, and economic rationale. This nexus is explained as follows. The PDO is to improve reliability of electricity supply, expand access to electricity, and scale up renewable energy generation. The analysis examined the causal chain that links project activities and inputs to these objectives in section VI. Results Framework and Monitoring. The risk and sensitivity analysis to those results included those in 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 midterm review, project restructuring (if it happens), and completion.

2. The preliminary analysis covered 93 percent of the total project cost. The analysis could not cover the remainder of the project cost due to the following reasons. Component 4: Institutional Strengthening and Capacity Building in the Energy Sector is not covered as the component is not yet defined in detail and some of the activities in Component 4 are studies. Reflecting these omissions, the analysis also reduced proportionally the project cost of the rest of the project's overarching activities.

Table 4.1. Summary of Key Assumptions

Plant Characteristics			
Udot PV MWp	0.11	International Organization for Standardization factor (%)	5
Satowan PV MWp	0.05	Utilization factor (%)	100
Weno PV MWp	2	Capacity factor IDA PUC medium-speed diesel genset	95
CPUC PV net capacity factor (net losses)	0.15		
IDA PUC diesel genset name plate (MW)	7.5	Auxiliary consumption PUC (%)	2
KUA battery MWh	1	Auxiliary consumption CPUC (%)	6
KUA battery MW	1	Auxiliary consumption KUA (%)	2
		Auxiliary consumption YSPSC (%)	9
Annual reduction of genset utilization	1%		
Annual reduction except: first year after maintenance	−1%	Photovoltaic degradation rates (%):	
		Year 1	2.5

[34] OPSPQ (Operations Policy and Quality). 2014. *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*; Meier, P. 2017a. *Power Sector Investment Projects: Guidelines for Economic Analysis*; Fay, M., S. Hallegate, A. Kraay, and A. Vogt-Schilb. 2016. *Discounting Costs and Benefits in Economic Analysis of World Bank Projects*; World Bank. 2017b. Shadow Price of Carbon in Economic Analysis Guidance Note November 2017.

[35] OPSPQ (Operations Policy and Quality). 2014. *Investment Project Financing Economic Analysis Guidance Note.*

Heat rate degradation factor:		Years 2–10	0.7
Year 1	5%	Years 11–20	1
Thereafter	1%		
Every major maintenance, 1% up from 100%	1%	Battery degradation rate (%)	4
New	−11%	Loss battery to load	90
		PUC total avoided outage SAIDI minutes	3,000
Timing			
Base year	2018	Residual year	2039
Start of generation:		**Availability at start:**	
Solar PV system and battery	2019	Solar PV system and battery	10%
Diesel gensets	2019	Diesel gensets	10%
Annual IDA commitment charge	0.5%	Approval	11/15/18
		Effectiveness	3/21/19
		Closing	11/30/23
FUELS			
Average crude oil price, real 2018 prices (US$/barrel) 2018–2023			61
Average international price of diesel (US$/gallon), real 2018 prices (US$/barrel) 2018–2023			1.76
Diesel:			
Net IDA PUC medium-speed diesel consumption (gallon/kWh)			0.07
Net non-IDA PUC system average high-speed diesel consumption (gallon/kWh)			0.08
Net new non-IDA PUC system average high-speed diesel consumption (gallon/kWh)			0.08
Net new non-IDA CPUC system average high-speed diesel consumption (gallon/kWh)			0.08
Net new IDA CPUC mini-grid system average high-speed diesel consumption (gallon/kWh)			0.07
Net non-IDA CPUC household average high-speed diesel consumption (gallon/kWh)			0.09
Net non-IDA KUA system average high-speed diesel consumption (gallon/kWh)			0.08
Net non-IDA YSPSC system average high-speed diesel consumption (gallon/kWh)			0.08
Lube oils:			
PUC high-speed lubes cost US$/gallon			5.49
PUC gross high-speed average lube cost US$/kWh			0.01
PUC gross high-speed lubes gallon/kWh			0.001
PUC IDA medium-speed system average lubes cost US$/gallon			11.07
PUC IDA gross medium-speed system average lubes gallon/kWh			0.0003
CPUC non-IDA gross high-speed system average lubes gallon/kWh			0.0003
KUA non-IDA lubes gross system average high-speed gallon/kWh			0.0003
YSPSC non-IDA lubes gross system average high-speed gallon/kWh			0.0004
O&M COSTS			
PUC IDA medium-speed diesel gensets fixed cost (US$/year)			93,949
PUC non-IDA high-speed diesel genset fixed costs (US$/year)			193,425
CPUC IDA Udot and Satowan high-speed diesel genset fixed costs (US$/year)			4,642
CPUC non-IDA Udot households high-speed diesel genset fixed costs (US$/year)			2,115
KUA non-IDA high-speed diesel gensets fixed cost (US$/year)			25,790
Variable:			
High-speed diesel gensets variable costs (US$/MWh)			18
PUC IDA medium-speed diesel genset variable costs (US$/MWh)			14
Periodic (major maintenance and overhaul):			
PUC medium-speed diesel gensets % of gensets cost (US$/5th year)			750,000
PUC high-speed diesel gensets % of gensets cost (US$/3rd year)			903,614

CPUC Udot/Satowan high-speed diesel gensets % of gensets cost (US$/3rd year)			22,500
KUA non-IDA high-speed diesel gensets % of gensets cost (US$/3rd year)			120,482
INFLATION AND EXCHANGE RATES	**DISCOUNT RATES, FOREIGN EXCHANGE PREMIUM (FEP)**		
Inflation rate (FSM)	1%	FOCC, real (%)	4
Inflation rate (US)	2%	Social discount rate, real (%)	1
Manufacturing unit value (MUV) index	2%	FEP (%)	2
Exchange rate (US$/SDR) 9/30/2018	1.39525		
WORKING CAPITAL AND INVENTORY			
CPUC accounts payable (weeks)			0.3
CPUC cash balance (weeks)			10
PUC accounts payable (weeks)			0.1
PUC cash balance (weeks)			2
KUA accounts payable (weeks)			0.2
KUA cash balance (weeks)			18
YSPSC accounts payable (weeks)			0.2
YSPSC cash balance (weeks)			17
With project PUC inventory of diesel (gallons)			4,361,096
With project CPUC inventory of diesel (gallons)			2,388
Without project PUC inventory of diesel (gallons)			4,776,438
Without project CPUC inventory of diesel (gallons)			117,334
Without project KUA inventory of diesel (gallons)			118,373
Without project YSPSC inventory of diesel (gallons)			62,301
TAXES			
Import for resale			
Gasoline and diesel fuel			US$0.05/ gallon
Import duty (on cost, insurance, and freight)			4%
Chuuk State			
CUPC service tax to electricity tariff			5%
Sales tax except gasoline, diesel fuel, tobacco, alcohol, unprocessed, and unpackaged items			3%
Room occupancy tax to the occupants of hotels, motels, and apartments			10%
Lessor/landlord pays tax on renting or leasing of land, buildings, or housing units			10%
US$40 departure fee per passenger departing from the Chuuk International Airport			40
Kosrae State			
Sales tax			
Equipment or appliance			5%
General merchandise			2%
Food			1%
Utilization fee of US$15 for all departing passengers at the Kosrae International Airport			15
Pohnpei State			
Sales tax			
General merchandise (except food)			1%
For items with costs in excess of US$500, gasoline and diesel fuels are exempted therefrom.			
Hotel occupancy tax of 5% is imposed in Pohnpei.			5%
Utilization fee of US$10 for all departing passengers at the Pohnpei International Airport			10
Yap State			

Excise tax			
General items			1%
Gasoline and diesel fuel			US$0.5/gallon
Home appliances			5%
Televisions, phonographs, stereos, and tape recorders			10%
Hotel occupancy tax			10%
TAXES	**ECONOMIC OPPORTUNITY COST OF LABOR (EOCL)**		
Social security contribution (employer)	7.5%		**Conversion Factor**
Social security contribution (employee)	7.5%	Project manager	0.88
Gross wage and salary tax annual		Procurement adviser	0.88
First 0–5,000 (exemption 1,000)	6%	Investigation, design Pohnpei power plant	0.91
5,000–11,000	6%	Social and environmental safeguards adviser	0.91
Over 11,000	10%	Energy adviser	0.88
Gross revenue business tax		Training and workshops	0.91
0–10,000	80	Owner's engineers	0.90
Over 10,000	3%	Weno international labor	0.92
Corporate income tax	21%	Weno local labor	0.58
		Udot mini-grid international labor	0.92
		Udot mini-grid local labor	0.60
		Udot mini-grid O&M staff wages	0.60
		Udot SHS installation and O&M wages	0.63
		Satowan mini-grid international labor	0.92
		Satowan mini-grid local labor	0.60
		Satowan mini-grid O&M staff wages	0.60

Emissions	**CO_2 kilogram (kg) /Terajoule (TJ)**	**CH_4 kg/TJ**	**N_2O kg/TJ**
Diesel	74,100	3.0	0.6
Lubricants	73,300	3.0	0.6
Diesel gas turbine	**NOx, ton/gallon**	**PM_{10}, ton/gallon**	**SOx, ton/gallon**
≥600 horse power	0.0002	0.000004	0.00003
< 600 horse power	0.0003	0.00002	0.00002

Economic Analysis

3. All values were converted to economic values and conversion factors were estimated, such as foreign exchange premium (shadow exchange rate),[36] economic opportunity cost of labor (shadow wage rate),[37] fuel inventory (working capital), and so on. Pursuant to the World Bank's guidance[38] noted above

[36] Estimated based on the methodology by Jenkins, Glenn P. 2008. *Program on Cost-Benefit Analysis on Economic Analysis/Project Appraisal*; Glenday, Graham. 2011. "Program on Project Appraisal and Risk Management." May 15–June 10, 2011, *Economic Opportunity Cost of Foreign Exchange*, Duke Center for International Development.
[37] Estimated based on the methodology by Jenkins, G., and A. Klevchuk. 2006. *Appraisal of El-Kureimat Combined Cycle Power 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).
[38] Fay, M., S. Hallegate, A. Kraay, and A. Vogt-Schilb. 2016. *Discounting Costs and Benefits in Economic Analysis of World Bank Projects*.

and guided by the country economist of the World Bank, an estimated social discount rate of 1.3 percent was used for the economic analysis.[39] The analysis is presented in US$ 2018 real prices.

The Counterfactual Scenario and the Expected Benefits

4. **PUC.** The PDO to improve reliability of electricity supply was assessed as reduced fuel, operational and maintenance costs, and outage with the new medium diesel gensets that would replace the existing old high-speed gensets. One of the PDO indicators is PUC's SAIDI, which is expected to be reduced by 3,000 minutes or about two days. Because PUC's system average interruption frequency index (SAIFI) is not available, in the counterfactual scenario, the household would experience an outage of about 2 times per year. The FSM 2010 census showed that about 50 percent of residential energy use in Pohnpei proper (about 95 percent of Pohnpei population) was spent on fridge and freezer, and the FSM Household Income and Expenditure Survey 2013/2014 (HIES 2013) shows that annual household expenditure on food was about US$4,100. Therefore, it is assumed that 50 percent of households in Pohnpei proper with fridge and/or freezer would store about 90 percent of the monetary value of the food in their fridge and/or freezer. In the counterfactual scenario, these households would lose about two weeks' worth of food expenditure (that is, two incidents of outages per year (up to 24 hours or one day per outage) could spoil food stored in the fridge/freezer to last for one week). Furthermore, the analysis assumed in the counterfactual scenario, the existing high-speed genset would operate until 2021 and from 2022, the new high-speed gensets would be operational. The counterfactual scenario assumes the need for more time to find the funding to replace the existing high-speed gensets and limited funding to purchase more expensive medium-speed gensets or considerations of potential pairing of high-speed gensets with RE.

5. **CPUC.** The PDO to expand access to electricity and scale up RE generation in the state of Chuuk is assessed as (a) about 2 MW of solar to replace the power generation from existing high-speed gensets in Weno and (b) solar-diesel hybrid mini-grids to connect 144 households in Udot (diesel generation 40 kW, solar generation 110 kWp, usable storage 190 kWh) and Satowan (diesel generation 50 kW, solar generation 50 kWp, and usable storage 140 kWh) to connect 80 households and 48 SHS in Udot. In the counterfactual scenario, in Weno the high-speed gensets would continue to generate power and in Udot, 41 households would continue to use their own small 2 kW gensets and the rest of the households in Udot and Satowan would not use the grid-connected electricity. The Balance Group surveys in 2015 found that 49 percent of households in Satowan, a 'remote' island, spend more than US$1,040 on energy per year.[40] This is much higher than US$201 for remote islands in the FSM HIES 2013/2014. However, they spent about half on kerosene (HIES). For Udot, US$637 average per household per year was spent on non-electric energy in the Chuuk Lagoon, for which about one-third was spent on kerosene (where there is no reliable access to electricity) according to the 2013 HIES. In outer islands (outside Weno), about 70 percent of households use kerosene for lighting based on the FSM 2010 census. Based on the above information, it was assumed that about US$100 would be spent on kerosene lamps in both Udot and Satowan, which would be replaced by light-emitting diode (LED). A 2003 study found that cost of kerosene lamp per kilolux hour (klxh) was on average 56 times that of LED. LED efficiency was significantly increased and thus the cost was reduced from 2003 by about one-third from 2003 to 2010, and further one-seventh from 2010

[39] Data source for this estimate was provided by the World Bank Country Economist for 2015–2040. The analysis adjusted to the project's life for 2018–2039.
[40] Balance Utility Solutions: Satowan Mini Grid Hybrid Systems, Inception Note and Site Visit Report (May 2015).

to 2017.[41] Also, the real international crude oil prices increased by 21 percent in 2017 from 2003. Although LED has been relatively more efficient and cost-effective in technical statistics in terms of lux, households may not perceive that much (more than 56 times). There are other benefits of using solar power LED lamps, such as health, safety, and energy security because due to climate change, the kerosene supply may be disrupted by increasingly unpredictable sea weather that disrupts fuel transport by sea and so on. Thus, it is conservatively assumed that the benefit of LEDs is 20 times that of the kerosene lamp.

6. **KUA.** The PDO to scale up RE generation in the state of Kosrae was assessed as the better utilization of expected new solar PV and saving of capacity and spinning reserves by the project-financed BESS. In the counterfactual, the expected 2 MW solar PV would not be fully used and the high-speed gensets need to continue to run. Even as of May 2018, the existing 345 kW grid connected solar without BESS is shut down on weekends or when loads fall to an alarming level, to avoid problems (short-term fluctuations, reverse power, voltage rise, frequency fluctuations, and so on). During 2015–2016, the share of RE generation to the grid increased from 3.17 percent to 6 percent. At the same time, generation-related SAIDI (unplanned, minutes per customer) increased from 1,356.02 to 2,906.92 (about 48.45 hours equivalent) and generation-related SAIFI from 4.96 to 6.51 (more than 7.4 hours per incident). Therefore, in the actual scenario, generation-related SAIDI is assumed to be one day (24 hours) less and generation-related SAIFI would be three incidences more than the counterfactual. The FSM 2010 census showed about 70 percent of residential energy use in Kosrae was spent on fridge and freezer, and HIES 2013 shows that annual household expenditure on food was about US$5,000. Therefore, it is assumed that 70 percent of households in Kosrae with fridge and/or freezer would store about 90 percent of the monetary value of the food in their fridge and/or freezer. In the counterfactual scenario, these households would lose about three weeks' worth of food expenditure (that is, a 7-hour incident could spoil food stored in the fridge/freezer to last for one week).

7. **YSPSC.** The PDO to scale up RE generation in the state of Yap was assessed as the better utilization of the solar PV and wind power with the project-financed additional pair of high-speed gensets. Due to the variability of wind and solar energy, the existing generator starts and stops very often. This rapid rate of stopping and starting the generator results in considerable wear and tear, weakening and aging the genset at a pace faster than under normal operational conditions, irrespective of its actual total running hours. Without the high-speed genset, YSPSC cannot make use of its RE facilities efficiently. In the counterfactual scenario, it is assumed that every three years, the existing high-speed genset needs to be out of service for extensive overhaul that disables the operation of PV and wind power. In the actual scenario, the two gensets are assumed to operate in turn to enable the PV and wind power generation. Furthermore, in the actual scenario, the utilization of RE is assumed to increase by 7 percent.

8. **PDO achievements.** The summary results in table 4.2 show that the project's activities and inputs would meet the PDO with an NPV of US$38 million, or about 11 percent of an estimated GDP in 2018, by the International Monetary Fund (IMF), an EIRR at 15 percent, and LCOE at US$0.26 per kWh. The reason for high levelized cost and low return in Satowan is because of transport costs of diesel for the backup diesel set for the mini-grids.

[41] Yukio Narukawa, Masatsugu Ichikawa, Daisuke Sanga, Masahiko Sano and Takashi Mukai 2010. "White Light Emitting Diodes with Super-High Luminous Efficacy." *J. Phys. D: Appl. Phys.* 43 (2010): 354002; The U.S. Energy Information Administration (EIA).

Table 4.2. Economic Analysis Results Summary

	PUC	CPUC				KUA	YSPSC	Total
	Genset Efficiency and Reliability	**Solar Weno**	**Udot Mini-grid**	**Satowan Mini-grid**	**Udot SHS**	**Battery Storage**	**Genset Supporting Renewable Energy**	
ENPV (US$, millions)	27.1	4.6	2.9	0.5	1.3	1.4	0.4	38.4
EIRR (%)	21	9	16	5	51	15	9%	16
LCOE excluding TA, real (US$/kWh)	0.26	0.14	0.93	1.86	0.40	0.82	0.14	0.26

	Total Project Costs	**Economic Analysis Conducted (%)**	**Total ENPV**	**Total EIRR**	**Levelized Costs, Real (US$/kWh)**
	30,000,000	93%	38,358,357	16%	0.26
% GDP in 2018 (IMF estimates)	9%	8%	11%		

Net benefit distribution								
ENPV @ social discount rate								
FNPV @ social discount rate				Externalities stakeholders @ social discount rate				
PUC	**CPUC**	**KUA**	**YSPSC**	**Government**	**Customers**	**Female Labor**	**Male Labor**	**Society**
84%	31%	4%	5%	−72%	47%	0.3%	0.3%	0.01%

	Total ENPV with CO_2e Low	Total EIRR with CO_2e Low	Total ENPV with CO_2e Low, NOx, PM10, SOx	Total EIRR with CO_2e Low, NOx, PM10, SOx	Total ENPV with CO_2e High	Total EIRR with CO_2e High	Total ENPV with CO_2e High, NOx, PM10, SOx	Total EIRR with CO_2e High, NOx, PM10, SOx	Switching Value of US$ CO_2e ton
	44,296,638	18%	44,296,638	18%	50,229,111	20%	50,229,111	20%	
% GDP in 2018 (IMF estimates)	13%		13%		15%		15%		
Net GHG Marginal Abatement Cost (US$/$CO_2$ e t)	−371		−371		−420		−420		−259

Avoided Emissions for 2019–2038				
	CO_2e	**NOx**	**PM10**	**SOx**
Tons (undiscounted)	137,190	2,395	44	376

9. **Development impacts.** The main development impacts are (a) the mitigation of risk to the security of electricity supply due to the increased RE, more reliable electricity supply, and energy efficiency and

(b) enabling of households' electricity use in outer islands under this project. The distribution analysis showed that the four utilities (especially PUC) will benefit the most from the fuel savings, followed by electricity consumers due to more reliable (PUC and KUA) and less-expensive electricity (small genset users in Udot) and use of electricity (Udot and Satowan). Local labor will also benefit from the mini-grid operations (the public sector employees are about 2.1 times higher paid)[42] and from temporary work during the construction phase of the project. As the project promotes gender equity and equality, it is assumed that both genders will receive equal labor benefits. Part of the society would benefit from some revenues because the utilities require operating expenditures to purchase from these vendors, but these increases are negligible amounts. The Government's grant spending on the project is justified by the overall welfare improvement of the society of the FSM.

Financial Analysis

10. Following World Bank guidance, the financial analysis of the entire project was from an implementing agency perspective.[43] Because each utility will carry out the project-funded activities, the financial analysis from a utility perspective was also conducted. As the project is fully financed by one financial source of IDA grant, the cost of grant was assumed to be the cost of equity or the Government's economic cost of capital (the Government's cost of raising capital).[44] Thus, the financial analysis used an estimated FOCC of about 4 percent, real.[45] The FNPV is US$37 million and results by technology are presented in table 4.3. As the IDA grant (cash inflow) entirely offsets the investment cost (cash outflow), a meaningful FIRR could not be computed for most of the subcomponents.

Table 4.3. Financial Analysis Summary

	PUC	CPUC				KUA	YSPSC	Total
	Gensets	Solar Weno	Udot Mini-grid	Satowan Mini-grid	Udot SHS	Battery Storage	Genset	
FNPV (US$, millions)	24.8	8.7	0.3	0.1	0.2	1.5	1.8	37.4
FIRR (%)	—	—	168%	59%	—	—	—	—
LCOE excluding TA, real (US$/kWh)	0.27	0.19	1.17	2.36	0.49	0.91	0.15	0.27

Total Project Costs (US$, millions)	Financial Analysis Conducted (%)	Total FNPV (US$, millions)	PUC FNPV (US$, millions)	CPUC FNPV (US$, millions)	KUA FNPV (US$, millions)	YSPSC FNPV (US$, millions)
30	93%	37	25	9	2	2
Levelized costs excluding TA, real (US$/kWh)		0.27	0.27	0.29	0.91	0.15

[42] IMF 2017. *IMF Staff Report for the 2017 Article IV Consultation with the Federated States of Micronesia*.
[43] 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*.
[44] ADB (Asian Development Bank). 2005. *The Financial Management and Analysis of Projects (the Guidelines)*.
[45] This estimate is based on the historical return and IMF's long-term outlook of nominal 5 percent return of the CTF and FSM Trust Fund, adjusted with an expected 0.9 percent inflation rate. The CTF's compound average annual return between FY06 and FY16 was 5.4 percent, net of fees, performing exactly at its benchmark. Between FY10 and FY16, the FSM Fund's average compound annual return was 5.9 percent. During this period, the net investment income was negative in FY10 and FY11. (IMF 2017 report).

Sensitivity Analysis

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 section V. Key Risks, such as technical capacity and design and implementation capacity and SORT. Table 4.4 shows the summary of the results. In the summary, table 4.4, sensitivity indicators show the ratio of the percentage change in the NPV to the percentage change in the parameter tested.

12. Regarding the macroeconomic risks (Moderate in SORT), inflation rates in the FSM and the United States and the MUV index show relatively less sensitivity to the results compared to the SDR exchange rate, and the higher sensitivity is due to the diesel fuel prices. Regarding the technical design and operational risk, the utilization factor is also sensitive to the results. The value of carbon dioxide equivalents (CO_2e) is not sensitive enough to significantly change the results.

Table 4.3. Sensitivity Analysis Results Summary

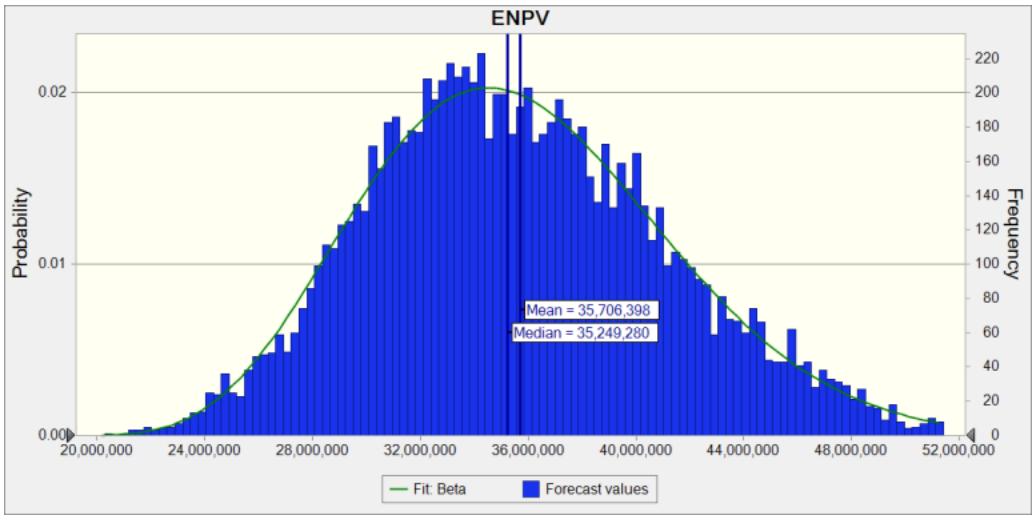
Parameters	Base Case	Change	ENPV (US$)	EIRR (%)	Sensitivity Indicator	Switching Value
Investment cost overrun factor (%)	0%	10%	35,835,544	14.1	−0.10	152%
Utilization factor (%)	100%	60%	27,650,390	12.7	0.60	14%
Inflation rate, the FSM (%)	0.92%	4%	28,609,133	17.6	0.10	12%
Inflation rate, the United States (%)	1.98%	4%	44,311,095	14.6	−0.10	−14%
SDR exchange rate 2019 % change	0%	−15%	49,349,934	22.6	0.20	57%
Cost of Diesel (US$/gallon)	1.6	2	41,234,089	15.0	0.50	−1.46
MUV index	1.8%	4%	39,357,401	16.2	0.02	−0.7
US$/$CO_2e$	0	38	44,234,204	18.0	0.10	−259
Financial sensitivity analysis						
Parameters	**Base Case**	**Change**	**FNPV (US$)**		**Sensitivity Indicator**	**Switching Value**
Investment cost overrun factor (%)	0%	10%	37,492,219		0.003	−3,257%
Utilization factor (%)	100%	60%	29,619,104		0.390	−93%
Inflation rate, the FSM (%)	0.9%	4.0%	39,108,463		−0.010	−73%
Inflation rate, the United States (%)	1.98%	4.0%	41,374,350		−0.050	−21%
SDR exchange rate 2019 % change	0%	−15%	43,128,635		0.100	109%
Cost of diesel (US$/gallon)	1.6	2.0	39,635,892		0.400	−2
MUV index	1.8%	3.5%	38,044,672		0.020	−97%

Risk Analysis

13. 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 was 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 (for example, operational and technical): annual utilization factor, crude oil prices (which is linked to diesel oil prices), capital cost of gensets, SDR exchange rate, MUV index, and United States and FSM inflation rates. A Monte-Carlo risk simulation was carried out over 10,000 trials with the help of

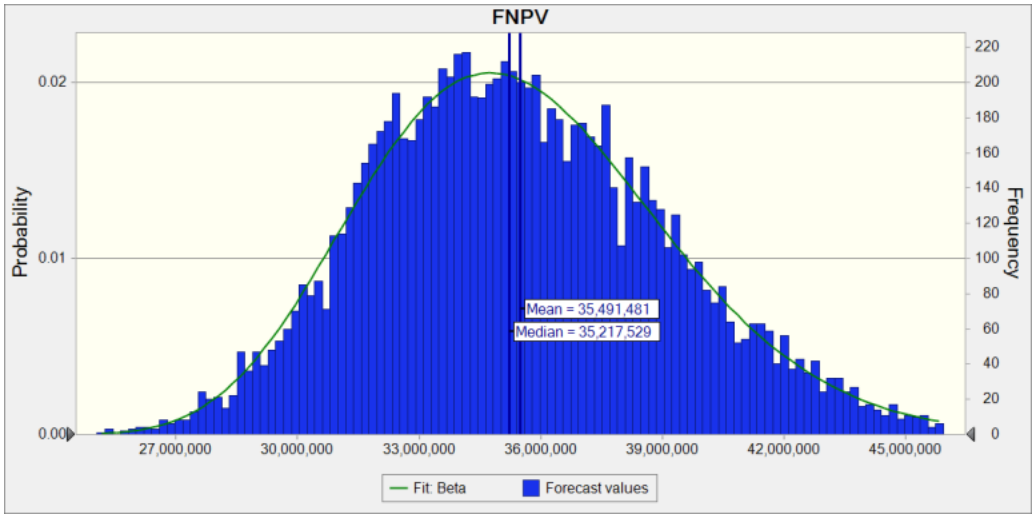
Crystal Ball software. The Tornado analysis of Crystal Ball was also conducted to analyze the critical variables. The results suggested a robustness of the project (figures 4.1 and 4.2).

Figure 4.1. Probability Distribution of Economic Outcomes



Source: World Bank project team's calculation

Figure 4.2. Probability Distribution of Financial Outcomes



Source: World Bank project team's calculation

14. **Financial sustainability.** The project would be financially sustainable based on 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. As of July 2018, all utilities hardly have enough revenue to cover costs beyond regular O&M. Compared to the potential availability of the grants for capital costs, the grants for recurrent costs for major overhaul, replacement of battery and inverters, and so on are limited. Recent World Bank and non-World Bank financed project

cost estimates by the International Finance Corporation were reviewed and showed large variances in costs.[46] Despite these uncertainties, solar power would mitigate volatile diesel price and supply shock.

15. **Fiscal substantiality.** An estimated avoided diesel and lube oil import (in estimated long-term international prices) per year is about US$0.8 million in present value in 2018 prices, which is about 7 percent of capital grant in 2015 in current prices of 2015, or more than US$15 million over 2019–2039. Hence, the project could contribute to mitigating potential risk to the diversion of emergency official capital grant to fuel expenditures in the event of the fuel price and supply shocks. Fiscal impact of IDA grant commitment charge is insignificant, about 0.6 percent of the 2015 capital grant. Table 4.5 shows the summary of the fiscal impacts.

Table 4.5. Fiscal Impacts (US$, millions)

Capital Grant	Average Annual Commitment Charge	Commitment Charge for 2018–2023	Annual Fuel Import Saving	Total Fuel Import Saving for 2019–2038
11.90	0.07	0.43	0.78	15.66
% of Capital Grant	0.6%	—	7%	—

NB: Present values in 2018 prices at FOCC, except the capital grant in 2015 nominal prices as the most recent IMF data.

16. **Environmental sustainability.** The project is expected to be environmentally sustainable. The project would reduce emissions of particulate matter 10 micrometers or less in diameter (PM_{10}), oxides of nitrogen (NOx), and oxides of sulphur (SOx) from diesel oil-fired power plants while the impacts are not significant, as presented in Table 4.2. Globally, as Table 4.2 shows, the proposed project is expected to avoid GHG emissions (about 137,000 tons CO_2e). Under World Bank guidance, total ENPV with CO_2e low value[47] is US$44 million and EIRR of 18 percent, and with CO_2e high value it is US$50 million and EIRR of 20 percent. The switching value of U.S. dollar per CO_2e ton was −US$259 per CO_2e ton and the net GHG marginal abatement cost was −US$321 per CO_2e ton, which means that the benefit of the project is higher than the cost of the project, and as presented in Table 4.2 following the World Bank guidance, the low and high values of CO_2e ton resulted in the negative net GHG marginal abatement cost, that is, beneficial impacts of US$371–US$420 per CO_2e ton.

17. **Provision of public sector financing.** As of 2018, the marginal productivity of capital in the private sector in the FSM is likely to be extremely low, due to the challenge of overcoming extreme remoteness, small size, and geographic dispersion to develop profitable private enterprise. Furthermore, it seems extremely unlikely in these environments that public investment would displace private investment or consumption. In fact, so great are the needs for public investment in basic infrastructure and so on that can facilitate improved business conditions and ease constraints to private sector development, that higher public investment is likely to have positive multiplier effects on private investment in the FSM.

[46] 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.

[47] The World Bank guidance increased the constant U.S. dollar 2017 prices by 2.25 percent per year. These prices were adjusted to real prices in 2018 FSM U.S. dollar 2018 prices, a low value starting from US$40 per ton and a high value starting from US$80 per ton from 2019 and increasing thereafter.

18. **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 sector capacity. The TA and capacity-building aspects of the project are a key part of the World 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 that can be readily shared with the FSM.

Conclusion

19. Overall, the analysis demonstrates the project's potential achievement of PDO. The economic NPV was equivalent of 11 percent of estimated GDP in 2018. Although uncertainties in O&M exist, if successful, both the Government and private sector could be confident in the private sector participation in promoting sustainable power sector in the FSM.

ANNEX 5: Procurement

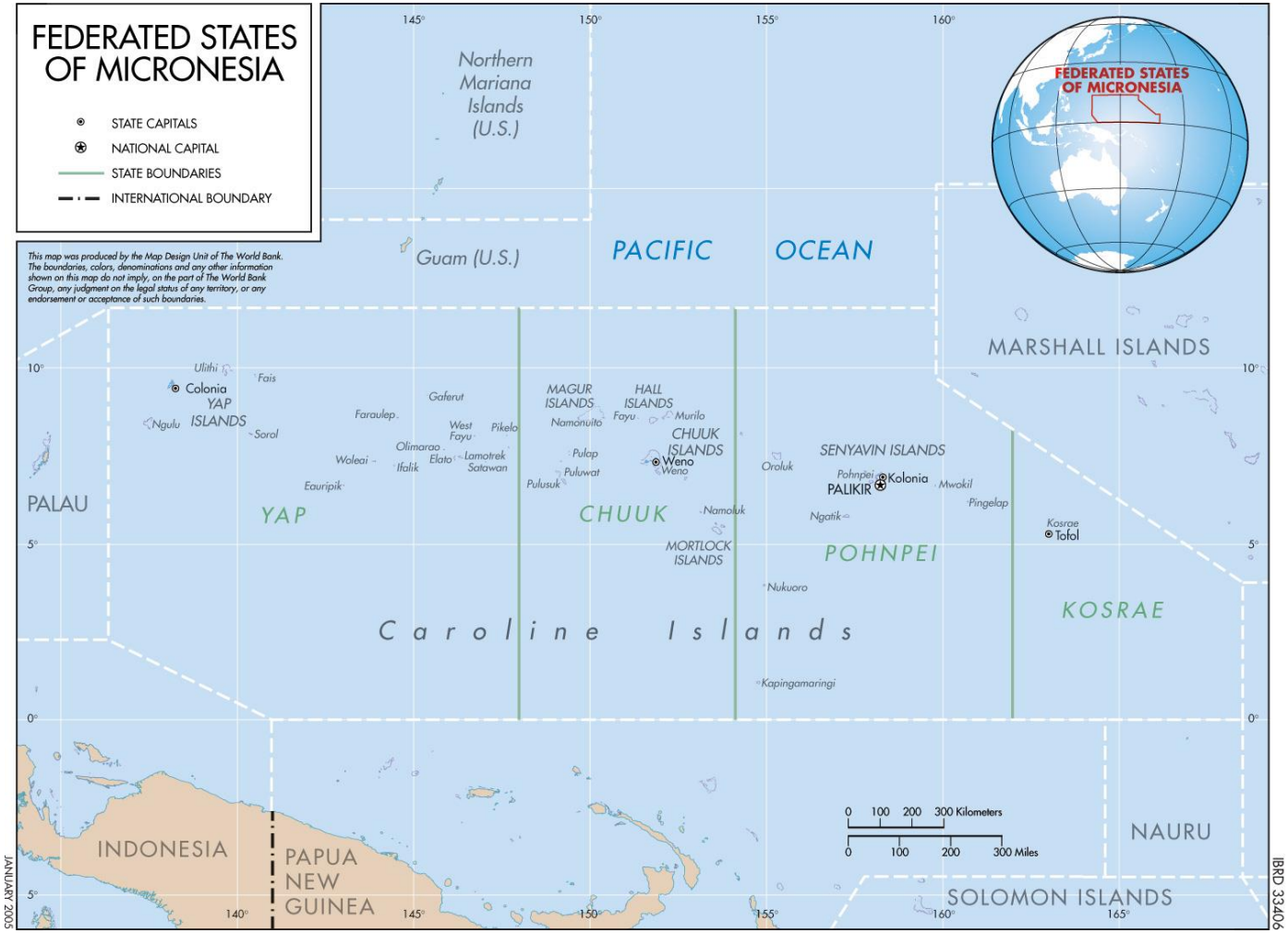
1. Procurement under this project will follow the World Bank Procurement Regulations for IPF Borrowers (July 2016 and revised in November 2017 and August 2018), Procurement Regulations. A Procurement Plan has been prepared and agreed to with the World Bank. The initial Procurement Plan was published on the World Bank website on October 15, 2018 and is summarized as follows:

Description	Procurement Category	Procurement Method	Estimated Amount (US$)	Review Type	Planned Start Date
Component 1					
Investigation and design for Pohnpei power plant restoration	CS	CDS	300,000	Prior	07/31/2018
PUC Genset 7.5 MW including installation	CW	RFB	7,500,000	Prior	03/31/2019
Grid enhancement	CW	RFB	1,400,000	Prior	04/30/2019
Waste oil storage tank and spill contaminant	CW	RFQ	500,000	Post	04/30/2019
Civil works and removal of obsolete generation equipment	CW	RFQ	300,000	Post	04/30/2019
Power system monitoring and protection devises	GO	RFB	1,500,000	Prior	04/30/2019
Owner's Engineer for PUC	CS	QCBS	300,000	Post	02/28/2019
Component 2					
Hybrid mini-grid installation in Udot	CW	RFB	1,700,000	Prior	04/30/2019
Hybrid mini-grid installation in Satowan	CW	RFB	1,500,000	Prior	04/30/2019
Solar home systems in Chuuk	CW	RFQ	150,000	Post	04/30/2019
Owner's Engineer for CPUC access	CS	CQS	100,000	Post	02/28/2019
Component 3					
Solar Power Plant in Chuuk	CW	RFB	6,000,000	Prior	12/15/2018
YSPSC Genset 0.83 kW including installation	CW	RFB	1,000,000	Prior	01/31/2019
YSPSC control system upgrade	GO	RFB	300,000	Post	01/31/2019
KUA Battery storage and Energy Management System	CW	RFB	2,100,000	Prior	03/31/2019
Owners Engineer (pre-construction phase) for CPUC solar	CS	CDS	50,000	Post	11/15/2018
Owners Engineer (construction phase) for CPUC solar	CS	CQS	250,000	Post	02/28/2019
Owner's Engineer for KUA	CS	CQS	200,000	Post	03/31/2019

Description	Procurement Category	Procurement Method	Estimated Amount (US$)	Review Type	Planned Start Date
Component 4					
Feasibility Study for Pohnpei Outer Islands	CS	CQS	100,000	Post	12/15/2019
Sector governance consulting	CS	QCBS	1,000,000	Prior	05/31/2019
Performance contract	CS	QCBS	400,000	Prior	05/31/2019
Efficient clean cookstove assessment	CS	CQS	200,000	Post	05/31/2019
Efficient clean cookstove awareness campaign	NC	RFQ	200,000	Post	05/31/2019
Component 5					
Energy Adviser	CS	INDV	800,000	Prior	08/31/2018
Environmental and social studies	CS	CDS	60,000	Post	07/31/2018
Project Manager	CS	INDV	800,000	Prior	08/31/2018
Administration support	CS	INDV	150,000	Post	11/15/2018

Note: CS = Consultant Services; CW = Civil Works; NC = Non-Consulting Services; GO = Goods; CDS = Direct Selection; RFB = Request for Bids; RFQ = Request for Quotations; CQS = Selection Based on the Consultants' Qualification; QCBS = Quality- and Cost-Based Selection; and INDV = Individual Consultant Selection.

ANNEX 6: Map


FEDERATED STATES OF MICRONESIA
STATE CAPITALS
NATIONAL CAPITAL
STATE BOUNDARIES
INTERNATIONAL BOUNDARY
This map was produced by the Map Design Unit of The World Bank. The boundaries, colors, denominations and any other information shown on this map do not imply, on the part of The World Bank Group, any judgment on the legal status of any territory, or any endorsement or acceptance of such boundaries.
Northern Mariana Islands (U.S.)
Guam (U.S.)
PACIFIC OCEAN
MARSHALL ISLANDS
PALAU
YAP
CHUUK
POHNPEI
KOSRAE
Caroline Islands
INDONESIA
PAPUA NEW GUINEA
NAURU
SOLOMON ISLANDS
Colonia
YAP ISLANDS
Ulithi
Fais
Ngulu
Sorol
Faraulep
Gaferut
Olimaraa
Woleai
Ifalik
Elato
Lamotrek
Satawan
West Fayu
Pikelo
Eauripik
MAGUR ISLANDS
HALL ISLANDS
Namonuito
Fayu
Murilo
CHUUK ISLANDS
Weno
Pulap
Puluwat
Pulusuk
Namoluk
MORTLOCK ISLANDS
Oroluk
SENYAVIN ISLANDS
Pohnpei
PALIKIR
Kolonia
Mwokil
Pingelap
Ngatik
Nukuoro
Kapingamaringi
Kosrae
Tofol
0 100 200 300 Kilometers
0 100 200 300 Miles
IBRD 33406
JANUARY 2005