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Report No: PAD2436

INTERNATIONAL DEVELOPMENT ASSOCIATION

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED {CREDIT/GRANT}
IN THE AMOUNT OF (SDRXX) MILLION
(US$6.5 MILLION EQUIVALENT)

AND

ON A PROPOSED STRATEGIC CLIMATE FUND-SCALING UP RENEWABLE ENERGY PROGRAM GRANT
IN THE AMOUNT OF US$7.1 MILLION

AND

ON A PROPOSED SMALL ISLAND DEVELOPING STATES INITIATIVE (SIDS-DOCK) GRANT
IN THE AMOUNT OF US$1.6 MILLION

AND

ON A PROPOSED GLOBAL ENVIRONMENT FACILITY GRANT
IN THE AMOUNT OF US$0.9 MILLION

TO THE

SOLOMON ISLANDS

FOR AN
ELECTRICITY ACCESS AND RENEWABLE ENERGY EXPANSION PROJECT (PHASE II)
SREP submission – Draft of OCTOBER 10, 2017

Energy & Extractives Global Practice
East Asia And Pacific Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective {May 03, 2017})

Currency Unit	=	Solomon Islands Dollar (SBD)
SBD 7.78	=	US$1
US$	=	SDR 1

FISCAL YEAR
January 1 - December 31

Regional Vice President:	Victoria Kwakwa
Country Director:	Michel Kerf
Senior Global Practice Director:	Riccardo Puliti
Practice Manager:	Jie Tang
Task Team Leader:	Isabel Neto

ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
BP	Bank Procedure
CAGR	Compound Annual Growth Rate
CapEx	Capital Expenditures
CIF	Climate Investment Fund
CPS	Country Partnership Strategy
DA	Designated Account
EAEP	Electricity Access Expansion Project
EPC	Engineering, Procurement and Construction
ERR	Economic Rate of Return
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
FM	Financial Management
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gases
GPOBA	Global Partnership on Output Based Aid
GRS	Grievance Redress Service
GWh	Gigawatt Hour
HES	Honiara Electricity System
HIES	Household Incomes and Expenditure Survey
IDA	International Development Association
IFC	International Finance Corporation
IFRs	Interim Financial Reports
INDC	Intended Nationally Determined Contributions
IPF	Investment Project Financing
IPP	Indigenous Peoples Plan
kW	Kilowatt
MMERE	Ministry of Mines, Energy and Rural Electrification
MoFT	Ministry of Finance and Treasury
MoLHS	Ministry of Lands and Housing Survey (MoLHS),
MW	Megawatt
NPV	Net Present Value
OBA	Output Based Aid
O&M	Operations and Maintenance
OP	Operational Policy
PDO	Project Development Objective
PPSD	Procurement Strategy for Development
PV	Photovoltaic
RAMSI	Regional Assistance Mission to the Solomon Islands
RE	Renewable Energy
RPF	Resettlement Policy Framework

SBD	Solomon Islands Dollar
SCD	Systematic Country Diagnostic
SCF	Strategic Climate Fund
SIDS-DOCK	Small Islands Development States Multi-donor Trust Fund
SIEA	Solomon Islands Electricity Authority
SIG	Solomon Islands Government
SISEP	Solomon Islands Sustainable Energy Project
SREP	Scaling-up Renewable Energy Program
TOL	Temporary Occupation License
TRHDP	Tina River Hydropower Development Project
US$	United States Dollars
WBG	World Bank Group

frisks

BASIC INFORMATION

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

[ ] Situations of Urgent Need of Assistance or Capacity Constraints

[ ] Financial Intermediaries

[ ] Series of Projects

Approval Date	Closing Date	Environmental Assessment Category
01-Feb-2018	30-Jun-2022	B - Partial Assessment

Bank/IFC Collaboration
No

Proposed Development Objective(s)

The project development objective is to increase access to grid-supplied electricity and increase renewable energy generation in Solomon Islands.

Components

Component Name	Cost (US$, millions)
Renewable energy hybrid mini-grids	8.00
Connections to low income households	1.50
Grid-connected solar power	5.00
Enabling environment and project management	1.60

Organizations

Borrower : Ministry of Finance and Treasury

Implementing Agency : Solomon Islands Electricity Authority (Solomon Power)

PROJECT FINANCING DATA (US$, Millions)

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

Total Project Cost:	Total Financing:	Financing Gap:
16.10	16.10	0.00
	Of Which Bank Financing (IBRD/IDA): 6.50	

Financing (in US$, millions)

Financing Source	Amount
Strategic Climate Fund Grant	7.10
Support for Small Island Developing States (SIDS) DOCK Suppo	1.60
Global Environment Facility (GEF)	0.90
IDA Grant	6.50
Total	**16.10**

Expected Disbursements (in US$, millions)

Fiscal Year	2018	2019	2020	2021	2022	2023
Annual	0.07	0.45	0.68	1.19	2.01	2.11
Cumulative	0.07	0.52	1.19	2.38	4.39	6.50

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	Low
2. Macroeconomic	Low
3. Sector Strategies and Policies	Moderate
4. Technical Design of Project or Program	Moderate
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	✓	
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

Appointment or recruitment of a qualified procurement specialist (no later than three months after effectiveness) [TBC]

Sections and Description

Adoption of Project implementation Manual (no later than three months after effectiveness) [TBC]

Conditions

Type	Description
Effectiveness	Appointment or recruitment of a project coordinator [TBC]
Effectiveness	Execution of the Subsidiary Agreement [TBC]
Effectiveness	The SREP Grant Agreement, the SIDS-DOCK Grant Agreement and the GEF Grant Agreement ("Grant Agreements") have been executed and all conditions to their effectiveness or to the right of the Recipient to make withdrawals under them (other than the effectiveness of this Agreement) have been fulfilled. [TBC]

PROJECT TEAM

Bank Staff

Name	Role	Specialization	Unit
Maria Isabel A. S. Neto	Team Leader(ADM Responsible)	Senior Energy Specialist	GEE09
Zhentu Liu	Procurement Specialist(ADM Responsible)	Senior Procurement Specialist	GGO08
Stephen Paul Hartung	Financial Management Specialist	Financial Management Specialist	GGO20
Duangrat Laohapakakul	Counsel	Senior Counsel	LEGES
Felix Peter Taaffe	Environmental Safeguards Specialist	Environmental Specialist	GEN2A
Kim Dagmar Baverstock	Team Member	Program Assistant	EACNF
Loren Jayne Atkins	Counsel	Associate Counsel	LEGES
Lorena Beatriz Gomez Estigarribia	Team Member	Operations Officer	GEE09
Maria Ayuso Olmedo	Team Member	Young professional	GEE02
Renee Berthome	Team Member	Operations Analyst	GEE09
Ross James Butler	Social Safeguards Specialist	Senior Social Development Specialist	GSU02

Extended Team

Name	Title	Organization	Location

SOLOMON ISLANDS
ELECTRICITY ACCESS AND RENEWABLE ENERGY EXPANSION PROJECT (PHASE II)

TABLE OF CONTENTS

I. STRATEGIC CONTEXT

A. Country Context

1. **An archipelago of 997 islands, Solomon Islands has a total land area of 29,900 km^2 spread over 1.34 million km^2 of ocean.** The population of approximately 616,000 is dispersed across 90 inhabited islands and has among the lowest population densities (20 persons per km2) and urbanization rates (17 percent) in the world.[1] Roughly 80 percent of the population is living in rural areas. The island geography presents formidable and in some cases immutable challenges to service delivery, infrastructure, and economic integration. The difference in access to services between urban and rural areas is particularly stark.

2. **Solomon Islands has one of the lowest levels of gross domestic product (GDP) per capita among the Pacific Island states, at US$2,013 per capita.** The country is still recovering from many years of intermittent political turmoil and civil strife. Locally referred to as the "tension," the conflict during 1998-2003 disrupted the functioning of state and social institutions which resulted in a 40 percent decline of GDP. To support the stabilization of Solomon Islands, neighboring countries led by Australia deployed the Regional Assistance Mission to the Solomon Islands (RAMSI) to restore law and order and other basic state functions. Ever since, peace has generally been maintained, barring major riots in 2006 (which did not trigger further conflict), and political protests in 2011 following a change in prime minister. RAMSI support left Solomon Islands in July 2017 and peace continues to be maintained by the local police and justice services.

3. **The Solomon Islands economy has rebounded since the civil unrest in 2003, but remains vulnerable to external shocks.** Solomon Islands remains a fragile country.[2] The economy recovered relatively strongly based on export of commodities such as logging and mining. However, the global financial crisis in 2009 hit the Solomon Islands hard, resulting in a sharp contraction of the economy, a budget crunch, and a depletion of foreign currency reserves. Solomon Islands Government (SIG) recognized the need for significant reductions in its current spending levels, especially those with significant impact on the balance of payments. The oil price spike of 2008 increased Solomon Islands' vulnerability to oil price volatility, and the country's balance of payments came under severe pressure as fossil fuel makes up a significant portion of all imports. To mitigate the impact of high cost diesel fuel, the SIG took the initiative in considering options for development of domestic sources of energy, particularly hydro and other renewables. At the same time, while the country had benefited from the Honiara Club Agreement,[3] the arrangement had also placed a moratorium on new loans, which made public financing of larger infrastructure projects very difficult. While this moratorium has since been lifted, it gave an initial impetus to the drive for private sector participation in infrastructure development, financing, and operation - a policy that was later embedded in the Government National Development Strategy (2011-2020).

4. **Income distribution is inequitable across Solomon Islands, particularly geographically, with rural income levels below urban income levels.** The 2012/13 Household Incomes and Expenditure Survey (HIES), released in November 2015, found urban households earn close to three times the average income of rural households, and twice the median and per-capita income. Wages/salaries and business incomes are higher in urban areas accounting for 83 percent of the total cash-income compared with 59 percent in rural areas. As expected, the third highest cash-income of rural households comes from subsistence-based activities

[1] Population data based on Solomon Islands 2012/13 HIES – National Analytical Report [Volume 1], October 2015.
[2] Solomon Islands is on the Harmonized List of Fragile Situations FY18 with a harmonized Country Policy and Institutional Assessment average score of 3.1.
[3] Honiara Club Agreement sets agreed principles to support Solomon Island's recovery.

(mainly agriculture). In urban and rural areas cash payments for energy is a primary household expenditure. In urban areas, cash-based expenditure primarily consists of rental payments, electricity, water, and gas. Liquid fuels as a source of energy are the largest cash-based expense in rural areas.

5. **Extreme poverty is relatively high in the Solomon Islands and the country's geography and remote location makes the provision of services, including electricity, particularly challenging.** An estimated 25.1 percent of Solomon Islanders live below the global extreme poverty line, on less than US$1.90 per person per day (in 2011 purchasing power parity terms), higher than elsewhere in the Pacific except Papua New Guinea. An estimated 56.7 percent of the population live on less than US$3.10 per person per day. The Solomon Islands is one of the few Pacific countries not achieving any of the eight Millennium Development Goals, in part reflecting the very high cost of providing essential services to such small pockets of people spread widely across a dispersed territory.

6. **The wide distribution of the population and the low densities make the capital costs of connecting consumers very high relative to the revenue generation.** As a result, there are few roads on most of the islands, limited commercial shipping between islands, and air transportation is unaffordable for most citizens. Access to essential services such as water, sanitation, or electricity is low: less than 20 percent of the population has access to any electrical power supply. When electricity is available, it is more costly than elsewhere in the world and is often less reliable. Rates of access to an improved water source (primarily piped water), improved sanitation, and grid electricity are significantly higher in urban areas, but the gaps are still substantial and the quality of services for those who have them is variable. Provision of infrastructure such as stable supply of grid-based electricity has the potential to promote economic growth, for example, by refrigeration of fish, pumped irrigation, processing of produce, and development of the tourism industry. Low levels of access to an adequate supply of electricity limit the ability of children to study, add to the burden of household work, and severely constrain economic activity.

B. Sectoral and Institutional Context

7. **Solomon Islands is almost entirely dependent on imported, refined petroleum fuels for national energy needs for electricity generation, transport, and lighting.** The Ministry of Mines, Energy and Rural Electrification (MMERE) is the supervising ministry, and its Energy Division bears responsibility for legal and regulatory development, institutional strengthening, and supervision of the vertically integrated, state-owned utility, the Solomon Islands Electricity Authority (SIEA), trading as "Solomon Power" since December 2015. Operating under the Electricity Act, Solomon Power is the main supplier of electricity in the country, and responsible for electric power generation, transmission, and distribution to all urban and provincial centers, including Honiara, nine provincial centers (so-called "outstations") and Noro Township in the Western Province. Given the island geography of the country (with population dispersed by many small islands), apart from the Honiara power system, most other service is provided by what can be considered mini-grids[4]. Outside of Solomon Power's existing service areas, there are a small number of community operated grids, standalone diesel generators, or small solar systems for basic lighting and phone charging. Since an independent regulatory authority does not exist in the Solomon Islands, Solomon Power also advises SIG on regulatory instruments, and is given the authority to issue licenses to entities who wish to generate and distribute electricity in areas not supplied by Solomon Power.

[4] Throughout literature there is not a consistent definition of mini (or micro) grids. In Africa and Asia, mini grids are sized according to MWs, while in the Pacific a 500kW system is considered to be a grid. For the purpose of the project, and in the Pacific context, a mini grid is defined as follows: "AC grids connecting a number of households and businesses with SE4ALL Tier 4 or 5 access to household electricity supply (or intended for Tier 4 or 5 service in the short to medium term). These mini grids will be capable of receiving generation such as from solar pV, mini hydros, biomass, etc. and may be later interconnected into island grids.

8. **Solomon Power supplies electricity to urban centers through diesel generators.** Solomon Power's Honiara power system is almost entirely diesel-based, except for a 50 kilowatt (kW) rooftop photovoltaics (PV) pilot project at Solomon Power's headquarters and a one megawatt (MW) solar farm commissioned in 2016. The total installed capacity of Honiara Electricity System (HES) is 33.6 MW, out of which 32.6 MW are diesel generators and one MW is a solar farm. Peak demand of the HES has increased from 9.3 MW in 2003 to 15.5 MW in 2016 representing a compound annual growth rate (CAGR) four percent. Over the same period, annual electricity generation in HES grew at 4.9 percent CAGR from 45.1 gigawatt-hours (GWh) to 83.9 GWh, with a notable 6.7 percent growth in 2016 alone mainly due to the increased generation capacity realized through the commissioning of four 2.5 MW diesel generators. Total electricity generated in the provincial grids was 6.7 GWh in 2016.

9. **Solomon Power has successfully rebounded from financial crisis in 2001**. The International Development Association (IDA)-funded Solomon Islands Sustainable Energy Project (SISEP), approved in June 2008 with additional financing to scale up the original project approved in November 2014, was instrumental in turning around the financial performance of Solomon Power, which dramatically recovered from making losses until 2010 to a net revenue of SBD 107 million in 2015.[5] Similarly, the SISEP has delivered significant benefits to customers through improved power system reliability and efficiency. The annual total length of time that a customer is without power in Honiara, taking into account all planned and unplanned outages (system average interruption duration index, SAIDI), has fallen from a very high 51,840 minutes (864 hours) in 2007 (prior to the SISEP) to 3,487 minutes (58 hours) in 2016. Over the same period, the number of times in a calendar year that a customer can expect to experience an interruption in power supply (system average interruption frequency index, SAIFI) dropped from 816 times to 46 times. In 2014, Solomon Power appointed a Capital Program Manager. The Capital Program Manager is tasked with strengthening the Solomon Power's project management capability, particularly the execution of its extensive capital works activities, including a new powerhouse for the capital city and generation and network upgrades across the country, and those financed under the SISEP additional financing. In addition, Solomon Power took further steps to improve their capability to effectively manage its pipeline of capital works projects, including restructuring the organization and appointing three new experienced engineers, including a Planning Manager in addition to the Capital Program Manager.

10. **To expand access and to improve reliability, affordability, and sustainability of electricity services**, Solomon Power plans to implement a least-cost expansion plan and expand its network coverage. The least-cost expansion plan requires installation of over 54 MW new capacity in a combination of hydropower, solar and storage, and diesel capacity to meet the demand growth at the least economic cost[6]. The annual demand is projected to grow to over 140 to 250 GWh by 2040 under different scenarios of CAGR. The base case scenario assumes (a) a 2.1 percent CAGR[7] for demand growth; (b) international crude oil price growing from US$64 per barrel in 2017 to US$72 per barrel in 2025, and growing up to US$87 per barrel by 2046 in real terms; (c) solar farm installation price going down from US$2.8 to US$1.6 million per MW from 2017 to 2030 and remaining constant afterwards; and (d) an economic discount rate of three percent pursuant to the Bank's Discounting Costs and Benefits in Economic Analysis of World Bank Projects (May 2016),[8]. The

[5] According to Solomon Power Annual Report, which also recorded net revenues of SBD 106 million (~US$13.6 million) in 2015 and SBD 91 million (~US$11.7 million) in 2014.

[6] This least-cost expansion plan analysis was prepared in the framework of the preparation for the Tina River Hydropower Project (TRHP).

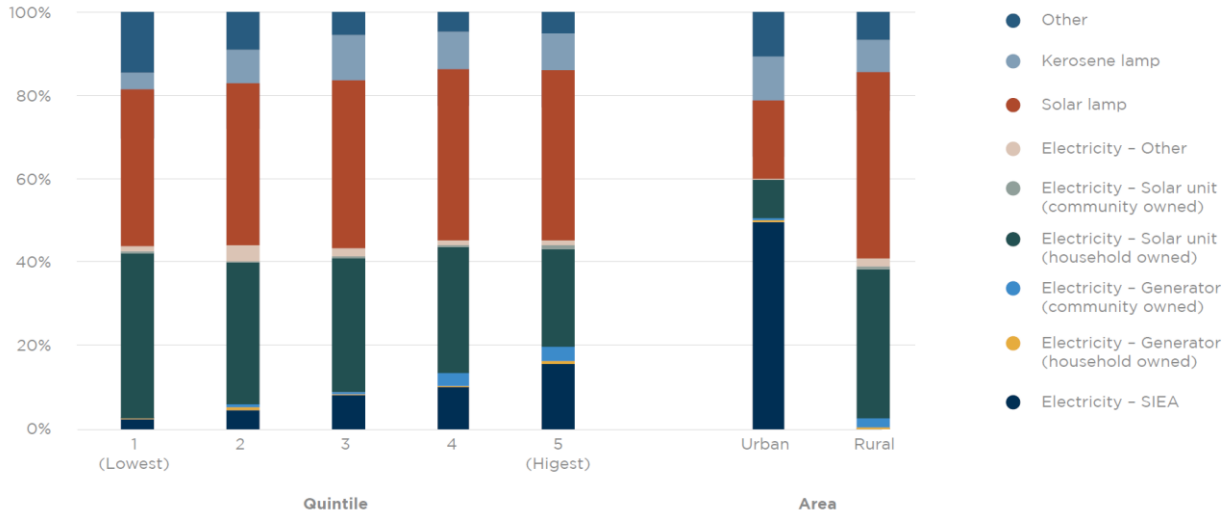
[7] From the Debt Sustainability Analysis of Solomon Islands carried out by World Bank and International Monetary Fund,

[8] This guidance recommends the use of discount rate of twice the projected rate of GDP per capita in real terms. It is anchored in welfare economics and implies that the net benefits of a project at different points in time should be valued according to their marginal impact on welfare at the time they occur. Higher (lower) growth prospects would normally imply a higher (lower) discount rate for a particular country.

proposed Electricity Access and Renewable Energy Expansion Project (Phase II) will contribute to this target by increasing the annual electricity output from renewable energy, which will reduce reliance on diesel generation and lower the blended cost of generation. Utility scale solar also has benefits in minimizing land issues as it can be installed adjacent to existing distribution lines on leased land. A reduction in the use of diesel fuel will also lower Solomon Power's operation and maintenance costs.

11. **Solomon Power is capable of absorbing the expected output of grid connected solar with no adverse effects on system stability.** With an average load of 75 GWh and generation capacity capable of an output of 84.9GWh[9], no negative impact on the grid is expected. As mentioned above, new generation capacity will be required to meet the growing demand. Increased solar generation will benefit the economy through (a) reduced importation of fossil fuels, (b) lower cost of power generation placing downward pressure on power tariffs thereby supporting private sector and reducing household expenditure, (c) improved energy security, and (d) reduced tariff volatility due to partial conversion of the national grid to renewable energy. Utilization of renewable energy also reduces greenhouse gas (GHG) emissions, which contribute to global warming.

Figure: Source of energy for lighting by quintile and by urban and rural areas



Source World Bank staff analysis of 2012/13 HIES.

12. **Solomon Islands has one of the lowest rates of electrification in the region.** Dispersed population across an island archipelago and the poor performance of Solomon Power in the past constrained its capacity to expand the grid even in the capital city (Honiara), but it is currently planning a significant program of grid extensions and development of outstations. According to the 2012/13 HIES, while 45 percent of the households are said to have access to electricity, a majority of the households only have small solar panels, typically of 20 watts. The percentage of households supplied by Solomon Power is merely 12 percent nationally. While 64 percent of the population of Honiara is connected, only six percent of the remainder of the country is connected to grid electricity. The access to electricity has been improving in both rural and urban areas, although the type of service is very different. For rural households with sufficient electricity for lighting, the vast majority use solar units owned by the household, or solar lamps. In contrast, however, the major source of electricity for urban households with sufficient electricity for lighting is the grid run by Solomon Power. While a lower-tiered access for households in rural areas and in informal urban settlements

[9] Data projected for 2016 in the Bank's Solomon Islands Cost of Service and Tariff Study: Phase 2: Renewable generation and Network capacity expansion, November 2015.

may be appropriate initially, when consumption is low, it provides a different level of service (including with respect to continuous supply) and has limited adaptability for scaled-up use for productive purposes. As effective demand increases in progressively more areas of Solomon Islands, higher-grade, scalable, or grid-supplied electricity access will be required.

13. **Solomon Power has a goal of doubling its existing customers by 2021.** Solomon Power has recently started to invest in strengthening and expanding its electricity network. This includes through the installation of an additional 10 MW of diesel generator capacity at Lungga Power Station in Honiara, and Solomon Power's investment plan includes 23 subprojects to expand the Honiara grid, which it plans to finance with its own funds. These areas include the most populated areas around Honiara that can be connected with simple grid extensions, and therefore represent the most cost-effective and least cost option to connect these households. Over time, this will require bringing additional generation onto the Honiara grid as well as financing the customer connections for the households situated in those areas. Solomon Power is also developing two outstations with solar-diesel hybrid systems and hybridizing five others. Its investment plan also lists another 35 potential new outstations. These investment plans have been prepared by Solomon Power to help it meet its ambitious goal to double the number of customers from 15,500 to 30,000 by 2021 – a goal that MMERE also supports. However, both MMERE and Solomon Power recognize that the high cost of connection is a serious impediment for new customers, especially low-income households, to connect.

14. **A major obstacle in expanding the use of electricity and promoting economic development is the high average retail electricity tariff of approximately US$65 cents/kWh, which is the highest in the Pacific and among the highest in the world.** This is due to its high reliance on expensive diesel generation with costs largely driven by the high transportation costs, inability to harness efficiencies from economies of scale, and exposure to volatility of global oil prices. The retail tariff is nationally uniform and is regulated by MMERE, and there is a cross-subsidy between the HES customers with relatively lower cost of supply and the customers of the outer islands with higher generation costs mainly due to the high cost of transporting fuel (a national uniform tariff is applied across the board for all of Solomon Power customers, including in outstations). The cost of generation has reduced over recent years, from US$35.6 cents/kWh in 2014 to US$ 23.8 cents/kWh in 2016, along with the drop in oil prices. Retail tariffs for grid-supplied electricity, adjusted down from US$93 cents/kWh in 2014 to US$65 cents/kWh as of January 2017. The 2017 reduction was partly due to low oil prices, and partly due to enforcement of a new tariff calculation methodology. The Tariff Regulation mechanism adopted since 2005 linked retail tariffs to fuel cost. However, while the retail tariff increased along with rising oil prices up to mid-2014, the drop in fuel cost that began in late-2014 was largely not translated into lower retail tariffs. In 2014, Solomon Power, with the support of the World Bank, conducted a cost-of-service and tariff review in order to develop recommendations on Solomon Power's future revenue requirements and its electricity tariff. The cost-of-service and tariff review was completed in 2016, resulting in the development and gazetting of the *Tariff Regulation 2016,* which came into effect in January 2017. Through the new tariff methodology, tariff levels are set by determining the Maximum Allowable Revenue for Solomon Power based on Non Fuel Revenue Requirements and a pass-through of Fuel Charges of all fuel costs, including power purchased under power purchase agreements, adjusted for heat rate and losses. However, the retail tariff is still significantly higher than the Pacific regional average of residential retail tariffs, which is approximately US$40 cents/kWh.[10] Although no affordability survey has been conducted, it is understood that the expensive tariff is one of the major factors for the extremely low annual consumption per capita. Having said this, unelectrified households currently spend a significant amount on expensive alternative sources of energy such as kerosene lamps, candles, and charging of

[10] Based on *2016 Pacific Infrastructure Performance Indicators*, Pacific Region Infrastructure Facility (August 2016). Note, however, that some governments subsidize retail tariffs.

batteries and mobile phones at diesel-based charging stations, while grid-supplied electricity, albeit expensive by international standards, is still more economical than the currently available alternatives[11].

15. **Renewable energy can play a key role in increasing access in a sustainable manner.** In order to reduce the exposure to the volatile global oil prices and to enhance energy security, SIG aims to increase the share of renewable energy to 50 percent of total installed capacity by 2020.[12] Apart from the small solar home systems, development of renewable energy has been slow in the Solomon Islands largely due to the weak financial position of Solomon Power until mid-2011, and the only prominent renewable energy sources operated by Solomon Power were the mini-hydros supplying Buala town on Isabel Province and Malu'u substation in Malaita. A number of initiatives, however, are under way that will provide additional generation needed to supply new consumers. Support from development partners is further described below.

16. **Potential for solar PV generation is being explored in complement to the Tina River Hydropower Development Project (TRHDP) under development.[13]** It is estimated that the irradiation is in the range of 5.5 to 6.5 kwh/m^2/day, and the daily load profile with maximum demand at mid-day makes PV with coinciding peak output hours a favorable option. In addition, the cost of PV continues to reduce and has an extremely low operating cost, making it an increasingly attractive alternative technology. Having said this, its outputs are intermittent and are only available during the day, and so beyond a particular penetration level, PV projects need to include storage and/or be combined with other type of compensation for the intermittency of the solar resource. Battery technologies, particularly lithium-ion batteries, are becoming an attractive enabling technology to address PV's intermittency and to store energy during the day for night-time consumption. While there is no technical limit to the penetration level, batteries are still relatively expensive in comparison with diesel and hydropower in its function to deliver energy and to provide ancillary services. An independent economic optimization study commissioned by the Bank in the framework of the TRHDP demonstrated that while hydropower and PV may compete depending on the combination of load, river discharge and insolation, hydropower predominantly displaces diesel as baseload electricity and facilitates the integration of PV at least-cost to the system.[14]

17. **The initial connection cost and support is being provided through the Electricity Access Expansion Project (EAEP), funded by the Global Partnership on Output Based Aid (GPOBA).** The initial cost to connect to the power system in Solomon Islands is extremely high. The cost of connection can be divided into (a) the cost of service line and meter to be installed by Solomon Power, and (b) cost of in-house wiring which has to be installed by a licensed electrical contractor. Solomon Power shoulders the cost of the service line for customers whose house is within 20 meters from the nearest distribution pole, but the customer has to pay SBD 800 (~US$100) for the meter and the actual cost of the service line (and auxiliary poles, if required) if the distance exceeds 20 meters. For example, the cost of connection for a house that is 30 meters away from the connection point requiring one auxiliary pole will be about SBD 2,500 (~US$313) excluding the cost shouldered by Solomon Power for the first 20 meters. Given that the monthly income of the lowest quartile in urban areas is SBD 2,000 and only SBD 850 in rural areas of the outer islands, the cost of the service line

[11] Although no affordability survey has been conducted, the economic and financial analysis conducted for the Electricity Access Expansion project (P151618) identified the willingness to pay at US$28/month for rural areas of Solomon Islands. This was done by comparing what communities were spending on alternative sources of power (namely battery charging.). The average consumption per month is 30kwh, which at the current tariff of US$0.65, means that, once connected to the mini-grid, consumers would be paying on average US$19.5/month, thereby saving 30%.

[12] Apart from the cost implications, diesel generation is a major source of GHG as well as local air and noise pollution.

[13] Supported by several donors, including the World Bank (see Report No: PAD2258).

[14] This is because, although hydropower outputs can also be variable, the reservoir capacity of the TRHDP, albeit small, can provide the fast-response needed to compensate the PV's intermittency and to regulate the frequency of the power system. Since it can also provide spinning reserves and inject inertia to keep the system strong, the TRHDP can contribute to enabling higher penetration of PV.

and meter is difficult to afford. Moreover, it is the exorbitant cost of the in-house wiring which makes access to grid-supplied electricity extremely difficult particularly for the low-income households. In accordance with the Electricity Act, in-house wiring can only be installed by licensed electrical contractors. Licenses are issued by Solomon Power, and Solomon Power also certifies the in-house wiring before it connects the service line to a new customer. While this stringent regulation is commendable, since there are only about 60 active licensed electrical contractors (and limited number of suppliers) – all of which are in Honiara – the cost of the in-house wiring services including the material cost seems to be artificially inflated. Evidence suggests in-house wiring can cost more than SBD 10,000 (US$1,200) for a small house. The Bank has approved the US$2.5million EAEP (P151618), supported by GPOBA, in July 2016 to provide targeted subsidies[15] to low-income households to help new customers pay the initial connection fee and basic in-house wiring for low-income households, which is a major impediment to increasing the electrification rate. Initial feedback from SIG and beneficiaries is very positive and there would be interest in expanding the program to more beneficiaries.[16]

18. **Solomon Islands is benefiting from the Scaling-Up Renewable Energy in Low-Income Countries Program (SREP)[17].** In June 2014, the SREP sub-committee endorsed an investment plan (SREP IP) submitted by MMERE, for the development of renewable energy opportunities totaling an estimated amount of US$ 40.3 million, including US$ 14 million of SREP funding and co-financing from the private sector, multilateral development banks (WB and ADB) and the private sector. The SREP IP, which aims to support the increased penetration of renewable energy and increased electricity access in the country, identifies renewable energy technologies and projects that would contribute to the sustainable development of Solomon Islands. The proposed Electricity Access and Renewable Energy Expansion Project contributes to the SREP IP's Renewable Energy Access Project. More details regarding the SREP IP and investment criteria are provided in Annex 5.

19. **Solomon Islands also receives support from the Small Islands Development States Initiative (SIDS-DOCK) Multi-donor Trust Fund[18] and the Global Environment Facility (GEF).** SIDS-DOCK provides grants to recipients with focus on two outcomes: (a) creating an enabling regulatory and institutional environment to remove barriers on the implementation of renewable energy and energy efficiency policy reforms, based on international best practices; and (b) implementation of renewable and energy efficiency projects that demonstrate the potential for scale-up through climate finance and other sources of funding. To achieve its outcomes, SIDS-DOCK supports analytical and advisory activities as well as some investments for renewable energy and energy efficiency initiatives. This project is in line with SIDS-DOCK outcomes. GEF has funded 40 projects in Solomon Islands in the areas of biodiversity, land degradation, and climate change, valued at over US$260 million in grant funding and US$900 million in additional co-financing.

[15] This includes funds a client executed grant of US$2.23million along with Bank executed funds for supervision in the amount of US$0.27million). A subsidy of US$794 is paid under the program for connections in Honiara, and US$994 for connections in outstations.

[16] A willingness to pay analysis was also conducted during preparation of EAEP to determine household's willingness to pay once they received an electricity connection. The economic analysis considered only the consumers' surplus of switching from the supply provided by charging and using car batteries to grid electricity supply. The surplus is based on the cost savings from charging batteries and replacing them every two years, to using grid electricity (30 kWh per month in Honiara, charging batteries cost approximately SBD 45 per charge, and the battery can last around a week, for a limited use of two energy efficient lamps, and phone charging). Thus, it is assumed that the willingness to pay of consumers is at least the amount they currently pay of US$24 a month. Also, switching to grid electricity avoids the need of replacing the battery, usually after two years, with a cost of US$100 per battery. Using the revised electricity tariff for the lowest residential tier below 50 kWh a month of US$0.70/kWh, the monthly bill would be US$21, lower than the current cost of charging batteries, but providing much more electricity than before.

[17] SREP is part of the Strategic Climate Fund, with the objective to pilot and demonstrate the economic, social, and environmental viability of low carbon development pathways in the energy sector by creating new economic opportunities and increasing energy access through the use of renewable energy

[18] SIDS-DOCK is a partnership of the Energy Sector Management Assistance Program, the United Nations Development Program, Alliance of Small Island States, the Government of Denmark, and the Government of Japan, established 2011.

20. **Several development partners provide support to Solomon Islands in the energy sector.** The Energy Program of the Secretariat of the Pacific Community's Economic Development Division provides technical assistance to MMERE, including on development of the Solomon Islands National Energy Policy in 2014. In 2014, a 50 kW demonstration grid-connected solar installation on the rooftop of Solomon Power's head office parking lot was commissioned, with financing from the Japan International Cooperation Agency. Solomon Power has commissioned a one MW grid-connected solar farm connecting to the Honiara grid, which was grant-funded by the Governments of the United Arab Emirates and New Zealand. Also, ADB is implementing the Solar Power Development Project, which aims to hybridize existing diesel-based outstations with solar and battery units. Also with ADB financing, Solomon Power is implementing 500 kW Fiu River Hydropower Project to connect to the Auki grid on the island of Malaita. The World Bank, the International Finance Corporation (IFC), ADB, Australia, Green Climate Fund (GCF), and other partners are supporting SIG to develop the 15 MW TRHDP, which will feed into the Honiara grid. TRHDP will increase generation capacity of baseload electricity and integration capacity of renewables into the grid. In addition, the previously mentioned SISEP aims to improve the operational efficiency, system reliability, and financial sustainability of Solomon Power. Increases in transmission capacity within the grid, improved efficiency of power supply, and tariff reforms are expected to lay the ground for increasing access to grid-based energy. As described above, the EAEP supports access to energy for the poor by addressing the ability of poor households to pay the up-front connection cost and the cost of in-house wiring. The proposed project complements these ongoing interventions.

C. Higher Level Objectives to which the Project Contributes

21. **Solomon Islands' 2016-35 National Development Strategy places emphasis on increasing electricity access and the promotion of renewable energy.** The Solomon Islands Draft National Development Strategy 2016-2035, prepared by the Ministry of Development Planning and Aid Coordination prioritizes increased electricity access. It is widely acknowledged that access to electricity contributes to economic and social development, and has particular benefits for improved education and health for women and children. For the case of Solomon Islands doing so through renewable energy enhances the system sustainability and reduced GHG emissions. This project is consistent with SIG's plans to increase electricity access and increase the percentage of renewable energy in the total energy mix.

22. **The project is aligned with the World Bank Group's Country Partnership Strategy (CPS) FY2013-2017, with the Solomon Island Systematic Country Diagnostic (SCD), and with the Bank's twin goals.** The World Bank Group's CPS is structured around two engagement areas: underpinning improvements in public service provision and strengthening economic resilience. The project supports the Bank's engagement in both areas by extending access to electricity and improving economic resilience by easing constraints, and promoting climate friendly growth. In particular, the project will support CPS outcome # 5 of lower cost and reliable electricity from cleaner energy sources.[19] The SCD recognizes the need to significantly expand access, in particular grid level access (including to enable productive purposes) and that the extent to which the increased availability of grid connections will translate into increased access will depend critically on the price of electricity. The project addresses these issues by expanding (mini) grid services to several outstations and introducing additional solar generation, which will contribute to displace expensive diesel generation. The proposed project supports the twin goals of reducing poverty and increasing shared prosperity for the poorest 40 percent of the population by extending and connecting additional people to electricity networks, while improving sustainability and affordability through the replacement of diesel generation with more

[19] Preparation of a new CPS will start soon.

affordable sources of power. Finally, the project is consistent with the objectives of clean renewable energy development of the World Bank's Energy Directions Paper.[20]

23. **The project will contribute to the reduction of GHG emissions and for SIG to achieve its Intended Nationally Determined Contribution (INDC) commitment.** The project will contribute to global efforts to mitigate climate change by promoting the use of clean energy technologies, including the use of solar energy solutions in rural areas, to displace the current use of mainly kerosene for lighting. SIG's INDC is to reduce GHG by 18,800 tons of carbon dioxide equivalent (tCO2eq) per year by 2025 and by 31,125 tCO2eq per year by 2030. Based on the economic analysis, the Electricity Access and Renewable Energy Expansion Project (Phase II) is cost effective in achieving GHG emission reductions. The project helps reduce GHG emission by 26,050 tCO2eq over the life of the project. Given the nature of the project activities, it is considered that the project currently has 87% of climate co-benefits (US$ 14.1 million)[21].

II. PROJECT DEVELOPMENT OBJECTIVES

A. PDO

The project development objective is to increase access to grid-supplied electricity and increase renewable energy generation in Solomon Islands.

B. Project Beneficiaries

24. The primary beneficiaries of the project's Component 1 (Renewable Energy Hybrid Mini-grids) and Component 2 (connections to low income households) are the households in the planned outstation mini-grid areas as well as those in the peri-urban areas within existing grid coverage and the planned extension of the Honiara grid. A total of 1,282 low income households (of which approximately 10 percent are female-headed), equating to approximately 7,311 people, will benefit directly from the project.[22]

25. The availability of reliable electricity supply will benefit all customers served by the project-supported mini-grids as there will be increased productivity and commercial activity, and there will be savings to end-users who no longer have to purchase alternative sources of energy for lighting and power generation. By providing households with access to electricity, women can undertake more productive activities, such as handicrafts in the evening promoting economic development, children can complete school homework and studies after school, food can be kept in a fridge or ice box, and the household can feel safe and secure in their residence at night. Public institutions, including health facilities and schools may also be connected to electricity, enabling the provision of improved health and education services to the communities for extended hours, as required. Small businesses benefit from affordable and reliable electricity.

[20] Report No. 79597.
[21] For the purposes of this calculation, and given the specific project activities being financed: (i) It is considered that component 1 (renewable energy hybrid mini-grids) has100% of co-benefits (refer to MDB report mitigation positive list category 1.1), (ii) component 2 (connections for low income households) has no co-benefits, (iii) component 3 (grid-connected solar power) has 100% of co-benefits (category 1.1) and (iv) component 4 (Technical assistance and project management) has 66% climate co-benefits. This component is prorated, assuming that the technical assistance activities and project management costs assigned to component 1 and component 3 will also be counted towards climate co-benefits.
[22] The total number of people is derived from the number of new household connections by the average household size in Solomon Islands (5.7 people per household). Solomon Islands 2012/13 HIES.

26. The primary beneficiaries of the project's Component 3 (grid-connected solar power) are the electricity consumers of Solomon Islands in the Honiara grid as the project will contribute to stabilizing and reducing prices over the longer term through fuel diversification; Solomon Power in terms of medium-term renewable energy plan and capacity to integrate renewable energy into the grid; and MMERE and SIG in terms of achieving longer-term sustainability for the sector.

27. More generally, the project will strengthen the capacity of Solomon Power, SIG, and MMERE to implement key energy sector projects and build technical and fiduciary skills to support rural electrification. The project will also contribute to building a sustainable private sector industry for the supply, operation, and maintenance of renewable energy systems in Solomon Islands, including in rural areas. As such, it will provide opportunities for employment, including for women.

C. PDO-Level Results Indicators

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

- People provided with new or improved electricity service (number); and
- Annual electricity output from renewable energy as a result of the renewable energy constructed under the project. (GWh).

29. Section VII describes the additional intermediate indicators and the SREP indicators to be used for this project.

III. PROJECT DESCRIPTION

A. Project Components

30. The proposed project has an estimated cost of US$16.1 million, but with the possibility of being scaled up if additional resources become available. It will include the components outlined below. More details are provided in Annex 1

31. **Component 1 — Renewable Energy Hybrid Mini-grids (US$8 million).** Component 1 would finance new hybrid mini-grids throughout Solomon Islands. Solomon Power has identified a long list of 35 potential locations suitable for mini-grids taking into account population density (number of households), public facilities such as hospitals and schools, 'anchor' loads such as tourism facilities, food processing or other commercial operations, and potential sources of renewable energy sources (mainly solar PV). These 'candidate' mini-grids are located in Central Province, Choisuel, Guadalcanal, Isabel, Makira, Renbul, Temotu, and Western Province. Solomon Power has established a process of prioritizing those mini-grids based mostly on the average cost per connection, accessibility and safeguards considerations, namely land availability[23]. Additional feasibility studies will be conducted by Solomon Power in the priority sites to determine their suitability.

32. **Component 2 — Connections to Low-income Households (US$1.5 million).** Component 2 would finance household connections to low income households, through an output based aid (OBA) mechanism,

[23] When calculating the average cost per connection will mostly depend of the total costs and population to be covered, but a number of factors comes into play, such as the costs linked to accessibility and logistics, environmental considerations and gender – currently under discussion.

building on the EAEP. This component would provide one-off OBA subsidies to eligible low-income households to cover a portion of the upfront cost of electricity service connections in the Honiara grid (existing service area and planned expansion areas) and in the outstations, including those being developed through Component 1, and possibly others. Eligibility criteria will be based on the geographic location, and then self-selection. Consumers will apply for a service connection per current processes.[24]

33. **Component 3: Grid-connected Solar Power (US$5 million).** Component 3 would finance the supply and installation for one or more grid-connected solar facilities in Solomon Islands, and associated technical assistance. This facility(ies) would be developed on the basis of an EPC contract, and with an option for a maintenance contract for an initial period of 3-5 years. Ownership and future operation will remain with Solomon Power. The displacement of fossil fueled generation is expected to improve energy affordability, relative to the present, and contribute to further improvements in financial performance of Solomon Power.

34. **Component 4 — Enabling Environment and Project Management (US$1.6 million).** Component 4 would finance specific areas of technical assistance and project management costs.

B. Project Cost and Financing

35. The total proposed financing by component is summarized in Table 1.

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

Project Components	Project cost	IDA Financing	Trust Funds SREP	Trust Funds SIDS-DOCK	Trust Funds GEF	Counterpart Funding
Component 1. Renewable Energy Hybrid Mini-grids	8.0	0.4	6.0	1.6	0.0	-*
Component 2. Connections to Low-income Households	1.5	1.5	0.0	0.0	0.0	-**
Component 3. Grid-connected Solar Power	5	4.1	0.0	0.0	0.9	-
Component 4. Enabling Environment and Project Management	1.6	0.5	1.1	0.0	0.0	-
Total Costs	**16.1**	**6.5**	**7.1**	**1.6**	**0.9**	**-**
Total Project Costs	16.1	6.5	7.1	1.6	0.9	-
Front End Fees	0.0	0.0	0.0	0.0	0.0	-
Total Financing Required	**16.1**	**6.5**	**7.1**	**1.6**	**0.9**	**-**

*Diesel engines to be potentially purchased by Solomon Power or otherwise financed through IDA – *to be discussed during appraisal*
** Customer contribution for the household connections is not included in the table, but it is estimated at US$0.1million. Solomon Power contribution to this component is US$0.3million.

[24] Under the current program and in order to qualify, consumers will fall into the following criteria: (i) beneficiaries fall under the prepaid residential category; (ii) beneficiaries do not have a previous connection under their name; (iii) service connection is capped to 10 A for a period of 12 months; and (iv) service connections are individual, and cannot be shared with other households.

C. Lessons Learned and Reflected in the Project Design

36. The project has been designed to consider lessons learned from experiences of the World Bank and other development partners in rural electrification and grid-connected solar energy projects. Experiences from specific projects include the Solomon Islands EAEP (P151618), first and second phases of the Vanuatu Rural Electrification Project (P150908 and P160658), the Kiribati Grid Connected Solar PV Project (P121878), as well as lessons learned from hybrid mini-grids for rural electrification around the world. Key lessons reflected in the design are:

a. **Technical assistance is needed to support implementation of project activities.** The project design reflects the thin implementation capacity at Solomon Power and the need to strengthen project management and procurement arrangements. The project also provides financing for extensive technical assistance to allow for additional design and supervision of the project components as needed, as well as for an appropriately staffed project management and implementation team.

b. **There is lack of maintenance resources and capacity in Solomon Islands.** The lack of capacity and resources has seen many of the systems installed under other projects in the Pacific fail to be maintained. Building on Solomon Power's (recent) experience of establishing and running a number of mini-grids in outer islands, this project seeks to leverage that experience and expertise, possibly combining it with maintenance contacts to be tendered out to the private sector, to provide communities with quality systems, while educating communities on basic maintenance to extend the life of the systems. Mini-grids will be procured through competitive tender and vendors will also be required to provide acceptable maintenance periods and defects liability period (on the order of five years).

c. **Leverage the private sector where possible.** Where possible, leveraging private sector investment and expertise is the most sustainable delivery model from a financial and operational point of view (especially when the private sector is selected on a competitive basis). Early indications are that the proposed mini-grids and grid-connected solar project may not have sufficient scale to attract direct private sector investment and/or operation. The team will nevertheless explore the opportunities available for private sector involvement for example in maintenance contracts mentioned above (see also discussion of the cascade under section D). Bundling several activities into a single procurement has the potential to further attract private sector and achieve lower prices through economies of scale.

d. **Land titling for electrification projects is complex in Solomon Islands.** Land is a complex and integral part of the Solomon Islands way of life and generally communally owned by clans or tribes. About 88 percent of land is customary and 12 percent registered.[25] People who want to apply for an electricity connection need to present a valid land title, but often these are difficult to obtain, as a large proportion of the population is living in areas for which there are no titles or for which there are temporary titles only. Under the GPOBA project, Solomon Power has entered into discussions with the Ministry of Land and Public Housing to find solutions to tackle the difficulties in obtaining land titles to benefit low income households. The solutions developed under the GPOBA project will be applied to this project.

[25] Solomon Islands SREP Investment Plan.

e. **Verify low-income household connections on a sample basis.** Inspection on a random sample basis should be done to verify that the installations were in off-grids areas, technical requirements have been met and systems were fully operational. Verification of the sale of products will be undertaken by a verification agent, who is appointed under the EAEP.

f. **Electrification can have a positive impact on women and children.** Access to lighting in other projects (e.g., in rural Vanuatu under Lighting Vanuatu) has contributed to energy autonomy for women, the elderly and children. Women are now playing a greater role in the management of a household's energy and lighting than they generally have in the past. During the review of Lighting Vanuatu, most women talked about the additional work they now undertake in a positive, social sense – small groups of relatives or friends coming together to work on weaving, sewing, or handicrafts in the evenings. This project will also provide economic opportunities for women and girls. More generally, most villagers found that there is now more opportunity to socialize. While lighting also brings with it the potential for some anti-social outcomes, it is surprising that none were mentioned during the extensive survey and interview processes – although it may take time for communities to fully appreciate both the upside and downside of improved and mobile lighting.

g. **Finally, the project design also takes into account lessons learned on the sustainability of rural electrification projects**.[26] Rural electrification projects must be consistent with the overall national electrification plan. Projects must also utilize least cost design and not be technology driven. Early efforts must be made to maximize community awareness, involvement, and support. Importantly, the design must reflect the capabilities of the retailers/vendors and service providers and ensure adequate financing. In addition, training should be provided to participating government staff, retailers/vendors, service providers, and consumers. Finally, customers must have access to quality equipment and products and qualified maintenance and repair services, as well as spare parts over the long term.

IV. IMPLEMENTATION

A. Institutional and Implementation Arrangements

37. The Ministry of Finance and Treasury (MoFT) will be the recipient for the various grants and will enter into the Financing/Grant Agreements with the World Bank. Overall responsibility for oversight and implementation of the project will lie with Solomon Power. Solomon Power will be the implementing agency for the project, and will sign a Project Agreement with the World Bank, as well as a Subsidiary Grant Agreement with the MoFT, passing on the grants.

38. A project coordinator with experience and qualifications acceptable to the Bank will be appointed or recruited by Solomon Power [by effectiveness] and will be responsible for the coordination and day to day implementation of all project activities, along with other involved Solomon Power staff. A procurement specialist will also be recruited or appointed to work with the project coordinator on this project. Solomon Power is currently recruiting a procurement specialist under the SISEP, and the same expert may be utilized as a shared resource for this and other projects.[27] This specialist (or its successor) will be responsible for

[26] Operational Guidance for World Bank Group Staff: Designing Sustainable Off-Grid Rural Electrification Projects: Principles and Practices, 2008.

[27] SISEP will initially be financing this expert, but the contract may then be rolled over as needed into the current project. If

conducting or supporting all procurement activities for the project. Depending on the workload of current Solomon Power staff there may also be need to finance a Project Accountant. Project accounts for SIESP and GPOBA are currently maintained using Solomon Power staff, but the additional work load required for this project may lead to Solomon Power requesting additional FM resources to be financed through this project. These experts will also be responsible for training Solomon Power's staff as necessary.

39. Implementation of Component 2 will follow the implementation arrangements defined under the EAEP. The OBA program manager will coordinate implementation of this component with the project coordinator. The OBA Independent Verification Agent will work the project coordinator to verify connections under component 2. If needed, the OBA program manager could also be financed by the project.

40. Solomon Power's finance department will be responsible for financial management of the project, in coordination with the project coordinator. The project coordinator will liaise and coordinate with the MMERE and other agencies as the case may be for coordination regarding the sector studies requiring their involvement (notably the sector studies planned under Component 4).

41. Solomon Power has been implementing Bank-financed projects for several years and has experience with World Bank project implementation, including with fiduciary and safeguard policies. Solomon Power is currently implementing two World Bank projects: SISEP (P100311) and EAEP (P151618).

42. Adequate technical assistance for project implementation will be critical. The project will provide support for the recruitment of an owner's engineer to assist with detailed design and preparation of bidding documents as well as with supervision of the contractors as needed.

43. Project implementation arrangements are described in more detail in Annex 3.

B. Results Monitoring and Evaluation

44. The results framework, described in Section VII, identifies results indicators for the project as a whole, as well as for each of its components. Solomon Power, as the project implementing agency, will be responsible for collecting and verifying data and for submitting progress reports to the Bank on an annual basis for PDO indicators and on a semi-annual basis for the intermediate indicators at component level.

C. Sustainability

45. SIG and Solomon Power have demonstrated strong commitment and ownership of the project. The project concept was developed by SIG through a participatory process as part of the SREP Investment Plan preparation in 2014. SIG further requested IDA financing for the project in mid-2017, reaffirming its commitment to the project activities.

46. **Technical sustainability.** The project has been prepared through a series of technical and economic analyses, including the SREP Investment Plan and the least cost system planning studies, to ensure the design is sound and provides the least cost solution to provide access to electricity and expand renewable sources of energy into the energy mix. The project components have been tested in Solomon Islands and/or

the SISEP-financed procurement specialist is not available, then Solomon Power shall recruited or appoint a procurement specialist for this project within three months of effectiveness.

other countries with similar characteristics, which means that Solomon Power has experience with the technology and arrangements, in particular:

- Component 1: Solomon Power recently commissioned two mini-grids in Seghe and Taro, and plans to extend the same model to other locations.
- Component 2: this is designed based on the current GPOBA project to connect low income households to the grid
- Component 3: Solomon Power is managing grid-connected solar facilities financed by the United Arab Emirates, New Zealand, and its own funds.

47. **Economic and financial sustainability.** The economic results and financial performance of the project are critical to ensure long-term sustainability of the project. The costs/tariffs for the systems provided, even if developed under grant or concessional finance, should cover operation and maintenance expenditure and the depreciation of the assets for long-term sustainability.

D. Role of Partners

48. **Current support of development partners.** Both the World Bank and a number of other development partners are active in the sector. The World Bank is supporting the sector through (i) the previously mentioned SISEP, working on improving operational efficiency, system reliability and financial sustainability of Solomon Power; (ii) the EAEP, which aims to increase access to electricity by providing a targeted subsidy to low-income households to pay for new service connections and in-house wiring which are unaffordable for households with limited income; and (iii) support for the 15 MW TRHDP, in association with the IFC, ADB, Australia, and GCF. With the assistance of the ADB, Solomon Power will also hybridize some of the existing diesel-based outstations with SREP funding. In addition, Solomon Power is also preparing to develop the 500 kW Fiu River Hydropower Project to connect to the Auki grid on the island of Malaita with financing from ADB. The Energy Programme of the Secretariat of the Pacific Community's Economic Development Division provides technical assistance to MMERE, including on development of the Solomon Islands National Energy Policy in 2014. The Japan International Cooperation Agency grant-funded a 50 kW parking lot rooftop solar facility for SIEA, and the Governments of New Zealand and United Arab Emirates co-financed the one MW solar farm mentioned earlier.

49. **Future support of development partners.** In addition to ongoing support, future projects are also being discussed. In particular, the Government of New Zealand is preparing a project covering expansion of mini-grids to outstations and connections to low-income households. The proposed project would be strongly complementary to this, as the two projects would be financing similar components, but in different geographical locations. The teams have been coordinating approaches to ensure synergies.

50. **Considerations regarding World Bank Group's "cascade" approach to infrastructure finance.** Given the limited public resources, the team has considered whether the proposed investments under the project could leverage private sector investment, consistent with the "cascade" principles - wherever possible, private sector should be called to bring investment and expertise. Given the weak financial viability of the proposed mini-grids and the relatively small size of both the mini-grids and the grid-connected solar facilities being proposed, indications are that there would be limited interest from the private sector at this stage. In addition, in the absence of a strong sector regulator and appropriate capacity at the Ministry[28], it was

[28] Capacity would be needed to define and manage concessions, ensure quality of the service provided, calculate appropriate tariffs and/or the size of a possible viability gap, etc.

considered that private sector investment would not be adequate until such capacity is strengthened. Going forward, and as experience and market for these mini-grids ripens through implementation of initial projects such as the current one, private sector could become more interested if suitable models are found – for example the use of subsidies to bridge the viability gap, or others. Component 4 will provide technical assistance to the Ministry and sector stakeholders to conduct upstream work, and lay the foundation for possible alternative models in the future that can enable additional private sector investment. For the time being, the project will facilitate private management contracts with local contractors to undertake the household connections under this project, and possibly also the operations and maintenance of the mini-grids. On the grid-connected solar component, while the development of the project with an independent power producer may not be feasible, testing the market with engineering-procurement-construction contracts could be the most effective approach.

V. KEY RISKS

A. Overall Risk Rating and Explanation of Key Risks

51. The overall risk rating is substantial. The key risks to the PDO are: (a) institutional capacity for implementation at Solomon Power, including sustainability and fiduciary risk; (b) safeguards aspects, in particular the availability of land; and (c) technical design of the project and the need to minimize complexity of implementation modalities.

52. **Institutional capacity for implementation, including sustainability and fiduciary risk.** While technical capacity at Solomon Power is good, capacity is overstretched given the many projects currently being implemented by Solomon Power. Technical assistance will be made available as needed (e.g., for preparation of bidding documents, in the area of preparation and implementation of safeguards studies, and for oversight of rehabilitation and construction works, etc.). The capacity of Solomon Power to sustain the operations and maintenance of infrastructure investments represents a risk and will be mitigated by possibly tendering out an operations and maintenance contract and selecting technologies that require simple maintenance on which Solomon Power has previous experience. Solomon Power has experience with World Bank project implementation, including with fiduciary and safeguard policies. Solomon Power is currently implementing two World Bank projects: SISEP and EAEP. Since SIEP became effective in 2009, Solomon Power has significantly increased its financial, operational, and engineering capacity. Having said this, Solomon Power still has weak procurement capacity and there have been delays with procurements. To supplement existing capacity, procurement and financial management expertise will be recruited with the support of the project as needed.

53. **Safeguards aspects and land availability.** Community ownership of land in Solomon Islands can be problematic because at times it is not clear as who owns the land. Disputes amongst families are common, especially if there is compensation associated with any development, which causes delays in achieving community agreement for the construction of infrastructure. Community ownership (communities agreeing to and “donating” land for distribution network and generation facilities), and SIG leadership in this regard will help expedite consensus. The inability to secure suitable land to develop the project is mitigated through the site selection and consideration of land owned by Solomon Power. For Component 1, land is required for the mini grid plant and the distribution lines. The physical availability of land is determined by Solomon Power as part of their initial shortlisting of sites, as well as its current ownership. For the chosen sites, Solomon Power will seek to obtain the land on a long term 'willing buyer-willing seller' basis, with a negotiated lease, and avoid conflicts. The ESMF describes the process in detail and includes Solomon Power having either internal safeguards staff or external safeguards consultants. The long-list will ensure that alternative locations

can be pursued if the land acquisition is significantly impeding a subproject. Solomon Power have experience building mini-grids across the country and both the task team and Solomon Power are well aware of the difficulties in SI when land is acquired by other means (e.g. eminent domain). For Component 3, the potential sites are currently owned by SP, except for one site which is privately held and would be bought if that site is selected for the development of the grid connected solar plant. The ESMF details land ownership, as well as due diligence being undertaken and to be undertaken on land acquisition.

54. **Technical design of the project and the need to minimize complexity of implementation modalities.** Most the activities being proposed are an extension of activities that Solomon Power is already carrying out – such is the case for the mini-grids and the connection of additional customers on the Honiara grid and outstations, as well as implementation of grid-connected solar. While the team will consider the various implementation modalities to determine the most appropriate implementation arrangements, in principle the investments would be following the models proposed for the similar activities that Solomon Power is already developing. Construction of the mini-grids would be outsourced through engineering-procurement-construction contracts, SP may further decide to handle operations and maintenance through external contracts (Component 1). It would use the existing OBA arrangement for the connections to low-income households (Component 2), and it would develop the solar plant(s) based on a supply and installation contract, but the facilities would be owned and operated by Solomon Power. These would minimize the risks of utilizing alternative and new arrangements that may not work.

55. **Climate and Disaster Risks.** A climate and disaster risk screening was conducted for this project.[29] Taking in consideration that the project is in the Solomon Islands (in various specific sites across the country), the following climate change and natural risks were identified as hazards to the project context: extreme temperature, extreme precipitation and flooding, droughts, sea level rise, storm surge, strong winds, earthquakes, volcanic eruption and landslide. The impacts of these hazards to the project were assessed based on the project location and on the project subsector. In this project, the subsectors identified are renewable energy (grid connected PV power plants and solar-diesel hybrid mini-grids) and thermal power generation (diesel generator back-up in the solar-diesel hybrid mini-grids). The hazards were determined to pose a high risk to the project due to the expected impact of climate change on Solomon Islands. Historic trends and future projections of average annual temperatures and average annual rainfall indicate that the country is exposed to moderate hazard of extreme heat and moderate exposure to extreme rainfall days caused respectively by an increase in average annual temperatures over the next 50 years and annual precipitations over the next 10 years. In relation to this, water scarcity is considered very low or non-existent in the Solomon Islands and is expected to occur less than once every 1,000 years, entailing a low risk of droughts in the country. Conversely, the hazards of sea level rise and strong winds are considered to pose a high risk in the Solomon Islands. Future projections indicate a sea level rise could reach almost half a meter in the next 80 years and average tropical cyclone wind speed will increase in the next 10 years. Regardless of the expected increase in strong winds and sea rise level, forecast of storm surges are highly uncertain. In addition to the climate change risks, the Solomon Islands is in a high seismic and volcanic hazard area, which entails a high exposure to earthquakes, volcanic eruptions and landslides.

56. The climate and disaster hazards were determined to pose a moderate risk to the project due to the nature of its subsectors. The impact of higher temperatures, increased precipitation or storm surges, stronger winds, longer dry periods and sea level rise is on average considered to be medium in the solar PV and storage capacity installed and rather low on the diesel generators implemented as back-up. Only earthquakes, volcanic eruption, and landslide may result in a high risk for the renewable energy technology installed, as

[29] To conduct the screening, the World Bank Group's Climate and Disaster Risk Screening Tool was used (Global website: climatescreeningtools.worldbank.org; World Bank users: wbclimatescreeningtools.worldbank.org).

these hazards may result in potential damage to solar panels, structures and overall plants' layout. Due to its robustness, the impact of these geophysical hazards on diesel generators is expected to be less stressed but still moderate. To mitigate the exposure of the project to geophysical hazards, extreme temperatures, costal and urban flooding, strong winds and storm surges, pertinent considerations will be taken into account in the technical design of the project and the selection of the technology.

57. The renewable energy-based technology that will be implemented in the Solomon Islands under the project is intended to result in more accessible, resilient, and sustainable power system, as well as increased energy security for the country. Key non-physical components of the project that could modify the risk posed by climate and geophysical hazards were also identified. These components are related to capacity building and technical assistance provided to the electrical utility and design studies that will accompany the project implementation. Overall, these components are considered to slightly reduce the impact of climate change and other natural hazards by contributing to increase the institutional knowledge and know-how of renewable energy technology, yet relatively innovative in the Solomon Islands. Finally, the broader development context of the project could significantly reduce the impact pollution in the Solomon Islands on the climate as the solar PV technology installed is expected to reduce fossil fuel consumption of end-users.

58. In conclusion, the assessment of the results obtained from the climate change and natural risk screening tool indicate that the overall climate and disaster risk for this project is moderate.

VI. APPRAISAL SUMMARY

A. Economic and Financial Analysis

59. The detailed findings of the economic and financial analysis for the project is presented in Annex 4.

60. The economic analysis shows that Component 1 is economically viable, as it reaches an economic rate of return (ERR) of 3.2 percent with local and global environmental benefits. At this stage, the findings of the economic and financial analysis are preliminary, and will need to be fine-tuned based on the capacity of the specific mini-grids to be selected, the final investment needs, and confirmation of the various assumptions used in the models. Some of these parameters need to be confirmed based on feasibility studies for the various priority sites suggested by Solomon Power and final site selection. An initial capital investment of US$3.4 million was estimated for the implementation of four hybrid mini-grids with service tier 4 and a total capacity of 1.1 MW In addition, an estimated investment of US$1.43 million is attributed to distribution costs. The techno-economic analysis was modeled using the same solar and diesel capacity installed as in existing pilots of hybrid mini-grids already implemented in the country, in the localities of Seghe and Taro, as these are found to be representative of the households number and demand needs to be served with the mini-grids that will be financed through the proposed project. The assumptions made on the capital investment are based on various experiences that have used solar PV in the country and they are further detailed on Annex 4. Going forward, the team will further refine the capital investment and operations and maintenance costs for the project, as well as the specific capacity needs and solar penetration in the mini-grids.

61. Component 2 will enable the successful implementation of low-income household connections in the Solomon Islands. Extensive economic payoffs are expected to result from these low-income household connections, as the country faces significant economic costs from not having a universal, reliable and

affordable supply of electricity. Given the nature of this component, an economic analysis is not planned to be undertaken.

62. The economic analysis shows that Component 3 is economically viable as it reaches an ERR of 3.4 percent and 5.1 percent with local and global environmental benefits. An initial capital investment of US$5 million was estimated for the installation of one MW of new on-grid solar capacity, including storage. Although the financial viability of the project is justified at a capital cost of US$5 million per MW of new solar capacity installed, previous studies recently conducted in Solomon Islands[30] point to a cost of US$2.8 million/MW of solar capacity installed and US$3.9 million/MW including storage. The techno-economic analysis presents a more favorable ERR of 8.7 percent, including local and global environmental benefits, when adjusting the capital investment to overall US$4 million for the implementation of one MW new solar capacity connected to the grid, including storage. Work with Solomon Power is ongoing to optimize the capital investment in this component and further lower the costs through the adoption of best practices and the assimilation of international competition in procurement.

B. Technical

63. Solomon Power has gained experience from implementing other World Bank financed projects. The utility has strengthened their team with additional staff, who are supported by a number of consultants funded through the World Bank financed projects. Having said this, capacity is still thin, and will be complemented by an owner's engineer who will provide technical assistance and expertise in the final design and specifications of mini grids, as well of the grid-connected solar investment (Components 1 and 3, respectively).

64. The equipment and technologies for implementation and operation of mini-grids and grid-connected solar generation are commercially available and have been deployed in developed and developing countries, and will be implemented according to internationally accepted technical standards and practices.

65. Component 1 (Renewable Energy Hybrid Mini-grids). For the mini-grids Solomon Power has recently successfully commissioned two mini-grids in Seghe and Taro, and plans to extend the same model to other locations from a list of 35 locations, with Bank financing (through the proposed project) and from the New Zealand government. The specific locations will be decided during project implementation based on several factors (size, viability, etc.), with the most important being availability of land.

66. Component 2 (Connections to Low-income Households). Solomon Power will be using the same mechanism already developed under the EAEP. The team will perform additional due diligence to ascertain whether the current level of subsidy is still adequate, as there are indications that Solomon Power has achieved some economies of scale/cost reductions. One of the difficulties faced during the EAEP has been the difficulty by applicants to present a valid land title, which Solomon Power requires to make a new connection. For the EAEP, a significant number of households in Honiara targeted by the project do not have a current title, specifically a Temporary Occupation License (TOL), as they are either in arrears with Ministry of Lands and Housing Survey (MoLHS), which causes the license to lapse, or have never held a title to the land. This issue has the potential to significantly reduce the number of households that can be serviced by the current project. Solomon Power is currently working with MoLHS on possible workarounds, including Solomon Power accepting letters from residents that are signed by the Commissioner of Lands, in lieu of a current TOL. The Environmental and Social Management Plans (ESMPs) developed for Component 2 will

[30] TRHDP, *http://projects.worldbank.org/P152779?lang=en*

include the finalized process for those applicants waiting on land formalization and/or in arrears with their previous TOL.

67. Component 3 (Grid-connected Solar Power). Solomon Power has recently commissioned a grid-connected solar project co-funded by the United Arab Emirates and the Government of New Zealand for the development of a one MW solar farm project at Fighter 1, Henderson. The grid-connected solar site to be developed through the project would in principle follow similar specifications. The owner's engineer to be hired will review the existing specifications and adapt them as needed. The owner's engineer will also be available for supervision during the first few years of the project.

68. Component 4 (Technical Assistance and Project Management). This component addresses:

(a) Technical assistance and capacity building to support the establishment of the right enabling environment for expanding access and for the introduction of renewables, and for promoting additional private sector investment in the sector. The proposed activities were selected in response to the client's priorities and also in coordination with other partners.
(b) Project Management and implementation support. Technical experts and advisors will provide assistance to the Department of Energy (at MMERE) during the implementation phase of the project. Encompassed in their expertise will be procurement knowledge to manage and monitor the bidding process and produce reports for independent verification of the OBA scheme.

C. Financial Management

69. The financial management assessment was carried out in accordance with the "Principles Based Financial Management Practice Manual" issued by the Board on March 1 2010 which states+ with respect to projects financed by the Bank, the grantee is required to maintain appropriate implementation arrangements which include – including accounting, financial reporting, and auditing systems – adequate to ensure they can provide the Bank with accurate and timely information regarding the project resources and expenditures. Overall, the financial management arrangements satisfy the financial management requirements of the Investment Project Financing Bank Policy. The assessed financial management risk of the project is considered **moderate** provided a project accountant can be financed through this project, if required, to assist Solomon Power to meet the financial management requirements for this project.

D. Procurement

70. The procurement under this project will follow procurement procedures specified in the World Bank Procurement Regulations for IPF Borrowers (July 2016) and the provisions stipulated in the Financing Agreement to be entered into by the Bank and SIG. The project implementation agency is Solomon Power, which will procure all the contracts under the project. A Project Procurement Strategy for Development (PPSD) was prepared as the basis for procurement arrangements and planning. A Procurement Plan covering the first 18 months of project implementation is available and will be finalized before negotiations. Key procurement risks are: (a) lack of procurement and contract management capacity which results in delay of procurement and inadequate management of signed contracts; (b) insufficient capacity in preparing technical sections of procurement documents in line with international good practice which may result in difficulties in contract management; and (c) limited number of local suppliers/contractors, etc. Risk mitigation measures have been discussed, including: (a) recruitment and/or appointment of project coordinator and procurement consultant; (b) adoption of the Systematic Tracking of Exchanges in Procurement to closely monitor progress and identify delays in procurement. Further details are provided in Annex 2.

E. Social (including Safeguards)

71. The project is expected to have positive social outcomes, while potential impacts relate to land acquisition and impact on physical assets. The provision of electricity supply through new connections (Components 1 and 2) and more reliable supply (Components 1 and 3) will strengthen socio-economic integration in subproject locations through access to education, improved health outcomes, and income generating opportunities. The majority of land required by the project is for solar PV arrays under Components 1 and 3, the latter of which will use one or more sites owned by Solomon Power. For Component 1, where customary land is required, Solomon Power will use a “willing buyer-willing seller,” negotiated lease/license or other agreed and documented arrangement. Customary land will also be used where power poles under Components 1 and 2 are required and cannot be located in the road corridor. However, the footprint is minimal (<1m^2) and consultation and consent of the landowner will be gained prior to construction, via the same methods as Component 1 for solar sites. Land acquisition issues are expected to be minimal as subproject identification has included ensuring a high level of community demand and ownership of the project. Clear documentation by Solomon Power of any land acquisition will further avoid land-related issues and improve subproject delivery. ESMPs prepared for subprojects under Components 1 and 3 will include due diligence reports on the land ownership and any recent acquisitions. Other social issues include minor construction impacts (dust, noise, and vibration), health and safety, and use of local water supplies.

72. An Environmental and Social Management Framework (ESMF) and a Resettlement Policy Framework (RPF) have been prepared that describe the potential social impacts, required assessments for subprojects, consultation and grievance redress procedures, and roles and responsibilities throughout project implementation. Subproject design and preparation has been on the basis that no involuntary acquisition will be used, and Solomon Power have experience with avoiding land acquisition on similar projects. However, in the scenario that a site is critically needed for a subproject and all other options have been exhausted, eminent domain may be applied. To this end, the RPF describes all possible acquisition processes for customary land and compliance with OP/BP 4.12, Involuntary Resettlement. Consultation and grievance redress will be managed by Solomon Power’s Customer Service Department and will include awareness campaigns, targeted consultations and a consultation program for each component.

73. Indigenous peoples (IP) will be the principal beneficiaries for subprojects in rural areas, and hence elements of an Indigenous Peoples Plan (IPP) have been incorporated into project design in line with OP 4.10,

Indigenous Peoples. Subprojects under Component 1 and some under Component 2 will be in rural areas, which are primarily inhabited by IP. The ESMF describes the requirements for subprojects that will affect IP, including free, prior, and informed consultation; social assessment, including potential adverse impacts; and preparation of an IPP per the Indigenous Peoples Planning Framework in the ESMF.

F. Environment (including Safeguards)

74. The project is category B under OP 4.01, Environmental Assessment, and is expected to have minimal environmental impacts, with most potential impacts related to the construction of the solar PV arrays under Components 1 and 3. The potential sites for the arrays and their ancillary equipment are between one and five hectares and located in the vicinity of Honiara, Auki, and coastal villages in Guadalcanal and Makira provinces. The sites are all anthropogenically altered and contain a mixture of cleared land, native grasses, brush, and secondary growth. Some sites will require clearing of vegetation. Potential impacts during construction include sedimentation of watercourses, poor waste management, and impacted air quality from dust and emissions. Some removal or trimming of trees may be required for construction of distribution lines. During the operation of the mini-grids, there are potential impacts from the improper disposal of spent storage batteries.

75. While no critical natural habitats have been identified for potential sites assessed in the ESMF, OP/BP 4.04 will be triggered in the case that other sites are used where habitats may exist. Villages across the country are in close proximity to areas of primary growth vegetation, and it is possible other sites will be considered for the project (specifically Component 1) where critical natural habitats are present. Solomon Power have a longlist of mini-grid locations and will plausibly consider locations beyond the four currently shortlisted. Similarly, physical cultural resources are unlikely to be encountered, but OP/BP 4.11 has been triggered as a precaution. In the event that an artifact or similar is found, for example during excavations as part of Components 1 or 3, a chance find protocol in the ESMF will ensure appropriate steps are taken.

76. An ESMF has been prepared that describes the environmental impacts and environmental assessments for subprojects. Subprojects under Component 3 will require an Environmental and Social Impact Assessment (ESIA) be undertaken that determines and plans for the range of potential impacts, while ESMPs will be required for Component 1 subprojects. A sample ESIA has been prepared for the East Honiara site, as part of the ESMF, as well as an ESMP template. Solomon Power is responsible for subproject ESIAs and ESMPs.

77. **Citizen engagement.** The project will engage the community in consultation throughout implementation, notably on environmental and social impacts of project activities, and this is tracked through an indicator in the results framework. The project will ensure that women are adequately informed, invited and participate in community consultations and their concerns and interests are addressed.
78.

G. Other Safeguard Policies (if applicable)

79. No other safeguard policies are triggered for the project.

H. World Bank Grievance Redress

Communities and individuals who believe that they are adversely affected by a World Bank (WB) supported project may submit complaints to existing project-level grievance redress mechanisms or the WB's Grievance Redress Service

(GRS). The GRS ensures that complaints received are promptly reviewed in order 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 World Bank's attention, and Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate Grievance Redress Service (GRS), please visit *http://www.worldbank.org/en/projects-operations/products-and-services/grievance-redress-service*. For information on how to submit complaints to the World Bank Inspection Panel, please visit www.inspectionpanel.org.

VII. RESULTS FRAMEWORK AND MONITORING

Results Framework

COUNTRY : Solomon Islands

Electricity Access and Renewable Energy Expansion Project (Phase II)

Project Development Objectives

The project development objective is to increase access to grid-supplied electricity and increase renewable energy generation in Solomon Islands.

Project Development Objective Indicators

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Name: People provided with new or improved electricity service	✓	Number	0.00	7311.00	6 monthly	Project reports	SIEA/SP
People provided with access to electricity under the project by household connections (grid or off-grid).	✓	Number	0.00	7311.00	6 monthly	Project reports	SIEA/SP
People provided with new or improved electricity service - Female	✓	Number	0.00	3582.00	6 monthly	Project reports	SIEA/SP
Description:							

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Name: Annual electricity output from renewable energy as a result of the renewable energy constructed under the project.		Gigawatt-hour (GWh)	0.00	2.62	6 monthly	Project reports	SIEA/SP
Description: This indicator measures the annual output from solar energy that is a result of the installations constructed under component 1 and 3. Component 1 is estimated to contribute with 0.95 GWh and Component 3 with 1.66 GWh							

Intermediate Results Indicators

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Name: Generation capacity of energy constructed or rehabilitated	✓	Megawatt	0.00	1.60	6 monthly	Project reports	SIEA/SP
Renewable energy generation capacity (other than hydropower) constructed under the project	✓	Megawatt	0.00	1.60	6 monthly	Project reports	SIEA/SP
Description:							

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
Name: Number of mini-grids constructed under the project		Number	0.00	4.00	6 monthly	Project reports	SIEA/SP
Description: This indicator measures the number of mini grids constructed under the project.							
Name: Number of people connected to electricity through a mini-grid constructed under the project		Number	0.00	3196.00	6 monthly	Project reports	SIEA/SP
Number of people connected to electricity through a mini-grid constructed under the project - female		Number	0.00	1566.00	6 monthly	Project reports	SIEA/SP
Number of people connected to electricity through a mini-grid constructed under the project - businesses and community services		Number	0.00	99.00	6 monthly	Project reports	SIEA/SP
Total households of which are female headed households received		Percentage	0.00	10.00	6 monthly	Project reports	SIEA/SP

Indicator Name	Core	Unit of Measure	Baseline	End Target	Frequency	Data Source/Methodology	Responsibility for Data Collection
electricity through a mini-grid							
Description: This indicator measures the number of people by total number of households connected to a mini grid constructed under the project. For Solomon Islands an average of 5.7 people usually live together in one household (Solomon Islands 2012/13 HIES).							
Name: Study on private sector participation conducted under component 4 (TA)		Yes/No	N	Y	6 monthly	Project reports	SIEA/SP
Description: This indicator measures the studies undertaken under component 4, which includes an analysis of private sector participation							
Name: Participants in consultation activities during project implementation		Number	0.00	5000.00	6 monthly	Project reports	SIEA/SP
Description: This indicator measures the level of community engagement in project implementation.							
Name: Grievances registered related to delivery of project benefits addressed		Percentage	0.00	100.00	6 monthly	Project reports	SIEA/SP
Description: This indicator measures the transparency and accountability mechanisms established by the project so the target beneficiaries have trust in the process and are willing to participate, and feel that their grievances are attended to promptly. It is understood that local sensitivities and tensions will not allow grievance or redress mechanisms to be established in all projects							

Target Values

Project Development Objective Indicators

Indicator Name	Baseline	YR1	YR2	YR3	YR4	YR5	End Target
People provided with new or improved electricity service	0.00	1500.00	2953.00	4407.00	5860.00	7311.00	7311.00
People provided with access to electricity under the project by household connections (grid or off-grid).	0.00	1500.00	2953.00	4407.00	5860.00	7311.00	7311.00
People provided with new or improved electricity service - Female	0.00	735.00	1447.00	2159.00	2871.00	3582.00	3582.00
Annual electricity output from renewable energy as a result of the renewable energy constructed under the project.	0.00	0.00	0.24	1.31	1.96	2.62	2.62

Intermediate Results Indicators

Indicator Name	Baseline	YR1	YR2	YR3	YR4	YR5	End Target
Generation capacity of energy constructed or rehabilitated	0.00	0.00	0.10	0.80	1.20	1.60	1.60
Renewable energy generation capacity (other than hydropower) constructed under the project	0.00	0.00	0.10	0.80	1.20	1.60	1.60

Indicator Name	Baseline	YR1	YR2	YR3	YR4	YR5	End Target
Number of mini-grids constructed under the project	0.00	0.00	0.00	1.00	2.00	4.00	4.00
Number of people connected to electricity through a mini-grid constructed under the project	0.00	0.00	799.00	1598.00	2397.00	3196.00	3196.00
Number of people connected to electricity through a mini-grid constructed under the project - female	0.00	0.00	392.00	783.00	1175.00	1566.00	1566.00
Number of people connected to electricity through a mini-grid constructed under the project - businesses and community services	0.00	0.00	9.00	49.00	74.00	99.00	99.00
Total households of which are female headed households received electricity through a mini-grid	0.00	0.00	10.00	10.00	10.00	10.00	10.00
Study on private sector participation conducted under component 4 (TA)	N	N	N	N	Y	Y	Y
Participants in consultation activities during project implementation	0.00	0.00	250.00	500.00	750.00	1000.00	5000.00
Grievances registered related to delivery of project benefits addressed	0.00	0.00	80.00	90.00	100.00	100.00	100.00

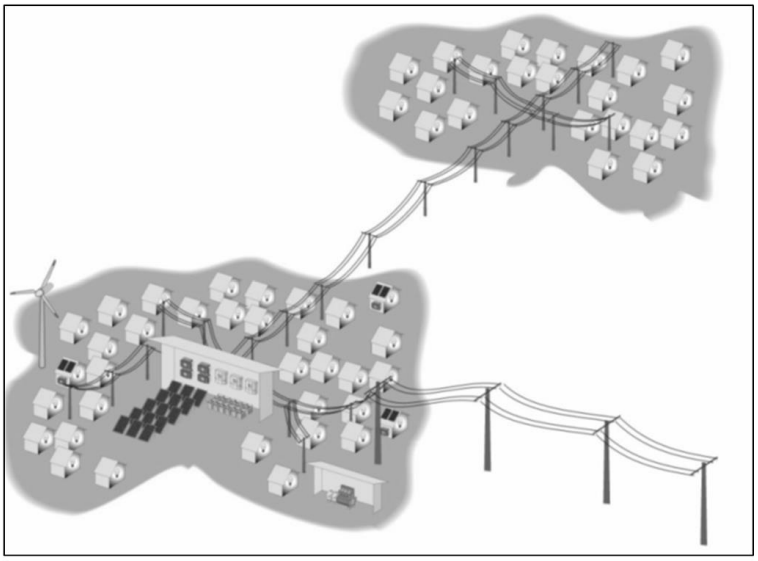
ANNEX 1: DETAILED PROJECT DESCRIPTION

COUNTRY : Solomon Islands
Electricity Access and Renewable Energy Expansion Project (Phase II)

1. The proposed project has an estimated cost of US$16.1 million, but with the possibility of being scaled up if additional resources become available. It will include the components described below.

2. **Component 1 — Renewable Energy Hybrid Mini-grids (US$8 million).** Component 1 would finance new renewable hybrid mini-grids throughout Solomon Islands. An example of a mini grid installation in a community is provided in **Figure 1** below. Solomon Power has identified a long list of 35 potential locations suitable for mini grids taking into account population density (number of households), public facilities such as hospitals and schools, 'anchor' loads such as tourism facilities, food processing or other commercial operations, and potential sources of renewable energy sources (mainly solar PV). These 'candidate' mini-grids are located in Central Province, Choisuel, Guadalcanal, Isabel, Makira, Malaita, Renbel, Temotu and Western Province. Solomon Power has established a process of prioritizing those mini-grids based mostly on the average cost per connection, accessibility and safeguards considerations, namely land availability[31]. Additional feasibility studies will be conducted by Solomon Power in the priority sites to determine their suitability. Land also needs to be secured, and this process will likely take up to one year and will depend on the category of land (customary, perpetual estate, provincial or government land).

Figure 1: Mini grid installation - example

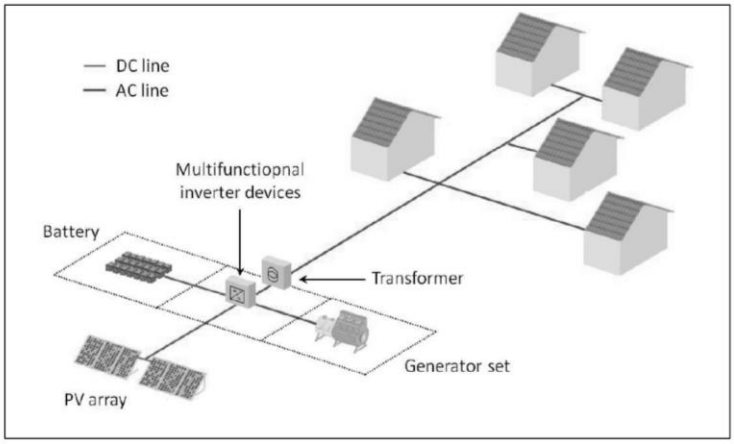


[31] When calculating the average cost per connection will mostly depend of the total costs and population to be covered, but a number of factors comes into play, such as the costs linked to accessibility and logistics, environmental considerations and gender – currently under discussion.

3. Although there are a range of mini grid solutions, the initial technical design is based on Solomon Power's recent experience establishing renewable energy hybrid mini grids in Seghe and Taro, where solar photovoltaics (PV) with battery storage and diesel back up was installed[32]. The solar system produces electricity during the day time while charging the batteries which supplies electricity at night time. The diesel generator is used as back up in cloudy days, early mornings, and/or during the evening peak demand if the battery storage is not sufficient. Solomon Power investigated the efficiency and adequacy of this configuration which came up as highly satisfactory. For this reason, a similar configuration is proposed for each mini grid to be established under component 1, appropriately scaled to fit the specific communities to be served. The installations will be modular, scalable based on the community size and with demand growth, and will allow for other generation sources, such as small hydro, to be connected in future.

4. Based on the long list of potential sites, the average number of households for each site is slightly over 150. Benchmarking the average hybrid mini-grid characteristics for Seghe and Taro, each mini-grid established under component 1 would potentially require solar panels of 150 kW, battery storage of 300kWh and a diesel generator as a back-up of 140kW to connect 100% of the houses. The exact size and technical aspects of each mini grid will be adapted to the population size and electricity demand of the selected sites. An example of the elements of the mini grid is provided in **Figure 2** below.

Figure 2: Elements of a Mini grid - example



5. The construction of the mini grids will be competitively tendered. Solomon Power will oversee the construction of the mini grids following an Engineering, Procurement and Construction (EPC) contract. Solomon Power is familiar with operating and maintaining hybridized systems and it is proposed that it would own, operate, and maintain these mini-grids. Having said this, and as an option, a maintenance contract for an initial period of 3-5 years could also be tendered out as part of the same package to ensure appropriate maintenance and learning by Solomon Power of the particular technology. Going forward,

[32] For example Taro, containing 157 households, required solar panels for 150 kW, diesel generation for 120 kW and 300 kWh in storage; Seghe with 113 households required solar panels for 100 kW, diesel generation for 120 kW and 200 kWh in storage to service 100% of households.

Solomon Power would decide whether to continue to procure these services with the private sector, or whether to perform operations and maintenance in-house.

6. While community management has been considered in the past, experience in the Pacific has shown that these kinds of solutions have a poor track record due to lack of technical and commercial expertise. In addition, initial due diligence was undertaken by a Bank team in July 2015 on the potential Rural Electricity Service Companies that had been identified to support mini-grids under the SREP project: it showed that these were operating as small scale operations energy retailers only, with limited ability to pre-finance the capital expenditure required for the mini-grids. The option of developing these mini-grids through private sector investment was also considered. However, given the poor financial viability of the mini-grids, and the absence of a sector regulator and appropriate capacity at the Ministry at this stage[33], it was considered that private sector investment would not be adequate in the short term. Having said this, component 4 will provide technical assistance to conduct upstream work, consider options and lay the foundation for possible alternative models in the future, including enabling additional private sector investment in the sector in the future.

7. Experience in the region points to a cost of approximately US$2 million per mini grids of similar sizes[34]. This figure will need to be scaled up or down depending on the actual size of the mini-grids that are ultimately selected for financing. Assuming similar sizes, the project would aim at financing four to five mini-grids. These estimated costs are high[35]. This may be explained by the high costs of doing business in remote islands in the Pacific, but SP may be able to obtain better prices through competitive selection procedures. If actuals costs come lower or if more financing becomes available, the project could cover more mini-grids. New Zealand is also interested in financing additional mini-grids through a parallel project.

8. The mini grids to be financed under the project will contribute to increase Solomon Power's customer numbers by adding 650 new customers including commercial, community services and low income households. A cost of service and tariff study have been conducted in 2015, taking into account the generation mix at the time and forecasting a progressive introduction of alternative renewable sources into the generation mix (i.e. hydro and solar) along with a customer growth rate of 12%/year. The study concludes that the tariff would be reduced going forward. Having said this, the study does not consider the possible increased costs of delivery through mini-grid (vs grid). Component 4 includes the financing of an update to the cost of service and tariff study to take into account Solomon Power's plans to expand significantly into outstations in the future. With regards to affordability, and as mentioned earlier, while no specific affordability survey has been conducted for this project, the economic and financial analysis conducted for the Electricity Access Expansion project (P151618) identified the willingness to pay at US$28/month for rural areas of Solomon Islands. This was done by comparing what communities were

[33] Capacity would be needed to define and manage concessions, ensure quality of the service provided, calculate appropriate tariffs and/or the size of a possible viability gap, etc.

[34] This figure is based on the cost of the recently established mini-grid in Taro and Seghe and the cost estimated for the establishment of mini grids under the Vanuatu Rural Electrification project (VREP II).

[35] An assessment conducted recently in Niger found the cost for solar mini-grids (including generation, storage, distribution and connections) to be around US$6,000 per kWp installed, which would be less significantly less than the estimated costs for this project and for a similar project in Vanuatu (P160658).

spending on alternative sources of power (namely battery charging). At the current tariff levels (which would be applied on an uniform basis), this means that for the average consumption of 30kWh per month, customers would be saving on average 30% on their energy expenditure.

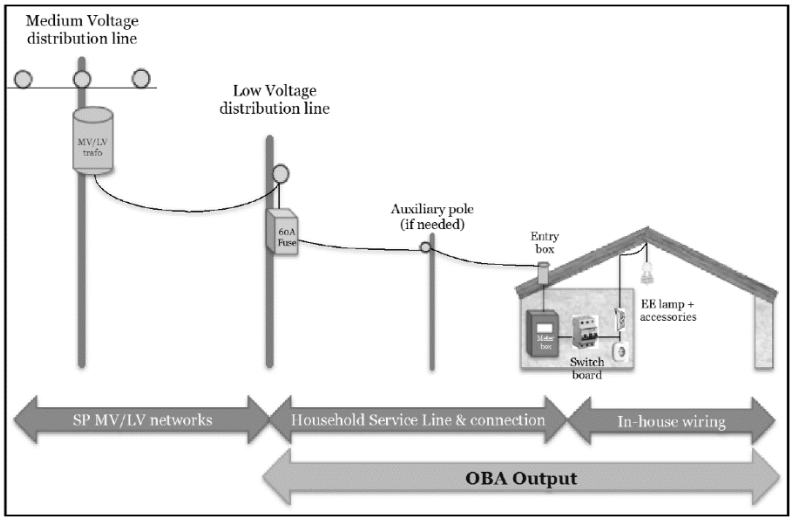
9. **Component 2 — Connections to Low-income Households (US$1.5 million).** Component 2 would finance household connections to low income households, through an OBA mechanism, building on the EAEP. This component would provide one-off OBA subsidies to eligible low-income households to cover a portion of the upfront cost of electricity service connections in the Honiara grid (existing service area and planned expansion areas), and in the outstations including those being developed through Component 1, and possibly others. Eligibility and screening criteria will be the same as the ones considered under EAEP: will be based on the geographic location, and then self-selection: interested consumers will apply for a service connection as per current processes.[36] The criteria to be applied will be described in the Project Manual and may be revised from time to time as may be appropriate.

10. The OBA subsidy will cover materials and installation of the service line and auxiliary pole, when needed; a pre-paid meter; and in-house wiring, including protection, earthing, and two LED light bulbs[37]. **Figure 3** illustrates the service line connection, in-house wiring and auxiliary pole (if needed). Solomon Power would competitively procure the materials for the service line and install the service line using its own staff/electrical contractors and also import in-house wiring materials in bulk. It would then contract licensed electrical contractors for large batches of works (e.g., up to 500 connections for Honiara). The combination of improved affordability of energy and profitability would contribute to improvements in the economics and financial returns from connecting new customers near existing grids, who are currently considered uneconomic to connect by the utility without an OBA subsidy. As part of the verification process, the Verification Agent will conduct a short survey with households to assess how the household perceives the electricity connections and the difference that it is making or is expected to make to their lives. The Verification Agent will also collect data on how many beneficiaries are female headed households.

[36] Under the current program and in order to qualify, consumers will fall into the following criteria: (i) beneficiaries fall under the prepaid residential category; (ii) beneficiaries do not have a previous connection under their name; (iii) service connection is capped to 10 A for a period of 12 months; and (iv) service connections are individual, and cannot be shared with other households. During preparation and implementation of EAEP there was an analysis of whether additional screening criteria should be used for low-income households. It is considered that these criteria are sufficient. As a matter of fact, all those living in outstation areas are considered to reside in low income housing and therefore eligible for subsidy.

[37] The current level subsidy per connection in the Honiara grid area is US$794 (SBD6,354), and the subsidy per connection in the outstations is USD994 (SBD7,954), and it accounts for 72 percent of the total cost of a household connection and wiring in Honiara, and 79 percent at outstation areas. These values will be defined in the Project Manual but may evolve over time based on evolution of costs, in which case the Project Manual may be amended to reflect the new agreed amounts from time to time as may be necessary after agreement with the Bank

Figure 3: Schematic Diagram of electricity network, service line and in-house wiring



11. The funds provided through this component will enable a scale-up of the existing OBA program operating under EAEP. The scale-up is meant to finance connection of households to the mini-grids to be built under Component 1, but also others across Solomon Power's grid network as a complement to the network extensions being performed by Solomon Power in its investment plan[38].

12. **Component 3: Grid-connected Solar Power (US$ 5 million).** Over the last few years market-based prices of solar PV electricity in developing countries are showing a clear rapidly decreasing trend, and single-digit PV electricity prices (per kWh) can now be achieved in many developing countries. Given the high cost of power in Solomon Islands, adding solar generation to displace diesel can go a long way in lowering the average cost of power in the country. There are some limits to the amount of variable sources of power that can be integrated in the country's generation mix, in particular intermittent generation without storage. Having said this, as of now the amount of variable generation is limited to one MW of solar at Henderson. When combined with storage and with projects like Tina hydro, there is significant room to grow solar generation in the country.

13. The addition of grid connected solar power would contribute to the overall share of renewable energy in Solomon Islands energy mix. A number of renewable energy projects are being developed in Honiara, and in outstations – this is happening through additional grid-connected solar power in addition to the recently installed and commissioned one MW grid connected solar at Henderson, possible hydropower projects such as the proposed Tina River Hydro Scheme (Honiara) and the Fiu River Hydro scheme (Auki, Malaita), or through new hybrid (solar-diesel) mini grids and/or conversion of existing outstations from all diesel to solar-diesel. The large displacement of fossil fueled generation is expected to improve energy affordability, relative to the present, and contribute to further improvements in financial performance of Solomon Power.

[38] It is estimated that around US$0.65million would be needed to connect the households in the mini-grid locations.

14. **Solomon Power would like to move quite fast on a number of grid-connected solar projects/sites.** One of the main constraints for these kinds of projects in the country is the availability of land. Solomon Power has identified a number of possible sites, as follows:

(i) East Honiara substation (0.5 MW, US$2.5 million): There is space in the existing East Honiara substation owned by Solomon Power that could be used to install 0.5 MW of grid-connected solar. The estimated cost for the solar facility including storage would be US$2.5m. The land is available and ready to use, and Solomon Power would like to promote this site as a 'green energy' hub.

(ii) Tanagai (1.5 MW, US$7.5 million): Solomon Power is in the process of acquiring land that it would like to use for a 1.5 MW grid-connected solar plant. The estimated cost for the solar facility including storage would be US$7.5 million. There is currently one person living on part of the land (along one of the site boundaries).

(iii) Henderson (2MW - US$10 million): Solomon Power has installed one MW solar at this site (financed by New Zealand and MASDAR/United Arab Emirates). In the same plot of land, there is still space to install an additional two MW. The estimated cost for the solar facility including storage would be US$10 million. The land is available and ready to use. However, there is currently an issue with evacuation of power from that site (there is no agreement with the neighboring land owner to create an easement for the power line(s) to go through).

(iv) Auki (1 MW, US$5 million): Solomon Power may also be interested to install a one MW solar facility in the Auki outstation. The estimated cost for the solar facility including storage would be US$5 million. There is limited availability of land 'readiness'.

Solomon Power is also considering using its rooftop to generate solar power and the site will also be considered when selecting the potential locations for the grid-connected solar plants.

15. The aggregation of all projects above come to a total of five MW of generation and US$25 million of investment. Depending on the envelope available for this project, the Bank would seek to finance one of the projects above, most likely the East Honiara Substation or a scaled down version of the Henderson site. If more financing becomes available from other sources, this component can easily be scaled up and cover additional locations.

16. The proposal would be for the solar plant to be developed on the basis of an EPC contract, possibly bundled with the procurement of the mini-grids to attract better conditions. An option for a maintenance contract for an initial period of 3-5 years would also be tendered out as part of the same package. Ownership and future operation will remain with Solomon Power. The utility is financially stable but has limited experience in working with independent power producers. The small size of the proposed facilities would also probably not be sufficient to attract serious independent power producer players and/or good prices under an auction. The project would therefore envisage to finance a smaller facility for demonstration effect of the benefits of a well-structured competitive process. Support would also be provided under Component 4 to assist the Government and Solomon Power perform upstream analysis to enable additional generation projects to come on board, if possible through private sector investment.

17. **Component 4 —Enabling Environment and Project Management (US$ 1.6 million).** Component 4 would finance project management and technical assistance for Solomon Power, but also provide some support to other sector institutions, in particular MMERE, as follows:

(a) Subcomponent 4.1 - Project management costs and technical assistance to Solomon Power. This subcomponent will finance project management support and technical assistance to strengthen the capacity at Solomon Power. This will include financing for consultants as needed notably for a project coordinator, procurement and financial management staff, an OBA program manager if needed. Financing will also be made available for any additional feasibility studies as may be needed to support the development of additional mini-grids, owners' engineers who will be responsible for the final design, development of bidding documents for the construction and operations of the facilities, supervision of the construction and commissioning works, and preparation of the environmental impact assessments and environmental management plans, compliance and reporting. Technical assistance and training may also be provided to Solomon Power in areas related to the project activities, for example in the fields of integration of renewables, and network planning. Finally, this component will finance incremental operating costs.

(b) Subcomponent 4.2 - Technical assistance for MMERE. This subcomponent will finance technical assistance and training to create an enabling environment and framework for increasing electricity access and the penetration of renewables in Solomon Islands[39]. While the areas for support still need to be further discussed and finalized, examples of possible areas are as follows: (i) development of a comprehensive electricity access strategy for the country (development of technical standards, institutional and implementation arrangements, financing needs and mechanisms); (ii) financing of upstream technical assistance facilitate additional private sector investment in the sector (identification of investments, PPP arrangements, suitable arrangements for concession agreements, licensing framework, etc) (iii) update of cost of service and tariff studies; (iv) training of electricians[40].

[39] Although some areas had been indicated under the SREP investment plan – such as the need to standardize and streamline the approach for land acquisition for distribution extensions and small mini grids – according to MMERE this support is no longer needed.

[40] As mentioned above, one area that has been highlighted as a bottleneck in the process of extending access to the grid to households that are currently not being served, is the limited number of licensed electricians that can install the internal wiring in new households to be connected to the grid (only 60 active licensed electricians and all in Honiara).

ANNEX 2: IMPLEMENTATION ARRANGEMENTS

COUNTRY : Solomon Islands
Electricity Access and Renewable Energy Expansion Project (Phase II)

Project Institutional and Implementation Arrangements

1. MoFT will be the recipient for the various grants and will enter into the Financing/Grant Agreements with the World Bank. Overall responsibility for oversight and implementation of the project will lie with Solomon Power. Solomon Power will be the implementing agency for the project, and will sign a Project Agreement with the World Bank, as well as a Subsidiary Grant Agreement with MoFT, passing on the grants.

2. A project coordinator with experience and qualifications acceptable to the Bank will be appointed or recruited within Solomon Power and will be responsible, for the coordination and day to day implementation of all project activities, along with other involved Solomon Power staff. A procurement specialist will also be recruited or appointed to work with the project coordinator on this project. Solomon Power is currently recruiting a procurement specialist under the SISEP, and the same expert may be utilized as a shared resource for this and other resources. This specialist (or its successor) will be responsible for conducting or supporting all procurement activities for the project. These experts will also be responsible for training Solomon Power's staff as necessary. Implementation of Component 2 (Connections to Low-income Households) will follow the implementation arrangements defined under the EAEP, and also further described below.

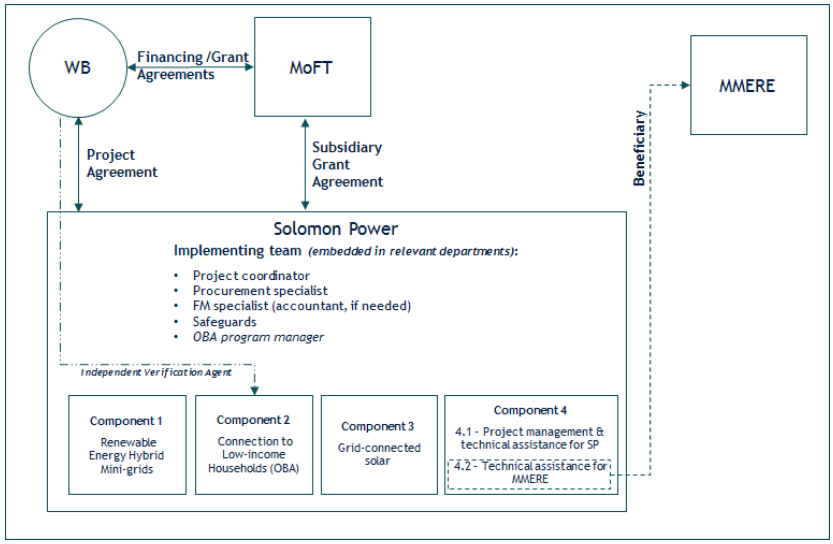
3. Solomon Power's finance department will be responsible for financial management of the project, in coordination with the project coordinator. The project coordinator will liaise and coordinate with the MMERE and other agencies as the case may be for coordination regarding the sector studies requiring their involvement, notably the sector studies in Component 4.2. Procurement and financial management for these contracts will still be conducted by Solomon Power, but MMERE will be the beneficiaries. As such, the MMERE will be called to contribute to the development of Terms of Reference (or technical specifications if applicable), participate in evaluation committees, and will also be responsible for supervision of the consultants' work.

4. Solomon Power has been implementing Bank-financed projects for several years and has experience with World Bank project implementation, including with fiduciary and safeguard policies. Solomon Power is currently implementing two World Bank projects: SISEP (P100311) and EAEP (P151618).

5. Adequate technical assistance for project implementation will be critical. The project will provide support for the recruitment of an owner's engineer to assist with detailed design and preparation of bidding documents as well as with supervision of the contractors as needed.

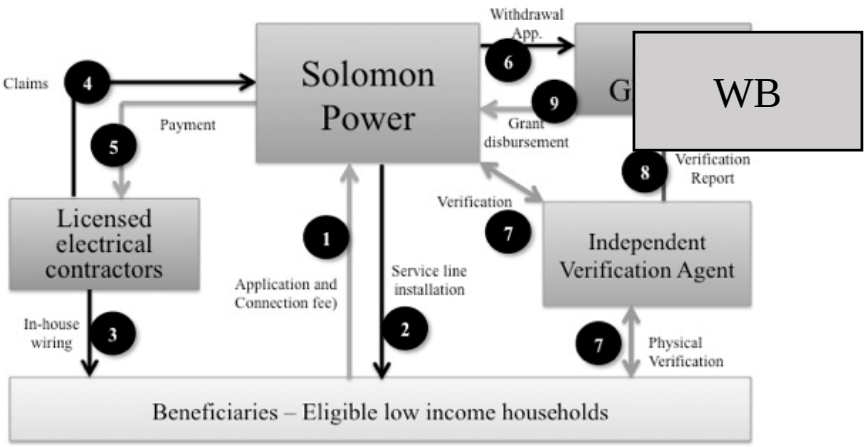
6. The project implementation arrangements, are shown schematically in Figure 4.

Figure 4: Project Implementation arrangements



7. **Implementation arrangements for Component 2.** The OBA program manager will coordinate implementation of this component with the project coordinator. If needed this expert could also be financed by the project. Solomon Power will manage the process of connecting households to the grid and installing household wiring. Solomon Power will be responsible for receiving customer requests for electricity connections and assessing the eligibility of each customer request. Solomon Power will carry out the electricity connections from the distribution line to the house, provide the materials for the standard basic in-house wiring, and assign a competitively selected electrical contractor to perform the in-house wiring. Prior to energizing the connection and installing the meter, Solomon Power will assess the safety standard of the in-house wiring. Solomon Power will procure the materials and pay for in-house wiring services, before consolidating a number of connections and submitting a 'subsidy claim' to the World Bank's task team and the IVA for verification. The IVA will verify the outputs claimed and will prepare an Output Verification Report (OVR) with recommendations for payments. The task team will review the OVR and recommend payments for the approved outputs. The implementation arrangements are presented below in **Figure 5**:

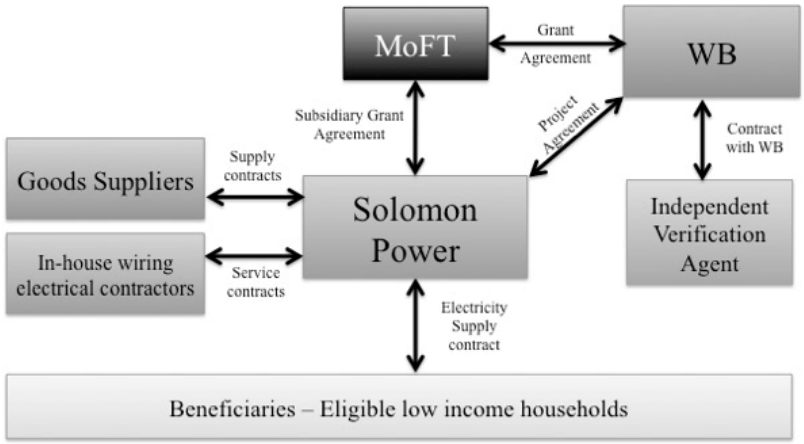
Figure 5: Implementation Arrangements for Component 2



8. **Targeted consultation and awareness campaign.** The customer service and public relations department of Solomon Power will be responsible to reach beneficiaries and inform them of the objectives and structure of the program, as well as encourage them to apply for the subsidy. Solomon Power will also provide communication material and information of the safe use of electricity, in the form of vouchers, posters, focus groups, among others. The awareness campaign will consist in public consultations and face-to-face interviews with beneficiaries to illustrate how the OBA subsidy scheme works. It is responsibility of Solomon Power to properly explain to eligible households and provide advice on the benefits, costs, and tradeoffs of grid electricity, as well as how the program works, who can benefit, what are the procedures, etc. The objectives of the identification process and the awareness campaign are: i) to inform the village of eligible participants; ii) to ensure that all eligible households who decide to participate are well advised of the costs, obligations, and financial requirements of participating; and iii) to raise awareness of the whole community on the OBA program. Posters and schematic drawings written in local language will be provided highlighting the dangers of inappropriate use of electrical appliances, and recommending best practices. The OBA Program Manager will support SP in the preparation and design of the awareness campaign.

9. Contractual agreements. **Figure 6** below summarizes the proposed contractual agreements for Component 2.

Figure 6: Proposed contractual agreements for Component 2



Financial Management

10. The financial management (FM) assessment was carried out in accordance with the "Principles Based Financial Management Practice Manual" issued by the Board on March 1 2010 which states with respect to projects financed by the Bank, the grantee is required to maintain appropriate implementation arrangements which include – including accounting, financial reporting, and auditing systems -- adequate to ensure they can provide the Bank with accurate and timely information regarding the project resources and expenditures. Overall, the financial management arrangements satisfy the financial management requirements of the Investment Project Financing Bank Policy. The assessed financial management risk of the project is considered **moderate**

provided a project accountant can be financed through this project, if required, to assist Solomon Power to meet the financial management requirements for this project.

11. **Implementing Agency.** Solomon Power will be responsible for the implementation of the FM aspects for this project. Solomon Power has had a long experience providing the FM requirements for World Bank financed projects through the SISEP, which commenced in 2008. There has been substantial progress in the FM performance of Solomon Power both within the organization and in FM implementation of World Bank financed projects. This is demonstrated in the continued improvement of the FM performance rating which has improved from "Unsatisfactory" 2010 to "Satisfactory" for the five most recent FM implementation reviews. Based on these reviews there is sufficient capacity within Solomon Power to satisfactorily deliver the FM requirements for this project. However, given that this is the third World Bank financed project being delivered concurrently through Solomon Power consideration should be given to financing a project accountant to assist Solomon Power to deliver this project.

12. **Accounting and Staffing Arrangements.** The project accounts will be included in the Solomon Power accounts consistent with other World Bank financed projects implemented by Solomon Power. The Solomon Power accounting package is capable of maintaining an adequate set of project accounts. Currently there is dedicated Solomon Power staff member who is responsible for maintaining the accounts of World Bank financed projects and liaising with the Bank on Financial Management related issues. Given the current FM load required by Solomon Power to meet the FM requirements for the total number of World Bank financed projects it is recommended this project make provision to finance a Project Accountant to ensure Solomon Power has adequate resources to meet the FM requirements for this project.

13. **Budget Arrangements.** The project budget will be prepared and monitored by Solomon Power which has experience in managing budgets, both for the corporation and ongoing World Bank financed projects. As there are four sources of finance funding different components within the project, the budget will need to be broken down both by component and source of finance adding some complexity to both the preparation and monitoring of the budget. Component 2 is proposed to be output based and monitoring of the budget for this component will be limited to ensuring the subsidies do not exceed the amount allocated for the component. An overall budget should be formulated, initially using the project paper as the first reference point and should be consistent with information provided in the procurement plan. A more detailed annual budget will be developed from the overall budget and monitored on a quarterly basis. Financial Reports (more below) will include budget to actual comparisons.

14. **Internal Controls.** Solomon Power has strong internal controls, which are documented in its Financial Manual. These controls are adequate to provide assurance over project expenditure. In addition, Solomon Power has developed a Financial Management Manual for SISEP and has a GPOBA manual. These manuals adequately cover FM processes and procedures for this project and can used as the basis for the FM section of the project manual. Project accounts will be maintained either by an employee of the Solomon Power or a project accountant financed through the project. Authorizations for expenditure provide adequate segregation of duties and staff from MoFT will have a mandatory signatory for Withdrawal Applications consistent with other World Bank financed projects implemented by Solomon Power. No additional internal controls are recommended for this project, there is generally compliance to the controls as outlined in the Financial Manual and the control risk is moderate.

15. **Flow of Funds.** In addition to using direct payments and possible pre-financing (reimbursement), project funds will flow from the Bank into a pooled designated account maintained by Solomon Power which includes funds from other World Bank financed projects. Solomon Power has an accounting system and capacity within the finance section to ensure adequate segregation of funds by project and source of funds within the one account using different fields. Monthly reconciliations of the designated account balance should be completed to show the breakdown of the balance by project and source of finance.

16. **Financial Reporting Arrangements.** Solomon Power will prepare calendar semester Interim Financial Reports (IFR) due to be received by the Bank within 45 days after the end of the reporting period. The format for these reports will need to be acceptable to the Bank and must include project commitments; and income and expenditure for the reporting period, year to date and cumulative figures.

17. **External Audit Arrangements.** No separate project audit will be required as the project activities will be included in the Solomon Power accounts. Hence a copy of the Solomon Power entity audited financial statements will meet the auditing requirements subject to the following disclosures in the main part of the accounts or in the notes to the accounts. The Bank will reserve the right to request additional assurance through a Special Purpose Audit, financed through project funds if there are concerns over the accuracy of the project accounting.

18. General Note (to be included in the Solomon Power Accounts)**:**

"Solomon Power received World Bank IDA funds, and Trust Funds from SREP, SIDS-DOCK, and GEF to implement the Electricity Access and Renewable Energy Expansion Project to provide hybrid mini-grids, connections to low-income households, grid connected to solar power, and project management costs."
For each source of finance and a consolidated summary the following note should be included, although the format can be agreed between Solomon Power and the Client prior to the first disclosure requirements.
"Note X. World Bank Financing
(a) "Solomon Power received (IDA/SREP/SIDS-DOCK/GEF) funds dated mm/dd/yy for implementation support

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

(b) The proceeds of the Electricity Access and Renewable Energy Expansion Project Grant has been expended in accordance with the intended purposes as specified in the Grant Agreement.

19. Supervision Plan

20. An FM implementation review field mission will be conducted at least once a year with additional missions early in implementation to ensure all World Bank FM requirements are met. In addition, the FM team will conduct a desk review of the semester IFRs and the project notes to the accounts in the Solomon Power audited annual financial statements

Disbursements

21. The project will be able to use three disbursement methods: advance, reimbursement and direct payment. A designated project account (DA) will be required but this can be pooled into an existing Designated Account used for SISEP. The ceiling for the DA will be determined at during the preparation of the Disbursement Letter. Disbursement for replenishments for the Designated Account will be based on a Statement of Expenditure. For Component 2, which will also be a separate category, in addition to the requirement of a one line Statement of Expenditure will require an Output Based Verification Report provided by an independent verification agent.

22. All direct payments will be paid based on records evidencing eligible expenditures, e.g. copies of receipts, supplier invoices. .

23. The project will have two disbursement categories as outlined in the table below.

Category	IDA (expressed in US$)	SREP	SIDS - DOCK	GEF	Percentage of Expenditures to be Financed (inclusive of Taxes)
Goods, consultancy services, incremental operating costs	5,000,000	7,100,000	1,600,000	900,000	100%
Subsidy payments for connections to Low-Income Households	1,500,000				100%
TOTAL AMOUNT	6,500,000	7,100,000	1,600,000	900,000	

Procurement

24. The procurement under this project will follow the procurement procedures specified in the World Bank Procurement Regulations for IPF Borrowers (July 2016) and the provisions stipulated in the Financing Agreement to be entered into by the Bank and SIG. The project implementation agency is Solomon Power, which will procure all the contracts under the project.

25. SP prepared a PPSD with the key conclusions of:

a) …
b) …

26. Accordingly, the procurement arrangements are:

27. For Component 1, it is expected that the mini grids will be procurement through RFB or RFP with international competition, PQ/initial selection will/will not be applied;

28. For Component 2, procurement will follow the same arrangement under EAEP, and a licensed contractor for installation will be contracted; verification??

29. For Component 3, it is expected that the mini grids will be procurement through RFB or RFP with international competition, PQ/initial selection will/will not be applied;

30. For Component 4, consultants will be employed through …….

31. The main risks and mitigation measures have been discussed between the Bank and SP, and are summarized as follows:

Risk Identified	Mitigation Measures
Limited capacity of SP	
Limited capacity of local market.	1.
Delay in procurement	1.
……	2.
	3.

Hands-on Expanded Implementation Support: With the agreed risk mitigation measures, it is expected that no additional hands-on support will be needed from the World Bank. However, the World Bank task team will provide necessary procurement training and normal advice at the early stage of project implementation.

32. **Procurement Plan**. Based on the analysis of the PPSD, Solomon Power has prepared a procurement plan which will be also published on the World Bank's external website. The procurement plan will be updated annually in agreement with IDA, or as required, to reflect project implementation needs. The summary procurement plan is as follows.

No.	Description	Estimated Cost US$'000	Selection/ Procurement Method	Review by Bank (Prior/Post)	Expected Contract Date	Comments

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

Environmental and Social (including safeguards)

34. Solomon Power will have responsibility for implementing the ESMF and ensuring compliance with World Bank safeguards policies. The scale of the potential impacts and the corresponding ESMF requirements is such that Solomon Power can incorporate the ESMF implementation into their usual business operations. Specifically, the Technical Department and Customer Service Department will cover most safeguard related responsibilities. It is noted that although they are in the processing of appointing them, Solomon Power currently do not have in-house environmental and social specialists, and consultants will be relied on in some instances. For components 1 and 3, roles and responsibilities on each subproject will be described in a subproject-specific ESMP.

35. Other entities will support Solomon Power in implementing the ESMF. The Environmental and Conservation Division will review and approve subproject ESMPs, followed by review and 'no objection' from the World Bank. The Environmental and Conservation Division will also be tasked with auditing implementation of the ESMPs (including review of monthly monitoring reports from Solomon Power) and ensuring acceptable environmental management and mitigation during the project. The World Bank task team will support Solomon Power in safeguards implementation throughout the project, including guidance on instruments, safeguards reporting and managing any impacts during subproject preparation and construction.

Monitoring and Evaluation

36. Monitoring and evaluation for the project will be undertaken with support from the Solomon Power project team, who will be responsible for collecting, verifying, and collating information and submitting consolidated reports to the Bank. The Results Framework (Section VII) identifies result indicators for the project as a whole as well as for each of its components, including the annual target values for the results indicators and baseline data against which project implementation progress and results will be measured. Semi-annual progress reports on intermediate indicators and annual reports on all indicators in the results framework will be submitted to the Bank.

ANNEX 3: IMPLEMENTATION SUPPORT PLAN

COUNTRY : Solomon Islands
Electricity Access and Renewable Energy Expansion Project (Phase II)

Strategy and Approach for Implementation Support

1. The strategy for implementation support has been developed on the basis of the nature of the Project and responds to specific nature of the Project. World Bank team members will be based in the region, mostly in the Sydney office to ensure timely response to the client, perform close project implementation support, and anticipate implementation problems. The objective is to ensure that the World Bank's resources and staff are sufficient to supervise and support implementation.

Implementation Support Plan and Resource Requirements

2. **Country and sector dialogue.** The Bank team will continue maintaining a close dialogue with the Government, MMERE, Solomon Power, and other relevant sector institutions in order to strengthen focus on project implementation.

3. **Support to project implementation capacity.** The Bank team will coordinate with the SIEA/SP and MMERE teams to provide support as needed to ensure that all the key functions are fulfilled, in particular the position of project coordinator. One procurement specialist [is being hired under SISEP and would continue to be supported under the project to provide support to Solomon Power on fiduciary aspects. Expertise at Solomon Power or MMERE will be further complemented as necessary to increase the team's efficiency.

4. **Support to investments execution.** Consultants will be hired to support Solomon Power to develop the detailed design and/or supervision of contracts related to the grid-connected solar and mini-grids. In addition, the Bank will undertake supervision missions to perform technical due diligence to ensure that contractual obligations are met. The Bank's project team and Solomon Power's project team will conduct regular site visits to project targeted areas throughout the duration of the project.

5. **Procurement requirements and inputs** The Bank's Procurement Specialist supporting the project is based in Sydney and will provide close support and advice to the implementation units of the projects. In addition to the prior review supervision to be carried out from the World Bank country office, two implementation support missions per year will be fielded. Additionally, annual ex-post review would be conducted on a sample basis for the contracts that are not subject to the Bank's prior review. One post review report, which would include physical inspection of sample contracts, would be prepared each year. The Bank's project team will help strengthen procurement management efficiency by: (a) reviewing relevant procurement documentation and providing timely feedback to the project implementation teams at Solomon Power; (b) providing clear guidance on the Bank's Procurement Regulation to the implementation units as needed; and (c) monitoring procurement progress against the updated Procurement Plans. Tailored training to procurement staff of the implementation units will be provided as part of implementation support to the project to facilitate the procurement process.

6. **Financial management requirements and inputs:** The Bank's FM Specialist supporting the project is based in Sydney. FM implementation support intensity and frequency will be in line with risk-based approach, and will involve a collaborative approach with the entire task team. A first implementation support mission will be performed two months after project effectiveness. Afterwards, the missions will be scheduled by using the risk based approach model and will include the following diligences: (a) monitoring of the financial management arrangements during the supervision process at intervals determined by the risk rating assigned to the overall FM Assessment at entry and subsequently during implementation (based on Implementation Status and Results Reports); (b) integrated fiduciary review on key contracts; (c) review of IFRs; (d) review of audit reports and management letters from the external auditors and follow-up on material accountability issues by engaging with the task team leader, client, and/or auditors; the quality of the audit (internal and external) is to be monitored closely to ensure that it covers all relevant aspects and provide enough confidence on the appropriate use of funds by recipients; and (e) other assistance to build or maintain appropriate financial management capacity and efficient internal control system.

7. **Environmental and Social Safeguards.** Compliance with environmental and social safeguards related to the rehabilitation and upgrading of the transmission and distribution networks will be a primary responsibility of the project implementation team at Solomon Power. The team will implement safeguards for the priority investments. The Bank's project team will pursue close monitoring of environmental and social management under the project.

8. The Bank team will be composed of a mix of skills and experience for successful project implementation. The table below outlines the expected staff weeks and travel required to make sure the actions and schedule are appropriately resourced. The total average annual budget is about US$100,000.

Table 1 – Estimated Implementation needs

Time	Focus	Skills Needed	Resource Estimate	Partner Role
First 12 months	Establishment of the project implementation unit for Component 1 at Solomon Power. Finalization of procurement documents.	Engineering; procurement; financial management; environmental; and social and legal.	US$140,000	Close cooperation with Solomon Power and MMRE
12-60 months	Review of progress in construction and capacity building; review of sector technical and financial performance; procurement; monitoring and evaluation; safeguards; financial management.	Engineering; sector regulatory and planning; Monitoring and Evaluation Specialist; environmental and social.	US$360,000	Close cooperation with Solomon Power and MMRE

Table 2 – Estimated Staff Weeks and Travel

Skills Mix Required

Skills Needed	Number of Staff Weeks per year	Number of Trips per year	Comments
General supervision and project management (Task Team Leader)	8	3/year	
Operations Officer	8	3/year	
Specialized technical experts	2	1	
Procurement specialist	2	2/year (shared with other projects)	
Financial management specialist	2	2/year (shared with other projects)	
Environmental specialist	1.5	2/year (shared with other projects)	
Social Development Specialist	1.5	2/year (shared with other projects)	
Administrative support	3	Field staff	
Disbursement specialist/analyst	2	-	
Independent Verification Agent	10	Field staff	

ANNEX 4: ECONOMIC AND FINANCIAL ANALYSIS

COUNTRY : Solomon Islands
Electricity Access and Renewable Energy Expansion Project (Phase II)

1.This annex provides a preliminary economic and financial analyses for the investments under the proposed project, which will be further refined before project appraisal.

Economic Analysis

2. **Component 1.** The economic analysis shows that Component 1 is economically viable, as it reaches an ERR of 3.2 percent at 3 percent discount rate[41] (see Table 1). These findings will need to be fine-tuned based on the capacity of the specific mini-grids to be selected, the final investment needs, and confirmation of the various assumptions used in the models. Some of these parameters need to be confirmed based on feasibility studies for the various priority sites suggested by Solomon Power and final site selection. Under the base case modeled, the following assumptions were made (a) there is enough demand to consume all electricity generated in the project; (b) international crude oil price increasing from US$64/barrel in 2017 to US$72/Barrel in 2025, and up to US$86/Barrel by 2045; (c)the capex of solar PV mini-grid with storage is estimated as the capital cost of solar PV grid-connected installed capacity plus a premium cost of 20 percent over the capital investment to reflect the smaller scale of mini-grids versus grid-connected farms and the increased costs of decentralizing the installed capacity in remote areas[42]; (d)solar PV farm with storage entails an initial capex of US$4 million/MW in 2017; and (e) distribution costs are estimated to be 50 percent of the capital investment cost, according to the existing experiences in other regions[43]. In addition, the following assumptions were taken in the analysis of this component: (a) diesel gensets entail an initial capex of US$1.5 million/MW in 2017 and it is constant through 2021; (b) implementation takes place at a rate of one mini-grid per year during the first four years of the project; (c) in absence of more accurate data at this stage of the project, standard mini-grids were considered for this analysis with average solar penetration (51 percent) and capacity (0.28 MW) of existing pilots in the country, Seghe, and Taro; (d) batteries are integrated in the mini-grids to guarantee continuous supply 24/7; and (d) operations and maintenance (O&M) expenditures are assumed to be equal to those registered in projects of similar nature, implementing diesel/solar hybrid mini-grids (with service tier 4[44])

[41] The Bank's discount rate guidelines issued in May 2016 recommend the use of discount rate that is twice the rate of increase in the projected GDP per capita in real terms. Since the per capita real GDP of Solomon Islands is projected to grow at an average rate of 1.2 percent during the project period, a discount rate of three percent has been used in the economic analysis by rounding out the discount rate implied by the guidance.

[42] The O&M costs attributed to distribution over the life cycle of the project are assumed to be included within the premium cost.

[43] The range may vary. In the Niger Solar Electricity Access Project (NESAP) (P160170), for example, the distribution costs are around 100% of the generation costs, but also include household connections.

[44] The Sustainable Energy for All Multi-tier Framework measures access on a the tiered spectrum, from Tier 0 (no access) to Tier 5 (the highest level of access). See: http://trackingenergy4all.worldbank.org.

in the region and, particularly, in Vanuatu.[45]

3. The expenditures incurred on diesel fuel are the largest cost of the project; over 42 percent of the overall cost. The analysis estimates that 65 percent of the economic benefits come from partly avoiding the cost of these diesel fuel expenditures. The population considered to be affected in the project was determined as an average population of the 37 priority sites identified by Solomon Power as potential sites to host the hybrid mini-grids. Given the very low population (less than 3,760 people), the project's local environmental benefits from avoided particulate matters, nitrogen oxides and sulfur oxides is almost negligible. The project has an impact on GHG emissions reductions, reaching around 6.6 ktons CO_2 emissions avoided and US$0.4 million monetary savings. The cost effectiveness of the project is not optimal as it presents a marginal abatement cost of US$39.2per ton of carbon dioxide avoided. All in all, the net present value (NPV) of the project, including environmental externalities, indicates US$0.1 million.

4. **Sensitivity Analysis.** A sensitivity analysis was conducted on this component at a discount rate of six percent. Under this assumption, capital costs decrease seven percent, O&M costs are one third lower and diesel fuel expenditures decrease to US$3.1 million (see Table 1). Under the assumption of six percent discount rate, benefits would also decrease over 21 percent due to less costly expenditures in diesel fuel over the lifetime of the project. The externalities and environmental impact remain having a low impact in the economic viability of the project and the GHG emissions avoided would decrease to around 4.6 ktons CO_2. The marginal abatement cost becomes US$240.3 per avoided ton of CO_2.

5. **Key findings.** An initial capital investment of US$8 million was estimated for the implementation of four hybrid mini-grids. The capacity of these mini-grids is yet subject to be further defined with feasibility studies of the 37 priority sites suggested by Solomon Power. At this stage, the techno-economic analysis was modeled using the same solar and diesel capacity installed as in existing pilots of hybrid mini-grids already implemented in the country, in the localities of Seghe and Taro, as these are found to be representative of the household number and demand needs to be served with the mini-grids that will be financed through the proposed project. In the present techno-economic analysis, an overall investment of US$4.85 million was considered following the assumptions on capex and distribution costs detailed above. Currently, the team supports Solomon Power in the selection of the most suitable sites and the development of feasibility studies. Work is therefore underway to refine the capital investment needs of the project, as well as the specific capacity needs and solar penetration in the mini-grids.

[45] According to the Rural Electrification Project -Phase II (*http://operationsportal.worldbank.org/secure/P160658/home*) conducted in Vanuatu, the O&M expenses incurred in a diesel/solar hybrid mini-grid with battery (tier 4) is two percent of the capex. The O&M expenses for a diesel-based mini-grid with the same service level reaches 20 percent due to the remoteness of the sites and the increased cost of transporting diesel to these areas.

Table 1: Summary of Economic Analysis Results of Component 1

	Discount rate		3.0%	6.0%
	Economic rate of return			
	ERR	[ ]	2.4%	2.4%
	ERR+local externalities	[ ]	2.4%	2.4%
	ERR+local+GHG@BankGuidanceValues	[ ]	3.2%	3.2%
	Composition of NPV			
	EAREEP Costs			
	Capital costs	[$USm]	3.4	3.2
	T&D costs	[$USm]	3.4	1.3
	Generation O&M	[$USm]	1.4	0.7
	Diesel fuel cost expenditures		1.0	3.1
	total costs	**[$USm]**	**10.3**	**8.3**
	Benefits [avoided capex and fuel]			
	Avoided diesel fuel	[$USm]	6.5	4.5
	Avoided diesel capex	[$USm]	0.7	0.7
	Avoided diesel O&M	[$USm]	2.8	2.0
	total benefits	**[$USm]**	**10.0**	**7.2**
	NPV (before environmental benefits)	**[$USm]**	**-0.3**	**-1.1**
	local environmental benefits: avoided grid generation	[$USm]	0.0	0.0
	NPV (incl. local environmental benefits)	[$USm]	**-0.3**	**-1.1**
	value of avoided GHG emissions	[$USm]	0.4	0.2
	NPV (including environment)	**[$USm]**	**0.1**	**-0.9**
	Lifetime GHG emissions, undiscounted	tons CO2	**6,647**	4,618
	Marginal abatement cost	$/ton	39.2	240.3

6. **Component 2.** This component will enable the successful implementation of low-income household connections in the Solomon Islands. Extensive economic payoffs are expected to result from these low-income household connections, as the country faces significant economic costs from not having a universal, reliable and affordable supply of electricity.In 2014, only 45 percent of the population (less than 210,000 people) had access to electricity.[46] In addition, access to electricity is very unevenly distributed across the country. While 64 percent of the population of Honiara has electricity connection, only six percent of the remainder population of the country is connected to the grid.

7. By multiplying grid connections, Solomon Power may have a higher potential to meet its goal of doubling the existing number of customers by 2021. Increasing demand and loads in the power system may contribute also to set the ground for higher shares of renewable energy in the energy mix, contributing this to the Government's goal of reaching a renewable energy share of 50 percent of the total installed capacity by 2020. With more electricity connections, the Solomon Islands can be expected

[46] *https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?view=chart* . Only 12 percent of the population is connected to Solomon Power's grid.

to launch itself into higher growth trajectory. Thus, the interest of this component for Solomon Islands is confirmed. Given the nature of this component, an economic analysis is not planned to be undertaken.

8. **Component 3.** The economic analysis of the component using the Bank recommended discount rate of 3 percent[47] finds that this component of the project is economically viable. The base case modeled under this component takes the assumptions made on component 1 with regard to demand and oil price. With an economic discount rate of 3 percent, pursuant to the Bank's Discounting Costs and Benefits in Economic Analysis of World Bank Projects (May 2016), the economic rate of return (ERR) of the Project is 3.4 percent and 5.1 percent with global and local environmental benefits (See Table 2).

9. Over 85 percent of the benefits of the project comes from the avoided diesel fuel expenditures. Global environmental benefits valued using the Bank-recommended social value of carbon constitute 1.7 percentage points of the ERR. Since the population density of the Solomon Islands is very low, local environmental benefits from avoided particulate matters, nitrogen oxides and sulfur oxides are not a major consideration and can be considered negligible. This component of the Electricity Access and Renewable Energy Expansion Project is cost effective in achieving GHG emission reductions. The component helps reduce GHG emission by 19.4 ktons CO2eq over the life of the project. The marginal abatement cost of the Project is -$9.6 per ton, which makes it a highly cost effective option for reducing GHG emissions in Solomon Islands.

10. **Sensitivity Analysis.** For a discount rate of six percent, capital costs decrease 4 percent, and solar O&M costs are one fourth lower (see Table 2). Under the assumption of six percent discount rate, benefits would also decrease 25 percent due to less costly expenditures in diesel fuel over the lifetime of the project. Doubling the discount rate has a large economic impact on the GHG emissions avoided. At six percent discount rate, the value of GHG emissions avoided decreases 30 percent and the marginal abatement cost drops down to -81.5 per ton. At six percent discount rate, also the overall economic flows including the global benefits of reducing GHG emissions become negative decreasing to - US$0.4 million from US$1.2 million at three percent discount rate.

11. **Key findings.** An initial capital investment of US$5 million was estimated for the installation of 1MW of new on-grid solar capacity, including storage. Although the financial viability of the project is justified at a capital cost of $5 million per MW of new solar capacity installed, previous studies recently conducted in Solomon Islands[48] point to a cost of US$2.8 million/MW of solar capacity installed and US$3.9 million/MW including storage. The techno-economic analysis presents a more favorable ERR of 8.7 percent, including local and global environmental benefits, when adjusting the capital investment to overall US$4 million for the implementation of one MW new solar capacity connected to the grid, including storage. Work with Solomon Power is ongoing to optimize the capital investment in this component and further lower the costs through the adoption of best practices and the assimilation of

[47] The Bank's discount rate guidelines issued in May 2016 recommend the use of discount rate that is twice the rate of increase in the projected GDP per capita in real terms. Since the per capita real GDP of Solomon Islands is projected to grow at an average rate of 1.2 percent during the project period, a discount rate of three percent has been used in the economic analysis by rounding out the discount rate implied by the guidance.
[48] TRHDP, *http://projects.worldbank.org/P152779?lang=en*

international competition in procurement.

Table 2: Summary of Economic Analysis Results of Component 3

[1]	Discount rate		3.0%	6.0%
[2]	**Economic rate of return**			
[3]	ERR	[ ]	3.4%	3.4%
[4]	ERR+local externalities	[ ]	3.4%	3.4%
[5]	ERR+local+GHG@BankGuidanceValues	[ ]	5.1%	5.1%
[6]	**Composition of NPV**			
[7]	*EAREEP Costs*			
[8]	Capital costs	[$USm]	4.8	4.6
[9]	T&D costs	[$USm]	1.2	1.2
[10]	Generation O&M	[$USm]	0.8	0.6
[11]	T&D O&M	[$USm]	0.2	0.2
[12]	**total costs**	**[$USm]**	**7.1**	**6.5**
[13]	*Benefits [avoided capex and fuel]*			
[14]	Avoided diesel fuel	[$USm]	5.5	3.8
[15]	Avoided diesel capex	[$USm]	1.3	1.2
[16]	Avoided diesel O&M	[$USm]	0.5	0.3
[17]	**total benefits**	**[$USm]**	**7.2**	**5.4**
[18]	**NPV (before environmental benefits)**	**[$USm]**	**0.2**	**-1.1**
[19]	local environmental benefits: avoided grid gen.	[$USm]	0.0	0.0
[20]	NPV (including local environmental benefits)	[$USm]	**0.2**	**-1.1**
[21]	value of avoided GHG emissions	[$USm]	1.0	0.7
[22]	**NPV (including environment)**	**[$USm]**	**1.2**	**-0.4**
[23]	Lifetime GHG emissions, undiscounted	tons CO2	19,403	13,3150.1
[24]	Marginal abatement cost	$/ton	9.6	--81.5

Financial Analysis

12. **Component 1.** This financial analysis is preliminary and will be refined as more accurate information regarding specific sites, mini-grid capacity needs and capital investments is disclosed in the feasibility studies. The financial analysis for this component of the project was carried out by valuing the additional electricity delivered as a result of the project in financial terms. To do so, the following assumptions were made: (a) taxes on capital cost account for 30 percent of the capital investment, (b) taxes on O&M account for 30 percent of the O&M expenses, (c) taxes on fuel expenditure account for 25 percent of fuel expenses[49], (d) local and global environmental benefits are excluded in the financial model as they were negligible in the techno-economic model; and (e) the financial analysis has been made in constant terms. The current tariff is US$0.65 per kWh, which was reduced from a value of US$93 cents/kWh in 2014. It is expected that the tariff may be further reduced in the next tariff review in 2020, in particular with the substitution of diesel by renewables in the country. Taking this into consideration,

[49] Tina River Hydropower Development Project (P161319)

a further tariff reduction of 20 percent was considered by 2020 and incorporated in the financial model. The preliminary financial analysis presents a FIRR of 12.5 percent for this component at a tariff of US$ 0.65 per kWh until 2020 and US$ 0.52 per kWh afterwards (Table 3). As discussed above, the analysis will be reviewed and fine-tuned going forward.

Table 3: Financial Internal Rate of Return of Component 1

				NPV	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026		2045
Solomon Power																
benefits																
electricity generated			[GWh]			0.52	1.03	1.55	2.07	2.07	2.07	2.07	2.07	2.07	#	2.07
electricity tariff			USD/KWh			0.65	0.65	0.52	0.52	0.52	0.52	0.52	0.52	0.52	#	0.52
Total Revenues			US $ million			0.34	0.67	0.81	1.08	1.08	1.08	1.08	1.08	1.08	#	1.08
Revenue																
costs																
capital costs	1.3		[$USm]	*3.7*		1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	#	0.0
premium cost	0.2			*0.6*		0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	#	0.0
incremental T&D costs	0.5			*1.4*		0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	#	0.0
O&M costs	1.3		[$USm]	*1.3*		0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	#	0.1
Fuel expenditure	1.25		[$USm]	*5.5*		0.1	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	#	0.3
Net financial flows			[$USm]	***6.3***		**-1.3**	**-1.0**	**-1.0**	**-0.8**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	#	**0.7**
FIRR			[ ]	12.5%												

ANNEX 5: SCALING-UP RENEWABLE ENERGY PROGRAM IN LOW INCOME COUNTIRES

Results Framework

Indicator	SREP funded project	Transformational Scale up[50]
Annual electricity output from RE as a result of SREP interventions (GWh)	2.6 GWh	102.9GWh[51]
Number of women and men, businesses and community services benefiting from improved access to electricity and fuels as a result of SREP interventions	7,311 people including 3,582 women[52] 226 businesses and community services	289,431 people including 141,821 women 8,946 businesses and community services
Financing leveraged through SREP funding [$ million]	US$11.72 million split as follows: SIDS DOCK: US$1.60m GEF: US$0.90 m IDA: US$6.50m GPOBA[53]: US$2.23m Gov. contr. US$0.39m Private sector US$0.1m	US$ 170 million
SREP leverage ratio [1:X]	1:1.6	1: 24
Tons of GHG emissions reduced or avoided -Tons per year [tCO_{2eq}/yr] -Tons over lifetime of the project [tCO_{2eq}]	1,042 tCO2eq/yr 26,050 tCO2eq over 25 years lifetime	355,825 tCO2eq

[50] *Based on Solomon Islands Government's Intended National Determined Contribution (INDC) target by 2030, http://prdrse4all.spc.int/system/files/solomon_islands_indc.pdf.*

[51] Based on 47MW as per the Solomon Islands INDC document cited above and average capacity factor of 25%.

[52] The number of beneficiaries has been estimated on the basis of 1,282 households. The average household size in Solomon Islands is 5.7 people per household (source: Solomon Islands 2012/13 Household Income and Expenditure Survey). . It is estimated that 49% of the population is female (source: World Development Indicators).

[53] Mobilized through a separate project, the Electricity Access Expansion Project (P151618). See paragraph 6 for more details.

Co-benefits[54] :

- Enhanced energy security from the development of endogenous sources of renewable energy electricity
- Reduced dependency on imported fossil fuels
- Reduced carbon emissions through replacement of diesel generation with renewable generation.
- Better health services due to lighting in clinics and improved ability to store vaccines.
- Reduce safety hazards from use of traditional sources of energy (e.g. household fire's from toppled kerosene lamps)
- Fostered economic development through job creation and income generation from productive uses of electricity
- Improved gender equality and women's socioeconomic status
- Promotion of a low-carbon development pathway.

Introduction

Country and sectoral context.

1. Solomon Islands is an archipelago consisting of six major islands and over 900 smaller islands and has a total land area of 29,900 km^2 spread over 1.34 million km^2 of ocean. The population of approximately 616,000 is dispersed across 90 inhabited islands and has among the lowest population densities and urbanization rates in the world, with approximately 20 people per km and 17 percent urbanization rate, respectively[55]. It also has one of the lowest GDP per capita among the Pacific Islands states. (approximately US$ 2,013). The country's recent history has been marked by intermittent political turmoil and civil unrest and natural disasters[56]. Since recovering from the 1998-2003 civil conflict, the country's commodity based economy remains fragile and vulnerable to external shocks.

2. Solomon Islands is highly dependent on imported, refined petroleum products to meet its energy needs for electricity generation, transport and lighting, which leaves the country vulnerable to global oil price fluctuations. Furthermore, it has one of the highest electricity retail tariffs in the Pacific region and in the world, with an average of US$65 cents per kWh in January 2017 (compared to approximately US$ 93 cents per kWh in 2014). In spite of the high electricity tariff, the overall electricity access rate is less than 20 percent, with an electrification rate below 5 percent in rural areas, home over 80 percent of the population.

3. According to the 2012/13 HIES, while 45 percent of the households are said to have access to electricity, majority of the households only have small solar panels, typically of 20 watts. The percentage of households supplied by the national utility Solomon Power is merely 12 percent nation-wide, most of which are located in Honiara, Solomon Islands capital city and largest load center. Data collected by *Doing Business* reveal that it takes approximately 53 days and costs 1,253.7 percent of

[54] Further co-benefits listed in paragraphs 21 to 24 of this section.

[55] Population data based on Solomon Islands 2012/13 Household income and Expenditure Survey – National Analytical Report [Volume 1], October 2015

[56] Earthquakes of April 2007 and February 2013 of magnitudes 8.1 and 8, respectively.

income per capita for a local business located in Honiara, to obtain permanent electricity connection and supply to warehouse[57].

4. The country's ability to provide reliable and affordable infrastructure services is constrained by its geographical spread, high energy cost and dependency on fossil fuels, which provide a low incentive to expand the distribution areas in underserved areas and thus, negatively impact the country's economic and social development. As part of its strategy to improve energy security, increase electricity supply and affordability, Solomon Power has embarked on the implementation of its least cost expansion plan, which requires the installation of over 54 MW new generation capacity. In addition, the country has developed comprehensive plan which outlines projects and interventions that would be needed to accelerate the development of renewable energy projects in the country; the SREP Investment Plan (the IP).

SREP Investment Plan

5. In May 2014, the government of Solomon Islands, through MMERE submitted an investment plan to the SREP sub-committee for endorsement for a funding allocation of US$ 15 million[58] of SREP funding to support a greater penetration of renewable energy and increased access to electricity in the country. The SREP IP was elaborated in consultation with all relevant government agencies and with the support of the World Bank and the Asian Development Bank. The total funding envelope presented under the SREP IP amounted to US$40.3 million with co-financing from SIG, the private sector and the two MDBs. The financing plan envisaged at the time of preparing the SREP IP is presented below.

Table 1: SREP IP indicative financing plan (2014)

		Private Sector	SREP	ADB[1.]	World Bank[1.]	Government/ SIEA	Total
Preparation of Investment Proposal			0.3				0.3
Regional Component[2.]			1.0				1.0
Renewable Energy Access Project (World Bank supported)							
1.	Renewable Energy Mini-grids	3.0	5.4	-	2.5	2.0	12.9
2.	Grid Extensions	-	-	-	3.5	3.0	6.5
3.	Project Preparation	-	0.5	-	-	-	0.5
4.	Technical assistance	-	1.0	-	1.0	-	2.0
	Subtotal	**3.0**	**6.9**	**0.0**	**7.0**	**5.0**	**21.9**
Solar Power Development Project (Asian Development Bank supported)							
5.	Grid-connected solar power	-	3.8	4.5	-	1.5	9.8
6.	Household solar	1.0	1.0	1.0	-	1.0	4.0
7.	Project Preparation	-	1.0	-	-	-	1.0
8.	Technical assistance	-	1.0	1.0	-	-	2.0
	Subtotal	**1.0**	**6.8**	**6.5**	**0.0**	**2.5**	**16.8**
	Total	**4.0**	**15.0**	**6.5**	**7.0**	**7.5**	**40.3**

Source: ADB/WB/Solomon Islands Government estimates
1. Financing by ADB and WB may be provided as either loan or grant (or both) depending on Solomon Islands governments decision for utilizing country allocation of respective agencies.
2. Activities to be presented under a separate proposal

[57] Source: World Bank, Doing Business 2017 Equal Opportunities for All - Economy Profile 2017: Solomon Islands

Box 1: Solomon Islands Electricity Access and Expansion Project

The Bank has approved the US$2.23million Solomon Islands Energy Access Expansion Project (P151618), supported by the Global Partnership for Output Based Aid (GPOBA), in July 2016 (and a supplementary grant of US$0.27 for project supervision). The project development objective is to increase access to electricity services in low-income areas of Solomon Islands, by providing targeted subsidies to low-income households to help new customers pay the initial connection fee and basic in-house wiring for low-income households. It will cover connection of households to the grid both in peri-urban areas within existing grid coverage and at planned outstation mini-grid areas.

Initial connection fees and in-house wiring have been found to be major impediments to increasing the electrification rate in the country. Under the project the Solomon Power will use their own staff and subcontractors for service line installation and connections, and will hire licensed electrical contractors competitively to complete the in-house wiring. It is expected that through hiring services in bulk (for extension of service lines and in-house wiring), economies of scale and cost reductions may be achieved. The subsidy per connection in the Honiara grid area is US$794 (SBD6,354), and the subsidy per connection in the outstations is USD994 (SBD7,954). The OBA subsidy accounts for 72 percent of the total cost of a household connection and wiring in Honiara, and 79 percent at outstation areas. Users from Honiara will contribute US$100, whereas users from outstations will contribute US$50. The OBA subsidy is disbursed on the basis or results: ie, upon verification of correctly installed and functioning electricity connections.

The first pilot connections were completed in January 2017 in peri-urban Honiara and initial feedback from SIG and beneficiaries is very positive and there would be interest in expanding the program to more beneficiaries. By October 2017, a total of 150 households have been connected. The project experienced a slow start linked to delays linked to various factors: (i) initial setup of the program team, (ii) delays in setting up the ready boards used to standardize and accelerate rollout; (iii) difficulties for several of the beneficiaries to obtain a valid land title enabling them to apply to the project. These issues now seem to be resolved, with mitigation measures for the land title difficulties having been agreed recently between SP and the Ministry of Lands and Housing. The number of connections is now expected to accelerate significantly. By the end of the 5-year program it is expected that a total of 2,565 low income households, equating to approximately 14,620 people, will benefit directly from the project.

6. Subsequently to the endorsement of the SREP IP and given the slow progress in mobilizing IDA funding, the World Bank decided to implement the Renewable Energy Access Project presented in the IP, under two standalone operations:
   - The Solomon Islands Electricity Access Expansion Project (EAEP), US$2.23million supports electricity connections to low income households under an output based mechanism. The EAP is financed by the Global Partnership for Output Based Aid – see Box 1 for more details; and
   - The Electricity Access and Renewable Energy Expansion project – Phase II (or the Project); which forms the basis of this proposal.

7. The Project financing amounts to US$16.1m with funding provided by IDA (US$6.5 million), Small Island Developing States Initiative – SIDS-DOCK - (US$1.6 million), the Global Environment Facility (US$ 0.9 million) and SREP (US$7.1 million).

Project description

8. The project development objective is to increase access to grid-supplied electricity and increase renewable energy generation in Solomon Islands.

9. The Project is split into three components, as follows:

- **Component 1 — Renewable energy hybrid mini-grids (US$8million).** Component 1 would finance new hybrid mini-grids throughout Solomon Islands. Solomon Power has identified a long list of 35 potential locations suitable for mini grids taking into account population density (number of households), public facilities such as hospitals and schools, 'anchor' loads such as tourism facilities, food processing or other commercial operations, and potential sources of renewable energy sources (mainly solar PV). These 'candidate' mini-grids are located in Central Province, Choisuel, Guadalcanal, Isabel, Makira, Renbul, Temotu and Western Province. Solomon Power has established a process of prioritizing those mini-grids based mostly on the average cost per connection, accessibility and safeguards considerations, namely land availability[59]. Additional feasibility studies will be conducted by Solomon Power in the priority sites to determine their suitability.

- **Component 2 — Connections to low income households (US$1.5million).** This component would finance household connections to low income households, through an output based aid (OBA) mechanism, building on the EAEP. This component would provide one-off OBA subsidies to eligible low-income households to cover a portion of the upfront cost of electricity service connections in the Honiara grid (existing service area and planned expansion areas), and in the outstations including those being developed through Component 1, and possibly others. Eligibility criteria will be based on the geographic location, self-selection. Consumers will apply for a service connection as per current processes.[60]

- **Component 3: Grid-connected solar power (US$ 5.0million).** Component 3 would finance the supply and installation for one or more grid-connected solar facilities in Solomon Islands and the corresponding technical assistance. This facility(ies) would be developed on the basis of an EPC contract, and with an option for a maintenance contract for an initial period of 3-5 years. Ownership and future operation will remain with Solomon Power. The displacement of fossil fueled generation is expected to improve energy affordability, relative to the present, and contribute to further improvements in financial performance of Solomon Power.

- **Component 4 — Enabling Environment and Project management (US$ 1.6million**). This component will focus on project management costs and technical assistance to Solomon Power as well as technical assistance for MMERE to enabling environment and framework for increasing electricity access and the penetration of renewables in Solomon Islands[61]. Financing will be provided to Solomon Power for project staff, additional feasibility studies as may be needed, the recruitment of an owners' engineers and for safeguard studies. With regards to MMERE, while the areas for support

[59] When calculating the average cost per connection will mostly depend of the total costs and population to be covered, but a number of factors comes into play, such as the costs linked to accessibility and logistics, environmental considerations and gender – currently under discussion.

[60] Under the current program and in order to qualify, consumers will fall into the following criteria: (i) beneficiaries fall under the prepaid residential category; (ii) beneficiaries do not have a previous connection under their name; (iii) service connection is capped to 10 A for a period of 12 months; and (iv) service connections are individual, and cannot be shared with other households.

[61] Although some areas had been indicated under the SREP investment plan – such as the need to standardize and streamline the approach for land acquisition for distribution extensions and small mini grids – according to MMERE this support is no longer needed.

are being discussed and finalized, examples of possible areas are as follows: (i) development of a comprehensive electricity access strategy for the country (development of technical standards, institutional and implementation arrangements, financing needs and mechanisms); (ii) financing of upstream technical assistance facilitate additional private sector investment in the sector (identification of investments, PPP arrangements, suitable arrangements for concession agreements, licensing framework, etc) (iii) update of cost of service and tariff studies; (iv) training of electricians[62].

10. **SREP Additionality.** Project supports the most important priorities of the SIG in the energy sector: increased access, greater affordability of electricity services and enhanced energy security. The SREP funds are critical to demonstrate the viability of hybrid solar-diesel mini-grids systems and enhance the capacity of the government to deliver on the RE agenda and to strengthen the institutional framework for a greater involvement of the private sector. Given the nascent stage of RE development in Solomon Islands, SREP financing is key to demonstrate viable approaches, reduce regulatory, financial and capacity barriers while creating the conditions for future replication and scale up.

11. Access to electricity is Solomon Islands is low (20 percent). The remoteness, lack of economies of scale, and poor infrastructure mean that to cost of providing electricity, including through conventional fuels, is high. Solomon Islands has an untapped potential for renewables, especially solar. The project would help demonstrate the viability of renewable energy base mini-grids as the best alternative for electrification. The use of SREP grant funding would be critical to lower the high upfront costs of solar-based renewable energy generation in a dispersed, island nation, thereby making end-use customer tariffs more affordable. SREP support for component 4 would allow for upstream work to be developed to attract additional private sector investment going forward. SREP support would also help increase the availability of renewable energy in rural areas, therefore reducing the dependency of fossil fuel. Solomon Islands is currently almost 100% dependent of fossil fuels. The proposed project is also highly complementary to other current or pipeline projects in the country, such as the Asian Development Bank (ADB)-supported project to hybridize existing diesel mini-grids, or plans by New Zealand to finance complementary mini-grid investments.

Assessment of Proposed Project with SREP Investment Criteria

12. **Increased installed capacity from renewable energy sources.** The Project will facilitate additional 1.6MW of solar generation capacity, including approximately 0.6 MW through the hybrid mini-grids This will be equivalent to an aggregate of approximately 2.6 GWh generated from renewable energy annually.

13. **Increased access to energy through renewable energy sources.** The primary beneficiaries of Component 1 (hybrid mini-grids) and Component 2 (Connections to low income households) are the households in the planned outstation mini-grid areas as well as those in the peri-urban areas within existing grid coverage and the planned extension of the Honiara grid. The proposed project will improve access to electricity to approximately 7311 people including 3582 women. This represents

[62] As mentioned above, one area that has been highlighted as a bottleneck in the process of extending access to the grid to households that are currently not being served, is the limited number of licensed electricians that can install the internal wiring in new households to be connected to the grid (only 60 active licensed electricians and all in Honiara).

1280 low income households (of which approximately 10 percent are female-headed).[63] It is estimated that 226 businesses and community services will benefit from the Project.

14. **Low Emission Development** y. The Project will contribute to a reduction of GHG emissions by 1,042 tCO2eq per year and 26,050 tCO2eq over the life of the investments, which is estimated to 25 years. This has been estimated using the marginal generation displaced by the project and assuming an emission factor of 0.66 kg/kWh for diesel and an efficiency of 0.36 as per recent projects conducted in the country[64].

15. **Affordability and competitiveness of renewable sources.** The project will facilitate access to additional people to electricity networks, while improving sustainability and affordability through the replacement of diesel generation with more affordable sources of power. At US$65 cents/kWh, Solomon Power has highest electricity rate in the Pacific and among the highest in the world. The project economic analysis identified that the project will avoid over $42million in diesel related costs which will facilitate tariff reduction by reducing the level of diesel dependency, generating clean and sustainable energy and subsidizing connections to over 1500 low income families, schools and health centers. Although no affordability survey has been conducted, it is understood that the expensive tariff is one of the major factors for the extremely low annual consumption per capita. Having said this, unelectrified households currently spend a significant amount on expensive alternative sources of energy such as kerosene lamps, candles, and charging of batteries and mobile phones at diesel-based charging stations, while grid-supplied electricity, albeit expensive by international standards, is still more economical than the currently available alternatives. The willingness to pay has been estimated at US$28 per month for rural areas of Solomon Islands, by comparing what communities were spending on alternative sources of power. At the current tariff levels (which would be applied on a uniform basis countrywide), this means that for the average consumption of 30kWh per month, customers would be saving on average 30 percent on their energy expenditure. A cost of service and tariff study has been conducted in 2015, taking into account the generation mix at the time and forecasting a progressive introduction of alternative renewable sources into the generation mix (i.e. hydro and solar) along with a customer growth rate of 12 percent per year. The study concludes that the tariff would be reduced going forward with the introduction of additional RE generation. However, the study does not consider the possible increased costs of delivery through mini-grid (vs grid). Discussions are ongoing to include, under Component 4 of the project, the financing of an update to the cost of service and tariff study to take into account Solomon Power's plans to expand significantly into outstations in the future.

16. **Productive uses of energy.** Increased energy access the hybrid mini-grids will stimulate income-generation activities the development of productive uses and job creation in rural areas. Small business owners and household beneficiaries will be able to extend the running hours of services such as charging stations, barber shops, tailor shops, grocery stalls, saw mills and grocery shops. mini-grids have the advantage of being able to provide high levels of power to support productive loads in remote areas (e.g., commercial, light industrial, agricultural processing, etc.), while stimulating employment and providing added value for local economic development. Experience has shown that rural electrification can lead to economic and social development, but targeted assistance may be

[63] The total number of people is derived from the number of new household connections by the average household size in Solomon Islands (5.7 people per household). Solomon Islands 2012/13 Household Income and Expenditure Survey. Solomon Islands National Statistics Office. Government of Solomon Islands. October 2015.
[64] Tina River Hydropower Development Project (P161319)

required to encourage beneficiaries offset the upfront cost of connecting to electricity. This will partially be provided through the Project's component 2 (connection of low income households).

17. **Economic, social and environmental development impact.** The Project will contribute to stabilizing and reducing prices over the longer term through fuel diversification. It will assist SP to integrate renewable energy into the grid and MMERE and the Government to improve longer term sustainability for the sector through a lower dependence of volatile fuel prices. In addition, it will foster the expansion of electricity infrastructure for economic and social development using low carbon sources through (i) improved electricity services in rural areas, (ii) accrued educational and health benefits due to reduced air pollution from reduced use of kerosene, (iii) reduced GHG emissions from using renewable energy sources, and (iv) increased opportunities for income generation through promoting productive uses of electricity.

18. **Economic and financial viability.** The economic analysis shows that Component 1 and Component 3 are economically viable, with an economic rate of return (ERR) of 3.2 percent and 5.1 percent respectively, with local and global environmental benefits. An initial capital investment of US$3.4 million was estimated for the implementation of four hybrid mini-grids with service tier 4 and a total capacity of 1.1 MW In addition, an estimated investment of US$1.43 million is attributed to distribution costs. The financial analysis of the mini-grids was carried out by valuing the additional electricity delivered as a result of the project in financial terms. The preliminary results presents a FIRR of 12.5 percent assuming a tariff of US$ 0.65 per kWh until 2020 and US$ 0.52 per kWh afterwards At this stage, the findings of the economic and financial analysis are preliminary, and will need to be fine-tuned based on the capacity of the specific mini-grids to be selected, the final investment needs, and confirmation of the various assumptions used in the models including the capital investment, operations and maintenance costs as well as the specific capacity needs and solar penetration in the mini-grids. See Annex 4 of the Project Appraisal Document for more details regarding the economic and financial analysis.

19. **Leveraging of additional resources.** The Project directly leverages financing resources from IDA, SIDS-DOCK and GEF totaling US$9 million. This is complemented by a parallel US$2.23 million financing from GPOBA to connect low income households to electricity (see Box 1) which will inform the implementation of the project component 2. Total co-financing is equivalent to US$11.72 million, including contributions of US$0.39 million from Solomon Power, and US$ 0.1million from customers/private sector to cover the service connections required to connect new customers under Component 2. Thus, US$1 of SREP funding leverage approximately US$1.65 of additional financing.

20. **Gender.** Gender gaps in the Solomon Islands are pronounced in the areas of (i) economic opportunity, with 76% of women concentrated in subsistence activities compared to 50% of men in rural areas, and only 30% of women compared with 51% of men in paid work in urban areas; (ii) women bear a high share of the burden of family care responsibility which reduces their time availability for potential productive activities; (iii) high levels of violence against women; and (iv) overall low participation in decision making at all levels. The project will conduct a full gender assessment by appraisal to inform the program of activities under the project and address specific gaps. Under Component 1, the assessment is expected to provide additional information to support the selection for mini-grid locations, and to identify entry points for the promotion of women participation in mini-grid O&M to increase access to employment opportunities. Under Component 2 the assessment will help to strengthen the gender dimension in the OBA subsidy scheme. This could include the adoption of an additional gender-sensitive criterion for female-headed households if these are found to be specially

disadvantaged, and identification of a specific outreach strategy to ensure women are informed about the subsidy. To reduce potential negative impacts such as cost burden post-electrification on low-income and female-headed households, other mechanisms such as communication campaigns on application, bill payment, and management of energy use, and smart-end-to-end operation to support customers to invest in energy efficient lighting and appliances might be considered. The project will ensure that women participate in consultations and community-decision making throughout implementation. The project will monitor activities through sex-disaggregated data regarding beneficiaries with respect to households connected to the mini-grids, and subsidy beneficiaries.

21. **Co-benefits of renewable energy scale up**. The Project is expected to have several co-benefits at both local and global scale.

    a) Environmental and health co-benefits. The Project will contribute to the reduction of greenhouse gas (GHG) emissions and for SIG to achieve its Intended Nationally Determined Contribution (INDC) commitment. SIG's INDC is to reduce GHG by 18,800 tons of carbon dioxide equivalent (tCO_{2eq}) per year by 2025 and by 31,125 tCO_{2eq} per year by 2030. The Project helps reduce GHG emission by 26,050 tCO_{2eq} over the life of the project. The health benefits of electricity stem from cleaner air, reduced risk of burns, fires, and accidents, better nutrition and food safety from refrigeration, and improved health knowledge from access to communications and mass media, as well as, ultimately, improved health services due to electrification of health clinics. There is some emerging (although still limited) evidence that women and children are those who benefit most from the switch from health-damaging kerosene lighting. A recent study reports that accidental ingestion of kerosene is the primary case of child poisoning in the developing world, and a frequent cause of infant burns (e.g. in Bangladesh, kerosene lamps are responsible for 23 percent of infant burns). In addition, women and children spend a larger proportion of their time indoors and thus experience a greater exposure to pollutants than males.

    b) Economic co-benefits. The economic benefit of the household connections derives from increased access to modern electricity services and a substitution away from lower quality or more expensive alternatives. The project will particularly target those customers that reside in areas with no grid coverage and are unlikely to have grid coverage in the near future. The main benefit type under Component 1 and 3 is the reduced spending on diesel fuel for electricity generation compared to the baseline fuel use in the existing village generators and co-generation gensets, given that the majority of Component 1 and 3 sites already have existing distribution infrastructure and several diesel generators. Enhanced energy security through reduced dependence on imported fossil fuels and traditional sources of energy will be achieved. In addition, the project will generate employment opportunities, mainly from construction, operation and maintenance of RE based mini-grids. Increased access to electricity will support income generating activities through fostering productive uses. The economic co-benefits of the project include:

        - Downward pressure on affordability of electricity.
        - Improved balance of payments due to reduced fossil-fuel imports and reduced outflow of foreign reserves.
        - Employment opportunities during project construction stage and then after for O&M.
        - Increased economic activity due to ability for households and small businesses to generate additional income through value-adding, particularly for agri-business.

- Increased empowerment of women who receive proportionally higher benefits from increased access to energy.

c) Social co-benefits. The social co-benefits result from improved access to electricity through renewable energy sources that is expected to help reduce the physical burden associated with organizing alternative energy sources. Access to electricity is expected to have positive benefits, particularly for women, by releasing valuable time spent on household chores to engage in income generation activities widening their employment opportunities (including in the renewable energy supply industry). Access to clean energy can go a long way in improving health and reducing premature mortality, especially among women and children, by reducing reliance on fuels such as kerosene for lighting and lowering indoor-air pollution. Clean, improved, and reliable lighting can also increase the opportunities for learning/education of children. Furthermore, access to electricity can help households engaged in agricultural and food production activities to use improved technologies such as water pumping for irrigation, grinders, millers, etc. impacting food security and income generation.

22. **Monitoring and Evaluation.** Overall monitoring and evaluation of the project activities would be performed by the Solomon Power. It that capacity it will have the responsibility to collect data and report on the performance indicators on a six-monthly basis for the PDO indicators and for the intermediate outcome indicators at the component level. The Project's result indicators and associated monitoring mechanisms are presented in Section VII (Results Framework and Monitoring) of the PAD.

Implementation Readiness

23. **Country/ sector strategies.** See Section I.C of the main PAD.

24. **Institutional arrangements.** The Ministry of Finance and Treasury (MoFT) will be the Recipient for the various Grants and will enter into the Financing/Grant Agreements with the World Bank. Overall responsibility for oversight and implementation of the Project will lie with Solomon Power. Solomon Power will be the implementing agency for the project, and will sign a Project Agreement with the World Bank, as well as a Subsidiary Grant Agreement with the Ministry of Finance and Treasury, passing on the grants. SP has been implementing Bank-financed projects for several years and has experience with World Bank project implementation, including with fiduciary and safeguard policies. Solomon Power is currently implementing two World Bank projects; (i) the Solomon Islands Sustainable Energy Project (P100311), and (ii) the Electricity Access Expansion Project (P151618). The implementation arrangements proposed for the project build on previous experience managing other World Bank-financed operations with Solomon Power. A detailed description of the proposed mechanisms is presented in Annex 2 (Implementation arrangements).

25. **Sustainability.** See Section IV. C of the main PAD.