



REQUEST FOR MSP APPROVAL

TYPE OF TRUST FUND: GEF Trust Fund

PART I: PROJECT IDENTIFICATION

Project Title:	SB Development of Community-based Energy Mini-Grids		
Country(ies):	Solomon Islands	GEF Project ID: ¹	4284
GEF Agency(ies):	WB	GEF Agency Project ID:	P122937
Other Executing Partner(s):	Solomon Islands Electricity Authority (SIEA)	Submission Date:	2013-10-12
GEF Focal Area (s):	Climate Change	Project Duration (Months)	14
Name of parent program (if applicable):	SUSTAINABLE ENERGY PROJECT (P100311)	Project Agency Fee (\$):	94,675

A. FOCAL AREA STRATEGY FRAMEWORK²:

Focal Area Objectives	Expected FA Outcomes	Expected FA Outputs	Trust Fund	Grant Amount (\$)	Co-financing (\$)
CC3: Promoting market approaches for renewable energy	Outcome 3.1: Investment in renewable energy technologies increased.	Output 3.1: Renewable energy capacity installed/rehabilitated. Output 3.2: Increased production of renewable energy in electricity grids..	GEFTF	389,220	3,534,177
	Outcome 3.2: Favourable policy and regulatory environment created for renewable energy investments.	Output 3.3: Renewable energy policy and regulations put in place	GEFTF	557,530	2,330,111
Total Project Cost				946,750	5,864,288

B. PROJECT FRAMEWORK

Project Objectives: To improve operational efficiency, system reliability and financial sustainability of Solomon Islands Electricity Authority through: improved financial and operational management, reduction of losses, and increase revenue collection.

Global Environment Objective (GEO): To support the development and sustainable operation of electrical mini-grids that use renewable energy and create an enabling environment (policy, legal and regulatory) that promotes investment in renewable energy technologies and increases access to more affordable energy services in rural areas of Solomon Islands.

Project Component	Grant Type	Expected Outcomes	Expected Outputs	Trust Fund	Grant Amount (\$)	Cofinancing (\$)
1) Strengthening Management	TA	Improved professionalism, management and performance of SIEA, so that it runs on a sustainable financial and operational basis. Mentor local management staff to significantly enhance their management skills and groom them to replace expatriate staff.	Commercialization of SIEA. Improved financial performance, with return to profitability. Improved operational performance, with improvements in reliability of power supply and efficiency of operations.	GEFTF	0	2,600,910

¹ Project ID number will be assigned by GEFSEC.

² Refer to the reference attached on the [Focal Area Results Framework and LDCF/SCCF Framework](#) when filling up the table in item A.

2) Improving financial performance, systems and processes	TA	<p>Review and restructure existing electricity tariffs so as to better encourage energy efficiency, affordability, sustainability.</p> <p>Development of power purchasing arrangements for community/private owned renewable generation.</p> <p>Development and adoption of: a) Connection Agreements and policies for electrical networks; b) Business models for community owned power</p>	<p>New tariff structure adopted</p> <p>Develop three Connection Agreement templates for on-grid renewables: Solar PV; hydro; and biofuel/biomass/biogas generation. Develop related policies regarding: i) power purchase pricing guidelines for small scale grid-connected renewable energy; ii) application and negotiations framework for parties seeking to connect to grids; iii) standard O&M services templates for small scale renewable energy facilities.</p> <p>Workable business models for community owned power in Solomon Islands.</p>	GEFTF	530,000	933,267	
3) Improving Technical Operations	Inv	<p>a) Rehabilitation of SIEA micro-hydro generation facilitation at Buala, on Santa Isabel.</p> <p>b) Increasing quality/access to services in Buala by strengthening the mini-grid.</p>	<p>a) Restoration of full 150kW capacity and annual energy output of Buala micro-hydro scheme to 667kWh/year; b) Augment 415V network at Buala to improve quality of supply and meet load growth Augmentations will comprise: i) 400 metre extension to a 415Volt feeder; ii) replacement of 500 metres of 95mm² Aerial Bunded Cable; iii) 1 x 415Volt switchboard panel..</p>	GEFTF	370,000	2,330,111	
Subtotal						900,000	5,864,288
Project Management Cost ³					GEFTF	46,750	
Total Project Cost						946,750	5,864,288

C. CO-FINANCING FOR THE PROJECT BY SOURCE AND BY NAME IF AVAILABLE, (\$)

Sources of Cofinancing	Name of Cofinancier	Type of Cofinancing	Amount (\$)
Other Multilateral Agency (ies)	IDA: P100311	Cash	3,860,288
Others	Solomon Islands Electricity Authority: P100311	In-kind	500,000

³ PMC should be charged proportionately to focal areas based on focal area project grant amount in Table D below.

Bilateral Aid Agency (ies)	AusAID (Australia): TF081184	Cash	1,000,000
Others	Solomon Islands Electricity Authority: P100311	Cash	504,000
Total Cofinancing			5,864,288

Table A3 summarizes the financing of the baseline project across its three components, by activity and sources of finance (GEF, Co-finance).

Highlighted in yellow are the new activities for which GEF financing is sought. The new activities fit under the baseline project's second and third components: 2) Improving financial performance; 3) Improving Technical Operations.

TABLE A3: BASELINE PROJECT FRAMEWORK

<p>Project Development Objective (PDO): To improve operational efficiency, system reliability and financial sustainability of Solomon Islands Electricity Authority through: improved financial and operational management, reduction of losses, and increased revenue collection.</p> <p>Global Environment Objective (GEO): To support the development and sustainable operation of electrical mini-grids that use renewable energy and create an enabling environment (policy, legal and regulatory) that promotes investment in renewable energy technologies and increases access to more affordable energy services in rural areas of Solomon Islands.</p>									
Project Component	Indicate whether Investment, TA, or STA ²	Activity	Expected Outcomes	Expected Outputs	GEF Financing ¹		Co-Financing ¹		Total (\$) c=a+ b
					(\$ a)	%	(\$ b)	%	
1) Strengthening Management	TA	Hire expatriate Board Director & Managers (GM & CFO).	Improved professionalism, management and performance of SIEA, so that it runs on a sustainable financial and operational basis. Mentor local management staff to significantly enhance their management skills and groom them to replace expatriate staff.	Commercialization of SIEA. Improved financial performance, with return to profitability. Improved operational performance, with improvements in reliability of power supply and efficiency of operations.	0	0%	2,600,911	100%	2,600,911
2) Improving financial performance, systems and processes	TA	Strengthen financial management and procurement capabilities, systems and processes in the SIEA.	Improve SIEA's procurement capacity. Strengthen SIEA's financial management capacity.	New procedures for procurement and financial management established and embedded in organization.	0	0%	146,720	100%	146,720
	INV	Purchase prepayment meters for household customers	Improved collections and cash flow.	Purchase of pre-payment meters & supporting IT equipment.	0	0%	230,572	100%	230,572
	TA	Loss reduction study.	Quantification of electrical losses on SIEA's main network, source of losses (technical, non-technical), and action plan to reduce losses. Implementation of action plan.	Report on electrical losses, including recommendations on: a) ways to reduce total electrical losses, particularly non-technical losses; b) improved processes for metering, billing and internal audit, and revenue collection; c) capital expenditure recommendations.	0	0%	313,746	100%	313,746

	INV	Improved metering, billing and revenue collection from largest electrical consumers.	Reduce Non-Technical Losses (i.e. theft and /or inaccurate metering and billing) of the largest commercial and industrial customers. Improved revenue collection.	Pole mounted meters for 40 largest customers.	0	0%	195,346	100%	195,346
	TA	Asset valuation	Revalue SIEA's assets and assess remaining asset life, in order to inform: reconstitution of balance sheet; assessment of revenue requirements; investment planning; and revisions to tariffs.	New asset register, including asset valuation.	0	0%	46,883	100%	46,883
	TA	Tariff review	Review and restructure existing electricity tariffs so as to better encourage energy efficiency, affordability, sustainability.	New tariff structure adopted	300,000	100%	0	0%	300,000
	TA	Power purchasing arrangements	Development and adoption of: a) Connection Agreements and policies for electrical networks; b) Business models for community owned power.	a) Connection agreement templates and policies b) Workable business models for community owned power in Solomon islands.	230,000	100%	0	0%	230,000
3) Improving Technical Operations	INV	Honiara Generation Maintenance/Rehab	Improved reliability of supply.	Refurbishment of water treatment and cooling system at Lungga Power Station to increase efficiency and generation reserve margin.	0	0%	173,663	100%	173,663
	INV	Lungga Power Station Generation refurbishment	Improved efficiency of generation, reduced diesel consumption,	Spare parts for major overhauls of base load generators.	0	0%	259,499	100%	259,499
	INV	Distribution network Rehabilitation	Improved reliability of supply in capital city, Honiara. Fewer power cuts, improved quality of supply, and improved measures of reliability (SAIDI, SAIFI).	Commissioning of: a) 33kV underground cable to Ranadi; and b) new 11 kV switchboard at Honiara Power Station.	0	0%	1,620,535	100%	1,620,535

	INV	Rehabilitation of rural hydro-power generation	Rehabilitation of SIEA micro-hydro generation facilitation at Buala on Santa Isabel	Restoration of full energy output at Buala so that near 100% of energy is from renewable source. Return to using the diesel generator at Buala as a back-up to the hydro-unit.	260,000	100%	0	0%	260,000
	INV	Increasing quality/access to services in rural provinces	Increasing quality/access to services in Buala by strengthening the mini-grid.	Augment 415V network at Buala to improve quality of supply and meet load growth	110,000	100%	0	0%	110,000
	TA	Engineering Consultancy Services	Owners' engineers to supervise distribution network & generation upgrades. Training of SIEA staff.	TA on meeting growing demand for power in Honiara area, plus project management of contractors.	0	0%	276,415	100%	276,415
Project Management					46,750	2%	NA³	98%⁴	NA³
Total Project Costs					946,750	14%	5,864,288	86%	6,811,038

¹ The percentage is the share of GEF and Co-financing respectively of the total amount for the activities.

² TA = Technical Assistance; STA = Scientific & Technical Analysis.

³ Parent Project Management co-financing is an integral part of the Parent Project's \$2.6 million Component 1, 'Strengthening Management'. Approximately \$80,000 of this \$2.6 million is estimated to be used by SIEA for managing the child project — see Table A1 above and Table F below.

D. GEF/LDCF/SCCF/NPIF RESOURCES REQUESTED BY AGENCY, FOCAL AREA AND COUNTRY¹

GEF Agency	Type of Trust Fund	Focal Area	Country Name/Global	Grant Amount (a)	Agency Fee (b)²	Total c=a+b
Total Grant Resources				0	0	0

¹ In case of a single focal area, single country, single GEF Agency project, and single trust fund project, no need to provide information for this table

² Please indicate fees related to this project.

E. DOES THE PROJECT INCLUDE A “NON-GRANT” INSTRUMENT? No

(If non-grant instruments are used, provide an indicative calendar of expected reflows to your Agency and to the GEF/LDCF/SCCF/NPIF Trust Fund).

PART II: PROJECT JUSTIFICATION

A. PROJECT OVERVIEW

A.1. Project Description

Global environmental problems, root causes and barriers that need to be addressed

In Solomon Islands, the cost of electricity is high and access to electricity is low due to the limited coverage of the existing power network dispersed population and, heavy reliance on imported petroleum fuels for power generation. In 2009, 99.3% of the 84.3 GWh of electricity generation came from diesel generation fossil fuels and just 0.7% from renewables. Similarly, in 2009 renewable generation capacity accounted for a mere 0.3% of the 36.1 MW of installed generation capacity and fossil fuel imports of US\$99 million accounted for 24.4% of total imports. Access to electricity nationally is only 21% of households, but access rates in rural areas where the bulk of the population lives is only 6% of households.

This situation exists despite an abundance of significant potential for renewable energy resource (solar, hydro, biofuel and recently geothermal). Geographic, commercial, regulatory, political and institutional factors have all contributed to this.

There are four critical constraints to building localized capacity and developing sustainable organizations that provide energy to the bulk of the population who live in rural areas of Solomon Islands:

1. The existing electricity tariff structure;
2. Shortcomings in legal and regulatory arrangements governing the energy sector, particularly the absence of: a) a streamlined and transparent approval process for Independent Power Producers (IPPs); b) standardized Connection Agreements (CA) and Power Purchase Agreements (PPA) for small scale independent power producers seeking to connect to existing grids and mini-grids, or to develop new mini-grids;
3. A lack of understanding of the range of sustainable business models for community scale power services that could work in rural areas of the Solomon Islands and how these can be effectively implemented; and
4. Weaknesses in the capacity of local communities and/or the SIEA to sustainably operate and maintain existing renewable energy schemes.

This proposed GEF-sponsored project, Developing Community Based Renewable Energy (P122937) seeks to address the four abovementioned constraints that adversely affect the sustainable development and operation of renewable energy schemes in rural areas of Solomon Islands. GEF can play a pivotal role in transforming the enabling environment for community-based mini-grids, supporting the rehabilitation of the country's largest existing micro-hydro scheme (150kW Buala hydro), and in assessing the potential impacts on the affordability of electricity arising from the potential development of major renewable energy projects.

The GEF financing in P122937 will be embedded as additional, trust funded co-financing to the existing IDA-sponsored Sustainable Energy Project (SISEP, P100311) and is to contribute to new activities that fall under two of the three high level components of SISEP. Co-financing of SISEP (P100311) totals nearly \$6.0 million, sourced from IDA, Australia, and the client.

It is proposed that US\$ 900,000 in GEF funds (exclusive of project management costs) be used to fully finance three new activities in SISEP:

1. Tariff Review (US\$300,000), to assess how existing electricity tariffs could be adjusted under assumptions of:
 - a. Business as usual (near 100% generation from fossil fuel (diesel)); and
 - b. With renewable generation (hydro and/or geothermal) displacing nearly all diesel generation on the main Honiara grid. There are two significantly transformative, and

potentially competing, 20MW renewable energy projects that are under preparation — Tina River Hydro (feasibility study stage) and Savo Island geothermal (resource assessment/prefeasibility stage) — and the impact they might have on tariffs, energy affordability, and the financial sustainability of the SIEA needs to be assessed;

2. Development of a suitable framework for community/privately owned small scale generation:
 - a. Standardized Connection Agreements, PPAs, O&M agreements and policies (US\$130,000);
 - b. Business models for community owned power (US\$100,000).
3. Improving rural electricity supply at Buala, Santa Isabel:
 - a. Rehabilitation of the existing Buala micro hydro scheme so that it meets nearly 100% of annual energy demand (US\$260,000);
 - b. Strengthening 415 V mini-grid at Buala to increase quality and access to electricity services (US\$110,000).

In addition, the GEF is being asked for US\$ 46,750 in project management of the above three activities in project management of the above three activities, comprising estimated travel for consultants (US\$ 45,000, 6 trips at US\$ 7500 per trip) and a consultation/dissemination workshop in Honiara (US\$ 1750).

Baseline scenario (Business as Usual (BAU))

- Near 100% of power generation in country sourced from diesel fuel oil.
- Existing 150kW micro-hydro scheme at village of Buala out of commission, and existing and future electrical load met via diesel generation.
- Diesel generation capacity expansion elsewhere on small grids around Solomon Islands.
- Nation's main load centre, Honiara (16MW peak load (2012) with suppressed demand, and around 90% of national annual electricity consumption), remains fully dependent on diesel generation to meet load.
- Electricity tariffs remain high, due to diesel reliance, and unreformed in structure.
- Two critical shortcomings in legal and regulatory arrangements remain: a) lack of a streamlined and transparent approval process for IPPs; b) lack of standardized Connection Agreements (CA) and Power Purchase Agreements (PPA) for small scale independent power producers seeking to connect to existing grids and mini-grids, or to develop new mini-grids.
- Continued lack of understanding of the range of sustainable business models for community scale power services that could work in rural areas of the Solomon Islands and how these can be effectively implemented.

Proposed Alternative scenario

- Refurbishment of micro-hydro schema at village of Buala allows almost all its load to be met with renewable energy over next 10 years, with diesel generation only used as a back-up.
- Extension of existing 415 Volt mini-grid at Buala to improve quality of supply to parts of network where increased load is expected to come on stream in next 12-24 months.
- Up to 5MW of small scale hydro generation capacity developed elsewhere on small grids around Solomon Islands. These schemes could be run using a range of sustainable business models that involve local communities and the private sector.
- Nation's main load centre, Honiara (around 90% of national annual electricity consumption), switches from diesel to renewable generation (either 20MW of hydro or geothermal) to meet load.
- Development of a suitable framework for community/privately owned small scale generation, that includes: a) Standardized Connection Agreements, PPAs, O&M agreements and policies; b) A range of workable and effective business models for community owned power generation.
- Clearer understanding of tariff implications around the Baseline scenario (Diesel only expansion) versus the Alternative scenario of Renewable Energy capacity expansion (either 20MW Tina River Hydro or 20MW Savo Island Geothermal). This understanding will critically inform the

decision making process to develop one of these schemes in next 10 years and to supply Honiara and displace around 20MW of diesel generation capacity.

- Electricity tariffs restructured.

Incremental cost reasoning

By supporting this proposal, the GEF would contribute to addressing fundamental issues that have constrained the development of renewable energy in Solomon Islands, particularly in relation to community mini-grids. The GEF would be addressing issues that no other development partners are currently. For Solomon Islands to achieve its aspirational targets of increasing access and increasing the share of renewable energy in its generation mix, it will require and expects international support. The GEF is well placed to be part of this support, and this proposal addresses areas which other development partners are not addressing; a fact known by the World Bank, which has been lead development partner in the Solomon Islands energy sector since 2004/05, shortly after the 1998-2003 civil conflict ended.⁴ The Bank's assistance has focused on turning around the national power utility, and preparing pre-feasibility and feasibility studies on a hydropower project (Tina River Hydropower project). In the course of that engagement, the Bank has gained a very good understanding of the constraints and challenges, together with what other development partners are doing and not doing. No other development partner, nor the government, is addressing fundamental issues for which GEF support is being sought.

The GEFTF financing of the restoration of renewable electricity supply at Buala and the upgrading of the 415V mini-grid there is estimated to: a) directly reduce greenhouse gas emissions by 10,977 tonnes of CO_{2e} by reducing the use of diesel fuel for power generation (see below for details); b) significantly reduce the operation and maintenance (O&M) costs of the diesel generators at Buala. The largest contribution to the reduction in diesel generator O&M costs arises from the estimated reduction in fuel use by 4,087,374 litres over 20 years.

Relative to the Baseline, the Net Present Value (NPV) of the estimated savings in diesel generator O&M costs arising from the refurbishment of the Buala micro-hydro scheme under the Alternative Scenarios are US\$3.4 million; assuming that the full 150kW nameplate capacity of Buala hydro is restored, the hydro unit operates at a 90% capacity factor, and load at Buala grows in line with the December 2012 forecast.⁵ For summary details, see Annex C.

These US\$3.4 million savings in the Net Present Cost of diesel generator O&M exceed the estimated capital expenditure of US\$260,000 required in year 1 to refurbish and rehabilitate the Buala micro-hydro scheme.

Global environmental benefits

The global environmental benefit to be delivered is mitigating climate change through the reduction of greenhouse gas emissions in line with the United Nations Framework Convention on Climate Change.

The following key indicators of the project relate to the activities to be financed by the GEFTF:

- a) Estimated Carbon Dioxide emissions avoided, comprising:
 - i) direct emissions reductions, 10,977 tonnes CO_{2e};
 - ii) indirect bottom-up emissions reductions, 32,932 tonnes CO_{2e};

⁴ The 1998-2003 civil conflict, known locally as the "tension", emerged as a result of grievances between the local Guadalcanal landowners and migrants, predominantly from the most populous island of Malaita, drawn by economic opportunities. Violent clashes involving rival militant groups led to deaths, displacement, and the widespread destruction of property.

⁵ Other assumptions include: 1) Fuel costs SBD8.75/Litre; 2) Fuel price escalation, 1.1% per annum; 3) Discount rate (real), 7%; 4) 20 year time horizon; 5) Maintain G-1 capacity > Maximum Demand; and 6) Exchange rate of SBD/US\$ is 7.28863; 6) Annual energy consumption at Buala grows from 393.7 MWh in 2013 to 778.6 MWh in 2017, then remains constant to 2032; 7) Maximum demand at Buala rises from 78 kW in 2012 to 153 kW in 2017, then remains constant to 2032.

- iii) indirect top-down emissions reductions, 958,113 tonnes CO_{2e}; and
- b) Investments in renewable energy supply.

Direct Emission Reductions

Part of the outputs of the project will be the following investments: (a) Restoration of full hydro generation capacity at Buala so that near 100% of its electrical energy consumption is from renewable source; (b) Augment existing 415V network at Buala to improve the quality of supply and meet electrical load growth.

These investments will result in direct greenhouse gas emission reductions during the project's implementation phase.

As a result of these investments during the project implementation period of 1 year, direct greenhouse gas emission reductions totaling 10,977 tonnes of CO_{2e} will be achieved over the lifetime of the investments of 20 years. In the non-GEF baseline case, these energy needs would be satisfied by diesel generation with an emission factor of 0.81 tonnes of CO_{2e} per MWh.

Direct Post-project Emission Reductions

The project does not include activities that would result in direct post-project greenhouse gas emission reductions.

Indirect Emission Reductions

Using the GEF bottom-up methodology, indirect emission reductions attributable to the project are 32,932 tonnes of CO_{2e}. This figure assumes a replication factor of 3.

Using the GEF top-down methodology, indirect emission reductions attributable to the project are 958,113 tonnes of CO_{2e}. This figure assumes that total technological and economic potential for GHG emission reductions in Solomon Islands power generation over 10 years is 1,596,856 tonnes of CO_{2e}, with a project causality factor of 60%.

The detailed assumptions and calculations regarding emissions reductions and investments are summarized in the table below.

Project Title	
SB Development of Community-based Energy Mini-Grids (P122937)	
Results	T CO_{2e}
Direct emissions reductions	10,977.44
Direct post project emissions reductions	-
Indirect bottom-up emissions reductions	32,932.32
Indirect top-down emissions reductions	958,113.43
Key Data	
Annual electricity saved / generated (MWh)	677.47
Emissions factor (T CO _{2e} / MWh)	0.81
Useful Investment Lifetime (years)	20.00
Revolving Fund Size (\$)	-
Revolving Fund turnover factor (t)	-
Replication Factor	3.00
P10 (T CO _{2e})	1,596,855.71
GEF Causality Factor (%)	60.00

Enter Project Components (Commensurate with the Log Frame)

Activities Contributing to Direct Emissions Reductions

- 1) Rehabilitation of 150kW Buala micro-hydro to full capacity
- 2) Displacement of diesel generation at Buala by hydropower to meet load.
- 3) Training of national utility staff in O&M of micro-hydro plants.
- 4) -
- 5) -

Activities Contributing to Indirect Emissions Reductions

- 1) Replication effect, with SIEA rehabilitating the existing Malu'u micro-hydro
- 2) Replication effect arising from development of up to 25 MW of new hydro/geothermal in next 10yrs (Tina River Hydro 20 MW (or Savo Geothermal 20 MW), plus 5MW of mini-hydros currently under Feasibility Study by Asian Development Bank).
- 3) Transformation in energy market in Solomon Islands as result of new policies and regulations.
- 4) New tariff structure supports development of new renewable energy mini-grids and displacement of diesel generation on existing grids.
- 5) Improved operation and maintenance of existing RE equipment via RESCOs, community co-ops, and SIEA.

Innovativeness, sustainability and potential for scaling up.

In the context of Solomon Islands the project is innovative because it facilitates the creation of an enabling environment for development of renewable energy by: a) establishing appropriate business models for community-based power supplies; b) putting in place a clearer regulatory framework, application and approvals process, and simple template agreements for small scale renewable energy projects seeking to connect to the grid. While the combination of sound business models and a suitable regulatory framework are critical foundations for harnessing the renewable energy potential of Solomon Islands, reforms to these areas have yet to be implemented. By supporting the implementation of such reforms, the GEF would contribute to fundamentally changing the rules and framework under which renewable energy projects are proposed and developed in Solomon Islands. Arguably, past and planned renewable energy projects in Solomon Islands have tended to focus on the engineering, technical, economic and financial feasibility of projects, and have paid insufficient attention to the regulatory, commercial and social contract aspects of renewable energy projects. Uncertainties around the social and commercial contracts have often led to long delays in the development of hydropower projects in Solomon Islands. Consequently, all future renewable energy projects will benefit from the creation of good business models for community-based power supplies, streamlined regulatory arrangements for approving and connecting independent power producers to the grid, and standard templates for contracting out operation and maintenance.

The project also addresses the some underlying human, technical and institutional capacity constraints that have inhibited the SIEA in effectively operating and maintaining its micro-hydro power plants. It does this by drawing on private sector contractors to rehabilitate the Buala hydro scheme, training SIEA staff in the operation and maintenance of micro-hydro power plants, and creating a contract template that will allow the SIEA to contract out the O&M of its hydro-power stations in the future.

The proposed GEF grant is fully blended with an IDA grant project that has been successful in commercializing and turning around the performance of the SIEA since 2010. Embedding this GEF grant into a successful IDA grant project will help ensure sustainability, and presents opportunities to scale up. Specifically, the successful rehabilitation of Buala micro-hydro by the SIEA would serve as an example for it to rebuild (and double the 36kW capacity) of its only other existing micro-hydro site, Malu'u, in Malaita province.

At present, Buala is the only provincial capital in Solomon Islands that has a hydro scheme capable of meeting all its electrical load.

However, the potential for replication and scaling up mini-hydro across other provincial capitals of Solomon Islands is significant:

1. There are currently advanced investigations of the prospects of mini-hydro plants being installed to serve other provincial capitals and displacing the energy generated from diesel. Specifically, during 2011-2012, pre-feasibility studies were prepared for four priority small hydropower sites under the Asian Development Bank's (ADB) "RETA-7329 Promoting Renewable Energy in the Pacific". These four mini-hydro sites have been screened and three sites selected for preparation of feasibility studies, which are being conducted in 2013 (refer Table 1).
2. In addition, during 2013-2014 a pre-feasibility study will be prepared by the ADB for the Mase River hydro site in New Georgia.
3. The ADB pre-feasibility study in 2012 identified two other potential mini-hydro sites in Western Province: Ringgi A (1210 kW, 10.4 GWh/year) and Ringgi B (4320 kW, 26 GWh/year).

Table 1: Three small hydropower sites under feasibility study, Solomon Islands, 2013

Load Center	Province	Estimated Installed kW	Investment Estimate (US\$ million)	Levelized Cost of Energy US\$/kWh	Financial Rate of Return	US\$/kW Installed Cost
Auki	Malaita	1,160	4.2	0.08	35%	\$3,600
Lata	Temotu	107	2.2	0.20	13%	\$20,300
Kirakira	Makira Ulawa	110	1.2	-	-	\$10,900

Source: ABD, "Pre-feasibility studies, RETA-7329 Promoting Renewable Energy in the Pacific", ADB, Manila, 2012

In addition, two potentially larger scale renewable energy projects under investigation in Solomon Islands both propose to use a public-private partnership business model — Tina River Hydro (15 to 20 MW) and Savo Island Geothermal (20 MW).

It is estimated that the **direct emissions reductions** of this proposed project are small (10,977 tonnes CO_{2e}) because of the small 150kW size of the micro-hydro plant at Buala that is proposed be refurbished and the projected limited increase in the village's small electrical load. Similarly, the **indirect bottom-up emissions reductions** are also estimated to relatively small (32,932 tonnes CO_{2e}), due to a conservative assessment of the scope to replicate the refurbishment of existing micro-hydro schemes across Solomon Islands in the next 10 years. Few such schemes currently exist. However, the **indirect top-down emissions reductions** are estimated to be large for Solomon Islands (958,113 tonnes CO_{2e}), on the assumption that the enabling environment changes financed by this GEF grant will contribute to the development of up to 25MW of significant renewable energy capacity (either hydro or geothermal) in Solomon Islands in the next 10 years, and effectively displace most of the existing diesel generation.

Climate change risks and risk mitigation measures

Global climate change might pose a risk to the project outcomes via: 1) impacts on water flow volumes in rivers; and 2) an increase in the frequency and/or severity of tropical cyclones in Solomon Islands.

Water flows could be affected in two ways by climate change affecting Solomon Islands. First, there may be a decrease in the dry season river flows, due to lower rainfall, which would result in a reduction in the level of energy production from hydropower plants. Second, there might be an increase in the volume of rainfall during the wet season, leading to increased river flows which might not have any positive impact on energy output if that is at a maximum that can be absorbed by demand. Instead, increasing floods might damage hydropower stations and related infrastructure.

An increase in the frequency and/or severity of tropical cyclones in Solomon Islands could also damage power infrastructure via landslides, downing of power lines, flying and floating debris, and flooding.

These climate change risks can be managed in a number of ways, see table below.

Type of risk	Event	Risk management options
Hydrological risk	Under-estimation of long term mean and annual river flows	<ul style="list-style-type: none"> High quality hydrological analysis using reliable data and independent auditing. Adjustment to concession contract terms to compensate for long term variances in hydrology. Minimum payment to guarantee debt service requirements.
	Variations in flow about mean	<ul style="list-style-type: none"> Optimize design of hydro projects Contractual. Minimum payment under Power Purchase Agreement to guarantee debt service. Adjustment to concession contract terms to compensate for long term variances in hydrology.
	Declining catchment yield	<ul style="list-style-type: none"> Contractual safeguards on catchment management. Co-operation with landowners.
Operating risk	Force Majeure: major floods, earthquake, fire, tsunami	<ul style="list-style-type: none"> Force Majeure clauses in concession agreements and power purchase agreements. Insurance for non-political Force Majeure events. Engineering designs to include safeguards to reduce plant and transmission line outage risks.

This project will seek to address the abovementioned climate change risks by: a) Developing of power purchasing arrangements for community/private owned renewable generation; b) Developing Connection Agreements and policies for electrical networks (including engineering standards); b) Developing suitable business models for community owned power to preserve catchment areas.

Solomon Islands is a party to the United Nations Framework Convention on Climate Change (UNFCCC), has ratified the Kyoto Protocol,⁶ and developed a National Adaptation Program for Adaptation (NAPA) to climate change.⁷ In addition, a recent report by the World Bank has: i) reviewed the extent to which disaster risk reduction (DRR) and climate change adaptation (CCA) activities have progressed in Solomon Islands; ii) identified gaps or impediments hindering the achievement of Hyogo Framework for Action (HFA) 2005-2015 principles; and (iv) identified opportunities for future DRR/CCA investment that would be timely, cost-effective, and implementable within a three-year timeframe.⁸

Country and Sector Background

Like other Pacific Island states, Solomon Islands faces complex development challenges stemming largely from its small, sparsely distributed population, its remoteness and limited connectivity to internal and external markets, and political instability. The population of Solomon Islands (515,870 according to the 2009 census) is spread over 300 islands, with 80% of the population living in rural communities that are geographically isolated from each other. There are few roads on most of the Solomon Islands, limited commercial shipping between islands, and air transportation is unaffordable for most citizens.

⁶ SIG 2001, “Solomon Islands - UNFCCC National Communication”, <http://www.sids2014.org/content/documents/152UNFCCC%20Nat%20Comm.pdf>

⁷ SIG 2008, “Solomon Islands - National Action Plan for Disaster Risk Reduction and Climate Change Adaption”, Ministry of Environment, Conservation and Meteorology, Solomon Islands Government (SIG), Honiara, November 2008. (URL <http://www.sids2014.org/content/documents/149Disaster%20Management%20Strategy>).

⁸ World Bank 2010, “Reducing the Risk of Disasters and Climate Variability in the Pacific Islands: Solomon Islands Country Assessment”, World Bank, GFFDR & GEF, Washington DC. (URL <http://www.sids2014.org/content/documents/149Disaster%20Management%20Strategy.pdf>)

Solomon Islands is a fragile, post-conflict, country in which it is often difficult to mobilize political decision makers to focus on the development and implementation of long-term policy objectives such as rural electrification. Political instability results in frequent changes in government, as shifting political coalitions form, break-up and new coalition governments are established.

The combination of geography, institutional capacity constraints and the political instability of Solomon Islands has resulted in weak economic growth and poor access to energy. Access to modern energy services in Solomon Islands is among the lowest in the Pacific Islands (see Table 2).

Table 2: National electrification rates of Pacific Island states, 2005

Electrification rate	Countries
>90%	Niue, Cook Islands, Nauru, Palau, Tonga, Samoa, Tuvalu and Tokelau.
50 – 80 %	Fiji, Republic of Marshall Islands (RMI), Kiribati, and Federated States of Micronesia (FSM).
<25%	Papua New Guinea (PNG), Solomon Islands, and Vanuatu.

Source: UNDP 2007 “Energy & Poverty in the Pacific Island Countries: Challenges and the Way Forward” Regional Energy Programme for Poverty Reduction, UNDP Regional Centre, Bangkok.

According to the 2009 Census of Solomon Islands, 79 percent of households are without access to any electrical supply. Grid-based electricity is confined to the capital city and largest electrical load center, Honiara, and nine provincial centers. In Honiara, 67 percent of households have access to electricity, with 96 percent of these households having access via the SIEA’s distribution grid (refer Annex B).

But in the provinces taken as a whole, access to any electricity supply is only 16 percent, with 6 percent being connected via traditional power grids serving the small provincial capitals, 9 percent from solar PV systems and around 1 percent from individually owned petrol or diesel generators. At a provincial level, the electricity access rate for grid power is highest in Western Province 12.1%, but access rates in the remaining provinces are extremely low; for example, Malaita 3%, Temotu 3%, Choiseul 2%.

There is a distinct urban-rural division. In the rural areas of the provinces, more than 95 percent (56,000) of rural households are without any electricity service. Those 5 per cent of rural households that do have access to electricity get it through a small number of off-grid and individual household solar and diesel systems.

The existing electricity grid-based systems are confined to a few towns across the country and operated by- the state-owned power utility, the Solomon Islands Electricity Authority (SIEA). These grids have not expanded significantly since Solomon Islands became independent in 1978.

SIEA is the corporatized public utility responsible for electric power supply and distribution in the capital, Honiara, and nine provincial centers: Auki, Buala, Gizo, Kirakira, Lata, Ma’alu, Munda, Noro, Tulagi. Box 1 outlines the constitution and functions of the SIEA.

Outside of these grid-based systems, electricity is provided by small-scale stand-alone diesel-fueled generators and solar PV systems. These standalone power systems serve individual households, health clinics and schools.

Grid based electricity production of 74 GWh in 2011 was sourced 100% from diesel fuel, with 90% of that in the capital city and only 10% on the nine provincial grids.⁹ SIEA’s two micro-hydro power stations at Buala (150kW) and Malu’u (36kW) have both been out of service, respectively, since December 2007 and February 2009. While the SIEA did undertake a small scale trial in 2012 of the use coconut oil biofuel in its diesel generators at Auki, and is investigating possible increases in the use of this biofuel, the volume of diesel displaced was small because: (i) only one of three generation units at Auki was used for the trial; and (ii) the energy output of entire Auki power station accounts for approximately 2% of the SIEA’s overall annual generation.

⁹ SIEA 2013, *SIEA Annual Report 2012*, Solomon Islands Electricity Authority, Honiara.

While Solomon Islands has abundant renewable energy resources, especially hydro and solar, these have not been effectively exploited over the last 50 years, as reflected in the country's access to electricity data and electricity consumption figures. The reasons for this lack of renewable energy development include: a) regulatory arrangements that are antiquated and do not provide an enabling environment for renewable energy; b) difficult land acquisition arrangements, involving both Customary Laws and practices and legislated requirements under the *Lands and Titles Act* that have resulted in long drawn out negotiations for proposed major hydro projects. Very long land acquisition processes were one the main reasons why the proposed Komarindi Hydro project (8 MW, 45GWh per year energy), devised in the period 1988-1991, failed to proceed. That project's detailed design was completed in 1991 and pre-registration of engineering contractors occurred, but the landowner agreement was not finalized until March 1996 — by which time key a key co-financier had cancelled a grant and interest in the project had cooled; d) the civil conflict in Solomon Islands in the period 1998 to 2003, which was influenced by ethnic differences, political power, landownership, economic opportunity and control of land related resource rents; e) a lack of suitable business models for community owned renewable energy projects; f) until 2011, the SIEA being in very poor financial shape and hence an unattractive and risky off-taker for private sector investors seeking to enter into renewable energy PPAs; g) high costs associated with developing renewable energy projects in a geographically remote Pacific Island state. Changes over the last 5 years have gone some way towards addressing f), but most of the others remain significant challenges that remain to be addressed. This project supports that, and has, for example been a key factor in the dramatic improvement in the performance of the SIEA.

The Solomon Islands highly aspirational target of 50% of electricity generation from renewables by 2015 will not be met because two alternative and competing large grid connected renewable projects will not be completed by then. Delays in the finalization of the Tina River Hydro project feasibility study mean that, at best that project will be commissioned in 2017. Similarly, the reported development timeframe for the Savo Geothermal project of three years to commissioning in 2017 is ambitious, especially given that the geothermal resource has not yet been proven through geotechnical drilling and a feasibility study. After feasibility studies are completed, environmental and social safeguards assessments and frameworks will have to be put in place, land acquisition completed (a significant risk in Solomon Islands), developer's selected, financial closure reached, construction commenced and completed, and commissioning take place.

Due to the reliance on diesel generation, power tariffs in Solomon Islands are relatively high. SIEA charges a national uniform tariff, which in 2010 was US\$0.59c/kWh to residential customers and US\$0.63/kWh to commercial customers. Due to the high cost of transporting diesel to the outstations, generation costs in the outer islands are considerably higher than in Honiara (US\$0.53/kWh in Honiara compared to US\$0.94/kWh in Lata).

Existing off-grid renewable energy projects in Solomon Islands include a range of household solar system programs and a small number of community based pico-hydropower schemes operating in remote villages. Wind monitoring is also proposed at target sites. Grid connected renewable energy is limited to mini-hydropower at Buala and Malu'u, and an SIEA trial to replace diesel with coconut oil in the second largest outstation (Auki, Malaita).

There are two potentially large renewable energy projects that are currently being investigated in Solomon Islands, both of which could displace most of the energy currently supplied by diesel fueled generators to the Honiara power grid, which accounts for around 90% of Solomon Islands' power consumption. First, the Tina River Hydropower Project (15 to 20 MW) is currently being prepared to supply the Honiara grid on Guadalcanal, with support of the World Bank, Australia, and European Investment Bank (EIB). Second, significant geothermal power potential has been identified on Savo Island, an extinct volcano around 35 km offshore and northwest of Honiara. Preliminary investigations, during 2012, of Savo Island's geothermal potential indicate that around 20 to 40 MW of electricity generation capacity could be available; and could be provided to Guadalcanal via a sub-sea DC cable. Further investigations of Savo Island's geothermal potential are planned during 2014, with the objective of proving up the geothermal resource and finalizing a feasibility study. The work on Savo Island is

being carried out by a private consortium, led by Geodynamics Ltd,¹⁰ a company listed on the Australian Stock Exchange.

The development of either (or both) the Tina River Hydropower Project or Savo Island Geothermal has the potential to transform the power sector in Solomon Islands, from being almost completely reliant on fossil fuels to being virtually 100% from renewable energy. Such a transformation would also reduce the cost of electricity by increasing its affordability and thereby contribute to the scaling up of access to electricity across the nation.

A key part of the project is seeking to understand the potential impact these development could have on energy prices in Solomon Islands, energy affordability, and the ability to increase access to modern energy services.

This application seeks the GEF's support in promoting market approaches for renewable energy (CC3) by: a) through the development of enabling policies, regulations and frameworks that facilitate on-grid renewable energy ; b) having the state owned power utility contract out the rehabilitation of an existing hydro power plant. GEF support is vital to achieving these objectives because in the absence of such support, the thin and weak capacity in Solomon Islands is likely to struggle to implement the necessary policy and regulatory reforms and to do so successfully. The World Bank Group has played a central role in reforming the energy sector in Solomon Islands in the period since 2005, and has tailored this proposal to address some key issues in the Solomon Islands energy sector. This proposal seeks to harness additional resources for a successful project in order to bring global knowledge, combined with an understanding of local conditions, to tailor fit-for-purpose solutions that support Solomon Islands developing its renewable energy resources.

Box 1: SIEA Constitution and Functions

- The SIEA was established under the *Electricity Act 1969* (Cap 128) and began operating January 1, 1969.
- The powers and duties of the SIEA under the *Electricity Act* are:
 - To establish, manage and operate electric power systems;
 - To secure the cost of electricity at reasonable prices;
 - To promote and encourage the generation of electricity with a view to the economic development of Solomon Islands; and
 - To ensure that there are adequate standards of safety, efficiency and economy in respect of the production, transmission and distribution of electricity.
- The SIEA is also governed by the requirements of the *State Owned Enterprises Act 2007*.
- The Authority is entrusted with: enforcing the *Electricity Act* and regulations, setting standards, examining and registering electricians; and is empowered to approve and license independent power producers (IPP).
- The electricity tariffs of the SIEA are regulated by the *Electricity Tariff (Automatic Base Tariff and Fuel Tariff Adjustment) Regulations 2005*. Under this regulation electricity tariffs are adjusted every quarter, principally to account for fluctuations in the petroleum fuel price.
- Since February 2010, the members of SIEA's Board are appointed under the *State Owned Enterprises Regulations 2010* (which sit under the *State Owned Enterprises Act 2007*). The Regulations seek to improve corporate governance of State Owned Enterprises (SOEs) and the professional expertise, quality and calibre of SOE Boards.

Other contributing factors to the low level of rural electrification in Solomon Islands include:

1. Policy and Institutional constraints:
 - a) Low and thin capacity within both the Ministry of Energy and the SIEA to develop a national electrification plan and to implement it.
 - b) A weak institutional and policy framework to address poverty/hardship alleviation through energy access. While a high-level national energy policy has been endorsed by the government of Solomon Islands, few steps have been taken to implement it. The

¹⁰ <http://www.geodynamics.com.au/home.aspx>

Ministry of Energy has few resources and staff, and the fragile political situation in Solomon Islands results in frequent changes in government. A cross-party and long term political commitment is required to effectively implement rural electrification and energy sector reforms.

2. Economic constraints:
 - a) Much of the population lives in rural areas, works in subsistence agriculture, and is not well integrated into the cash economy.
 - b) The cost of grid-based electricity is very high and is unaffordable for most rural households and many urban households. The high electricity price has arisen because of the near 100% reliance on fossil fuels for power generation, high costs of service due to remoteness and scale, and operational inefficiency as reflected in the high level of non-technical losses.
 - c) While the SIEA is now taking positive steps to improve efficiency and reduce non-technical losses (15-17% of power generated in 2010), it is still faced with high fuel costs, particularly for provincial grids away from Honiara. These generation costs are typically higher than the amount that can be recovered via the national uniform tariff, so there is little incentive for the SIEA to seek to extend its existing power networks; particularly in cases where rural households have low energy demands and where new connections results in financial losses to the utility that can't be fully recovered through a combination of implicit cross-subsidies in the uniform tariff or via explicit subsidies, such as Community Service Obligation (CSO) payments.
3. Financial constraints: Over many years until 2012, either capital constraints or the poor financial performance of the SIEA meant that was not been able to finance extensions to peri-urban areas close its existing grids, let alone contemplate long-term systems planning and investments. Instead, the Solomon Islands government and SIEA have largely depended on donor technical assistance for planning energy infrastructure capacity expansion and for investment finance.

Positives for increasing access and the use of renewable energy

There are three strong positives in Solomon Islands that would contribute to increasing access to electricity using renewable energy.

Firstly, the Solomon Islands has good renewable energy endowments (solar, hydro, and coconut oil and potentially geothermal) and considerable energy efficiency potential. The high solar insolation rates mean that solar PV is a viable option in most parts of the nation. There are also significant hydro resources, with at least 300 MW of small-scale hydro potential identified across seven of the islands. Coconut oil production is well established and local experience has verified its use as a diesel substitute in generators. Initial investigations in 2012 of geothermal potential on Savo Island, an old volcano 14km offshore from Guadalcanal, estimates between 20 – 40 MV of geothermal might be possible. Hence, renewable energy technologies have potential to become the least-cost option for increasing access to modern energy services. Given that much of the power is consumed in Honiara the proposed Tina River Hydro and/or Savo geothermal project also offer the prospect of a major shift towards renewable energy displacing diesel as the main source of electricity in Solomon Islands for the capital city and main load center, Honiara, and especially for households in remote communities of the Solomon Islands.

Investment in solar PV, small scale hydro and fuel switching has the potential to avoid much of the expenditure of households and enterprises on kerosene and dry-cell batteries for lighting, and on diesel.

Secondly, the IDA-sponsored Sustainable Energy Project (SISEP) is making some positive progress in improving the management, financial and operational performance of the SIEA. Over the last year, particularly since September 2011, there has been a substantial improvement in the operations and performance of the SIEA, which can be attributed to actions taken by the SIEA that have been supported by the IDA-sponsored Sustainable Energy Project.

The long-term sustainability of the SIEA is critical to the provision and extension electricity services across the country because: a) it is the repository for most of the country's power systems knowledge; b) it would likely be the main source of skilled electricians, linesmen, engineers, and possibly private energy service entrepreneurs; c) it could be the main off-taker of power injected into grids; and d) one of the SIEA's objectives under the *Electricity Act* is to increase access to electricity.

The recent improvement in the SIEA's performance and its shift away from a constant state of crises is now allowing consideration of a number of strategic issues to be examined, including: a) review of electricity tariffs; b) long term power system planning; c) improving energy efficiency; d) increased use of renewable energy; e) grid extensions; and f) ways in which the private sector can play a greater role in providing energy services, especially through the use of small scale, grid-connected, renewable power generation.

Thirdly, international experience shows that the development of entrepreneurial private sector and community based energy service providers can greatly contribute to rural electrification, when there is a clear regulatory environment and a well-structured government policy and strategy in place.

The Issue

Remote energy systems in Solomon Islands require localized expertise for on-going Operations and Maintenance (O&M). Localized capacity building and ownership of energy systems offers a significant opportunity for sustainability, due to the geography of Solomon Islands and the subsequent limited access to fast and efficient transportation.

However, there are four critical constraints to building localized capacity and developing sustainable organizations that provide energy to the bulk of the population who live in rural areas of Solomon Islands:

1. The existing electricity tariff structure;
2. Shortcomings in legal and regulatory arrangements governing the energy sector, particularly the absence of: a) a streamlined and transparent approval process for Independent Power Producers (IPPs); b) standardized Connection Agreements (CA) and Power Purchase Agreements (PPA) for small scale independent power producers seeking to connect to existing grids and mini-grids, or to develop new mini-grids;
3. A lack of understanding of the range of sustainable business models for community scale power services that could work in rural areas of the Solomon Islands and how these can be effectively implemented; and
4. Weaknesses in the capacity of local communities and/or the SIEA to sustainably operate and maintain existing renewable energy schemes.

Each constraint is discussed further below.

1) The existing electricity tariff structure

Solomon Islands electricity tariffs:

1. Have costs that are dominated by the Honiara electricity network, which accounts for over 80% of the electricity generated and consumed nationally. All the power for the Honiara grid is generated from diesel, like most of the other islanded grids operated by the SIEA.
2. Comprise a non-fuel and fuel component. The non-fuel component is adjusted annually taking into account changes in the SIEA's asset base and the Consumer Price Index (CPI). The fuel component of the electricity tariff is adjusted quarterly and follows changes in the landed cost of petroleum fuels.
3. Have a simple two-part structure that arguably lacks incentives for efficient use (e.g. time of day pricing).
4. Are nationally uniform and do not reflect the differing location-specific costs of power generation and distribution. The imposition of a policy of nationally uniform pricing creates internal cross subsidies between different classes of customers and different parts of the country and creates a disconnection between the cost of generation at a location and the price

paid by customers there. As such, the uniform price can create inefficiencies in the consumption and production of electricity in the short-term and distort long term investment planning; in both cases resulting in economic inefficiencies.

5. Are high by international standards, and by the standards of other Pacific Islands that rely on diesel for power generation. Part of the explanation of this high price in Solomon Islands is: a) the tariff is adjusted with CPI and there has been a relatively high inflation rate in Solomon Islands; b) the sustained high cost of diesel fuel since 2002.

The existing tariff structure also: 1) lacks clarity around how small-scale, grid-connected, renewable generation is to be priced; and 2) appears to be a contributing factor in power system planning being distorted towards fossil fueled generation, despite the abundance of renewable resources in Solomon Islands.

However, it is questionable whether the existing tariff structure provides sufficient revenue for sustainable operations and maintenance, and ongoing investment. In the past, the SIEA has had an inadequate program of asset maintenance and would delay scheduled maintenance and overhauls if its cash-flows only allowed it to purchase fuel and lubricants (which account for between 60 and 80% of operating costs); particularly when oil prices were very high and a number of its largest customers had not paid their bills. Planned maintenance was also often delayed due to a lack of reserve capacity. For many years, when scheduled maintenance is carried out in Honiara, there is planned power rationing; but brownouts can and do occur regularly during these times. When there are forced outages of equipment, the lights go out in parts of the capital city, Honiara. The same thing occurs on some of the SIEA's smaller networks, but these are less affected by a lack of reserve generation capacity than is Honiara.

The SIEA has taken steps to improve its operations and maintenance programs and is seeking to increase the level of reserve capacity. This requires substantial new investment. The SIEA is now seeking to finance this new investment using a combination of equity from its own balance sheet and debt; rather than relying solely on donor grant financing.

Both the SIEA and Solomon Islands government have sought technical assistance from the World Bank with: i) the evaluation of the existing electricity tariff structure; ii) the design of new tariffs; iii) assessment of whether the tariffs promote efficiencies in the short, medium and long term; and iv) provide sufficient revenues for long-term sustainability.

It is sensible that any such a review of the electricity tariffs is done as part of SISEP because the setting of new tariffs is critical to the objectives of: a) improving the efficiency and affordability of energy usage through a shift to lower-cost, renewable sources of electricity, compared to expensive liquid petroleum products; b) promoting efficient long-term supply of electricity through efficient O&M and investment; c) providing sufficient returns for the sustainable long-term operation of the SIEA; d) providing a sensible framework for negotiating power purchase prices between the SIEA and IPPs.

2) Lack of standardized connection agreement and power purchase templates for small scale independent power producers seeking to connect to existing grids and mini-grids or develop new mini-grids.

At present in the Solomon Islands, there is a lack of clearly defined and workable processes for seeking connection of small-scale generators to existing electricity grids/mini-grids or to develop new mini-grids that are independent of or interconnected to those of the SIEA. The SIEA has some regulatory and safety functions and is empowered under the *Electricity Act* to issue generation licenses to IPPs and companies wishing to set up and operate independent mini-grids; but each such application is treated on a one-by-one basis by the SIEA, with a process that is not well understood or necessarily always followed in practice. This has led to misunderstandings between the SIEA and various small scale IPP proponents about: a) license application and approval procedures; b) technical and other information needed to assess a proposal; c) connection standards and protection equipment; d) roles and responsibilities of network owner and party seeking to connect to network; d) division of commercial risks and liabilities;

e) sharing of costs associated with connection, particularly associated network strengthening costs upstream of the connection point.

The difficulties that currently arise around licensing, connection, and PPA negotiations are considered to be a significant barrier to entry by IPPs in the Solomon Islands. The development of a clear process for small scale IPPs to connect to existing grids or develop new mini-grids, together with standardized templates for connection of small scale IPPs and a related standardized PPA template would greatly help to streamline and shorten the process, and reduce the potential for disputes between the SIEA and IPP proponents. This in turn would help facilitate greater electrification across the nation. The SIEA strongly supports this TA activity and sees a range of benefits from it, both for it and for IPP proponents.

3) A poor understanding of what could constitute workable business models for community scale power services.

There has been mixed results with the different business models used for small-scale electricity generation in rural areas of Solomon Islands; particularly in the case with micro-hydropower, which is one of the most abundant renewable resources in the Solomon Islands.

Hydro-based village electrification schemes were first set up in Solomon Islands in 1983. The first of these was a micro-hydro scheme at Iriri village, a small community about 45 minutes by power boat from Gizo, the provincial capital of Western Province.

The existing micro-hydro schemes in Solomon Islands have been developed in two ways: 1) by villagers with the support of NGOs or private entrepreneurs; and 2) using donor aid (bilateral).

In the case of NGO and entrepreneur supported micro-hydro, the philosophy has been to: a) use simple designs that are constructed, as much as possible, using local materials and labour; b) having strong community ownership via the creation of village committees that are responsible for the operation and maintenance of the hydropower systems; and c) use basic imported technology for electrical and mechanical equipment, and controls, that can be readily supported and maintained in remote parts of the Solomon Islands using in-country resources.

In projects that have been funded using donor aid, such as Malu'u and Buala, the approach has been to: a) design projects to international standards; b) have projects constructed using imported equipment and labour for engineering and civil works; c) use imported electrical, mechanical and control equipment; d) have the SIEA operate and maintain the scheme. In the case of Buala, the SIEA found the maintenance of relatively advanced hydro-electric control equipment in a remote location to be difficult due to: a) the limited financial resources of the utility; and b) the utility's thin capacity and expertise in operating and maintaining hydro-electric generators relative to its knowledge and experience with diesel-fuelled generators.

While there have been a number of successes using both approaches, other projects have run into difficulties that have adversely affected their long term sustainability.

On small scale rural energy projects that have encountered difficulties, there is often a combination of three critical factors at work:

1. Limited technical capacity in rural areas regarding the technical operation and maintenance of equipment;
2. Shortcomings in the development or application of sustainable business models and plans. The absence of a sustainable business plan often results in inadequate financing of equipment maintenance over time, which eventually result in the breakdown of equipment. Some communal trust funds for equipment maintenance have been inadequately funded through tariffs or have been used for other purposes. Due to its poor financial performance in the period 1997 to 2011, the SIEA has for many years lacked the financial resources to adequately maintain its generation equipment and has tended to focus its maintenance budget and human resources on thermal generation, which its mechanics and engineers are familiar

with and which serve larger populations than that served by the two micro-hydro plants it operates;

3. Disputes among landowners concerning the size and sharing of benefits arising from micro-hydro schemes located on their communal land.

While bilateral and multilateral development agencies — including GTZ (Germany), AusAid (Australia), New Zealand, JICA (Japan), UNDP, Asian Development Bank (ADB), and World Bank — have all funded a range of renewable energy resource assessments and pre-feasibility studies; up until 2006 there had been very little evaluation of what would constitute workable and sustainable business models for rural energy service companies (RESCOs) in Solomon Islands.

Expansion of private and community power supply: 2006 Review of Electricity Act & Regulations

A 2006 report by consultancy firm, Maunsell (now AECOM), reviewed the electricity sector regulations in Solomon Islands and outlined a number of important steps that could facilitate the expansion of private and community based power supplies.¹¹ Maunsell's 2006 report found that reform of the existing legal framework is needed. Many of the key laws are old and reflect that at the time they were drafted rural electrification was not a Government priority. In particular, the existing *Electricity Act* deals primarily with urban grid electrification based on a state-owned utility model. A broader framework is needed to support rural electrification delivery models based on state, private and community ownership. It must also facilitate the development and exploitation of local renewable energy sources for rural electricity supplies.

The review focused on what adjustments to the existing legal and regulatory framework were needed to allow for increased rural electrification, funded either by the private sector or by donor agencies.

The 2006 Maunsell report:

1. Reviewed the existing regulatory framework for rural electrification in the Solomon Islands;
2. Developed a framework for financing rural electrification programs;
3. Developed a rural electricity infrastructure quality standard for the Solomon Islands;
4. Developed a public-private partnership model to expedite the provision of electricity into rural areas; and
5. Made recommendations to update the *Electricity Act* and subsidiary electricity regulations.

Reforms to the *Electricity Act* were recommended “to permit grid extension and off-grid (mini-, micro- and pico-systems) development using implementation and financing options based on state, private and community ownership using the following [business] models:

- **Utility service delivery model**, in which SIEA retails electricity to consumers connected to one of its grids;
- **Rural Electrification Service Company (RESCO) service delivery model**, in which a developer retails electricity to consumers connected to a grid extension or a mini-grid it has developed within its licence area;
- **Community-based service delivery model**, in which a community develops an electrification system and supplies electricity on a non-profit basis;
- **Direct purchase model**, in which villagers purchase pico-systems (primarily solar PV) to electrify their households.”¹²

“These [business] models should be regarded in a dynamic light. Rural electrification systems will grow, merge and change their form over time. Whether an expanding SIEA grid overtakes private or community mini-grid systems, or whether adjacent mini-grids coalesce to form larger grids, the legal

¹¹ Maunsell 2006, “Review of Solomon Islands Electricity Act and Rural Electrification Framework”, Final Report, Prepared for Pacific Islands Energy Policy and Strategic Action Planning (PIEPSAP) and Solomon Islands Department of Energy, Prepared by Maunsell Limited, Auckland, November 2006.

¹² Maunsell 2006, p. ii.

rights of parties affected by these changes should be defined in the *Electricity Act* and clear procedures specified to give clarity and certainty to the growth and evolution of rural electrification systems. The option of the State resuming private systems and putting them in public hands should be considered. This may be the most effective way of integrating adjacent and overlapping systems so that economies of scale can be captured for the benefit of consumers.”¹³

To date, none of the recommended legal and regulatory reforms has yet been implemented by the Solomon Islands Government, due to a combination of frequent changes in government, financial constraints and capacity constraints. In addition, the government has focused its attention on trying to turn-around the performance of the SIEA, which is prerequisite for its attempts to develop the 15 to 20 MW Tina River hydropower scheme to serve Honiara that would dramatically improve energy affordability across the country.

The small increase in the electrification rate that has occurred in Solomon Islands since 2006 has come primarily from five sources: a) gifts of household solar PV systems from development partners, in particular from Taiwan; b) donor, NGO and missionary sponsored larger scale solar PV systems for schools and clinics, some with mini-grids; c) direct purchase of household solar PV systems by villagers; d) RESCO's providing solar home systems to villagers; and e) RESCO-Village partnerships to develop micro-hydro power and micro grids.

The government is committed to increase the level of access to modern energy services and sees merit in increased private sector, community-based and household power projects. This commitment is reflected in: a) the policy platform of the current government; b) the *National Energy Policy Framework of 2007*;¹⁴ c) the *National Development Strategy 2011-2020*;¹⁵ and d) in the *Solomon Islands Rural Electrification Policy 1996*.¹⁶

However, progress at increasing access to electricity has been very slow, and the poor financial state of the SIEA from 2006 to late 2011 meant that the national utility was not in a position to finance grid extensions.

The challenge for the government and country is having better tools to scale up and replicate proven successful business models that can be workable in the context of the Solomon Islands.

4) Weaknesses in the capacity of local communities and/or the SIEA to sustainably operate and maintain existing renewable energy schemes.

As discussed above, these weaknesses can arise from of combination of: a) limited technical capacity in rural areas; b) inadequate financing of equipment maintenance over time; and c) disputes among landowners.

Illustrative of this are the Malu'u and Buala micro-hydro schemes, which were built on communally owned land using development aid; then operated and maintained by the SIEA. As a result, both the Malu'u and Buala micro-hydro scheme have been inoperative for several years.

Malu'u micro-hydro: The 36kW scheme at Malu'u in Maliata province, commissioned in 1986, has not operated since February 2009 due to range of technical problems and disputes within the community on whose land the scheme is located.

¹³ Maunsell 2006, p. ii.

¹⁴ Solomon Islands Government 2007, “National Energy Policy Framework”, Energy Division, Ministry of Mines and Energy, Honiara.

¹⁵ Solomon Islands Government (SIG) 2011, “National Development Strategy 2011-2020”, Ministry of Development Planning and Aid Coordination, Honiara, July 2011.

¹⁶ SIG Ministry of Energy, Water & Mineral Resources 1996, "Solomon Islands Rural Electrification Policy", Prepared by Energy Division/Mini Hydro Resource Centre, Under the Assistance of the GTZ/SI Ministry of Energy Joint Programme: "Improvement of Rural Electricity Supplies in the Solomon Islands", Honiara, January 1996.

Buala micro-hydro: The 150kW micro-hydro scheme at Buala, near the town of Jejevo in Santa Isabel province, was commissioned in 1996 but has not operated since December 2007 because of a range of technical issues that the SIEA has not been able to resolve.

In both cases, as a result of these schemes being inoperative, the SIEA has substituted energy generated from diesel engines for that which would otherwise have been produced by the micro-hydro schemes. This has resulted in a much higher cost of generation at these locations than would otherwise be the case if the micro-hydro systems had been operational.

This additional cost of diesel generation at Malu'u and Buala exceeds the revenues that can be recovered via the nationally uniform electricity tariff; and the resulting shortfall has either been carried as a financial loss to the SIEA arising from servicing these communities or, since 2010, by the taxpayers of Solomon Islands via a Community Service Obligation (CSO) payment from the government to the SIEA. The CSO is a public subsidy to the SIEA for serving remote communities.

In contrast, six out of the seven community-owned micro-hydro schemes in Solomon Islands are operational. Table 3 lists both the currently installed and decommissioned micro-hydro schemes in Solomon Islands. The locations of these micro-hydro schemes are shown in Figure 1.

Table 3: Micro-hydroelectric systems in Solomon Islands as at October 2010

Year built	Site	Ownership	Turbine & manufacturer	Typical output	Status (October 2010)
1973	Atoifi	Adventist Hospital	Pelton -Gilkes	30kW	Decommissioned. Ceased operation circa 1980.
1986			Pelton - Hydro Systems	36kW	Under repair
1983	Irii	Community	Pelton -Apace	3kW	Decommissioned. Ceased operation 1997.
1984	Malu'u (Manakwai)	SIEA	Crossflow - SKAT	16kW	Suspended (Land & technical issues)
1993	Vavanga	Community	Crossflow -Apace	2kW	Decommissioned. Ceased operation 2001
2004			Pelton -Pelena	8kW	Operating
1995	Manawai	Community	Pelton -Canyon	16kW	Operating
1996	Buala (Jejevo)	SIEA	Pelton -Andritz	150kW	Suspended (Technical issues)
1999	Bulelavata	Community	Crossflow -Pelena	24kW	Operating
2003	Raea'o	Community	Pelton -Pelena	30kW	Operating
2004	Nariao'a	Community	Pelton -Pelena	30kW	Operating
2010	Masupa	Community	Pelton -Pelena	40kW	Operating

Source: Peter D. Lynch 2010, "Micro-hydroelectricity in Solomon Islands – Current Status October 2010", paper presented to Symposium on Renewable Energy Technologies, Fiji National University, Suva, 7 October 2010.

Why has community based micro-hydro worked well in Solomon Islands?

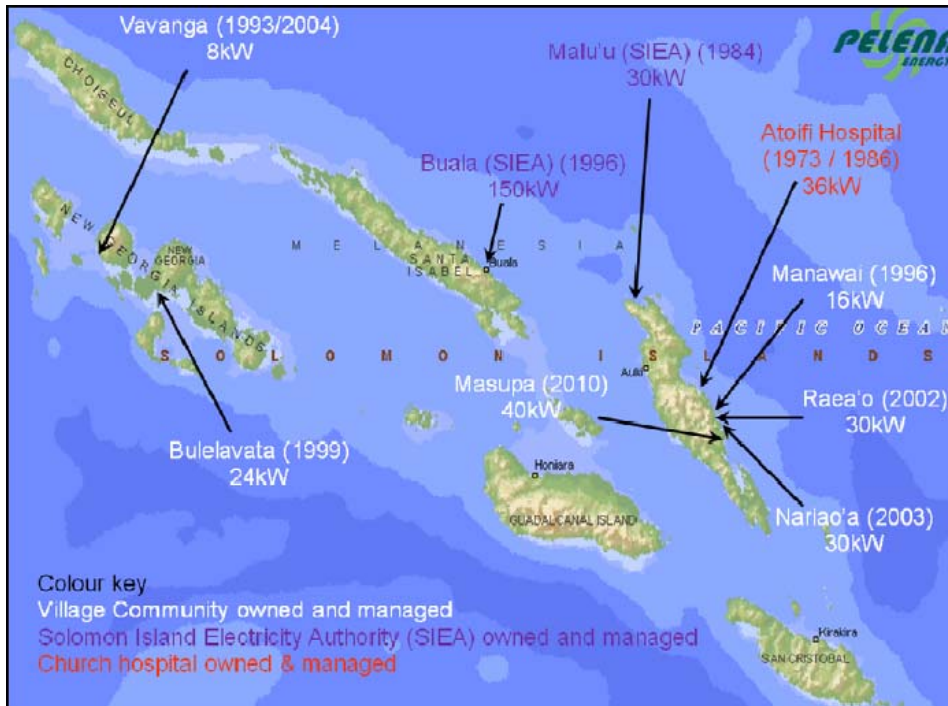
The relative success of the community based micro-hydro schemes versus those that are donor funded and managed by the SIEA appears to be due to six features:

- a) a strong sense of community ownership in the schemes and the benefits they provide in terms of energy services and income generation;
- b) the fact that electricity prices for these schemes are set outside the National Uniform Tariff, taking into account the long run costs of the scheme and capacity of the community to pay;
- c) the schemes have been effectively operated and maintained by trained local technicians familiar with micro-hydro and the specifics of each scheme;
- d) most schemes are run along commercial lines, with adequate provision for O&M, depreciation, and the purchase of spare parts, and a return on investment;
- e) the mechanical and electrical equipment and controllers are simple, robust and readily repaired in remote locations; and
- f) technical support and spare parts for the schemes are available within Solomon Islands through a local privately owned, for-profit, RESCO, Pelena Energy Solomon Islands. This

RESCO is in turn backed up by the original equipment supplier, Pelena Energy, which is located in nearby Australia.

These six features should inform the development of a suitable framework for community and privately owned small scale generation that enables long-run sustainable operation of renewable energy schemes in Solomon Islands.

Figure 1: Micro-hydroelectric systems in Solomon Islands as at October 2010



Source: Lynch 2010

How the Project seeks to address the issues

This GEF-sponsored project seeks to address the four abovementioned constraints that adversely affect the sustainable development and operation of renewable energy schemes in rural areas of Solomon Islands.

The GEF financing will be embedded as additional, trust fund co-financing to the existing IDA-sponsored Sustainable Energy Project (SISEP) and is to contribute to new activities that fall under two of the three high level components of SISEP. In addition \$1 million in new co-financing of SISEP has been secured from Australia (AusAID).

It is proposed that US\$900,000 in GEF funds (exclusive of project management costs) be used to fully finance three new activities in SISEP:

1. Tariff Review (US\$300,000);
2. Development of a suitable framework for community/private owned small scale generation:
 - a) Standardized Connection Agreements, PPAs, O&M agreements and policies (US\$130,000);
 - b) Business models for community owned power (US\$100,000).
3. Improving rural electricity supply:
 - a) Rehabilitation of the existing micro hydro scheme at Buala (US\$260,000);

- b) Strengthening the 415V mini-grid at Buala to increase quality and access to electricity services (US\$110,000).

In addition, the GEF is being asked to co-finance \$46,750 in project management of the above three activities, comprising estimated travel for consultants (\$45,000, 6 trips at \$7500 per trip) and a consultation/dissemination workshop in Honiara (\$1750).

Each of these activities is discussed further below.

1. Tariff Review

As mentioned above, electricity tariffs in Solomon Islands are regulated by the *Electricity Tariff (Automatic Base Tariff and Fuel Tariff Adjustment) Regulations 2005*. Both these tariff regulations and the SIEA's current tariff structure are dated and appear to be contributing to the very high price of electricity in Solomon Islands.

There are several reasons why reforms to the SIEA's existing electricity tariffs and the tariff adjustment mechanism are required, including:

- First, restructuring the existing tariffs could dramatically improve the affordability of electricity in Solomon Islands for poorer households; while at the same time generating sufficient revenues to sustainably operate the existing national power system, and financing much needed investments that would improve the reliability and efficiency of supply and contribute to extensions to the SIEA's existing grids.
- Second, a tariff review could clarify how small-scale grid-connected renewable generation is to be priced. In Solomon Islands, such generation would most likely be from solar PVs, micro-hydro, biofuels, or biomass. The tariff review could develop a simple pricing framework for small scale generation that feeds into the grid, or a simple 'feed-in' tariff that is based on the long-run levelized cost of power supplied.
- Third, the review could address any inherent distortions towards fossil fueled generation that the existing tariff may induce in power system planning. Increased investment in and use of renewable energy is critical to increasing the economic efficiency and affordability of electricity in Solomon Islands, as well as contributing to the operational, financial and environmental sustainability of the power sector.
- Fourth, a tariff review could provide standardized guidelines on how off-grid power might be priced so that off-grid systems can be operated and maintained in a long-run sustainable manner. These guidelines should provide flexibility in the setting of tariffs in order to allow a balance to be found between prices, subsidies, local costs, social structure, wealth, local issues and (in the case of private suppliers) profit. New electrification projects and improvements in the sustainability of existing systems would be fostered by allowing freedom to strike an appropriate balance for the particular circumstances of each village. At the same time, however, an *ad hoc* approach risks discord between villages paying different tariffs. A standardized, transparent approach to tariff determination would avoid this. A standardized approach could involve issuing (and periodically updating): a) Standardized rural electrification tariff calculation guidelines; and b) Tariff calculation templates that provide pro-forma methods of calculating tariffs using costs based on generation technology, location and other factors, as appropriate.

The proposed tariff review would include the following key elements:

1. Critically review the SIEA's existing electricity tariff structure (including energy charges, connection charges, fixed charges, other fees and penalties) and the regulatory arrangements for determining retail tariffs (i.e., establishing revenue requirements and allocating capital

and operating costs and other charges among consumer groups). Recommend changes to tariff setting regulations, if required.

2. Review and utilize (and if necessary modify) the new financial model of the SIEA's business in order to determine the average system revenue requirement for the SIEA's existing power system, comprising the Honiara grid and the nine smaller town grids on other islands (i.e. the SIEA's so-called "Outstations").
3. Model the marginal cost structure of the entire power system as a basis for recommending the structure of tariffs across consumer groups that is both economically efficient and collects required revenue determined in the financial analysis. As part of this, calculate internal cross-subsidies between customers by customer class and by location. Assess impact of existing policy of national uniform tariffs on economic efficiency, affordability of electricity, and on level of community service obligations.
4. Recommend revisions to the existing structure and level of retail tariffs which provide sufficient revenue for SIEA to remain commercially viable and earn an appropriate rate of return while supplying reliable electricity to existing consumers and funding new investment to both improve service quality and access where it is commercially viable. Assess options for and make recommendations regarding: a) Lifeline tariffs for poor households; b) incentives for efficiency in electricity supply and consumption; c) Standby charges and maximum demand tariffs; d) Feed-in tariff for small scale renewable generators; e) use of back-up generators; and f) CSO payments.
5. Develop written provisions for retail tariffs to be incorporated in legislation and regulations (as required) with new procedures for review and for automatic and periodic adjustments.

2. Development of a suitable framework for community/privately owned small scale generation to overcome existing barriers to small-scale generation projects.

Reform of the existing legal framework governing the electricity sector is needed to increase access to electricity by facilitating private-sector development of the Solomon Islands' large renewable energy potential. Many of the existing electricity sector laws are old and, at the time they were drafted in the late 1960s, rural electrification was not a Government priority. In particular, the existing *Electricity Act* deals primarily with urban grid electrification based on a state-owned utility model.

A broader framework is needed to support rural electrification delivery models based on state, private and community ownership. It must also facilitate the development and exploitation of local, renewable energy sources for rural electricity supplies.

A new framework for small-scale power generation that is privately or community owned would include: a) standardized templates for Power Purchase Agreements (PPAs), Connection Agreements; b) O&M Agreements; and c) clearer streamlined regulatory approval processes. This framework would help facilitate increased opportunities for the development of privately funded or community owned generation projects, by increasing understanding of what is required to prepare a project and by overcoming existing barriers to small-scale generation projects.

Overcoming existing barriers to small-scale generation projects

Numerous studies have shown the large potential for micro-hydro, biomass and biofuel power generation in Solomon Islands (e.g. UNIDO 1986,¹⁷ JICA 2001)¹⁸. There is also significant potential for the development of micro-grids and mini-grids fed by small scale renewable energy generation sources. In nearly all cases, most of the developments will tend be small in scale (<1000kW).

¹⁷ UNIDO "Prefeasibility studies of hydropower in the Solomon Islands and Recommendations on Priorities", Draft Final Report, July 1986.

¹⁸ JICA 2001, "Master Plan Study of Power Development in Solomon Islands", Draft Final Report, JICA, Tokyo.

However, for a variety of reasons – geographic, economic, political, financial, technical, legal and regulatory – little of this potential renewable energy has been developed. As a result, Solomon Islands has one of the lowest electrification rates in the Pacific.

A key reason for this is that the existing *Electricity Act* deals primarily with urban grid electrification based on a state-owned utility model rather than through private sector and community-based small-scale generation projects. While this approach might have made sense at the time the *Electricity Act* was drafted 44 years ago, international experience shows that private investment is a vital element in effectively implementing national electrification. The private sector can, given the appropriate policy, legal and regulatory framework, play in major role in increasing access to affordable electricity services and then operating them efficiently on a commercial and sustainable manner.

A complete overhaul of the *Electricity Act* should take place, but that is an ambitious undertaking which arguably may be best undertaken separately as part of a broader redesign of the electricity sector's laws and regulations and institutional arrangements.

The more limited objective of this project proposal is to seek to overcome four of the critical barriers that appear to be limiting the implementation of beneficial community-based or privately owned renewable energy projects in Solomon Islands.

These four barriers, which are common to both fossil fuel and renewable energy generation projects are:

1. The lack of a pricing framework and other terms and conditions of contract that can be offered for energy that is produced by renewable energy generators. Without a methodology to determine the pricing and other terms and conditions within a PPA, the revenue of a project is undetermined. It is important to work out a methodology to determine what SIEA might be willing to pay for intermittent renewable energy (and other terms and conditions of the PPA, such as the duration of the contract, escalation etc.). The pricing methodology should not be shown to outside parties, but the terms and conditions of contract other than price should be provided to potential project developers.
2. The lack of transparent rules associated with connection to the network of generators owned by IPPs. The lack of a framework for connection of IPP generators means that a Connection Agreement is difficult to negotiate with any potential developer. The risks associated with the connection of a generator (not being able to export energy to the network for example) need to be determined.
3. Project operations and maintenance arrangements. Due to the small scale of the energy projects likely to be developed in the Solomon Islands, it is unlikely that some developers will wish to retain personnel solely to operate and maintain the renewable energy projects in Solomon Islands, unless the developer is from Solomon Islands. There are two possible ways in which standardize O&M contract templates might be used. First, SIEA could provide these O&M services to energy developers, including community owned scheme, if trained SIEA personnel were made available under contract. Operations and Maintenance Agreements for different renewable energy generation types could be offered by SIEA to renewable energy generation developers. Second, these O&M contract templates could be used by the SIEA or others to engage the services of private contractors who would provide O&M services to privately owned, small scale, energy facilities.
4. Clarifying the regulatory environment for the development and the operation of generation projects in Solomon Islands. The regulatory environment for project development and operation should be available to future project developers. Streamlined processes for license applications, environmental approvals, building approvals, operational health and safety approvals, and other regulatory requirements should be prepared and documented. All the associated fees and levies, whether one-off payments or on-going, that a developer may need to pay should be disclosed.

The preparation of a new framework to overcome these four barriers would provide a transparent 'one-stop-shop' for project developers and communities seeking to develop small scale renewable power generation projects, either as stand-alone off-grid developments or grid-connected generation, or islanded

micro-grids. This framework would aim to have simple processes, accessible information and language on how small-scale renewable energy project proponents could get technical support for project development, applications and approvals.

This new framework would operate within the existing *Electricity Act*, as amended.

Business models for community owned and privately owned power supply

A report would be prepared that assesses the features of internationally successful business models for community and privately owned power supply, and how these could be adapted for Solomon Islands.

The business models would include: RESCO model, community-based service delivery model, and direct purchase model.

This report would also draw lessons from Solomon Islands own experience by:

- assessing historical, existing and proposed engagement of the private sector in the development of renewable energy projects;
- identify barriers for engagement of the private sector in provision of renewable energy, including regulatory framework, political risk, land acquisition risks, financing barriers. This would draw on other assessments, including the 2006 “Review of Solomon Islands Electricity Act and Rural Electrification Framework”; and
- reviewing lessons learned in Solomon Islands from the Sustainable Energy Financing Project (SEFP), community owned micro-hydro projects and other projects.

The report would seek to develop a range of prioritized actions and options to reduce the barriers for engagement of the private sector in provision of renewable energy, and to adapt or refine successful business models for conditions of the Solomon Islands.

3. Improving rural electricity supply using renewable energy resources

The third area that the GEF funds would be applied is improving rural electricity supplies using renewable energy resources.

It is proposed that two activities be supported:

- a) Rehabilitation of the SIEA’s existing rural micro hydro scheme at Buala (US\$260,000) so that Buala switches to having 100% of its power generated from hydropower rather than diesel; and
- b) Strengthening 415V distribution grid in Buala (US\$110,000).

A. Rehabilitation of SIEA’s micro-hydropower station at Buala

Rehabilitation of the SIEA’s 150kW micro-hydropower station at Buala is proposed, together with training of SIEA staff in the operation and maintenance of micro-hydro systems. The Buala micro-hydro scheme is the largest hydro scheme currently installed in Solomon Islands, and restoration of the scheme would significantly reduce the current cost of power generated on the island of Santa Isabel; all of which is presently sourced from diesel. The staff training would contribute to improving the operations, maintenance, efficiency and long-run sustainability of the SIEA’s micro-hydro schemes.

The 150kW Buala hydroelectric system has been inoperative since January 2008, and prior to that did not perform as well as expected in the years following its 1996 commissioning. When the hydropower unit did operate, it provided baseload, intermediate and peaking power to small distribution area; with a back-up diesel generator only dispatched when the hydro unit was out of service.

In June 2011 the SIEA began to seek an engineering assessment of the Buala hydropower system. In December 2011 an experienced hydropower engineer familiar with micro-hydro in Solomon Islands, Mr. Peter Lynch, visited the site at Buala, and his report was submitted to the SIEA in March 2012.¹⁹

The engineer's assessment report for Buala hydro found:

- “Sound engineering design principles appear to have been adopted for most, but not all, of the system. Primarily, the electrical control system for frequency, voltage, and turbine protection was inappropriate and now redundant. Access to spare parts has been difficult.”
- “According to information supplied by S.I.E.A. representatives, the hydro system had not reliably operated since its commissioning in 1996. Various attempts had been made to address faults and maintenance issues since 1996, but overall the hydro performance has been below expectation.”
- “As a general observation, the fact that the significant majority of components of the hydro system remain in good condition suggests that the hydro was designed and built to a reasonably high standard. However, it appears that the poor reliability is largely [attributable] to a lack of training, lack of access to spare parts, and failures of specialised proprietary electrical and electronic componentry.”
- “Reports from local operators plus SIEA staff associated with the original commissioning in 1996 indicated that the control system has never operated as intended. The control system appears to be a combination of a proprietary hydroelectric controller by Sulzer coupled with a standard alternator Automatic Voltage Regulator (AVR) with inputs being: i) Headpond tank level; ii) Proximity switch on alternator shaft for speed measurement; iii) Voltage, frequency, and electrical current measurements. Output control appears to have been achieved by a combination of: i) Fast-acting electrical resistive load bank or ‘dummy load’ of a size unknown but significantly less than system rating; ii) Slow-acting oil hydraulic spear valve; iii) Possibly a medium speed oil-hydraulic jet deflector; iv) Standard Automatic Voltage Regulator (AVR).”
- “...the originally installed control system is excessively complex with too many interrelated input and output devices such that the overall reliability of the system has been compromised.”

The engineer's report recommended:

1. That a full refurbishment of the Buala hydropower system be undertaken, focusing primarily on the turbine house control system & turbine/alternator protection.
2. Repairs and maintenance be carried out on a number of civil components including a penstock pipe leakage, penstock pipe bridge repair, headpond cement mortar works, and Powerhouse re-painting.
3. A new frequency, voltage, and turbine control system be installed that is locally supportable in Solomon Islands.
4. A least six technicians from the SIEA's two micro-hydro sites of Buala & Malu'u attend an intensive two-week hydro training course in conjunction with other trainees from Solomon Islands hydro systems.

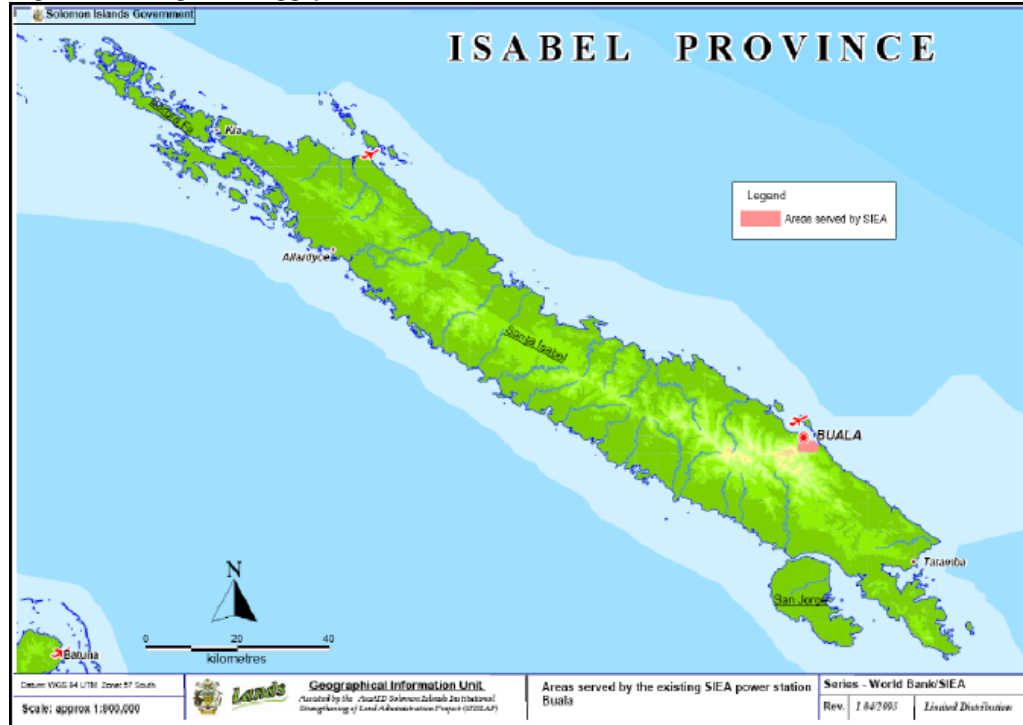
The engineer estimated the cost of this refurbishment to be AUD 253,400 (approximately US\$ 260,000), which includes the costs of three trainees from Buala attending an intensive hydro training course in Australia.

Background – power supply in Buala

¹⁹ Lynch, Peter 2012, ‘Buala Mini-hydroelectric System, Santa Isabel Island, Solomon Islands: December 2011 Site Visit Report & Refurbishment Estimation’, report by Peter Lynch (Pelena Energy) to Solomon Islands Electricity Authority, Document reference 148A-R-001A, 11 March 2012.

The only grid supply power on the island of Santa Isabel is for the provincial capital of Buala (see Figures 2 and 3). Power is generated and distributed by the SIEA. Buala's electricity supply is derived solely from the SIEA's hydro / diesel power generating station located on a river between the two major settlements of Buala, Jejevo and Buala village.

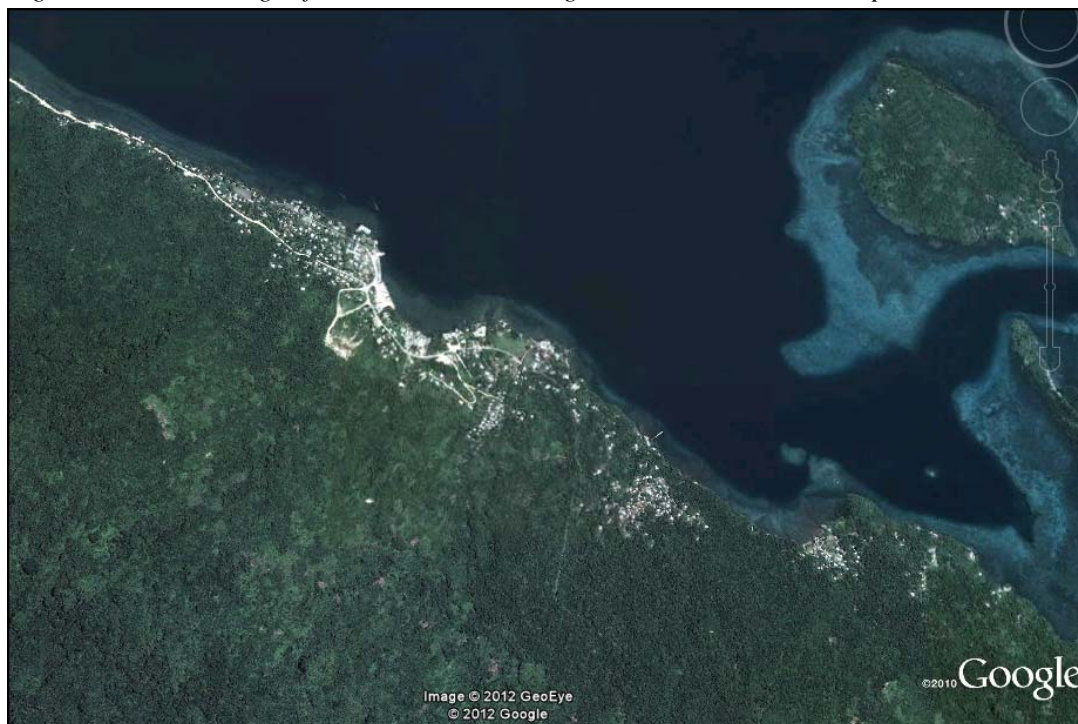
Figure 2: Grid power supply at Buala in Isabel Province, Solomon Islands



The current area of SIEA electricity supply to the Buala town area is bounded by the Maringe Lagoon to the north, Buala village, approximately 1.1km to the east of the power station, Jejevo village, approximately 0.5 km to the west of the power station, and up to 300 – 400m inland between Buala village and Jejevo village.

Power is distributed to consumers in Buala via two overhead 415V feeders. The 415V/240V Low Voltage system consists of overhead (open wire and ABC) distribution lines supported on galvanised steel poles. Service connections are generally made via an overhead service line to the customer's distribution board.

Figure 3: Satellite image of Buala and surrounding areas connected to mains power



Buala Power Station

The powerhouse consists of a mini-hydro unit (B1) and a single high speed diesel generator (B2); see Table 4. The existing maximum demand of Buala (92 kW) can be met using either the hydro unit or the diesel unit. The diesel engine generator currently installed at Buala Power Station operates on base load duty when the hydro unit is out of service.

Table 4: Installed Generators - Buala Power Station

No.	Type	Manufacturer	Nameplate Rating (kW)	Derated Capacity (kW)	Speed (rpm)	Year Installed	Comments
B1	Hydro	Otto Batholdi	150	100	1500	1996	Out of service
B2	Diesel	Cummins	103	103	1500	2006	In service

Source: SIEA

The two generators (B1 & B2) generate at 415V and supply a single 415V switchboard. This switchboard then supplies Buala's distribution system via two 415V overhead feeders (Buala and Jejevo feeders).

History of Buala hydro power scheme and its design features

Following a March 1995 feasibility study by SIEA, with assistance from Germany and the Solomon Islands Ministry of Energy, a decision was made to develop the 150kW Buala hydro power scheme as the least cost option for supplying power to community of Buala. The scheme was commissioned in 1996.

The hydro scheme was designed to largely displace energy from the diesel generator at Buala. With a net head of 224 metres, the 918 metre long penstock of Buala hydro delivers 90 litres/second of water to a single jet Pelton turbine to generate a maximum of 150 kW of electrical output.

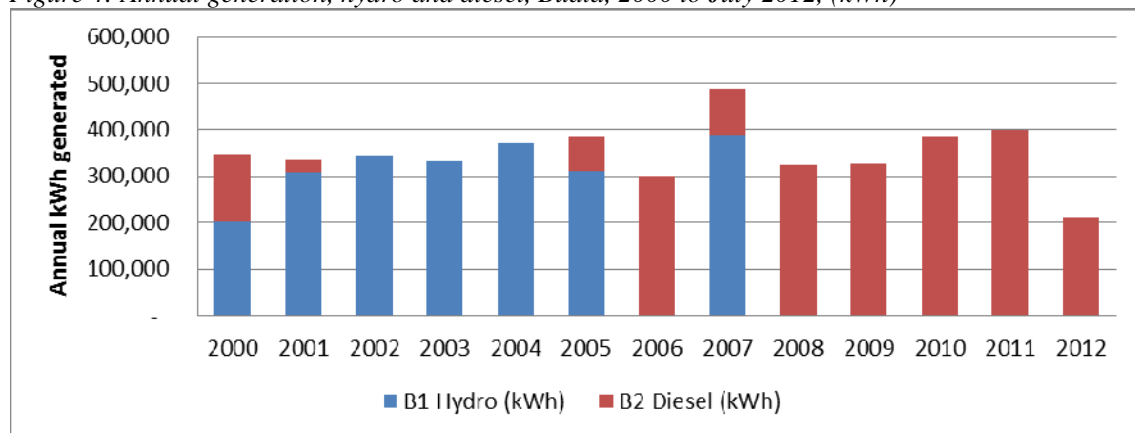
The Buala hydro scheme comprises:

- Reinforced concrete weir with Tyrolean Intake on a tributary of the Jejevo River.
- Settling tank (Sand Trap): rectangular concrete tank, approximately 10 m long.
- A 170 m long headrace with a 350mm diameter polyethylene pipe.
- A forebay headpond with daily storage of 420 m³.
- Catchment area: 2.1 km².
- Gross head: 242.70 m.
- Net head: 224.43 m.
- Minimum stream flow (100% exceedence): approx 12 litres/second.
- Design flow: 90 litres/second.
- Penstock: Ductile Iron Concrete Lined (DICL), with total length 918 metres, in three segments of different diameter: 41 m of 300mm diameter; 507 m of 250 mm diameter; and 370 m of 200mm diameter. One section of the penstock above ground is attached to a 17.5 metre long open truss pipe bridge that crosses Korosaba Creek.
- Turbine: Single nozzle 150kW Pelton turbine, manufactured by Turbal (now Andritz) of Switzerland.
- Alternator: Synchronous 200kVA, 50Hz, 4-pole, 1500 RPM, 420 VAC three-phase, manufactured by Otto Bartoldi AG of Switzerland (now GMB AG of Switzerland). This alternator was tailor made in 1996 for the Buala hydro project.
- Control system: manufactured by Sulzer.
- Distribution: via low voltage (415kV) overhead lines to Buala township and surrounding villages of Jejevo, Buala and Tit'hiro.

In the period 2000 to 2005, most or all of Buala's energy was supplied by the hydro unit (see Figure 4), with very little from the back-up diesel unit. However, no electricity was produced by the Buala hydro unit from October 2005 to January 2007, inclusive. Hydropower generation was restored in February 2007 and it provided the bulk of Buala's energy requirements in that year. Unfortunately, the hydropower unit ceased producing energy at the end of December 2007.

Since January 2008 all power supplied to Buala has been from the diesel generator. This total reliance on the single diesel generator at Buala means that reliability of supply is reduced because there is no back up: in the event of an outage of the diesel generator unit, no power can be supplied by SIEA from the hydro unit.

Figure 4: Annual generation, hydro and diesel, Buala, 2000 to July 2012, (kWh)



Source: SIEA. Note: 2012 figure is only for part of the year (Jan to July 2012).

Historical energy consumption and maximum demand

In 2011 Maximum Demand for Buala was 92 kW, annual energy production 400.3 MWh, total diesel consumption was 135,230 litres and diesel fuel efficiency averaged 0.3378 litres/kWh (Table 5).

Table 5: Buala energy mix, maximum demand, diesel consumption & efficiency, 2000 to 2012

	Maximum Demand (kW)	Total energy generated (kWh)	Energy production by generation unit (kWh)		Share of total energy generated (%)		Diesel fuel consumed (litres)	Average diesel fuel efficiency (litres/kWh)
			B1 Hydro	B2 Diesel	Hydro	Diesel		
2000	65	348,850	201,530	147,320	58%	42%	50,830	0.34503
2001	65	334,511	309,702	24,809	93%	7%	13,300	0.53610
2002	60	344,571	344,571	-	100%	0%	-	na
2003	57	331,152	331,152	-	100%	0%	-	na
2004	64	369,823	369,823	-	100%	0%	-	na
2005	80	387,695	310,482	77,213	80%	20%	30,686	0.39742
2006	86	300,080	-	300,080	0%	100%	94,260	0.31412
2007	93	488,033	390,592	97,441	80%	20%	35,015	0.35935
2008	82	324,230	-	324,230	0%	100%	94,440	0.29127
2009	107	327,634	-	327,634	0%	100%	113,310	0.34584
2010	82	384,417	-	384,417	0%	100%	129,233	0.33618
2011	92	400,349	-	400,349	0%	100%	135,230	0.33778
2012 ^a	72	213,313	-	213,313	0%	100%	73,068	0.34254

Source: SIEA

Note: a) 2012 data covers first seven months only (January to July 2012). na = Not Applicable because diesel unit did not operate.

Customer numbers and energy sales mix by customer type

The number of customer connections to the Buala grid in August 2012 was 223, of which 194 are on traditional cumulative kWh meters and 29 on prepayment meters. Of the 194 customer connections on traditional cumulative kWh meters: 138 are Domestic customers; 44 are Commercial customer; 1 is Industrial; 6 are Government institutions; and 5 are classed as “Other”.

Annual energy sales comprise: commercial customers 44%, households 34%, government 19%, and others 3%.

Buala, Expected new electrical loads (2013-2018)

Through discussions with the stakeholders, the following new loads were identified (see Table 6).

Table 6 – Buala Significant Upcoming Loads/Connections, 2013-2018, (kW at maximum demand)

New Load/Connection	Estimated Maximum Demand (kW)	Expected Year of Connection	Load type	Notes
Provincial office	20	2013	Commercial	
Exhibition centre	10	2013	Commercial	
Provincial assembly chamber	1	2013	Commercial	
Multipurpose hall (cold storage)	10	2014	Commercial	
IDC hardware	5	2014	Commercial	
Residential housing	25	2018	Commercial	25 new houses by 2018
Works Department	10	2013	Commercial	
IIC office development	20	2013	Residential	
Store and residence	1	2013	Commercial	
Total new load (kW)	102			

Forecast maximum demand & annual energy (2013-2018)

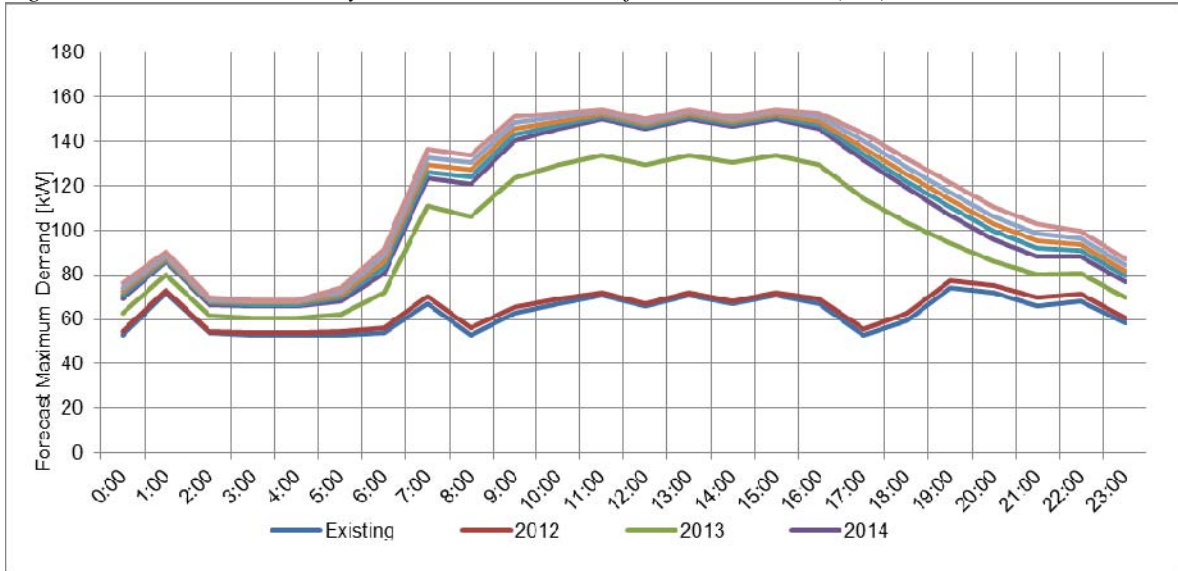
Table 7 – Forecast Maximum Demand (kW) & Annual Energy (MWh), Buala, 2013-2018.

Forecast	Base Case	2012	2013	2014	2015	2016	2017	2018
Maximum Demand (kW)	74.0	77.5	134.0	150.1	151.1	152.2	153.2	154.4
Annual Energy (MWh)	375.9	393.7	680.9	762.5	767.8	773.1	778.5	784.6
Average Load (kW)	42.9	44.9	77.7	87.0	87.6	88.3	88.9	89.6

Source: SKM 2012, "Solomon Islands Electricity Authority: OUTSTATION PLANNING STUDY REPORT HA01739", SKM, Sydney, December 2012.

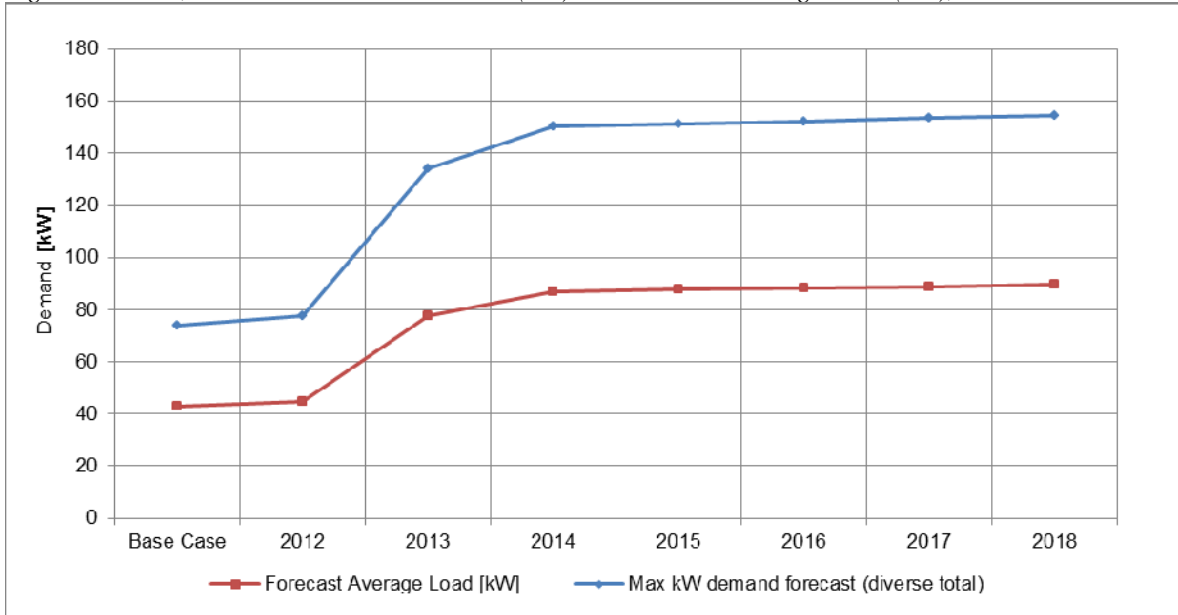
Based on the expected loads, the forecast load profile, maximum demand, and average demand is shown in Figures 6 and 7.

Figure 6: Buala, Forecast Daily Maximum Demand Profile, 2013 to 2018, (kW)



Source: SKM 2012, "Solomon Islands Electricity Authority: OUTSTATION PLANNING STUDY REPORT HA01739", SKM, Sydney, December 2012.

Figure 7: Buala, Forecast Maximum Demand (kW) and Forecast Average Load (kW), 2012 to 2018



Source: SKM 2012, "Solomon Islands Electricity Authority: OUTSTATION PLANNING STUDY REPORT HA01739", SKM, Sydney, December 2012.

B. Strengthening 415kV distribution grid in Buala

The increase in demand forecast over the next five years will place additional burden on the existing mini-grid at Buala. With the maximum demand forecast to increase to 150kW over the next 2 years, a number of network reinforcement actions will be required to supply the additional loads.

In the absence of any new electrical loads, the loadings on the existing 415V feeders will increase marginally; however, loadings will remain below the conductor and cable ratings.

However, the new loads identified in Table 6 will require an additional feeder emanating from the power station at 415V.

In order to meet the expected increase in demand, the recommended distribution network development plan for Buala is to install a new overhead 415V feeder to supply the demand growth area (see Table 8 and Figures 8 & 9 below).

The recommended network development plan involves installing a 415V overhead feeder emanating from the power station and running approximately 400 metres to the town centre. Provision has also been made to replace 500 metres of existing LV conductor per annum with 95mm² Aerial Bundled Cable (ABC).

Network analysis confirms that without the installation of a new overhead 415V feeder, the extension and use of the existing Buala and Jejevo 415V feeders would result in voltage drops outside acceptable limits.

The capital cost of the proposed network development plan is estimated at SBD787,038 in 2012 dollars (approximately, US\$110,000).

Table 8 – Description of 415 V Distribution network upgrade, Buala

Description	New/additional asset required	Features/Advantage	Risk/Disadvantage
Installing a new overhead 415V feeder to supply to the demand growth area.	415V switchboard panel × 1 415V overhead line × 0.4km LV (240V) overhead line, service drops and meters × as required	Simple straight forward solution. No changes to the existing power station setup apart from an addition of new 415V switchboard. No brownfield work on the existing 415V feeders.	NA

Source: SKM 2012, "Solomon Islands Electricity Authority: OUTSTATION PLANNING STUDY REPORT HA01739", SKM, Sydney, December 2012.

Figure 8 – Single line diagram of generation development options and 415 V network upgrade, Buala

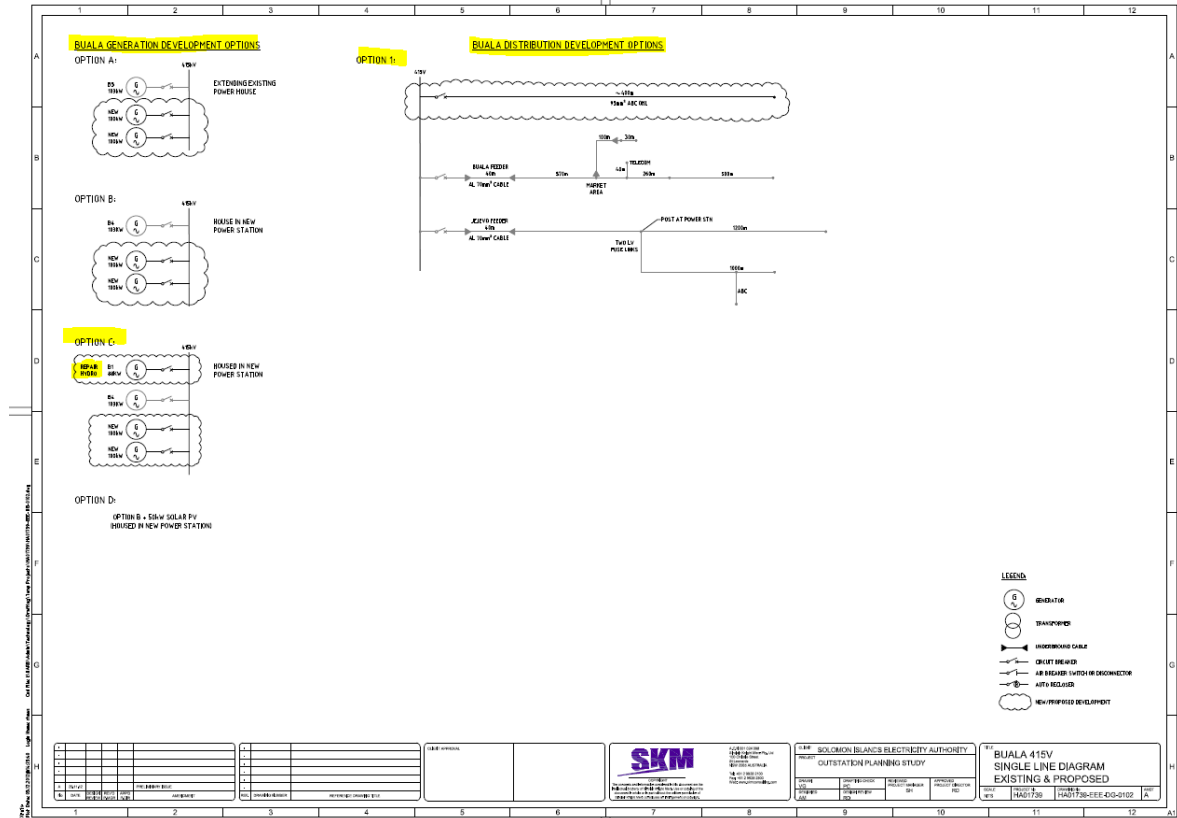
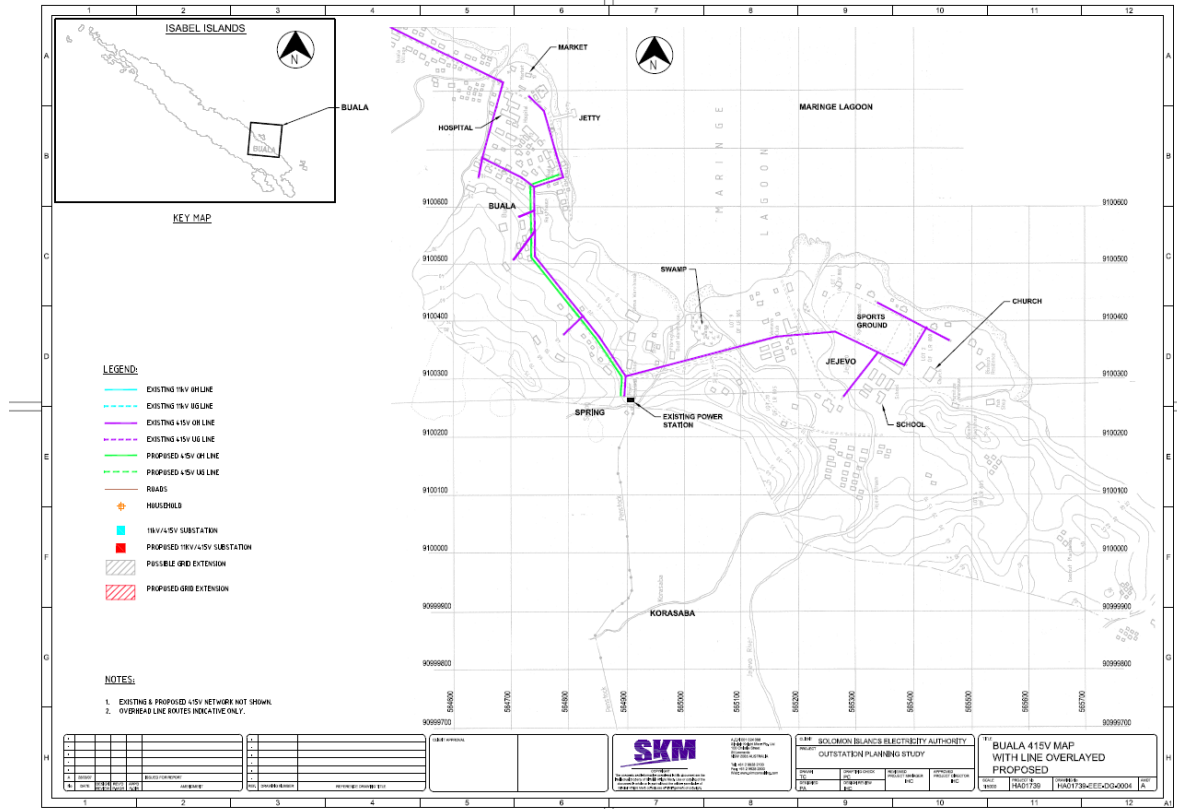


Figure 9 – Map with existing 415 V distribution network (purple) and proposed upgrade (green), Buala



A.2. Stakeholders.

Key stakeholders include: a) Electricity consumers (i.e. households, commercial and industrial customers); b) the national power utility, SIEA; c) government (national — in particular the Ministry of Energy and the Ministry of Finance — and provincial); d) rural communities; and e) privately owned energy service companies.

Stakeholder engagement has occurred during preparation of this project, and the execution of the project will also include stakeholder engagement. The engagement has included: consultations in country, provision of engineering reports, site visits and discussions with local stakeholders.

The objective of the engagement during preparation has been to design a package of new activities that address matters of priority for the stakeholders.

A.3. Socioeconomic benefits to be delivered by the Project at the national and local levels

The socioeconomic benefits to be delivered by the Project at the national and local levels include:

1. Improved reliability of power supplies, with a reduction in the frequency and duration of power outages;
2. Improved financial performance and sustainability of the national power utility, SIEA, so that it can continue to provide essential energy services across the nine service areas it currently serves, and can look to finance increases in access to its services, such as through grid extensions and augmentations;
3. Facilitating the scaling up of access to electricity in rural areas of Solomon Islands, through the development of a range of workable business models for energy service provision and associated regulations that are suitable Solomon Islands;
4. Improved affordability of electricity supplies, via: a) tariff reforms; b) generation cost reductions from improved efficiency of generation; c) improved collection rate; and d) reductions in distribution network electrical losses (both technical and non-technical).

For the final beneficiaries of the proposed project, the project has significant social impact, associated with the benefits of access to reliable electricity supply. It will address the irregularity of supply, providing confidence to start to store food in refrigerators without the fear that they will need to throw it out due to extended power outages. It will result in less frequent occurrence of low voltage or high voltage spike, damaging electric equipment, thus reducing customers cost for appliance replacement.

The lack of access to affordable, modern, energy services in Solomon Islands also has some gender-specific dimensions; including:²⁰

- Like women in most developing countries, women in Solomon Islands experience energy poverty differently and more severely than men. Women often carry out energy intensive household activities (cooking, washing) and are to a large extent responsible for household and community energy provision (e.g. gathering firewood) in many developing countries.
- Without access to modern energy services, women and girls spend most of their day performing basic subsistence tasks, including time-consuming and physically draining tasks of collecting biomass fuels, which constrains them from accessing decent wage employment, educational opportunities and livelihood enhancing options, as well as limits their options for social and political interaction outside the household.
- Increased exposure to smoke from cooking with biomass has a particularly detrimental impact on the health of women and children:
 - Globally, of the estimated two million annual deaths attributed to indoor air pollution generated by fuels such as coal, wood, charcoal and dung, 85% are women and children

²⁰ Drawn and adapted from UN Women & UNIDO 2013, “Sustainable Energy for All: the gender dimensions”, Guidance Note.

who die from cancer, acute respiratory infections and lung disease (WHO & UNDP, 2009).

- o Globally, illnesses from indoor pollution result in more deaths of women and children annually than HIV/AIDS, malaria, tuberculosis and malnutrition combined (IISD, 2013).
- o Other important direct health impacts from dirty energy use and indoor air pollution include life-long or chronic diseases, such as asthma; burns to children; injuries to women from carrying wood; and increased violence against women and girls because of lack of street lighting at night (ESMAP, 2007).

Because of the gendered nature of energy poverty, access to modern, sustainable energy can also significantly enhance the empowerment of women by reducing their time and labour burdens, improving their health, and providing them with opportunities for enterprise and capacity building.

This project, by improving access to modern, sustainable, affordable energy in Solomon Islands will improve the lot of women there, both economically and from a health perspective.

As discussed above, the global environmental benefit to be delivered is mitigating climate change through the reduction of greenhouse gas emissions in line with the United Nations Framework Convention on Climate Change. The following key indicators of the project relate to the activities it is proposed be financed by the GEFTF: a) Total Carbon Dioxide emissions avoided (Direct and Indirect) total 1,002,023 tonnes CO_{2e}; and b) Investments in renewable energy supply.

A.4 Risks to achievement of project objectives & risk mitigation

The substantial risk of this project is mainly caused by two factors: the first is a lack of capacity in the Government in general, and particularly in the Ministry of Mines, Energy and Rural Electrification. The second factor is the highly volatile political environment. For example, the past high turnover of the political leadership in the Ministry of Mines and Energy was a major factor in the delay of preparing this project.

The SIG has limited experience with SOE reform. This project is the first significant SOE reform activity. While that makes the project important as an example for others, failure of this project and consequently, the energy program can have significant impact.

To mitigate against these risks, the project design is simple and focused on the most important required improvements. The straight forward technical assistance activities will facilitate a reduction in generation and network losses, while capacity building and improved IT systems will assist the utility with required aggressive collection of tariffs from households but even more so from other SOEs and Government entities.

The critical risks for the project are summarized below, together with risk mitigation measures:

Risks	Risk Mitigation Measures	Risk Rating with Mitigation
<i>To project development objectives</i>		
Lack of government commitment in commercializing SIEA.	SIG agreed to restructure SIEA's debt before negotiations commenced for this project. The Government has also provided support to SIEA by emphasizing, in the cabinet decision on the debt restructuring, that SIEA should stop providing electricity to non-paying customers, including SOEs and Government authorities.	S
Non-payment of bills by SOE's, Councils and other Government entities.	The Government has provided SIEA with a mandate to turn off the electricity for non-paying customers and Government entities. The financial system is upgraded and after the systems are set up, SIEA can monitor arrears on a daily basis. An arrears report is now mandated for each Board meeting.	H

	Forgiveness of past arrears will only be done gradually and will go hand in hand with payment of current tariffs. The Project Agreement includes a covenant that the Government will cause and SIEA will ensure that SIEA's annual bill collection from state-owned enterprises and other Government entities will be at least 75% of what is due and no arrears will exceed more than 120 days.	
Nonpayment of electricity bills by consumers, who view electricity as a public good.	The project is supporting SIEA in implementing a community awareness campaign on the costs of electricity, on the efficient use of electricity and introducing prepaid meters which can be loaded with prepaid cards obtained from a large number of retail outlets.	S
Procurement and Financial Management indicating high and moderate risk for SIEA and general lack of capacity in these areas in Solomon Islands.	RAMSI ²¹ is financing the early employment of the commercialization manager, which will have a significant impact on improving financial management and procurement processes. The project provides for extensive training of SIEA staff in financial management and training in procurement.	M
To component results		
Failure to achieve SIEA Commercialization	Working closely with SIEA to identify experienced and well qualified Utility managers. In addition, the Bank will assist SIEA Board to find a qualified experienced external director to participate in SIEA board meetings, educating both the Board and management, and assisting with the monitoring of the performance of the managers.	M
Frequent turnover in political leadership leading to changes in the energy department, resulting in unpredictable/ unreliable sector regulation.	Major efforts will be made to document agreed arrangements and provide transparency in the application of regulations. Technical assistance will assist the Government with a review of the <i>Electricity Act</i> .	M
Overall risk rating		S

Note: Risk Rating — H (High Risk), S (Substantial Risk), M (Moderate Risk), N (negligible or Low Risk)

Source: World Bank 2008, "Project Appraisal Document — Solomon Islands Sustainable Energy Project", WB Report No. 43120-SB, 12 June 2008, World Bank, Washington DC, p. 11.

The project's Environmental Category is C, which reflects the fact that the proposed investments are essentially funding of replacement of distribution feeders, upgrading of other network distribution elements including transformers to reduce network losses, spare parts and replacing existing meters with prepaid meters. Existing generation facilities are being provided with the necessary spare parts to improve the reliability and efficiency. The operation also focuses on institutional strengthening, technical assistance and commercialization through improved financial management, improved accounting systems and operational IT support. Hence, no environmental or safeguard policies are triggered by investments proposed in this project.

The **climate change risks and risk mitigation measures** for this project are discussed in Section A, which also covers estimated emissions reductions.

²¹ Regional Assistance Mission to Solomon Islands (RAMSI), also known as *Operation Helpem Fren*, has worked to bring to an end to the violence that had crippled the Solomon Islands in the five years 1998 to 2003. RAMSI is a partnership between the people and Government of Solomon Islands and fifteen countries of the Pacific. RAMSI arrived in Solomon Islands in July 2003 at the request of the Solomon Islands Government. (URL www.ramsi.org)

A.5. Explain how cost-effectiveness is reflected in the project design:

As noted in the guidance provided in the paper “Cost Effectiveness Analysis in GEF Projects” from the June 2005 GEF Council meeting, interventions under the Climate Change Focal Area which focus on barrier removal cannot generally be meaningfully measured using quantitative estimates. Instead, the cost effectiveness is demonstrated by comparing alternative approaches to achieve the agreed barrier removal goal and identifying the approaches which will most efficiently achieve the objective. GEF-supported activities will be an integral part of development of a renewable energy-based access expansion approach for Solomon Islands. Cost effectiveness of the specific projects to be developed with the proposed co-financing is assured as communities will not be willing to proceed with investing their own resources unless the benefits of the projects clearly outweigh alternatives, including the cost of having no electricity supply. The mini-grids will represent the least-cost electricity supply systems for the communities in which they are built. That is, they will be the least-cost option for electricity supply at a minimal GHG emission level. Other options, such as on-grid or solar home systems will be less cost effective in these communities.

A.6. Outline the coordination with other relevant GEF financed initiatives [not mentioned in A.1]:

Originally, these GEF funds were earmarked for the Solomon Islands within the regional GEF- project, the Sustainable Energy Financing Project (SEFP); but the Solomon Islands and PNG components of SEFP have since been cancelled.

The Solomon Islands Government (SIG) and two Trust Fund contributors to SEFP, AusAID and the Global Environment Facility (GEF), have agreed that trust fund monies from SEFP associated with Solomon Islands should be used in energy sector work supervised by the World Bank.

With the cancellation of SEFP in Solomon Islands, there remain two World Bank projects in Solomon Islands:

1. the Sustainable Energy Project (SISEP, P100311); and
2. Tina River Hydropower Development Project (TRHDP, P114317).

The SIG and World Bank agreed that the SISEP would be the most appropriate energy project to allocate these trust fund monies, rather than the Tina River Hydropower Development Project (TRHDP, P114317), which is still under preparation.

The GEF finance is now proposed to support the objectives of the Sustainable Energy Project (SISEP, P100311).

A.7 Describe the institutional arrangement for project implementation: SIEA to implement the project as integral part of SISEP (P100311), with World Bank to supervise implementation as part of SISEP. It is proposed that the GEF funds (approx US\$0.9 million) be used in the restructured baseline project, the Solomon Islands Sustainable Energy Project (SISEP, P100311). The Project Implementation Unit for SB Developing Community Energy (P122937) would be the Solomon Islands Electricity Authority (SIEA), which is also the implementing agency for SISEP (P100311). The baseline project has been effective since June 2009, and since 2012 there has been a marked improvement in the financial and operational performance and sustainability of the SIEA. The SIEA is keen to develop workable methods of community owned renewable power generation with stand-alone mini-grids or having connection arrangements from such sources into its own distribution grids.

B. DESCRIPTION OF THE CONSISTENCY OF THE PROJECT WITH:

B.1 National strategies and plans or reports and assessments under relevant conventions

The proposed project is fully consistent with the plans of the Solomon Islands Government (SIG) to undertake least cost planning and develop domestic renewable energy resources and improve energy efficiency as measures to improve energy security and buffer the electricity sector and economy from future oil price increases and volatility.

The government’s commitment to increase the level of access to modern energy services and increased private sector, community-based and household power projects is reflected in: a) the policy platform of

the current government; b) the *National Energy Policy Framework* of 2007;²² c) the *National Development Strategy 2011-2020*;²³ and d) in the *Solomon Islands Rural Electrification Policy 1996*.²⁴

B.2. GEF focal area and/or fund(s) strategies, eligibility criteria and priorities

The proposed project is consistent with CC3 (promoting market approaches for renewable energy). The overarching goal for GEF-4 is to achieve a decrease in GHG emissions through market transformation. It is explicitly recognized that this is a long process, usually with the need for follow on investments beyond the GEF support. Incorporating the proposed GEF funding (to address six key constraints to the development demonstration community-managed, grid-based renewable energy projects, thereby reducing barriers to market development) into the larger Sustainable Energy Project (P100311) will mean that additional resources are available to help transform the market.

B.3 The GEF Agency's program (reflected in documents such as UNDAF, CAS, etc.) and Agencies comparative advantage for implementing this project:

The absence of GEF funding would mean that the barriers to community based renewable energy mini-grid projects, that have been identified during the course of implementation of the SEFP project in Solomon Islands, would not be fully addressed or attention to these issues would be delayed until an alternative source of funding were to be identified. The value-added of the GEF funding is to quickly respond to clearly-defined constraints so as to make the most the opportunities for communities, small businesses and the SIEA to work effectively to develop and sustainably operated mini-grid renewable energy investments across rural areas of Solomon Islands. By effectively addressing these constraints it is expected there will a significant increase in the likelihood of achieving increased adoption and use of small-scale renewable energy technologies in Solomon Islands.

C. DESCRIBE THE BUDGETED M & E PLAN:

The project's Monitoring and Evaluation (M&E) will be conducted by the SIEA and supervised by the World Bank. Annex A contains the project's results framework, plus additional M&E indicators for the proposed three new activities to be financed by the GEF.

²² Solomon Islands Government 2007, "National Energy Policy Framework", Energy Division, Ministry of Mines and Energy, Honiara.

²³ Solomon Islands Government (SIG) 2011, "National Development Strategy 2011-2020", Ministry of Development Planning and Aid Coordination, Honiara, July 2011.

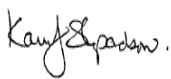
²⁴ SIG Ministry of Energy, Water & Mineral Resources 1996, "Solomon Islands Rural Electrification Policy", Prepared by Energy Division/Mini Hydro Resource Centre, Under the Assistance of the GTZ/SI Ministry of Energy Joint Programme: "Improvement of Rural Electricity Supplies in the Solomon Islands", Honiara, January 1996.

PART III: APPROVAL/ENDORSEMENT BY GEF OPERATIONAL FOCAL POINT(S) AND GEF AGENCY(IES)

- A. RECORD OF ENDORSEMENT OF GEF OPERATIONAL FOCAL POINT (S) ON BEHALF OF THE GOVERNMENT(S):** (Please attach the [Operational Focal Point endorsement letter\(s\)](#) with this template. For SGP, use this [OFP endorsement letter](#)).

NAME	POSITION	MINISTRY	DATE (MM/dd/yyyy)
Mr. Rence Sore	Permanent Secretary	ENVIRONMENT, CONSERVATION & METEOROLOGY	07/07/2009

B. GEF AGENCY(IES) CERTIFICATION

This request has been prepared in accordance with GEF/LDCF/SCCF/NPIF policies and procedures and meets the GEF/LDCF/SCCF/NPIF criteria for project identification and preparation.					
Agency Coordinator, Agency name	Signature	DATE (MM/dd/yyyy)	Project Contact Person	Telephone	Email Address
Karin Shepardson, Program Manager, CCGIA, World Bank		02/17/2014	Jiang Ru	202 473-8677	jru@worldbank.org

ANNEX A: PROJECT RESULTS FRAMEWORK

Table A.1: Results Framework — Project Development Objective

Project Development Objective (PDO): The objective of the project is to improve operational efficiency, system reliability and financial sustainability of SIEA through: improved financial and operational management, reduction of losses, and increased revenue collection.											
PDO Level Results Indicators*	Core	D=Dropped C=Continue N= New R=Revised	Unit of Measure	Baseline	Cumulative Target Values**				Frequency	Data Source/ Methodology	Responsibility for Data Collection
					FY2010	FY2011	FY2012	FY2013 & FY2014			
SIEA will operate profitably		R	Text	Loss SB\$44 million	Paper Profit	Break-even	Profit SB\$25 million	Profit SB\$45 million or more	Internal Auditing and financial management review External Auditing Semi-annual project progress reporting	SIEA progress reports Semi-annual project progress reports to SIG as required under the SOE Act.	SIEA
Quarterly financial management reports, and rolling projections for SIEA performance within 14 days after end of each quarter.	<input type="checkbox"/>	R	Text	None	4	4	4	4	Quarterly	SIEA's financial data	SIEA
Number of days between due date of tariff, and if not paid , notice of arrear	<input type="checkbox"/>	R	Days	365	365	30	15	15	Quarterly	SIEA management information system	SIEA
Generator efficiency improved		R	%	L06 00% L08 55% L10 40%	L06 60% L08 55% L10 90%	L06 70% L08 80% L10 80%	L06 80% L08 80% L10 80%	L06 85% L08 85% L10 85%	Yearly	SIEA operational management	SIEA
Revenue per kWh generated		R	SB\$/kWh	1.39	2.00	2.80	2.80	3.00	Supervision missions and annual financial reports and performance based reports	External audit reports. SIEA monthly operation reports. FMR	SIEA
System Average Interruption Duration Index (SAIDI)		R	Text	51,840 minutes	40,000 minutes	32,000 minutes	25,920 minutes	25,920 minutes	Supervision missions and Yearly & Semi-	SIEA monthly reports	SIEA

									annually and project progress		
System Average Interruption Frequency Index (SAIFI)		R	Text	68	50	35	30	30	Supervision missions an Yearly & Semi-annually and project progress	SIEA monthly reports	SIEA
System losses		R	%	21%	19%	18%	16%	12%	Supervision missions an Yearly & Semi-annually and project progress	SIEA monthly reports	SIEA
Number of prepaid meters installed		R	Number	487	3500	7500	8000	9000	SIEA operational reports	SIEA quarterly reports	SIEA
Average number of debtor days to collect billed revenue		R	Days	360	120	90	30	30	SIEA's financial management system	SIEA quarterly reports	SIEA
Collection ratio		C	%	72%	80%	85%	90%	90%	Supervision missions an Yearly & Semi-annually and project progress	SIEA monthly reports	SIEA

Table A.2: Results Framework — Global Environment Objective

Activity	Indicate whether Investment, TA, or STA ²	Expected Outcomes	Expected Outputs	Expected Timeframe
1. Tariff Review	TA	Review and restructure existing electricity tariffs so as to better encourage energy efficiency, affordability, sustainability, & any disincentives for small-scale renewable generation.	New tariff structure adopted	June 2014 adaptation of new tariff structure
2. Development of power purchasing arrangements for community/privately owned generation	TA	Development and adoption of: a) Connection Agreements and policies for electrical networks; b) Business models for community owned power.	a) Connection agreement templates and policies b) Workable business models for community owned power in Solomon Islands.	May 2014
3. Rural electricity supply	Investment	a) Restoration of 150kW hydro energy output at Buala so energy supply is once again close to 100% renewable; b) Improved quality of supply to customers on 415V distribution grid in Buala.	a) Rehabilitation of SIEA micro-hydro generation facility at Buala, Santa Isabel; b) Strengthening 415V distribution grid in Buala.	May 2014

ANNEX B: SECTOR DATA

Percentage of private households by main source of lighting by province, Solomon Islands, 2009

Main source of lighting	Place of residence											
	National Total	Provinces (excl. Honiara)	Choiseul	Western	Isabel	Central	RenBell	Guadacanal (excl. Honiara)	Malaita	Makira	Temotu	Honiara
Electricity -main grid	11.78	6.04	4.12	12.10	5.79	3.85	0.44	8.22	3.39	3.69	2.70	64.36
Own Generator	0.75	0.79	1.10	1.05	1.21	0.67	0.15	1.33	0.30	0.67	0.19	0.35
Solar PV	8.68	9.39	10.14	8.35	16.92	3.83	74.85	3.48	12.16	5.91	12.36	2.25
Total electricity	21.21	16.22	15.37	21.50	23.92	8.36	75.44	13.03	15.85	10.27	15.25	66.95
Gas	0.16	0.16	0.40	0.07	0.39	0.14	0.00	0.12	0.20	0.11	0.05	0.14
Kerosene Lamp	74.68	79.39	82.11	75.75	74.37	91.25	21.08	82.72	78.67	79.95	79.74	31.57
Coleman lamp	0.25	0.24	0.36	0.14	0.31	0.00	0.00	0.12	0.11	1.03	0.51	0.40
Wood/coconut	0.95	1.05	0.04	0.64	0.06	0.00	0.00	2.39	0.93	0.86	1.58	0.03
Other	2.44	2.63	1.61	1.73	0.91	0.20	1.74	1.32	3.94	6.57	2.77	0.67
None	0.31	0.32	0.11	0.17	0.04	0.04	1.74	0.29	0.31	1.20	0.12	0.23

Source: Solomon Islands Census, 2009. Table H10 of "Report on 2009 Population and Housing Census: Basic Tables and Description" (Statistical Bulletin 06/2011), Solomon Islands National Statistics Office, Honiara.

ANNEX C: Direct savings in Net Present Costs arising from reduced diesel generation O&M costs following hydro refurbishment at Buala

Net Present costs (NPC) of option:	Diesel generation O&M	Diesel generation O&M	Generation (kWh) over 20 years			Diesel fuel consumption over 20 years (Litres)	Average annual diesel fuel efficiency (Litres/KWh)
	(SBD)	(US\$)	Diesel	Hydro	TOTAL		
A) Base Case (Diesel generation only)	28,193,140	3,868,099	15,055,054	-	15,055,054	4,540,944	0.30162
B) Hydro rehab (88kW, 90% capacity factor)	3,588,291	492,314	1,609,967	13,445,088	15,055,054	485,041	0.30127
C) Hydro rehab (150kW, 90% capacity factor)	3,423,331	469,681	1,505,505	13,549,549	15,055,054	453,570	0.30127

Savings in NPC from hydro refurbishment	Savings in Diesel generation O&M (SBD)	Savings in Diesel generation O&M (US\$)	Diesel generation displaced (kWh)	Hydro generation restored (kWh)	Savings in diesel fuel consumption (Litres)
Option B vs. Base Case (A)	24,604,849	3,375,785	(13,445,088)	13,445,088	4,055,902
Option C vs. Base Case (A)	24,769,809	3,398,418	(13,549,549)	13,549,549	4,087,374

Assumptions:

- 1) Fuel costs SBD8.75/Litre (approx. US\$1.20/litre)
- 2) Fuel price escalation, 1.1% per annum
- 3) Discount rate (real), 7%
- 4) 20 year time horizon.
- 5) Maintain G-1 capacity > Maximum Demand
- 6) Exchange rate of SBD/US\$ is 7.28863

ANNEX D: Map of Solomon Islands

