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INTERNATIONAL DEVELOPMENT ASSOCIATION

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED CREDIT IN THE AMOUNT OF SDR1.4 MILLION
(US\$2.0 MILLION EQUIVALENT)

AND A

PROPOSED GRANT IN THE AMOUNT OF SDR1.4 MILLION
(US\$2.0 MILLION EQUIVALENT)

AND A

PROPOSED SCF-SREP GRANT IN THE AMOUNT OF US\$6.77 MILLION

AND A

PROPOSED PRIF GRANT IN THE AMOUNT OF USD\$3.4 MILLION

TO THE

REPUBLIC OF VANUATU

FOR A

RURAL ELECTRIFICATION PROJECT STAGE II
RVP/CD CLEARANCE DATE}

Energy & Extractives
EAST ASIA AND PACIFIC

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CURRENCY EQUIVALENTS

TO BE UPDATED - (Exchange Rate Effective {Aug 29, 2016})

Currency Unit = Vatu

106 Vatu = US\$1

US\$1.35 = SDR 1

FISCAL YEAR

January 1 - December 31

Regional Vice President: Victoria Kwakwa

Country Director: Michel Kerf

Senior Global Practice Director: Riccardo Puliti

Practice Manager: Jie Tang

Task Team Leader(s): Kamleshwar Prasad Khelawan

ABBREVIATIONS AND ACRONYMS

| | |
|--------|---|
| AC | Alternating Current |
| CapEx | Capital Expenditures |
| CIF | Climate Investment Fund |
| COM | Council of Ministers |
| DA | Designated Account |
| DC | Direct Current |
| DoE | Department of Energy |
| DSA | Debt Sustainability Analysis |
| ECOP | Environmental Code of Practice |
| EIRR | Economic Internal Rate of Return |
| ESIA | Environmental and Social Impact Assessment |
| ESMF | Environmental and Social Management Framework |
| ESMAP | Energy Sector Management Assistance Program |
| ESMP | Environmental and Social Management Plan |
| FIRR | Financial Internal Rate of Return |
| FMIS | Financial Management Information System |
| GDP | Gross Domestic Product |
| GHG | Greenhouse Gases |
| GIZ | Deutsche Gesellschaft für Internationale Zusammenarbeit |
| HIES | Household Income and Expenditure Survey |
| ICT | Information and Communication Technologies |
| IFRs | Interim Financial Reports |
| INDC | Intended Nationally Determined Contributions |
| kW | Kilowatts |
| LCOE | Levelized Costs of Energy |
| MW | Megawatt |
| NPV | Net Present Value |
| NERM | National Energy Road Map |
| NZMFAT | New Zealand Ministry of Foreign Affairs and Trade |
| OpEx | Operational Expenditures |
| OVR | Output Verification Report |
| POM | Project Operations Manual |
| PPSD | Procurement Strategy for Development |
| PRIF | Pacific Region Infrastructure Facility |
| PV | Solar Photovoltaic |
| RPF | Regional Partnership Framework |
| RPF | Resettlement Policy Framework |
| SCD | Systematic Country Diagnostic |
| SE4ALL | Sustainable Energy for All |

| | |
|---------|--|
| SHS | Solar Home System |
| SREP | Scaling-up Renewable Energy Program |
| UNELCO | Union Electrique de Vanuatu Ltd |
| URA | Utilities Regulatory Authority |
| US\$ | United States Dollars |
| VREP I | Vanuatu Rural Electrification Project Stage I |
| VREP II | Vanuatu Rural Electrification Project Stage II |
| VUI | Vanuatu Utilities and Infrastructure |
| VUV | Vatu |
| WACC | Weighted Average Cost of Capital |
| WBG | World Bank Group |
| Wp | Watt Peak |
| WTP | Willingness to Pay |

**BASIC INFORMATION**

| | | |
|--|--------------|-----------------------------------|
| Is this a regionally tagged project? | Country(ies) | Lending Instrument |
| No | | Investment Project Financing |
| <input type="checkbox"/> Situations of Urgent Need of Assistance or Capacity Constraints | | |
| <input type="checkbox"/> Financial Intermediaries | | |
| <input type="checkbox"/> Series of Projects | | |
| Approval Date | Closing Date | Environmental Assessment Category |
| 27-Apr-2017 | 30-Jun-2022 | B - Partial Assessment |
| Bank/IFC Collaboration | | |
| No | | |

Proposed Development Objective(s)

The Project Development Objective is to support increased penetration of renewable energy and increased access to affordable electricity services in the dispersed off-grid areas of Vanuatu.

Components

| Component Name | Cost (US\$, millions) |
|--|-----------------------|
| Solar Home Systems and construction of micro grids in rural areas of Vanuatu | 5,370,000.00 |
| Construction of mini grids in rural areas of Vanuatu | 6,800,000.00 |
| Technical Assistance and Project Management | 2,000,000.00 |

Organizations

| | |
|-----------------------|---|
| Borrower : | Ministry of Finance and Economic Management |
| Implementing Agency : | Department of Energy, Ministry of Climate Change and Natural Disaster |



PROJECT FINANCING DATA (IN USD MILLION)

| | | | | | |
|--|-------------------------------|--|---|---|---|
| <input type="checkbox"/> Counterpart Funding | <input type="checkbox"/> IBRD | <input checked="" type="checkbox"/> IDA Credit <input type="checkbox"/> Crisis Response Window <input type="checkbox"/> Regional Projects Window | <input checked="" type="checkbox"/> IDA Grant <input type="checkbox"/> Crisis Response Window <input type="checkbox"/> Regional Projects Window | <input checked="" type="checkbox"/> Trust Funds | <input type="checkbox"/> Parallel Financing |
| Total Project Cost: 14.17 | | Total Financing: 14.17 Of Which Bank Financing (IBRD/IDA): 4.00 | | Financing Gap: 0.00 | |

Financing (in US\$, millions)

| Financing Source | Amount |
|---|--------------|
| Strategic Climate Fund Grant | 6.77 |
| International Development Association (IDA) | 2.00 |
| IDA Grant | 2.00 |
| Pacific Regional Infrastructure Facility Trust Fund | 3.40 |
| Total | 14.17 |

Expected Disbursements (in US\$, millions)

| Fiscal Year | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|-------------|------|------|------|------|-------|-------|
| Annual | 0.07 | 1.56 | 1.80 | 3.72 | 3.60 | 3.36 |
| Cumulative | 0.07 | 1.63 | 3.43 | 7.15 | 10.75 | 14.11 |

INSTITUTIONAL DATA



Practice Area (Lead)

Energy & Extractives

Contributing Practice Areas

Climate Change and Disaster Screening

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

Gender Tag

Does the project plan to undertake any of the following?

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

Yes

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

Yes

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

Yes

SYSTEMATIC OPERATIONS RISK-RATING TOOL (SORT)

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

**COMPLIANCE****Policy**

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

☐ Yes ☒ No

Does the project require any waivers of Bank policies?

☐ Yes ☒ No

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

Legal Covenants**Conditions****PROJECT TEAM****Bank Staff**

| Name | Role | Specialization | Unit |
|-------------------------------|---------------------------------|--------------------------|-------|
| Kamleshwar Prasad Khelawan | Team Leader(ADM Responsible) | Senior Energy Specialist | GEE09 |



| | | | |
|----------------------------|---|--------------------------------------|-------|
| Zhentu Liu | Procurement Specialist(ADM Responsible) | Senior Procurement Specialist | GGO08 |
| David Bruce Whitehead | Financial Management Specialist | Financial Management Specialist | GGO20 |
| Anuja Utz | Team Member | Senior Operations Officer - Gender | GED02 |
| Kim Dagmar Baverstock | Team Member | Program Assistant | EACNF |
| Penelope Ruth Ferguson | Environmental Specialist | Consultant | GENDR |
| Renee Berthome | Team Member | Operations Analyst | GEE09 |
| Ross James Butler | Safeguards Specialist | Senior Social Development Specialist | GSU02 |
| Rowena Margaret S. Gorospe | Counsel | Senior Counsel | LEGIA |
| Thimo Mueller | Team Member | Economic and Financial Analysis | GEE09 |

Extended Team

| Name | Title | Organization | Location |
|-------------|--------------|---------------------|-----------------|
|-------------|--------------|---------------------|-----------------|



VANUATU
RURAL ELECTRIFICATION PROJECT STAGE II

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I. STRATEGIC CONTEXT

A. Country Context

1. The Republic of Vanuatu is an archipelago of 83 volcanic islands (65 of them inhabited) covering a total area of about 12,200 square kilometers, of which approximately a third is land. The country has been a democratic republic since gaining independence from the United Kingdom and France in 1980. Vanuatu's population is approximately 258,000 people, almost evenly distributed among the six administrative provinces: Malampa, Penama, Sanma, Shefa, Tafea and Torba. The national household count stands at an estimated 55,000, of which approximately 13,750 households (25 percent) are located in urban areas and the remaining 41,250 (75 percent) are dispersed in rural areas.
2. The average household monthly income in Vanuatu is VUV 83,800 (US\$791), with an average household monthly income of VUV 97,500 (US\$921) reported in urban areas, compared with VUV 79,500 (US\$750) in rural areas. In per capita terms, this equates to VUV 18,700 (US\$176) per person per month in urban areas and VUV 16,400 (US\$154) per person per month in rural areas. Generally, urban households in Vanuatu rely on wages and salaries from labour-based activities as their main source of income. However, because of the intermittent and costly access to transport services connecting the rural communities to urban centers, rural households rely mainly on home consumption (subsistence) and household enterprises based around the sale of agricultural products, handicrafts, and other goods produced in the home.
3. For female headed households the average monthly income across Vanuatu is VUV 59,300 (US\$560) – VUV 85,200 (US\$804) in urban areas and VUV 51,200 (US\$483) in rural areas. In per capita terms, for female headed households VUV 18,300 (US\$172) per person per month in urban areas and VUV 13,700 (US\$129) per person per month in rural areas.
4. Vanuatu has become one of the fastest growing economies of the Pacific region. The economy has experienced strong and sustained growth mainly driven by tourism, construction, and aid inflows. The per capita Gross Domestic Product (GDP) is estimated at US\$3,100, yet the cost of basic infrastructure services is high and affects the business environment in the country. For instance, Vanuatu ranks 83rd in the “ease of doing business” indicator reported by the World Bank Group, which analyzes a total of 189 economies, and 81st in “getting electricity” indicator, down from 75th in 2015, mainly due to the high cost associated with obtaining a new connection to the electricity grids.

B. Sectoral and Institutional Context

5. **Institutional Context:** Electricity services in Vanuatu are delivered through three types of models. These models include: (a) independent “main grid systems” in the main urban centers (Port Vila and Luganville); (b) isolated “mini grids” in lesser population concentrations but where a grid supply system is still a technically and economically competitive option (e.g., parts of Tanna and Malekula); and (c) decentralized energy service



systems. Grid electricity in Vanuatu is supplied by two concessionaires, Union Electrique de Vanuatu Ltd (UNELCO) in three provinces (Shefa, Malampa and Tafea) and Vanuatu Utilities and Infrastructure (VUI) in Sanma province.

6. The private sector is responsible for generating and supplying electricity under concession agreements with the Government of Vanuatu. There are currently four concession areas in Vanuatu operated by UNELCO and VUI. UNELCO has been operating in Vanuatu since 1939 and supplies the Efate (Shefa province), Malekula (Malampa province) and Tanna (Tafea province) concession areas. In Efate, the concession is in force until the year 2031 and provides UNELCO exclusive rights to generate and supply electricity. The concessions in Tanna and Malekula are in force until the year 2020. VUI, a subsidiary of Pernix Group, has supplied the Luganville concession area since January 1, 2011, after signing an Operations and Maintenance agreement with the Government of Vanuatu for the Luganville concession (Sanma province). The Government of Vanuatu is re-tendering the Luganville concession area.

7. The installed generation capacity and supply to the grid network in Port Vila, Luganville and parts of Tanna and Malekula islands is insufficient to meet national demands for electricity. The total installed capacity in these grids is 31.6 Megawatts (MW). Of this capacity 26.5 MW is in Port Vila (peak demand 11.3 MW), 4.1 MW in Luganville (peak demand 1.50 MW), 0.5 MW in Malekula (peak demand 0.12 MW) and 0.5 MW in Tanna (peak demand 0.12 MW). Around 29 percent of electricity is produced using renewable energy and the remaining 71 percent of electricity is generated from diesel powered plants using imported fuel.¹ In some other areas, such as provincial centres in Torba, Penama and Malampa provinces, electricity is provided through the provincial government and there are some community operated electricity generators such as Port Olry, but operation of this grid was recently taken over by VUI due to the inability of the community to continue to operate and maintain the grid.

8. The Department of Energy (DoE), within the Ministry of Climate Change Adaptation, Meteorology, Geohazards, Energy, Environment and Disaster Management, on behalf of the Government of Vanuatu, has recently completed a number of biofuel mini grids through a construction contract with UNELCO. The DoE is negotiating an interim management contract with one of the incumbent utilities for the operation of these mini grids. For the longer term, the Government's intention is for the mini grids to be "rolled into" the adjacent concessions when the concessions are renewed. The Government will also make provisions in the concession agreements for the incorporation of mini grids into the concessions in the future, starting with the Luganville concession agreement which is being tendered. Until such time as the mini grids are incorporated into the concessions, the Government intends to negotiate management contracts with the appropriate concession holders.

9. The Utilities Regulatory Authority (URA) regulates electricity tariffs in the concession areas. The electricity tariffs fluctuate with fuel, labor, and material prices in country. Prices for electricity supply outside the concession areas are not regulated. Outside the concession areas, the DoE is responsible for electrification projects (rural electrification). The DoE is responsible for central coordination of the development of the energy sector in Vanuatu, and plays a central role in coordinating energy sector development and policy. Other Government Ministries involved in the electricity sector include the Ministry of Infrastructure and Public

¹ Vanuatu Utilities Regulatory Authority



Utilities, which is responsible for all the public infrastructure of the government, and the Ministries of Education and Health, which have in the past been beneficiaries of solar energy packages for social institutions through various donors.

10. **Sectoral Context:** An estimated 30 percent of the Vanuatu population has access to electricity. On the four islands with electricity grids (Efate, Espiritu Santo, Tanna and Malekula), the share of those without access to electricity remains high: Efate (24 percent), Santo (65 percent), Tanna (86 percent), and Malekula (84 percent).² Even within the concession areas, about one in five households remain without access to electricity, primarily because of the up-front costs of connection to the grid and the grid network does not yet extend to all communities within the concession boundaries.

11. Access to electricity rates drop off considerably in rural areas; the population without access in rural areas ranges from 83 - 85 percent in Tafea and Shefa provinces, 89 percent in Sanma province, 92 percent in Malampa province and 97 percent in Torba province.³ Overall, it is estimated that only 20 percent of the rural population has access to electricity, usually through the use of diesel generators or solar systems. The lower population density in rural areas, remoteness and large distances between customers, lower electricity loads, and lower incomes (lower economies of scale and scope) have meant that the extension or building of new electricity grids for supply to peri-urban and rural consumers are generally not affordable or financially attractive. Further, there is absence of technical expertise and readily available supply chain in the remote areas and the implementation capacity in the Government is low. Government/supply driven approaches and community ownership and operations of facilities have generally not worked mainly due to the inability of government departments to fund the supply and maintenance in a sustainable manner and the communities' lack of technical and financial expertise. Alternative methods of services, such as private sector delivery, have been much more effective.

12. The most recent Household and Income Expenditure Survey (HIES) reported over half of the households in Vanuatu do not usually use electricity as the main means of lighting their homes. This number increased to approximately 70 percent in rural areas and decreased to 20 percent in urban areas. The HIES found that 42 percent of rural households use kerosene lamps as the main means of lighting, and approximately one-third of all Vanuatu households use such means for lighting, while other sources of lighting include candles (3 percent); wood/coconut shells (2.4 percent); Coleman lamp (1 percent); gas (0.4 percent), and of the total rural households, 20 percent of households reported 'other' sources of lighting.⁴ The Vanuatu socio-economic Atlas found only 6.3 percent of households have a solar system or solar lamp as the main source of lighting. The use of a solar system or solar lamp as the main source of lighting varies across the provinces: 7.5 percent in Torba, 7.2 percent in Sanma, 3.5 percent in Penama, 9.9 percent in Malampa, 7 percent in Shefa, 13.1 percent in Tafea.⁵ Of those households using electricity, 91 percent were supplied through UNELCO and VUI compared with only 3 percent using household generators and 2 percent receiving their electricity through the provincial government.

² Vanuatu: National Energy Road Map (NERM), 2013

³ NERM, 2013

⁴ Vanuatu Household Income and Expenditure Survey 2010, Vanuatu National Statistics Office, 2012.

⁵ Vanuatu Socio-Economic Atlas, 2014



13. There is consumer demand for higher capacity and semi-permanent solar systems (Solar Home Systems (SHS) and micro grids) that go beyond lighting and provides services for mobile phone charging, radios, laptops, water pumps, small fridges, etc. However, affordability is the biggest barrier for consumers to move up to SHS with higher power outputs and enhanced user benefits. The average total rural household income is VUV 79,500 (US\$750) per month, of which an average of VUV 69,300 (US\$630) is spent on total expenditures per household per month. On average, only 59 percent of a consumer's income is in the form of cash.⁶ Table 1 below shows average monthly income, average monthly cash income and net cash incomes in US\$ for the various provinces in Vanuatu. Moreover, access to finance is difficult for rural households who do not have a regular income, may not own land, and cannot demonstrate a credit history. The reach of financial services in the remote areas is being promoted but is in its infancy. Further, there is anecdotal evidence that consumers in Vanuatu have a preference to save before buying equipment. This may be due to unfamiliarity with credit mechanisms or due to distrust of arrangements due to prior bad experience with borrowing.

Table 1: Average Monthly Household Income by Province⁷

| | Torba | Sanma | Penama | Malampa | Shefa | Tafea | RURAL |
|-----------------------------------|-------|-------|--------|---------|-------|-------|-------|
| Average income (US\$) | 599 | 855 | 616 | 548 | 1,199 | 486 | 841 |
| Average cash income (US\$) | 317 | 496 | 289 | 306 | 971 | 146 | 426 |

14. In addition to SHSs and micro grids, a mini grid is an alternative option for electrification in more isolated island bound communities. While not a new technology, mini grids have recently captured growing interest as renewable energy becomes increasingly cost effective and technological advances – such as demand side management, energy efficient appliances, battery storage and smart grid developments – facilitating renewable integration and reducing the cost of decentralized generation.⁸ In addition, recent advancements in battery technologies and significant reductions in the cost to install storage systems has increased the viability for widespread adoption of storage systems in grid systems. In many remote applications, renewable energy mini grids are already the most cost-effective electrification option, and can provide a sustainable and secure energy service.

15. Throughout literature there is not a consistent definition of micro and mini grids. In Africa and Asia, mini grids are sized according to MWs, while in the Pacific a 500kW system is considered to be a grid. For the purpose of the project, and in the Pacific context, SHS/micro grids and mini grids are defined as follows:

- a. **Micro grids** = Direct Current (DC) or Alternating Current (AC) grids connecting a small number of contiguous households or businesses providing mainly SE4ALL Tier 2 or 3 access to household electricity supply (e.g., a school, staff quarters, local shop or a health center, staff quarters with

⁶ Vanuatu Household Income and Expenditure Survey 2010, Vanuatu National Statistics Office, 2012

⁷ Vanuatu Household Income and Expenditure Survey 2010. Vanuatu National Statistics Office, Government of Vanuatu. December 2012.

⁸ ITP, Development of Off-Grid Electricity Supply in Vanuatu – Pre-feasibility studies for Hybrid Mini grids



possibly some Tier 4 or 5 service, e.g., for refrigeration in a health center (AC with an inverter). This is essentially a large solar home system by Australian standards.

- b. **Mini grids** = AC grids connecting a number of households and businesses with SE4ALL Tier 4 or 5 access to household electricity supply (or intended for Tier 4 or 5 service in the short to medium term). These mini grids will be capable of receiving generation such as from mini hydros, biomass, etc. and may be later interconnected into island grids.

16. The lack of access to modern energy services that are affordable, safe and clean forces the low-income population to accept using higher priced inferior alternatives. Left unchecked, such a situation of “energy poverty” entrenches the income poverty trap, exacerbated by the inferior quality of health care, education and other local services needed, while also limiting income generation opportunities. Well-orchestrated and targeted actions and investments for scaling up modern energy access to all can make a significant difference in improving the lives of otherwise excluded rural and low-income population segments. In particular, well designed and targeted policies and investment plans for the sector aimed at bridging the “affordability gap”, especially for the low-income segments of the population, are crucial for ensuring broad-based and sustainable benefits.

17. Access to modern energy is a fundamental enabler and catalyst for economic development, and enhancing livelihoods and well-being of the population. The relationship between the use of modern energy and economic growth and development is fairly well established and documented. Energy fundamentally influences most aspects of people’s daily lives and well-being. Directly and otherwise, modern energy is central to achieving progress on almost all dimensions of human welfare and development, including education, health care, access to water, essential communications and information, as well as simple financial transactional services, income generation, and environmental sustainability. It is widely accepted from worldwide experience that electricity use and GDP per capita are highly correlated. Energy and development are mutually reinforcing factors in that energy not only returns from but also actively contributes to economic growth and development in national aggregated average terms.

18. The Government of Vanuatu has made the development of the electricity sector a top priority. The Government has recognized that access to electricity is a key driver for social and economic development. The Vanuatu National Energy Roadmap (NERM) 2013 - 2020, which was developed with support from the World Bank, lays the foundation for future energy sector policy and investment in Vanuatu. It seeks to address key constraints that have prevented the energy sector from delivering affordable modern energy access in an efficient and sustainable manner to the vast majority of the population of Vanuatu.

19. The NERM identifies five priority areas and targets for Vanuatu’s energy sector, including: (a) *Access* – Access to secure, reliable and affordable electricity for all citizens (100 percent) by 2030; (b) *Petroleum Supply* – reliable, secure and affordable petroleum supply throughout Vanuatu; (c) *Affordability* – lower cost energy services in Vanuatu; (d) *Energy Security* – an energy secure Vanuatu at all times; and (e) *Climate Change* – mitigating climate change through renewable energy and energy efficiency.

20. To address the climate change imperatives and meet its Intended Nationally Determined Contributions (INDCs) the Government of Vanuatu has set NERM targets to achieve 65 percent electricity generation from renewable energy by 2020 and 100 percent by 2030. Further, it proposes to achieve the access targets in a



sustainable manner with solutions (on the Sustainable Energy for all (SE4ALL) spectrum) that take into account: (i) economic and financial viability, and least cost approaches; (ii) countries' resources, technical expertise and implementation capacity; (iii) geographic spread – economies (or lack of) scale, and supply chain; (iv) affordability considerations; and (v) sustainability – built around creating sustainable private sector industry both for grid and off grid supply.

C. Higher Level Objectives to which the Project Contributes

21. The development of Regional Partnership Framework (RPF), which would include consideration of Vanuatu's priorities and objectives, is underway. The draft RPF sets out four focus areas and objectives supported by the World Bank Group (WBG) program: 1) *Fully exploiting the available economic opportunities*, 2) *Enhancing access to employment opportunities*, 3) *Protecting incomes and livelihoods*, and 4) *Strengthening the enablers of growth opportunities (macroeconomic management, infrastructure and addressing knowledge gaps)*. Objective 4.2, *increased access to basic services and improved connective infrastructure* identifies the WBG program in Vanuatu will contribute to improving access to basic infrastructure services through rural electrification and peri-urban electricity supply in Vanuatu. The project is well aligned to the focus areas and objectives of the draft RPF.

22. A Systematic Country Diagnostic (SCD) including eight (8) Pacific Island Countries (PIC8) has been completed and includes the priority areas of strengthening climate and disaster resilience and maintaining and developing economic infrastructure. The project is consistent with the priorities set out under SCD for PIC8 and directly supports the Government's Priority and Action Agenda 2006-2015 which aims to: (a) reduce the cost of services; (b) extend the coverage of rural electrification; and (c) promote the use of renewable energy. The project is consistent with Government of Vanuatu's current vision for a more diversified economy and more equitable social and economic development.

23. The project will also contribute to global efforts to mitigate climate change by promoting the use of clean energy technologies, including the use of solar energy solutions in rural areas, to displace the current use of mainly kerosene for lighting and contribute to the World Bank's twin goals of (i) eliminating extreme poverty and (ii) boosting shared prosperity and the objectives of the SREP Investment Plan.

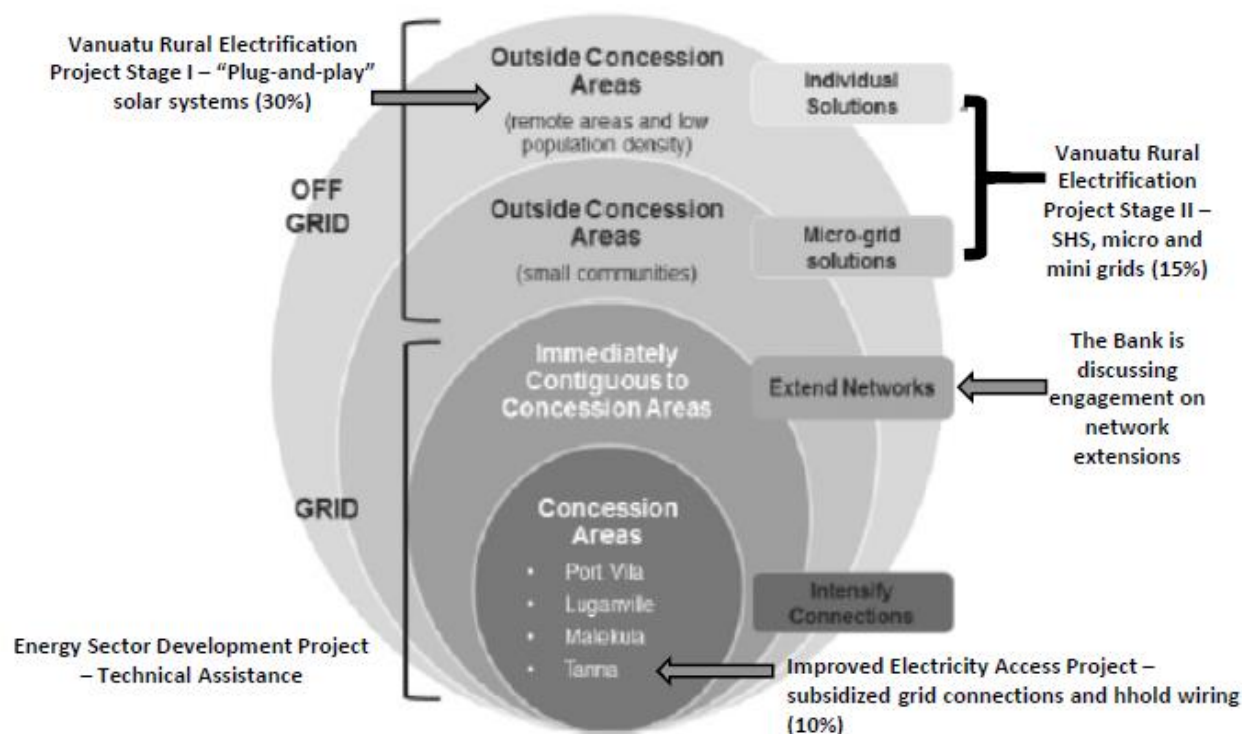
24. This project supports the Government of Vanuatu's objectives and targets for increasing access to secure, reliable and affordable electricity of its citizens under the NERM. The Project will contribute to increased access and affordability of electricity for communities in rural Vanuatu, in line with the key targets for electricity access as identified in the updated NERM: (i) by 2030, provide modern electricity access to 100 percent of households in off-grid areas, (ii) electrify 100 percent of public institutions in off-grid areas by 2030, (iii) 100 percent electricity generated from renewable sources, and (iv) 14 percent of electricity generated from biofuels.

25. This project is well placed within the World Bank's engagement in Vanuatu's energy sector. Figure 1 illustrates how the World Bank is supporting the Government of Vanuatu to achieve access and renewable energy targets of the NERM for Vanuatu through a comprehensive investment program targeted at different



segments of the energy sector.⁹ Together the World Bank supported energy projects will increase access to electricity from the current 30 percent to over 80 percent over the medium term.

Figure 1: Strategic Framework for Scaling up Electricity Access Nationwide by 2030



26. Of the 55,000 households in Vanuatu, an estimated 23,300 are in grid-concession areas or in adjacent areas feasible for grid-extension. The DoE is implementing the Improved Electricity Access Project, which provides assistance to low income consumers who are still not connected or currently share a connection within the existing concession areas. The project is funded by the Global Partnership on Output-Based Aid through the World Bank and is being delivered by UNELCO and VUI. The project is targeting over 4,300 households within the concession areas and will increase the total population with access to electricity by 10 percent. To date, the project has supported over 750 households to obtain an electricity connection and household wiring to standard.

27. The remaining 31,700 households are in areas termed “off-grid”. Some of these households are in dispersed off-grid areas that are located beyond the economic grid extension areas, and those that are too dispersed across the off-grid areas to be considered for isolated micro and mini grid configurations (approximately 19,740 households). The Government of Vanuatu is working with the World Bank to implement the Vanuatu Rural Electrification Project Stage I (VREP I) to scale up access to electricity services through “plug-and-play” systems, between 5 Watt Peak (Wp) and 100 Wp, for 17,500 rural households (approximately 85 percent of dispersed off grid households) and aid posts and community halls.¹⁰ VREP I is the first phase of the

⁹ NERM, 2013

¹⁰ “Plug-and-play” solar system is defined as a portable system comprising one or more solar panels and battery that provides



World Bank supported project under the Scaling-up Renewable Energy Program (SREP) Investment Plan for Vanuatu (details below). VREP I will contribute an additional 30 percent of households with access to electricity, and will increase the share of generation of electricity from renewable sources.

28. The remaining households are relatively concentrated and are more likely to benefit from advanced SHS or a micro or mini grid configuration, powered by local resources, such as solar, hydro and other renewable energy technologies where available, biodiesel/diesel generators, or hybrids of the two. It is estimated that 30 percent of off-grid households (approximately 9,500 households) are in this category (including the few estimated to have operating or forthcoming micro or mini grid installations). In addition to the off-grid households, schools, health centers, dispensaries, post offices and aid stations provide vital services to poor and isolated communities. The Government of Vanuatu commissioned a pre-feasibility study to determine potential sites for mini grids in rural Vanuatu as part of the implementation of the SREP Investment Plan for Vanuatu. The findings of the pre-feasibility study are reflected in the project design. VREP II will contribute an additional 20 percent of households with access to electricity, and will increase the share of generation of electricity from renewable sources.

29. The SREP was developed under the CIF umbrella to demonstrate the social, economic and environmental viability of low carbon development pathways in the energy sector. In March 2012, Vanuatu and Solomon Islands were invited to participate in the SREP Pacific Regional Program and to prepare country specific investment plans. The Government of Vanuatu in 2013 prepared Vanuatu's country specific investment Plan. The Government and the (SREP sub-committee endorsed and approved respectively the Investment Plan for Vanuatu in November 2014. The Investment Plan was put forward for consideration for investment funding with two projects: (i) investment in two small hydro projects through the Asian Development Bank and (ii) the Vanuatu Rural Electrification Project (VREP) through the World Bank. VREP comprises two components: (i) VREP I - "plug-and-play" solar systems under a vendor model to consumers in rural and remote areas where micro and mini grids are not feasible, and (ii) VREP II - Solar Home Systems (SHS), and where feasible micro and mini grid development in areas where extension of existing grids is not an option.

30. Finally, the project will broadly contribute to increased gender equality in Vanuatu. The World Bank publication, "One Goal, Two Paths", notes that the improved access to electricity and modern cooking solutions promote gender equality and empower women in line with Sustainable Development Goal (SDG) 5 – *Achieve gender equality and empower all women and girls*. In addition, access to electricity also has a significant impact on the achievement of the SDGs (SDG 7 – *Ensure Access to affordable, reliable, sustainable and modern energy for all*). Lighting is one of electricity's most important and widely adopted benefits and positively impacts many of the SDGs. Lighting enables reading after daylight and a better environment for education, development of home enterprises, social interactions and leisure activities. SDGs seek to reduce poverty while increasing education, empowering women and improving child and maternal health to agreed levels by 2030. Access to modern energy is a crucial input to meeting the SDGs and requires progress on both paths: electricity and modern cooking solutions.

lighting and phone charging. The system does not require specialist technical knowledge to install the system.



II. PROJECT DEVELOPMENT OBJECTIVES

A. PDO

The Project Development Objective is to support increased penetration of renewable energy and increased access to affordable electricity services in the dispersed off-grid areas of Vanuatu.

B. Project Beneficiaries

31. The primary beneficiaries are the households, public sector institutions and businesses in rural off-grid areas that are considered suitable for SHS, micro or mini grid configurations.¹¹ A total of approximately 8,950 households (of which approximately 13 percent are female-headed) and public institutions and business located in these rural communities will benefit directly from this project.¹²

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

33. The project will contribute towards building a sustainable private sector industry for the supply, operation and maintenance of renewable energy systems in the rural areas. As such, it will provide opportunities for employment, including for women, in the rural areas.

34. The project will strengthen the capacity of the Government of Vanuatu and the DoE to implement key energy sector projects and build technical and fiduciary skills within the Department to support rural electrification.

C. PDO-Level Results Indicators

35. Progress will be measured against the following results indicators:

- a. Generation capacity of energy constructed or rehabilitated (MW) – The indicator measures in MW the generation capacity of renewable energy facilities constructed through operations supported by this project.

¹¹ Micro and mini grids will be solar photovoltaic systems with battery, with biodiesel backup to meet system stability and reliability needs. Gas, such as LPG, is emerging as an alternative to biodiesel and may be considered as backup options.

¹² Vanuatu Household Income and Expenditure Survey 2010, 15, Vanuatu National Statistics Office, 2012



- b. Annual electricity output from renewable energy as a result of renewable energy constructed under the project (GWh)
- c. People provided with new or improved electricity service (number) – This indicator measures the number of people that have received new electricity services through operations supported by this project.

III. PROJECT DESCRIPTION

A. Project Components

36. The project will strengthen the capacity of the Government of Vanuatu and the DoE to implement key energy sector projects and build technical and fiduciary skills within the Department to support rural electrification. This project will support the implementation of the SREP Renewable Energy Investment Plan for Vanuatu. The project under the Investment Plan comprises two projects: Vanuatu Rural Electrification Project Stage I (VREP I) and Vanuatu Rural Electrification Project Stage II (VREP II).

37. VREP I was prepared and approved in parallel to the preparation and endorsement of the Vanuatu SREP Investment Plan. The objective of VREP I is to scale up access to electricity services through plug-and-play solar systems for rural households, aid posts and community halls located in disbursed off grid areas. The total project cost is US\$7.8 million comprising a Pacific Region Infrastructure Facility (PRIF) grant totaling US\$4.7 million and US\$3.1 million in the form of customer contributions toward the retail cost of the systems. VREP I consists of two components: Electrification of 17,500 off-grid households, 230 aid posts and 2,000 community halls (US\$6.2 million) and technical assistance and project management (US\$1.6 million). The project subsidizes the retail cost of the approved solar systems by 50 percent initially. The level of subsidy will be scaled back as the market becomes self-sustaining. The initial level of subsidy was determined through an assessment of Willingness to Pay, average cash income levels for rural households and the expected retail costs of systems.

38. Under VREP I, Vendors (retailers registered and approved by the DoE) supply approved products that are included in a Product Catalogue (products must be registered under the Lighting Global program) to qualify for subsidies. Using Lighting Global certified products ensures high energy system performance, such as lighting output and run time as well as high quality and durability, such as protection from physical ingress and water and battery protection. The size of “plug-and-play” systems was initially limited to between 5 Wp and 30 Wp to target the very remote communities. The size of products will be increased over time with the condition being that the products be suitable for installation and maintenance by users due to the remoteness of the target beneficiaries and lack of technical expertise in those areas.

39. The roll out of “plug-and-play” systems commenced in February 2016. Since February, over 650 approved systems have been sold in more than 20 islands achieving national coverage. Overall sales have been increasing as the vendors gain confidence with the demand for the products and increase the size of their orders, strengthen and expand their supply chain, and work towards innovative ways of supporting householders in remote areas of Vanuatu to access the products and to finance their contribution.



40. Building on VREP I, VREP II will support SHS, micro and mini grids in rural areas, strengthen institutions, and increase business opportunities for the private sector for the supply decentralized electricity services. VREP II will transition from “plug and play” systems to more advanced SHS that require technical support, micro grids and mini grids where the latter can be supported on economic or piloting benefits. The project includes three components:

41. **Component One:** *Provision of Solar Home Systems and micro grids in rural areas of Vanuatu (US\$5.37 million).* This component will support expansion of access to reliable electricity service in rural Vanuatu through SHS and micro grid configurations where mini grid configurations are unlikely to be economically viable and which are not earmarked for mini grids under this or other donor or government projects or are the least cost solution. SHS and micro grids will be available to rural households and public institutions.¹³ This component will target approximately 37 public institutions and 8,400 rural households, which equates to approximately 42,000 people.¹⁴

42. SHS and micro grids may include systems for household use (of varying capabilities and costs as per demand) and will be available for purchase to all rural consumers, a community application, for example, for a church, electrification of a health center based on its needs, and may include solar water pumps or other similar applications. To ensure the project is reaching the targeted beneficiaries, data on household income will be collected during either the application or verification process. The project will partly subsidize the retail cost of SHS and micro grids. An amount will be established (initially 33 percent of retail cost) and then may be varied over time depending on the take up rate and the size of the system. The consumer will arrange his/her portion of the funds for the purchase (initially 67 percent of the retail cost), either by means of cash or microfinance credit (either via a microfinance provider or through the vendor).

43. Under this market-based mechanism, consumers will purchase systems from competing vendors at subsidized prices. Information on products will be disseminated through vendors and communities via a Product Catalogue, which will list all products the vendors are selling and that are eligible for a subsidy under the project. The technical standards (international standards) and the type of products available under this component will be set out in the catalogue which will be reviewed from time to time, or in the case of micro grids it may be sourced through tender which will set out the specifications, standards and operations and maintenance arrangements. Vendors may also undertake direct marketing and road shows such as those done for VREP I and drawing on the experience from the Sustainable Energy Financing Project in Fiji. The consumer will inform the vendor of his/her intended purchase, either by visiting the shop or through post/phone/email communication, and arrange payment.

44. **Component Two:** *Construction of mini grids in rural areas of Vanuatu (US\$6.8 million).* This component will support the expansion of access to reliable electricity services for rural communities through support for the design, supply, installation and commissioning of mini grid systems. The project will finance the construction of 5 mini grids, based on initial cost estimates. The criteria for selection of sites with potential to support a mini grid is: (i) community household numbers greater than 75 households; and (ii) business and public institutions load greater than 50 percent of the total load. This component will support electricity service

¹³ Public institutions under this component may include community facilities such as community halls and churches.

¹⁴ On average 4.9 (or five) people usually live together in one household...Urban households were on average slightly larger than rural ones with an average of 5.2 people. Vanuatu Household Income and Expenditure Survey 2010, 15, Vanuatu National Statistics Office, 2012.



provision to approximately 550 rural households, which equates to around 2,750 people, and public institutions and businesses.

45. **Component Three: Technical Assistance and Project management (US\$2.0 million).** This component addresses three key areas of the project, the first focusing on the vendor registration model for Component one, the second focusing on Owners' Engineer for Component two and the third focusing on project management. In addition, there is an allowance for Government contribution (US\$1.5 million "in kind") that will cover the Government of Vanuatu's direct project related costs, such as arrangements for voluntary land donation and other inter-departmental support. The main areas and key activities funded under the project are set out below:

- a. Vendor and product registration arrangements, communications and implementation arrangements. Building on the established implementation arrangements under VREP I, the following activities will be financed to support the implementation of the investment activities under Component 1: (a) hire a technical consultant to prepare technical standards; (b) amendment of the vendor registration arrangements to incorporate SHS and micro grids; (c) amendment of product registration arrangements (for a product catalogue) to incorporate SHS and micro grids; (d) development of program and product awareness, safety and product care training material for communities, and end users; (e) establishment of a grievance mechanism for end-user and communities; (f) explore opportunities for the development of a microfinance product to encourage lending in rural areas; and (g) support for adoption of legislation, regulations and/or further refinement of the VREP I Environmental Code of Practice (ECOP) for disposal of batteries and solid wastes for products under the project.
- b. Owners' Engineer. The following activities will be financed to support the preparation and implementation of the investment activities under Component 2: (i) site selection; (ii) technical design of each micro and mini grid; (iii) prepare the environmental and social impact assessment and management plans; (iv) preparation of bid documents and contracts for the construction of the micro and mini grids and assist with the bidding and award process; (v) supervision of the construction and commissioning works; and (vi) compliance and reporting on the implementation of the environmental and social impact assessments and management plans.
- c. Project management and support. The following activities will be financed for effective implementation, monitoring and reporting under the project: (i) execution of awareness programs to rural communities and consumers in Vanuatu, in particular consultation with communities on the long list to request their expression of interest to receive a micro or mini grid; (ii) verification agent to certify the retail sales of SHS and micro grids under Component 1; (iii) capacity building and implementation support to the DoE through the Owners' Engineer; (iv) monitoring, evaluation and annual reviews of the project; and (v) operating costs associated with this project as provided for in the legal agreement.



B. Project Cost and Financing

46. The total estimated project cost is approximately US\$14.17 million, with an IDA credit of US\$2.0 million equivalent and IDA grant contribution of US\$2.0 million equivalent. The IDA funds will leverage US\$6.77 million grant funding from SREP and US\$3.4 million equivalent from New Zealand through the Pacific Region Infrastructure Facility. Customers (households and public institutions) will contribute approximately US\$11.2 million toward the total cost of the project (customer contribution for a SHS or micro grid and customer contribution toward service connection and household wiring to a mini grid). The customer contribution is determined by the total number of SHS and micro grids solar and the total number of mini grids constructed under the project.

47. The table below presents the indicative financing plan.

| Project Components | Project cost | IBRD or IDA Financing | Trust Funds |
|---|--------------|-----------------------|-------------|
| Provision of Solar Home Systems and micro grids in rural areas of Vanuatu | 5.37 | 1.5 | 3.87 |
| Construction of mini grids in rural areas of Vanuatu | 6.8 | 2.5 | 4.3 |
| Technical Assistance and Project management | 2.0 | | 2.0 |
| Total Costs | | | |
| Total Project Costs | 14.17 | 4.0 | 10.17 |
| Total Financing Required | 14.17 | 4.0 | 10.17 |

C. Lessons Learned and Reflected in the Project Design

48. The project has been designed taking into account lessons learned from experiences of the World Bank and other development partners in rural electrification. Experiences from specific projects include Lighting Vanuatu funded by Australian Aid/Australian Department of Foreign Affairs and Trade, VREP I (P150908), Fiji Sustainable Energy Financing Project (P098423), and Bangladesh Rural Electrification and Renewable Energy Development I and II (P071794; P131263) have been considered, as well as lessons learned from hybrid mini grids for rural electrification around the world. Key lessons reflected in the design are:

- a. There is a strong demand for solar in rural communities where grid electricity is not available: In Fiji, apart from early loans for biodiesel and some energy efficiency



equipment, lending has been virtually exclusively for renewable energy, especially solar PV for which there is now a strong market and retail business in Fiji.

- b. The best and sustainable delivery model is through the private sector by stimulating demand to create viable, competitive supply business: In the case of Fiji through a risk facility and in Vanuatu through subsidies (VREP I). A similar approach is envisaged for Component 1 of VREP II through subsidies to stimulate demand and create a sustainable industry. A private sector delivery model for supply and maintenance also addresses the issue of lack of capacity at government level.
- c. Use of existing supplier networks in Vanuatu to distribute solar lanterns (Lighting Vanuatu) and plug-and-play solar systems (VREP I): in addition to the retailers participating in VREP I, there is a number of other retailers who have experience in providing, installing and maintaining larger solar home systems in rural areas of Vanuatu. Increasing the scale and scope of the rural electrification program through VREP II has the potential to attract international players in the market, especially in the delivery of SHS, micro and mini grids.
- d. Targeted subsidies: Other projects, such as the rural electrification project in Bangladesh, have used targeted public subsidies to reduce the upfront costs and increase affordability of SHS to low-income consumers.¹⁵ Accordingly, the design of this Project includes a subsidy for households, public institutions and businesses.
- e. Microfinance to complement or substitute the subsidy approach: Other projects have used microfinance to reduce the upfront costs and customer contribution and increase affordability of SHS. One of the service providers under VREP I is already considering an arrangement with the National Bank of Vanuatu for microfinance. Microfinance will be considered under VREP II.
- f. Lack of maintenance resources and capacity in Vanuatu: The lack of a capacity and resources has seen many of the systems installed under other projects in the Pacific fail to be maintained because of the lack of the resources and capacity and due to competing demands. As examples, community run systems such as Port Olry mini grid in Vanuatu have suffered from lack of commercial and technical expertise and competing demands of core business of health and education departments which has meant that the capacity and funds have not been readily available to maintain those electricity supply systems. Therefore, in response to Vanuatu's rapidly changing rural electrification environment, this project seeks to provide communities with quality systems and educate communities on basic maintenance to extend the life of the systems. The systems are also provided with these constraints in mind; for the very remote communities the systems of choice are the "plug-and-play" systems, for areas with higher population density and easier access SHS and micro grids are more appropriate. Where economic, mini grids are to be

¹⁵ Bangladesh Rural Electrification and Renewable Energy Development Project. Implementation Completion and Results Report. World Bank. June 26, 2013; Mongolia Renewable Energy and Rural Electricity Access Project. Implementation Completion and Results Report. World Bank. December 17, 2012.



considered. The demand-driven approach to retail systems, ensures that suppliers reflect the costs in their warranties and thus ensure a market-based selection of the right systems. High maintenance, donor supply-driven approaches have led to sub-optimal solutions (in size in maintenance needs), which have led to systems failing due to lack of maintenance (e.g., rural projects in Kiribati and Vanuatu). In addition, for systems that require technical expertise for supply and maintenance, the process for qualifying vendors will require such expertise and geographic reach. The vendors will also be required to provide acceptable warranty periods and defects liability period (of the order of 5 years). Mini grids will be operated and maintained by local service providers and procured through competitive tender by the Government of Vanuatu.

- g. Verification on a sample basis: Inspection on a random sample basis to verify that the installations were in off-grids areas, retailers have used certified products, technical requirements have been met and systems were fully operational. Verification of the sale of products will be undertaken by a verification agent, who is appointed under VREP I.
- h. Positive impact on women and children: Access to solar lanterns in rural Vanuatu under Lighting Vanuatu has contributed to energy autonomy for women, the elderly and children. Women are now playing a greater role in the management of a household's energy and lighting than they generally have in the past. Previously, they were often forced to wait for their husbands' to return from the store with fuel in order to start the generator or light the kerosene lamp. Furthermore, the worry associated with children, the elderly, or other vulnerable people handling kerosene lamps has now been eliminated. During the review of Lighting Vanuatu, most women talked about the additional work they now undertake in a positive, social sense – small groups of relatives or friends coming together to work on weaving, sewing or handicrafts in the evenings. This project will also provide economic opportunities for women and girls. More generally, most villagers found that there is now more opportunity to socialize. People regularly mentioned the use of solar lanterns for village and inter-village functions. While lighting also brings with it the potential for some anti-social outcomes, it is surprising that none were mentioned during the extensive survey and interview processes – although it may take time for communities to fully appreciate both the upside and downside of improved and mobile lighting.

49. Finally, the project design also takes into account lessons learned on the sustainability of rural electrification projects.¹⁶ Rural electrification projects must be consistent with the overall national electrification plan. Projects must also utilize least cost design and not be technology driven. The report highlights, early efforts must be made to maximize community awareness, involvement, and support. Importantly, the design must reflect the capabilities of the retailers/vendors and service providers and ensure adequate financing. In addition, training should be provided to participating government staff, retailers/vendors, service providers, and consumers. Finally, customers must have access to quality equipment and products and qualified maintenance and repair services, as well as spare parts over the long term.

¹⁶ Operational Guidance for World Bank Group Staff: Designing Sustainable Off-Grid Rural Electrification Projects: Principles and Practices, 2008



IV. IMPLEMENTATION

A. Institutional and Implementation Arrangements

50. The Ministry of Finance and Economic Management will be the Recipient and would enter into a Financing Agreement with the World Bank. There will be three Financing Agreements signed for this project, one for each source of financing (IDA, SREP and PRIF). Other line ministries and governmental departments (Ministry of Health; Ministry of Education; Department of Environment; Department of Local Authorities; and potentially others) will be directly or indirectly involved in performing roles and implementing activities within their respective mandates.

51. The DoE, within the Ministry of Climate Change and Natural Disaster, will be the Implementing Agency for the Project and will therefore have overall responsibility for project management. The DoE is implementing other World Bank financed energy projects, the Energy Sector Development Project (P145311), Improved Electricity Access Project (P133701) and VREP I (P150908), and is familiar with the Bank's policies and procedures (i.e., procurement and financial management). Since 2011, the DoE has grown from 1-2 staff to over ten (10) staff. The DoE is recruiting for a number of key positions which will further strengthen the current capacity of the department. In addition, the DoE staff are supported by five consultants funded under World Bank financed projects, including the Project Manager for VREP I & II.

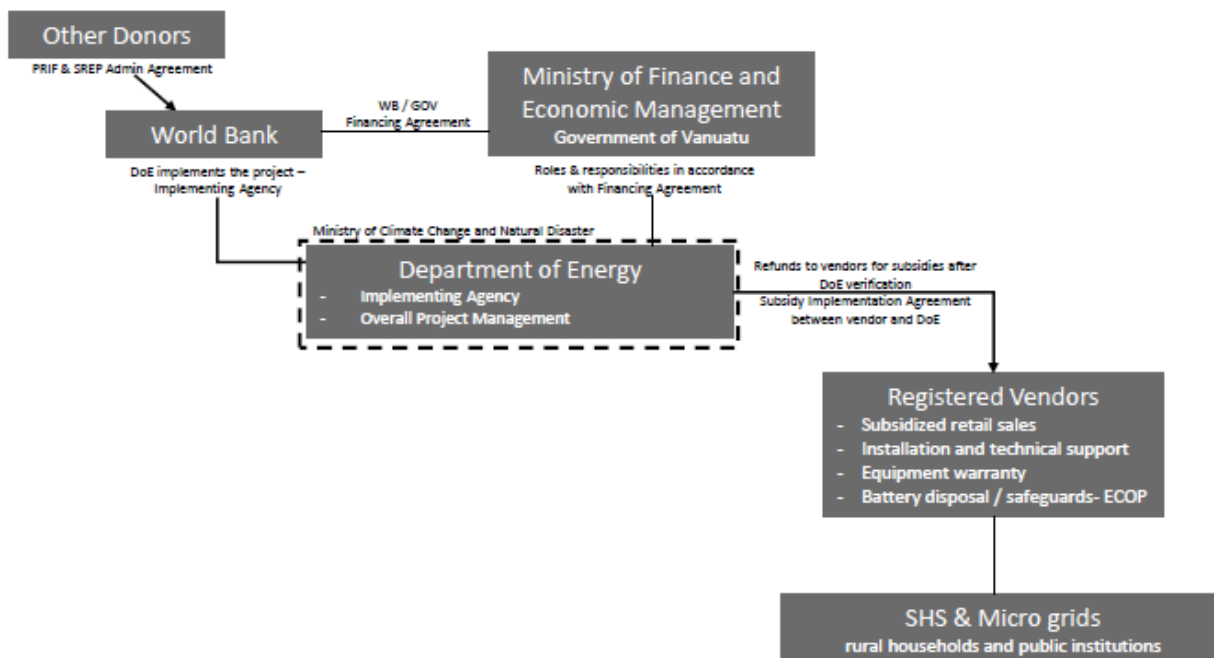
52. VREP II will be the largest program the Department has undertaken. The implementation of VREP II will stretch the capacity of DoE's staff and consultants. The project will provide under Component 3 project implementation support and technical assistance to strengthen DoE's technical capacity, environmental and social safeguards oversight and its fiduciary capacity. The project will support the recruitment of a technical specialist to support the vendor and product registration arrangements, communications and implementation arrangements and a verification agent to verify product sales to support implementation of Component 1 and an Owner's Engineer to support implementation of Component 2.

53. Under Component 1, energy retailers will apply to the DoE to be registered as Vendors to participate in the project. Each Vendor will enter into a Subsidy Implementation Agreement (SIA) with DoE on behalf of the Government of Vanuatu. The SIA sets out the rights and obligations of all parties to the agreement, and establishes the legal basis for paying the subsidy. Vendors may register (or deregister) at any time after the project becomes effective and until the project closing date in accordance with the criteria and procedures set out in the Project Operations Manual (POM) and the Subsidy Implementation Manual (SIM). The vendors will be responsible for submitting subsidy payment requests to the DoE for verification by a verification agent. The verification agent will verify the sales of SHS and supply of micro grids and other qualifying products and record the subsidies provided to end users. The POM and SIM will set out the roles and responsibilities, processes and monitoring and evaluation requirements for Component 1 of the Project.

54. The implementation arrangements for Component 1 are presented in **Figure 2**.



Figure 2: Implementation Arrangements for Component 1



55. Under Component 2, the DoE will hire through competitive selection an Owner's Engineer. The owner's engineer will be responsible for preparing the detailed designs, technical specifications and tender documentation for each mini grid system, supervise the construction of the mini grids, and support preparation of the necessary safeguard documents and implementation of any safeguard documents (e.g., Environmental and Social Management Plans). The Owner's Engineer will report to the Director, DoE, with day to day supervision provided by the VREP Program Manager.

56. The DoE will be responsible for inviting communities identified on a long list of potential sites for mini grids to elect to receive electricity through a mini grid and inform them of the objectives and structure of the project. The communities will identify suitable land to house the mini grid infrastructure. The preference is for Government or Church leased land. The DoE will be responsible for negotiating land access for the mini grids and overall preparation of the necessary safeguard documentation to meet the requirements of the Environmental and Social Management Framework (ESMF) and the Resettlement Policy Framework (RPF).

57. The community engagement process will consist of public meetings and face-to-face discussions with communities to discuss energy needs and issues in the community, enable the Department to illustrate the technology, discuss the technology benefits and the implications of the community becoming customers, and to discuss and identify suitable land to house the necessary infrastructure. The objectives of the engagement process are: (i) to understand the energy issues and needs of the community; (ii) inform communities they are eligible to receive a mini grid, and (iii) to ensure that all communities who decide to receive a mini grid are well advised of the benefits, costs, obligations, and financial requirements of participating. The Owners' Engineer will support the Department in the preparation and planning for the community engagement process. An emphasis will be placed on ensuring that women are engaged, and that all community members are well

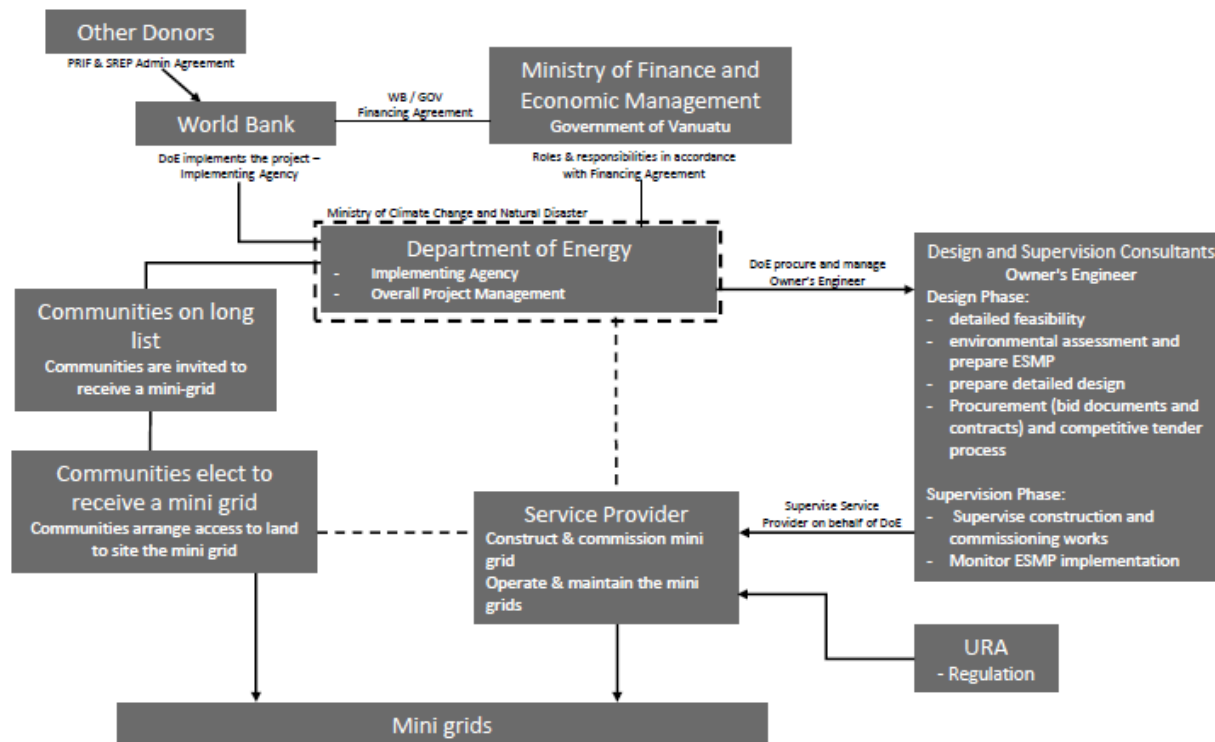


informed and have a chance to participate.

58. The construction and commissioning of the mini grids will be undertaken by a Service Provider, which may be the incumbent utilities (UNELCO and VUI) or a new private sector operator, identified through competitive tender. The operation and maintenance of the mini grids will be funded through tariffs. The mini grids will be operated and maintained by a Service Provider under a management contract until such time as the concessions come up for re-tender or the mini grids will be “rolled into” the neighboring concession areas. Community based models have failed in Vanuatu and other PICs due to a lack of technical and financial capacity and have not been considered as an option. The operations and maintenance contract may be by competitive tender or by negotiation with the incumbent utilities. The management contract will be negotiated and signed by the Service Provider and the Government of Vanuatu, and administered by the URA.

59. The implementation arrangements for Component 2 are presented in **Figure 3**.

Figure 3: Implementation Arrangements for Component 2





60. **Gender:** The project aims to increase access to energy services in rural communities. Improved access to electricity and modern fuels reduces the physical burden associated with organizing alternative energy sources. Access to electricity also frees valuable time, especially for women, widening their employment opportunities. Access to modern energy can go a long way in improving health and reducing premature mortality, especially among women and children.

61. The project's objective is to increase access to electricity services for rural households, including female headed households, by subsidizing the retailer cost of SHS and micro grids and subsidizing a household service connection and household wiring to a mini grid through the ongoing Improved Electricity Access Project. Where feasible mini grids will install pre-paid meters. Pre-paid meters are proposed to help consumers to control their consumption and therefore expenditures on electricity. Information on how to use, read and manage the pre-paid meter, where/ how to purchase the top up, etc., needs to be broadly conveyed to consumers.

62. In Vanuatu, land tenure is either matrilineal or patrilineal depending on the island and province. The design of community engagement will take into account the differentiation in land rights in the various geographical regions where the mini grid equipment will be installed to ensure the project does not undermine women's status and authority in regards to land tenure. In addition, the engagement process will try to organize meetings at times when women are available to participate, to conduct separate meetings with men and women if the context so requires, and to ensure that communication and information reach out to women and utilize the most appropriate communication methods that will ensure women are fully informed and can participate meaningfully in decision-making.

63. The project will track the number of people provided with access to electricity by household connections – disaggregated by gender. The intermediate indicators will also cover the number of direct project beneficiaries (number), of which are female (percentage). The project will also record the number of female headed households who receive a SHS, micro grid or a connection to a mini grid under the project.

64. **Citizen Engagement:** The key mechanism for citizen engagement will be site-specific consultations. These consultations will be held in each project location and with invitations extended to the broad community with special focus on women, vulnerable groups, schools, medical centers, and small business owners, in order to have broad discussions on energy issues in the community, the costs and benefits of the project, opportunities for ensuring the project provides benefits across the community, and potential social risks from the project are avoided or mitigated. The consultations will be recorded by the Department of Energy including how many people attended the consultations disaggregated by gender. The verification process under Component 1 may also involve short interviews with representatives from the household to obtain consumer feedback and satisfaction with their experience and use of the SHS or micro grids. Broad community engagement will also consider engaging various sectors for the consultation and public awareness campaign (including Vanuatu National Council of Women; Vanuatu Women's Center, youth groups, etc.). During a Mid-Term Review, the Department of Energy will conduct a survey to assess what impact obtaining electricity has had on the household, including whether the communities' needs were heard and whether they are satisfied with the results. A final survey will be completed just prior to the project closing date.



B. Results Monitoring and Evaluation

65. The monitoring and evaluation system, including but not limited to assessing the progress and effectiveness of the Project, will be based on the agreed specific indicators defined in the Results Framework. Additional indicators, such as monitoring of the number of female headed households who benefit from the project, will be set out in the Project Operations Manual. As the implementing agency, the DoE will be responsible for ensuring the timely and accurate collection of the requisite indicator data. The achievements of the indicators will be reflected in the requisite six monthly reports prepared by the DoE and submitted to the World Bank for review.

66. **Project reporting.** A series of reports from DoE and the owners' engineers will allow for the specific monitoring and evaluation of the implementation of the project and achievement of its objectives.

- a. DoE will submit six monthly performance reports to the World Bank in accordance with the reporting requirements set out in the Project Operations Manual.
- b. DoE will provide Interim Financial Reports on a six monthly basis to the World Bank.
- c. DoE will provide audited project financial statements annually.
- d. DoE will provide a Completion Report not later than three (3) months after the Closing Date of the Grant Agreement.

C. Sustainability

67. The Government of Vanuatu has demonstrated strong commitment and ownership of the project. The project concept was developed by the Government of Vanuatu through a participative process as part of the SREP Investment Plan preparation in 2014. The IDA financing for the project was approved by the Council of Ministers (COM 56/2015) in May 2015. The main driver for sustainability of the project is the Government's commitment to off-grid electrification to achieve the access and renewable energy targets set out in the NERM. The DoE will benefit from technical assistance from the Owner's Engineer. The Owner's Engineer will provide expertise and best practices related to rural electrification and hybrid mini grids.

68. The economic results and financial performance of the project is critical to ensure the long term sustainability of the project. Both the economic and financial outcomes are challenging and the components have been designed to support those mini grid installations that are going to have the best prospect of financial sustainability. Further, electrification for households where mini grids are not likely to be economic or financially viable will be through SHS and micro as least cost solutions. Financial viability of the mini grids remains an issue, so the mini grids will need to be subsidized while balancing the impacts on the Government, the service providers, the end users (beneficiaries) and the communities. As such, only 5 mini grids are proposed initially. Rollout of mini grids beyond the initial stage will be subject to recalibration and lessons learnt from the piloting phase.

69. A sustainable market for SHS and micro grids created over the life of the project, will create employment and small business opportunities to the wider community of Vanuatu, from establishing a private sector for the supply of SHS and micro grids in the outer islands and from the generation of long-term maintenance of



the larger solar installations. The private sector will also indirectly benefit from the establishment of an accreditation program and the development of national standards and regulations, in strengthening their business and operation practices and delivering and installing only safe and compliant systems to the communities.

D. Role of Partners

70. This project has been developed in accordance with the NERM which seeks to coordinate donor efforts in the Vanuatu energy sector and is in accordance with the Vanuatu's Scaling-Up Renewable Energy Investment Plan, 2014. The Government of Vanuatu coordinates development partner activities in the country. In addition, the World Bank coordinates its activities through the Pacific Region Infrastructure Facility forums to maximize synergies and avoid duplication with project financed by other donors, and to build on shared knowledge and active dialogue among the donors working with the Government of Vanuatu in the area of renewable energy.

71. The partners in this project, the World Bank, CIF/SREP and New Zealand Ministry of Foreign Affairs and Trade (NZMFAT), in addition to providing funds (details in section B), provide expertise, knowledge and donor oversight for the project design and implementation.

V. KEY RISKS

A. Overall Risk Rating and Explanation of Key Risks

72. The overall risk rating during preparation and implementation is substantial.

73. The micro and mini grids will lack economies of scale and will be dispersed. This may require significant incentives and/or "packaging" of the systems to create a commercially viable operation to attract the private sector. The sales of SHS and micro grids will require strong oversight to ensure the products reach the targeted beneficiaries.

74. Whilst VREP I has opened the market for energy retailers to participate in the sale of solar products and expand their distribution networks across Vanuatu, SHS and micro grids will require an additional level of technical expertise to install the systems. In addition, retailers will need to undertake periodic maintenance which will require deploying trained technicians to the outer islands or relying on locally based trained technicians. There is a risk that there are not enough energy retailers based in Vanuatu to create a competitive market for the provision of SHS and micro grids to rural areas.

75. The private sector may not be interested in constructing and operating and maintaining the mini grids. Using the incumbent utilities ensures a sustainable mechanism and utilizes their expertise, local knowledge and reach. Similarly, the utilities operating in outer islands, such as Tanna and Malekula, could operate mini grids in contiguous areas and can utilize locally based staff and spare parts reducing costs for travel and shipment.



76. Community ownership of land in Vanuatu can be problematic because at times it is not clear who owns the land. Disputes amongst families are common, especially if there is compensation associated with any development, which causes delays in achieving community agreement for the construction of a micro or mini grid. One of the concession holders has recently constructed small grid systems indicating that consensus is possible.

77. Finally, Government of Vanuatu's implementation capacity will be critical to the delivery of this project. A consultant will be engaged to assist the Government with the preparation of the project, and once approved with the implementation (supervision and commissioning), however, the community consensus on mini grids will have to be secured by the Government of Vanuatu (DoE, Lands, Environment and State Law Office). Delays when dealing with the communities on this matter is risk that will need monitored and managed in a timely manner.

VI. APPRAISAL SUMMARY

A. Economic and Financial (if applicable) Analysis

78. The project partially finances the provision of SHS, micro grids and the development of mini grids in rural areas of Vanuatu where there is no connection to the electricity grid. It is well documented that access to electricity contributes to social and economic development. Rural access to modern energy services reduces the cost of energy services and improves access to sustainable lighting and communication services. It also improves the quality of basic social services (health, education, and security, especially in combination with public lighting) and increases local productivity.¹⁷ Through providing households with access to electricity, women are able to undertake income generating activities at alternative times promoting economic development, children can complete school homework and studies after school, food can be kept in a fridge or ice box, and the household can feel safe and secure in their residence at night. Public institutions, including health facilities and schools - both boarding and non-boarding - will be able to provide improved health and education services to the communities for extended hours, as required. Businesses benefit from affordable and reliable electricity.

79. The Project will strengthen the capacity of the DoE and GoV to implement World Bank projects and build technical skills within the DoE in the rural electrification. Other indirect beneficiaries include national organizations, vendors selling solar systems in collaboration with suppliers, and microfinance lenders. The project will contribute towards building a sustainable private sector industry for the supply, operation and maintenance of renewable energy systems in the rural areas.

80. **Economic analysis:** The economic analysis is based on the benefits and costs of the project to the society. The net cash flow, i.e. the cash flow delta between benefits and costs, has been discounted at a rate of 6 percent (according to WB technical guidelines) over 20 years (equal to the lifetime of SHS/Micro and Mini Grids, including replacement of biodiesel generators and batteries). The resulting NPV/EIRR represents the discounted net benefit to the society.

¹⁷ Cabraal, A., Barnes D., & Agrawal, S. (2005), Productive Uses of Electric Energy for Rural Development. Annu. Rev. Environ. Resour., 30, 117 – 144.



81. The benefits are expressed as the Willingness to Pay (WTP) of households and businesses. The WTP for households stems from a survey, which has been conducted by GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit) on four islands in Vanuatu in 2015.¹⁸ The WTP of US\$27 per month is the median WTP (own disclosure by households) of the village in the study regarded as most comparable to the villages in scope of this project and refers to a household's willingness to pay for 'access to enough electricity for good quality lighting, radio use, phone charging and to operate a video player 4 hours a week' (about 36 kWh per month). The WTP for public institutions and businesses is based on the operating cost of standalone diesel generators, which is the alternative to micro and mini grids. For SHS and micro grids, a percentage of load is assumed at a higher WTP (i.e. business WTP, based on the size of systems) to reflect high value applications such as refrigeration. For the mini grids benefits are determined as the weighted average WTP of household and business loads.

82. Further potential benefits, such as increased income generation opportunities and increased WTP, social and environmental benefits and costs of using solid fuels, diesel, etc., avoided CO₂-emissions, demand on time vs productive activity and poor quality of health and education services, lack of security and reduced productive hours, have not been quantified due to the lack of reliable and accurate data.

83. Consultants, IT Power engaged by the DoE undertook an economic assessment of 60 mini grid configurations (Biodiesel, PV/Biodiesel, PV/Battery/Biodiesel, and PV Battery) for 5 classes of rural village sizes (from 25 to 150 inhabitants) and 3 different levels of energy access and consumption. The analysis assumes (i) that for villages above 100 inhabitants, 50 percent of the energy consumption is for households and 50 percent for public institutions and businesses, (ii) assumes a willingness/capacity to pay for households based on the GIZ study and for businesses/public institutions based on avoided OpEx LCOEs for Diesel generation (US\$1.16 per kWh) and (iii) includes all costs (including household connection and wiring costs). Business load as a proportion of total load increases with the size of the communities. Costs are composed of Capital Expenditures (CapEx) and Operational Expenditures (OpEx), which also include replacement investments for batteries and Diesel generators.¹⁹ Costs have been modelled differently for each mini grid technology and type of SHS/Micro Grid. For SHS and micro grids, CapEx (ranging from US\$1,300 for small SHS to US\$48,400 for micro grids, incl. installation costs) and annual OpEx (ranging from 2 percent to 4 percent of initial CapEx plus battery replacement costs) have been considered in the economic analysis.

84. The Net Present Value (NPV) at 6 percent for mini grids is set out in the Table 2 below. The results show that a PV/Battery and Biodiesel (which is the least cost configuration and close to a 100 percent renewable) mini grid in communities with a significant share of business load and a village size of above 75 households are likely to be economically viable. Figure 4 shows the Levelized Cost of Electricity (LCOE) by mini grid configurations, and household sizes for a daily consumption of 1.2kWh/day. In addition, the Figure shows the

¹⁸ H. Wade, J. Salong, P. Johnston, Report 2: Site Visit and Survey Report: Ability and Willingness to Pay for Electricity and Estimated Electricity Demand for Emae, Makira, Mataso and Aneityum Islands, 12 June 2016; please see details further below in main text.

¹⁹ The most significant CapEx are the investments in PV generation (USD2,200 per kW), battery storage (USD330 per kWh) and grid (USD52 per meter), household connection and wiring costs for households connected to a mini grid (USD850 per household). In addition, one-off costs as transportation, installation, mobilization and contingencies have been accounted for. Regarding OpEx, fuel costs of Diesel (USD1.50 per liter) escalated by 6.6 percent p.a., battery, PV and distribution grid maintenance are the most important cost items. Diesel generators are assumed to be replaced every 60,000 operating hours and batteries after 10 years in operation.



LCOEs for SHS of 0.5, 0.9, 1.6kWh/day and for micro grids.

Table 2: NPV for Mini grids

| | 50 | 75 | 100 | 125 | 150 |
|-------------------------------|---------|--------|---------|---------|---------|
| Share of non-residential load | 5% | 10% | 25% | 50% | 50% |
| PV/Batt/BioD NPV | -69,703 | 27,260 | 167,147 | 373,362 | 500,953 |

85. The NPV/EIRR table shows the PV/Battery/Biodiesel configuration will be economic dependent on the business load and number of households in the communities. The LCOE analysis shows that SHS/micro grids are the least cost solution for most communities. A higher commercial load or the prospect of catalyzing commercial activity and loads can improve the economic results. It should also be noted that mini grids bring a higher reliability, better scalability and different level of service. In this regard, mini grids should be promoted where the prospect of economic viability exists. Noting the earlier correlation between the number of households and business activities, communities with more than 75 households and a higher proportion of commercial load will be the likely candidates for mini grids. The economics of Micro Grids and SHS are displayed



in Table 3.

Figure 4: LCOE by mini grid configurations²⁰

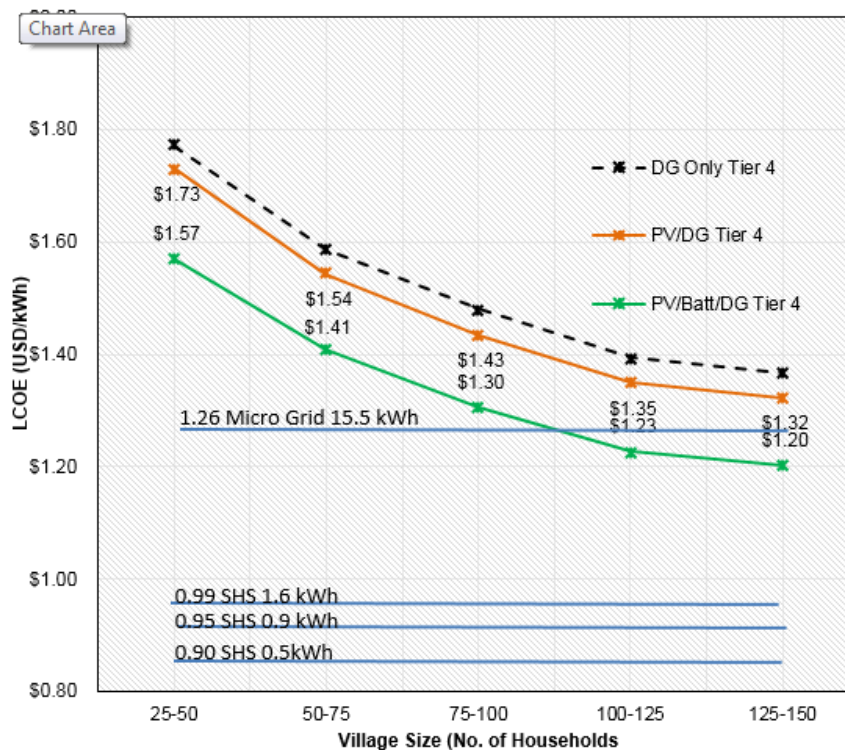


Table 3: Economic Analysis SHS/Micro Grids

| | | Economic Analysis |
|------------|----------------|-------------------|
| Micro grid | NPV [USD] | 11,726 |
| | IRR [%] | 9% |
| | LCOE [USD/kWh] | 1.26 |
| SHS 0.5 | NPV [USD] | 53 |
| | IRR [%] | 6% |
| | LCOE [USD/kWh] | 0.90 |
| SHS 0.9 | NPV [USD] | 80 |
| | IRR [%] | 6% |
| | LCOE [USD/kWh] | 0.95 |
| SHS 1.6 | NPV [USD] | 6 |
| | IRR [%] | 6% |
| | LCOE [USD/kWh] | 0.99 |

²⁰ The LCOE curve for PV/Battery has been omitted as it is far above the other curves so that the differences between the remaining technologies become more prominent.



86. All systems achieve an NPV>0 and therefore are considered economic. Assuming further cost reductions over time through technological progress and economies of scale and scope, it appears likely that economic viability can be improved. Under this project the supply of SHS and micro grids will be demand driven, so the consumers decide the type and size of systems they would purchase.

87. Mini grid LCOEs and CapEx are high compared with international observations (US\$1,000 to 2,000 per household), however, it should be noted that this project provides almost 100 percent renewable energy up to 24 hours a day by using battery storage technology and underground cabling for distribution (to build resilience against cyclones). In addition, the remoteness of Vanuatu like other PICs, the dispersed islands within the country and small and dispersed population centers mean that there are limited economies of scale contributing the high Capex, Opex and LCOEs. The costs for mini grids have been developed “bottom up” by consultants who have experience with solar PV/battery grids in the Pacific and validated against experience on other Pacific island projects. The cost per end user comparison needs to take the significant portion of businesses/institutions load into account, which would result in per household CapEx down to about US\$6,000. The project will initially focus only on a small number of grids to be procured through a competitive tender process. This will serve to firm up the costs and provide a sound basis for further extension of mini grids in Vanuatu.

88. **Public Institutions and businesses:** the typical communities were further assessed for number of public institutions and businesses (the greater the number, the better prospect of economic viability). Table 4 below shows the number of communities in the typical range that have one or more public institution or commercial business.

Table 4: The number of communities and public institutions in identified communities by range of Households

| Range of Hholds | 50-75 | 75-100 | 100-125 | 125-150 | Total |
|---------------------------------------|-------|--------|---------|---------|-------|
| No. Communities in each range | 37 | 11 | 2 | 1 | 51 |
| No. with Public institutions/Business | 6 | 9 | 1 | 1 | 17 |

89. Based on the above assessment the project will initially target 11 communities for mini grids (those >75 households), or where the commercial loads are higher. The project has budgeted for 5 mini grids reflecting the fact that mini grids will be provided to communities nominating to receive them, in accordance with the Resettlement Policy Framework. Should the costs be lower, or the economics improve, or additional funds become available then the project will be extended to include more mini grids.

90. **Financial Analysis:** The financial analysis assesses the project from the perspective of the service providers (for mini grids) and the households/businesses (for SHS/micro grids and mini grids). As a result, different discount rates apply, i.e. 8 percent for the service providers based on WACC (Weighted Average Cost of Capital) adopted by the Utilities Regulatory Authority of Vanuatu and 10 percent for households/businesses based on an assumed borrowing rate.

91. The household's benefits are estimated at the WTP. The household's costs are the CapEx incl. installation and battery replacement costs for SHS and connection and household wiring costs and ongoing electricity



tariffs for mini grids. If the household is connected to a mini grid it is assumed that it pays the tariff applicable in the existing concessions (average Vanuatu tariff of US\$0.49 per kWh) for its monthly consumption of 36 kWh (1.2 kWh per day, increasing by 5 percent per annum). In the case of SHS, the household has to bear the OpEx and replacement costs (battery after 10 years) of the system.

92. From the perspective of the service providers, their revenues from the average tariff is the benefit. On the cost side, it is assumed that the service providers bear the LCOEs (incl. CapEx) of the mini grid.

93. Financial viability of the mini grids remains an issue (see further below), so the mini grids will need to be subsidized while balancing the impacts on the Government, the service providers, the end users (beneficiaries) and the communities. As such, only 5 mini grids are proposed initially. Preliminary calculations based on 5 mini grids show that the existing tariffs across all grids would have to increase by US\$0.006 per kWh (1.2 percent of the current base tariff). The project will meet the viability gap for the development of mini grids by financing the capital costs.

94. Table 5 shows the NPV for PV/Battery/Biodiesel configuration mini grids. The NPV is shown from the utility's perspective at the average tariff in Vanuatu (US\$0.49 per kWh). As outlined set out below, the NPV is negative, i.e. the costs for the utility are higher than its revenues, which reveals the need for cross-subsidization within a concession area.

Table 5: NPV for PV/Battery/Biodiesel configuration mini grids (utility perspective)

| | 50 | 75 | 100 | 125 | 150 |
|-------------------------------|----------|----------|----------|------------|------------|
| Share of non-residential load | 5% | 10% | 25% | 50% | 50% |
| PV/Batt/BioD NPV | -513,827 | -673,752 | -833,837 | -1,006,288 | -1,155,094 |

95. For households connected to the mini grids, the result of the financial analysis shows a NPV of -US\$71 per household and an FIRR of 7.1% over a 10 year period, which is below the discount rate of 10 percent. This financial return is despite the fact that the household is assumed to pay the average Vanuatu tariff (US\$0.49 per kWh). The reason for this is the upfront costs of service connections and household wiring that a householder will need to contribute in addition to the ongoing tariffs. If a higher utility tariff is assumed, then the financial outcomes for the household will deteriorate. This demonstrates the challenge for the project to achieve a four-way balance of results for the utility (concessionaire), new customers, government/policy and existing customers.

96. The financial analysis for a householder with a SHS and for a public institution with a micro grid are provided below²¹. This shows that subsidies are needed.

²¹ Benefit for households (SHS) was calculated using a WTP of USD0.75 per kWh, while WTP for micro grids was assumed to be equal to the WTP of business of USD1.16 per kWh.



Table 6: Financial Analysis SHS/Micro Grids

| | | Financial Analysis w/o subsidy |
|------------|----------------|-----------------------------------|
| Micro Grid | NPV [USD] | -3,322 |
| | IRR [%] | 9% |
| | LCOE [USD/kWh] | 1.44 |
| SHS 0.5 | NPV [USD] | -294 |
| | IRR [%] | 6% |
| | LCOE [USD/kWh] | 1.06 |
| SHS 0.9 | NPV [USD] | -576 |
| | IRR [%] | 6% |
| | LCOE [USD/kWh] | 1.13 |
| SHS 1.6 | NPV [USD] | -1,140 |
| | IRR [%] | 6% |
| | LCOE [USD/kWh] | 1.17 |

97. **Willingness/capacity to pay:** The WTP for businesses/public institutions is based on the OpEx LCOEs of Diesel generation at US\$1.16 per kWh (which is the alternative supply option for existing businesses/institutions²²). The willingness/capacity to pay for households is derived from GIZ Report 2: Site Visit and Survey Report: Ability and Willingness to Pay for Electricity and Estimated Electricity Demand for Emae, Makira, Mataso and Aneityum.²³ An affordability assessment has been undertaken against the rural incomes reported in the Vanuatu Household Income and Expenditure Survey.²⁴ The assessment is against both the total income and cash income. For mini grids, this assessment assumes that the household connection and wiring costs are recovered over a 12 months' period. Table 7 shows the household expenditure for 36 kWh of electricity consumed at WTP, average tariffs and Lifeline (LL) without and with the recovery of connection and wiring costs. This shows that the household wiring and connection costs would need to be subsidized, similar to that for low income consumers under the existing World Bank supported Improved Electricity Access Project, to bring the ongoing costs to below 10 percent of monthly cash incomes.

Table 7: Household expenditure without and with connection and wiring costs by province

| Affordability Running Cost Electricity | Torba | Sanma | Penama | Malampa | Shefa | Tafea | Rural |
|---|-------|-------|--------|---------|-------|-------|-------|
| WTP as % of monthly income | 4% | 3% | 4% | 4% | 2% | 5% | 3% |
| WTP as % of monthly cash income | 7% | 5% | 8% | 8% | 2% | 16% | 5% |
| Base Tariff as % of monthly income | 2% | 1% | 2% | 2% | 1% | 3% | 2% |
| Base Tariff as % of monthly cash income | 4% | 3% | 4% | 4% | 1% | 9% | 3% |
| LL Tariff as % of monthly income | 1% | 1% | 1% | 1% | 0% | 1% | 1% |
| LL Tariff as % of monthly cash income | 1% | 1% | 1% | 1% | 1% | 1% | 1% |

²² For new business, the full LCOEs (i.e. including CapEx) of Diesel generation would be the alternative supply option.

²³ H. Wade, J. Salong, P. Johnston, Report 2: Site Visit and Survey Report: Ability and Willingness to Pay for Electricity and Estimated Electricity Demand for Emae, Makira, Mataso and Aneityum Islands, 12 June 2016. Note this is the current costs of alternatives.

²⁴ Vanuatu Household Income and Expenditure Survey 2010, Vanuatu National Statistics Office, 2012



| Affordability incl. Connection & HH-Wiring | Torba | Sanma | Penama | Malampa | Shefa | Tafea | Rural |
|--|-------|-------|--------|---------|-------|-------|-------|
| WTP as % of monthly income | 14% | 10% | 14% | 15% | 7% | 17% | 12% |
| WTP as % of monthly cash income | 27% | 17% | 29% | 27% | 9% | 58% | 20% |
| Base Tariff as % of monthly income | 12% | 9% | 12% | 13% | 6% | 15% | 10% |
| Base Tariff as % of monthly cash income | 23% | 15% | 25% | 24% | 8% | 50% | 17% |
| LL Tariff as % of monthly income | 11% | 8% | 11% | 12% | 5% | 13% | 9% |
| LL Tariff as % of monthly cash income | 21% | 14% | 22% | 21% | 8% | 43% | 16% |

98. Table 8 shows the monthly costs of SHSs against the monthly cash incomes only. The analysis assumes that the capital costs are subsidized by 33 percent, and the householder contribution repaid/financed over 4 years at 10 percent. The householders have a choice of systems (note the mini grid analysis is based on 1.2kWh/day), the costs of which within the range of mini grids.

Table 8: Monthly costs of SHSs against monthly cash incomes only by province

| Affordability SHS | Torba | Sanma | Penama | Malampa | Shefa | Tafea | Rural |
|--|-------|-------|--------|---------|-------|-------|-------|
| Power Cube (0.5 kWh/day) as % of ann. cash | 7% | 4% | 7% | 7% | 2% | 15% | 5% |
| 2 Panel Kit - 12 Volts (0.9 kWh/day) as % of ann. cash | 13% | 8% | 14% | 7% | 2% | 15% | 5% |
| 4 Panel Kit - 12 Volts (1.6 kWh/day) as % of ann. cash | 24% | 15% | 26% | 24% | 8% | 51% | 18% |
| 4 Panel Kit - 24 Volts (2.2 kWh/day) as % of ann. Cash | 63% | 40% | 69% | 65% | 21% | 137% | 47% |

99. **Conclusion from economic and financial analysis:** Mini grids can be economic in the longer term for communities with more than 75 households and at least 50 percent of consumption from public institutions or where the consumption from public institutions exceeds that assumed in the models. The LCOE analysis shows that mini grids will cost in the range of US\$1.20 to \$1.30 per kWh, whilst the tariffs for equity and affordability reasons are expected to be around US\$0.49 per kWh. From a financial perspective the service providers will require support with the investment (proposed to be government funded) and subsidies or cross subsidies to recover operating costs. Householders will require support with connections costs and household wiring for mini grids to be affordable for them.

100. In this regard, development of mini grids under this project should be approached on an incremental basis to reduce the burden on the rest of the market and the Government. This approach will provide the Government the opportunity to refine the technical design, understand and refine the costs and understand the impact on the sector before it proceeds to scale up mini grids.

101. For communities with less than 75 households, or household only loads with low probability of increase business activity the least cost solutions are SHS and micro grids. The project provides for a range of subsidized SHS products that the consumers could purchase based on their needs and capacity to pay. The level of subsidy can be varied over time and complemented with micro finance to improve access. The design of this project also retains the flexibility to allow the Government to move between solutions depending on sector needs and



lessons learned during the period of the project.

102. SHS and micro grids, where they are least cost, require subsidies on capital costs for them to be affordable.

103. **Rationale for Public Sector Provision/Financing:** Globally, multiple effective rural electrification models have been piloted. Some of them are based on public sector provision, others on private operators and/or communities. All of them, however, have been based on sustained commitment of the authorities and on public sector financial support.

104. In Vanuatu, the utilities would not extend their concession area to the sites considered in the scope of this project without public financing since it would require significant investments that will not provide an adequate return. The financial analysis above shows that grant funding is required to cover the viability gap (and meet government policy objectives) for mini grids and to ensure SHS and micro grids are affordable.

105. For grid-connected electricity supply, the VREP II model is based on mini grid investment by Government and operations and maintenance services under management contracts. When the existing concessions come up for re-tender or a new concession is created the assets are transferred to the private sector and tariff levels are reviewed by the URA.

106. SHS and micro grids will be subsidized and supplied through a demand-driven approach by private sector retailers operating in Vanuatu. It will build on the model currently in place for VREP I to achieve a sustainable renewable energy industry in Vanuatu for the supply and maintenance of solar systems.

107. **Value added of Bank's support:** The VREP II project is a continuation of the VREP I project, which allows to benefit from existing infrastructure and capacities and would strengthen the Bank's engagement in Vanuatu. The Bank will contribute its international knowledge and experience from similar projects in other countries (e.g. Bangladesh, Tanzania, Mali, and Nepal). In addition, the Bank will continue to work to mobilize funds and develop products to achieve the Government of Vanuatu's objective for rural electrification that is sustainable in the longer term.

B. Technical

108. The DoE has gained experience from implementing other World Bank financed projects. The Department's has strengthened their team with additional staff, who are supported by a number of consultants funded through the World Bank financed projects. Furthermore, the Department will be supported by an Owner's Engineer who will provide technical assistance and expertise in the design and specifications of mini grids (Component 2) and a verification agent to verify the sales of SHS and micro grids (Component 1).

109. The equipment and technologies for implementation and operation of mini grids under Component 1 and Component 2 are commercially available and have been deployed in developed and developing countries, and will be implemented according to internationally accepted technical standards and practices. The Bank has evaluated all technical and other aspects of this project and is satisfied that the arrangements in place are adequate.

110. **Component One:** The Project will subsidize the retail cost, by an initial 33 percent (refer calculations on



affordability above). SHS and micro grids will be supplied, installed and maintained by energy retailers. Typical sizes and applications for SHS are set out in the Table 9 below which can also include inverters for AC supply.

Table 9: SHS sizes and typical applications

| SHS Type | Appliances Supported by SHS |
|---|---|
| 1 Panel Kit – 12 Volts (0.5 kWh/day) | few lights, radio, phone, tablet and laptop and DC refrigerator |
| 2 Panel Kit - 12 Volts (0.9 kWh/day) | lights, DC pump, radio, phone, tablet and laptop, small DC refrigerator |
| 4 Panel Kit - 12 Volts (1.6 kWh/day) | 3 lights, phone, radio, laptop, TV, large DC refrigerator |
| 4 Panel Kit - 24 Volts (2.2 kWh/day) – inverter for AC appliances | Lights, a pump, efficient fridge, modem, TF and other entertainment equipment |

111. The provision of SHS and micro grids will be demand driven with the households, communities and institutions electing to purchase systems. The purchaser will pay the subsidized amount agreed with the vendor for the eligible system. The vendor will provide the necessary data and information to DoE in order to claim the subsidy amount. DoE will pay eligible subsidies following verification of the sales from the designated account (DA). The DA will be replenished for the subsidy payments made based on DoE submitting an Output Verification Report (OVR) with its Withdrawal Application.

112. Systems eligible under this project must meet the technical standards established set out in the POM and the SIM. Product warranty would cover:

- a. The entire product, including the battery, for a minimum specified time period from the time of purchase by the end-user; and
- b. Manufacturing defects that may affect the operation under normal use.

113. VREP I is successful in utilizing existing markets and existing vendors' (local energy retailers) networks for distribution of "plug-and-play" solar systems. As there is an existing network of vendors, including those vendors participating in VREP I, this project will use their networks for sales and distribution to reach rural communities across the country. The project will ensure that the vendor is financially and technically sound as part of the vendor registration process. Vendors will have an obligation to provide easy to understand product information (capability, service requirements, safety, etc.), and put in place arrangements for regular maintenance and the return of equipment and parts, especially those that are made from toxic material, such as lead-acid or lead-gel batteries.

114. To ensure that high quality products are being provided under the Project, that the vendors ensure that adequate after sales service and/or information is available to consumers, and that used batteries are disposed of safely in accordance with adopted Waste Management legislation and regulations or, if the amended legislation and regulations have not been adopted at the time of project approval, the project's ESMF including the VREP I ECOP for battery disposal, the project will adopt the vendor registration program for vendors, and a the product catalogue. Some applications, for example community application such was water pumps may require access to private property, the agreement to which will be achieved through the processes set out in



the RPF. Periodic verification will be undertaken to ensure that the products supplied under this component meet the technical specifications, are included in the product catalogue and comply with the ESMF.

115. Basic consumer awareness on methods to improve the longevity of the systems will be financed through activities under Component three below. Maintenance, to replace batteries, will be required for the household systems. Used batteries can be disposed of by the consumer at the Area Council office, for further collection and transportation to Port Vila. It will be the Vendors responsibility for financing the recovery of used batteries from the outer islands and disposing of them.

116. **Component Two:** Based on the economic and financial analysis, the Project will initially target 5 mini grids. The estimated number of communities (5) and households (550) targeted by the mini grids and the total costs is provided below. These communities include around 10-12 public institutions (schools and health centers) and some business / commercial operations. Table 4 shows the number of communities by typical range and the number of communities that also have public institutions and commercial loads.

117. Although there are a range of potential mini grid solutions, the initial design will be based on solar photovoltaics (PV) with battery storage with biodiesel generators for backup. PV will be utilized when directly available, otherwise it is stored for use later. The generator will be used as backup when the batteries are discharged and there is no solar input. The generator backup services a dual purpose to provide regular battery equalization chargers, and to quickly charge the batteries when discharged to reduce long-term damage to the battery. The generator will be sized to be able to meet the full load when insufficient storage is available. The installations will be modular utilizing standardized component scalable with demand growth and will allow for other generation sources, such as small hydro, to be connected in future.

118. The Department of Energy has identified a long list of potential mini grids taking into account population density (number of households), public facilities such as hospitals and schools, and other 'anchor' loads such as tourism facilities, and food processing or other commercial operations. The potential for clustering of mini grids to achieve scale during construction and operations will also be taken into account. The Energy Sector Management Assistance Program (ESMAP)/ SE4ALL five tiers of energy access for categorizing the villages and energy access goals was also taken into account.²⁵ For 24 hour service delivery, the load profile was compared to early measurements on the Malekula and Tanna main grid systems and found to correlate well, with higher commercial loads in the daytime as to be expected in larger villages, which tend to have a higher density of business and institutional loads.²⁶ However, the exact duration of service delivery (4-6hrs, 8hrs, and 24hrs) will be determined during detailed design.

119. The DoE has identified a preliminary list of 60 communities ranging from 128 to 49 households. Of these, 17 communities has one or more public institutions or commercial businesses. The number of public institutions and businesses show a correlation to the number of households in the communities. The analysis shows that mini grids are likely to be least cost for communities that are larger than 75 households and have least 50 percent of load coming from public institutions and businesses. On the basis of this assessment 5 communities will be selected for mini grids initially.

120. The locations of the mini grids will be determined through a process of villages self-selecting to receive

²⁵ ESMAP, Beyond Connections Energy Access Redefined, Technical Report 008/15, 2015

²⁶ ITP, Development of Off-Grid Electricity Supply in Vanuatu – Pre-feasibility studies for Hybrid Mini grids



electricity. Communities will elect to receive a mini grid and will identify land suitable for siting the powerhouse, solar modules and associated distribution infrastructure (low voltage wires, poles, meters, etc.). The availability of Government owned or leased land will be considered first, and where Government owned or leased land is either not available or not suitable, the Government will consider Church-leased land and then customary/community land, to identify a suitable agreed-upon location. The location will be formalized through a negotiated agreement between the community and Government in accordance with the processes set out in the RPF. Once the negotiated agreement is finalized, the design/configuration of mini grids and environmental and social assessment will be undertaken in accordance with the Environmental and Social Management Framework (ESMF).

121. Component Three: Technical Assistance and Project Management – This component addresses three key areas of the project, the first focusing on Owners’ Engineer for Component two, the second focusing on the vendor and product registration for Component one and the third focusing on project management. For the effective implementation of the project and to further build capacity within the DoE in Vanuatu from complementary projects in the sector, the following activities will be financed:

- a. Communications, supervision and verification. This component will provide resources to enable to DoE to market the product to suppliers and potential beneficiaries (rural consumers), support the project implementation and supervise the delivery of both components 1 and 2 of the project. The DoE will engage the services of technical consultants to confirm/verify that the delivery is in accordance with the technical specifications and meets the arrangement set out in the POM, SIM, ESMF and the RPF;
- b. Capacity building and implementation support. Technical experts and advisors will provide assistance to the DoE during the implementation phase of the project. Encompassed in their expertise will be procurement knowledge to manage and monitor the bidding process and contract and independent verification processes.
- c. Workshops and training for the DoE (and possibly other Governmental departments). Under this activity, the project will finance approved workshops, training courses and activities, related to the technical components of this project, for the DoE staff to attend. Workshops and seminars hosted and held by the DoE will be financed under this activity. It is expected these workshops will build capacity locally, and invitations will be extended to the outer island communities to attend these workshops. For example, approved workshops will inform local vendors on the standardization of the solar energy market. Training for the installation and maintenance of SHS and micro grids will be funded under this activity, and open to governmental staff of other ministries who are involved directly in the project (i.e. Ministry of Health and Ministry of Education).
- d. Other costs. The Project will cover project related incremental operating costs associated with this project as provided for in the legal agreement.



C. Financial Management

Summary

122. The existing financial management systems are assessed as adequate to meet the financial management requirements as stipulated in Operational Policy / Bank Policy 10.00. The project's overall financial management risk is rated as "Moderate".

Budgeting

123. The DoE will develop a total project budget and break this down into annual budgets. The DoE will review this document either quarterly, six-monthly or annually, with analysis of budget vs. actual expenditure.

Counterpart Funding

124. No counterpart funding is envisaged.

Funds Flow

125. The Ministry of Finance and Economic Management will co-ordinate the funds flow of the project. The Credit and Grants will be signed with the Government of Vanuatu in SDR for IDA and US dollars for the Trust Funds. A designated account will be established for the project under the GoV Development Fund in the Central Treasury Account, and will be maintained in the local currency (VUV) and managed by MoFEM. Credit and Grant proceeds will flow from the Bank into the Designated Account (DA). Credit and Grant proceeds can also flow to contractors via direct payments. DoE will be directly responsible for the management, maintenance and reconciliation of DA activities for project components, including preparation of withdrawal applications and supporting documents for Bank disbursements.

Accounting and Maintenance of Accounting Records

126. The Government of Vanuatu's Financial Management Information System (FMIS) will be used for the processing of payments and the recording of transactions. The accounting software package used within the agency and all other government agencies is Smartstream. This will be supplemented by the implementing agency with spreadsheet-based systems to keep track of payments against contracts, budgets and expenditures by activity – this supplemental information will be used in the preparation of withdrawal applications. DoE will be responsible for managing, monitoring and maintaining accounting records for the project. Original supporting documents will be retained by the DoE and are to be made available to both auditors and the World Bank, as required.

Internal Controls; including Internal Audit

127. The Government of Vanuatu's financial management systems and processes will be used for the processing of payments and the recording of transactions. The existing regulations and internal controls will be applied including the Public Finance and Economic Management Act and the Financial Regulations.



Periodic Financial Reporting

128. Unaudited Interim Financial Reports (IFRs) will be prepared by DoE for the project on a semester basis. The financial reports will include an analysis of actual for the semester, year to date and project to date, compared to total project budget, and commitments. The format will be developed by the DoE and agreed to by the World Bank, prior to submission of the first IFRs. The IFRs will be forwarded to the World Bank within 45 days of the end of each fiscal semester.

External Audit

129. The Auditor General is responsible for auditing all Government ministries and departments. A separate audit of the Projects financial statements will be required annually.

DISBURSEMENTS

Disbursement Methods and supporting Documentation Arrangements

130. Three disbursement methods will be available for the project: advance, reimbursement, and direct payment. Supporting documents required for Bank disbursement under different disbursement methods will be documented in the Disbursement Letter issued by the Bank.

Designated Account

131. The project would need a DA for Advances. The currency of the DA would be Vatu. One segregated DA would be required to receive the proceeds of each financing source. The DA will be in the Central Treasury Account in the Reserve Bank of Vanuatu. A separate General Ledger code will be used the Smartstream accounts to separate project accounts and each financing source to record funds receipts and expenditures while funds physically sit in the one central treasury account.

Disbursement Conditions

132. Disbursement conditions for the Subsidy Payments Category will be required, including Subsidy Implementation Manual, Subsidy Implementation Agreement, and appointment of a verification agent.

Retroactive Financing

133. Retroactive financing is being considered.

D. Procurement

134. The project implementation agency is the DoE of the Ministry of Climate Change and Natural Disaster. Procurement of this project will be implemented by the team of financial officers in DoE. Currently, DoE is implementing the Energy Sector Development Project (ESDP--P145311) and Rural Electrification Project I (VREP I--P150908). ESDP mainly supports policy development and sector reform and VREP I mainly finances subsidies for households to purchase solar panels from certified vendors. Through these two projects, DoE obtained



experience with the procurement procedures of the World Bank, especially, the selection of individual consultants and firms through CQS as well as shopping of goods. However, the nature and size of procurement under VREP II will be challenging to DoE.

135. Procurement will be carried out in accordance with the World Bank's "Procurement Regulations for IPF Borrowers" dated July 2016 and the specific provisions stipulated in the legal agreements.

136. During project preparation, the World Bank team assessed the procurement risks. The overall procurement risk rating is "substantial" due to lack of capacity and experience to implement procurement of the proposed project.

137. Consulting Services: This project will finance the costs of a "owner's engineer" -- a consulting firm which will assist DoE to prepare the detailed technical design and procurement documents, conduct procurement processes, and supervise construction of grids; a verification agent to certify the retails under Component 1; and consultants for monitoring and evaluation.

138. For SHS and micro grids under Component 1, DoE will follow the same arrangements for VREP I, including signing a Subsidy Implementation Agreement with each registered vendor. Detailed procedures and criteria for registration/selection of vendors, and procedures and criteria for the registration in the product catalogue will be defined in the Project Operational Manual (POM) agreed with the Bank. The Subsidy Implementation Agreement will also set out the rights and obligations of the parties and other terms and conditions for participation in the program. Depending on the size and timing, DoE may also procure SHS or micro grids through open bidding process.

139. Construction of Mini/Micro Grids under Component 2: Based on the detailed design, mini/micro electric grids will be constructed by contractors under supply and installation contracts. At the project appraisal, it is expected that up to five grids will be constructed. DoE will conduct consultation with the villagers to agree on the site, land and technologies to be used for each of the locations. The owner's engineer will prepare detailed design based on the agreement between DoE and villages and conduct procurement process through open competition. It is expected that, whenever possible, locations will be grouped into one package to be procured for the purposes of efficiency and economy.

140. DoE prepared a Project Procurement Strategy for Development (PPSD) for this project and the summary of PPCS is:

- a. Owner's Engineer: Currently, there are a limited number of qualified persons active in this sector in Vanuatu and whom may be interested in this assignment. Other potential consultants for this service may come from international sources. This service will be procured through international competition using the method of quality and cost based selection (QCBS).
- b. Mini/Micro grids: based on the information from PPCS, the supply and construction capacity of national contractors will be described. If national capacity is not enough, international bidding will be needed. Depending on the size of contracts, the procurement method will be request for bids or request for quotations. Supply and installation contract will be used.
- c. Risks were identified and mitigation measures were agreed as in the following table.



| Risk Identified | Mitigation Measures |
|---|---|
| 1. Limited capacity of DoE for the type and size of contracts | 1. The World Bank Procurement Regulations for IPF Borrowers and related guidance notes will be disseminated to DoE early on in project preparation. 2. A procurement expert will be included in the team of Owner's Engineer to support procurement of mini/micro grids. 3. The World Bank team will provide necessary training in the early stage of project, especially for selecting the Owner's Engineer. |
| 2. Limited capacity of national market. | In the event the local capacity cannot be identified, international providers will be sought through a competitive process. |
| 3. Lack of capacity of contract management | The Owner's Engineer should establish a contract management system to monitor the quality, progress, payment, etc. This will be included in the TOR and contract of the Owner's Engineer. |

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

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|----------------------|---------------------------------------|----------------------------------|-------------------------------------|------------------------------------|----------------------------------|-----------------|
| Reference No. | Description of Contract | Estimated Cost \$US\$'000 | Selection/Procurement Method | Review by Bank (Prior/Post) | Expected Contracting Date | Comments |
| 1 | Supply and installation of mini grids | 6,800 | ICB | Prior | January, 2018 | |
| 2 | Project Manager | 300 | ICS | Prior | July, 2017 | |
| 3 | Owner's Engineer | 1,200 | QCBS | Prior | July, 2016 | |
| 4 | Project Officer | 150 | OCS | Post | July, 2016 | |

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



E. Social (including Safeguards)

143. Communities in the long listed sites will be invited by the GoV to elect to receive a mini grid under the project. This is an initiative where communities elect to benefit from project outcomes and will be delivered in partnership with the communities. Accordingly, communities electing to receive mini grids will identify suitable land for the siting of the generation installations and siting of the distribution network. Government land will be prioritized, followed by Church land. As detailed in the RPF, if customary land is required, then negotiated land access will be undertaken. There is no intention to compulsorily acquire land for the project. There may, however, be a need to remove trees and other income producing vegetation/installation for technical reasons, which will be avoided to the maximum extent possible. The ESMF and RPF provide processes for ensuring that no individual is worse off because of the project under these circumstances.

144. The Bank's consultation and documentation requirements for land access (as outlined in the project RPF) will need to be satisfied to ensure all parties are actively involved and that no particular individuals experience an unequal burden on behalf of the community.

145. SHS, micro and mini grids with reliable power supply are expected to yield economic, environmental and social benefits – better health, education, productivity, and overall improvement of the human development indicators in rural and peri-urban areas.

146. Based on an assessment carried out in 2013 by OPCS, OP 4.10 indicates that all four defining characteristics should be present to trigger the Indigenous Peoples policy and these characteristics are not present in Vanuatu. Accordingly, the policy is not triggered for the project. Given the strong community driven nature of the works in the electricity sector, extensive consultation and citizen engagement will be required to allow effective implementation. This would include engagement with all components of the communities.

F. Environment (including Safeguards)

147. Component 1 of the project will involve the supply of SHS and micro grids on demand. The main issue relates the safe disposal of batteries. Vanuatu is already implementing the Vanuatu Rural Electrification Project Stage I that is supported by an ECOP for battery disposal. Further, recently with the support of a World Bank Technical Assistance Project, the Government of Vanuatu has developed draft legislation for disposal of solid wastes, including batteries that is being considered by the State Law Office.

148. Component 2 of the project will involve siting of modular solar/battery/diesel hybrid systems, installation of solar panels, and construction of distribution lines within existing, remote communities. Solar panels will be installed either on roof tops of existing or new buildings or as ground mounted structures. Batteries and diesel generators will need small buildings to be constructed or modified. There will be relatively minor local environmental impacts during construction. Grid design and operational procedures will require the careful storage and management of diesel fuel and batteries to avoid land or water contamination, and consideration of the future disposal of solar panels and batteries. Physical Cultural Resources are unlikely to be impacted because the community will be involved in site selection. However, a chance find procedure will be used during the construction phase. No significant land disturbances are required that would significantly impact natural habitats.



149. To ensure compliance with both World Bank Safeguard policies and the environmental legislation of the Vanuatu, an ESMF has been prepared which provides a guide to the screening of candidate projects integrating safeguards into the community engagement processes, and requires the preparation of project-specific ESIA and ESMP. The Owner's Engineer will have safeguards capability on their team to prepare the ESIA and ESMP and oversee the implementation of the ESMP during detailed design and construction.

G. Other Safeguard Policies

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

H. World Bank Grievance Redress

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



VII. RESULTS FRAMEWORK AND MONITORING

Results Framework

COUNTRY : Vanuatu

Rural Electrification Project Stage II

Project Development Objectives

The Project Development Objective is to support increased penetration of renewable energy and increased access to affordable electricity services in the dispersed off-grid areas of Vanuatu.

Project Development Objective Indicators

| Indicator Name | Core | Unit of Measure | Baseline | End Target | Frequency | Data Source/Methodology | Responsibility for Data Collection |
|--|------|-----------------|----------|------------|-----------|-------------------------|------------------------------------|
| Name: Generation capacity of energy constructed - renewable energy facilities | | Megawatt | 0.00 | 4.50 | | | |
| Description: | | | | | | | |
| Name: People provided with a new electricity service | | Number | 0.00 | 44750.00 | | | |
| Description: | | | | | | | |

Intermediate Results Indicators



| Indicator Name | Core | Unit of Measure | Baseline | End Target | Frequency | Data Source/Methodology | Responsibility for Data Collection |
|--|------|-----------------|----------|------------|-----------|-------------------------|------------------------------------|
| Name: Households received a Solar Home Systems or micro grids | | Number | 0.00 | 8400.00 | | | |
| Description: | | | | | | | |
| Name: Public Institutions received a Solar Home System or micro grid | | Number | 0.00 | 37.00 | | | |
| Description: | | | | | | | |
| Name: Number of mini grids constructed under the project | | Number | 0.00 | 5.00 | | | |
| Description: | | | | | | | |
| Name: Number of People connected to electricity through a mini grid constructed under the project | | Number | 0.00 | 2750.00 | | | |
| Description: | | | | | | | |



| Indicator Name | Core | Unit of Measure | Baseline | End Target | Frequency | Data Source/Methodology | Responsibility for Data Collection |
|--|------|-----------------|----------|------------|-----------|-------------------------|------------------------------------|
| Name: Participants in consultation activities during project implementation (number) | ✓ | Number | 0.00 | 2000.00 | | | |
| Participants in consultation activities during project implementation - female | ✓ | Number | 0.00 | 980.00 | | | |
| Description: This indicator measures the level of community engagement in project implementation. | | | | | | | |
| Name: Grievances registered related to delivery of project benefits addressed (%) | ✓ | Percentage | 0.00 | 100.00 | | | |
| Description: This indicator measures the transparency and accountability mechanisms established by the project so the target beneficiaries have trust in the process and are willing to participate, and feel that their grievances are attended to promptly. It is understood that local sensitivities and tensions will not allow grievance or redress mechanisms to be established in all projects. | | | | | | | |

**Target Values****Project Development Objective Indicators**

| Indicator Name | End Target |
|---|------------|
| Generation capacity of energy constructed - renewable energy facilities | 4.50 |
| People provided with a new electricity service | 44750.00 |

Intermediate Results Indicators

| Indicator Name | End Target |
|---|------------|
| Households received a Solar Home Systems or micro grids | 8400.00 |
| Public Institutions received a Solar Home System or micro grid | 37.00 |
| Number of mini grids constructed under the project | 5.00 |
| Number of People connected to electricity through a mini grid constructed under the project | 2750.00 |
| Participants in consultation activities during project implementation (number) | 2000.00 |
| Grievances registered related to delivery of project benefits addressed (%) | 100.00 |
| Participants in consultation activities during project implementation - female | 980.00 |



Annex 1. Scaling-up Renewable Energy Program in Low Income Countries

COUNTRY : Vanuatu Rural Electrification Project Stage II

Results Framework (includes VREP I and VREP II)

| Indicator | SREP/IDA Project | Scaled up phase 65 percent generated from RE by 2020 and 100 percent by 2030 (NERM and Second National Commission Targets) |
|--|---|--|
| Annual electricity output from RE as a result of SREP interventions (GWh) | 2.7 GWh | 42.25 GWh |
| Number of women and men, businesses and community services benefiting from improved access to electricity and fuels as a result of SREP interventions | <p>132,250 people (26,450 hholds) consisting of 64,800 female and 67,450 male beneficiaries, of which^{27, 28}:</p> <p>a. 87,500 people (plug-and-play SHS), 230 aid posts and 2,000 not-for-profit community halls</p> <p>b. 42,000 people (SHS and micro grid) and 37 public institutions</p> <p>c. 2,750 people (mini grids), approximately 60 public institutions and 60 businesses</p> | 269,500 people (55,000 households) consisting of 132,000 female and 137,500 male beneficiaries |
| Financing leveraged through SREP funding [\$ million] | <p>US\$27.9 million, of which:</p> <p>d. WB (IDA) US\$4.0m</p> <p>e. New Zealand US\$8.1m²⁹</p> <p>f. GoV in-kind US\$1.5 million³⁰</p> <p>g. Project Beneficiaries US\$14.3m</p> | US\$ 180 million |
| SREP leverage ratio [1:X] | 1 : 4 | 1:25 |
| <p>Tons of GHG emissions reduced or avoided</p> <p>-Tons per year [tCO_{2eq}/yr]</p> <p>-Tons over lifetime of the project [tCO_{2eq}]</p> | <p>5,300 tCO₂ / yr</p> <p>106,000 tCO₂</p> <p>Over 20 year lifetime</p> | 72,000 tCO₂/yr in the energy sector |

²⁷ On average 4.9 (or five) people usually live together in one household...Urban households were on average slightly larger than rural ones with an average of 5.2 people. Vanuatu Household Income and Expenditure Survey 2010, 15, Vanuatu National Statistics Office, 2012.

²⁸ Excludes the 4,375 households, equal to approximately 21,875 people, provided with grid connected electricity under the Improved Electricity Access Project (P133701).

²⁹ Includes VREP I US\$4.7 million and VREP II US\$3.4 million.

³⁰ Government contribution (US\$1.5 million "in kind") that will cover the Government of Vanuatu's direct project related costs, such as arrangements for voluntary land donation and other inter-departmental support.



Introduction

1. **Country context:** The Republic of Vanuatu is an archipelago of 83 dispersed volcanic islands (65 of them inhabited) covering a total area of about 12,200 square kilometers, of which approximately a third is land. Vanuatu's population is approximately 258,000 people, almost evenly distributed among the six administrative provinces: Malampa, Penama, Sanma, Shefa, Tafea and Torba. The national household count stands at an estimated 55,000, of which approximately 13,750 households (25 percent) are located in urban areas and the remaining 41,250 (75 percent) are dispersed in rural areas.

2. The average household monthly income in Vanuatu is VUV 83,800 (US\$ 791), with an average household monthly income of VUV 97,500 (US\$921) reported in urban areas, compared with VUV 79,500 in rural areas (US\$750). In per capita terms, this equates to VUV 18,700 (US\$176) per person per month in urban areas and VUV 16,400 (US\$154) per person per month in rural areas. Rural households rely mainly on home consumption (subsistence) and household enterprises based around the sale of agricultural products, handicrafts, and other goods produced in the home. For female headed households the average monthly income across Vanuatu is VUV 59,300 (US\$560) – VUV 85,200 (US\$804) in urban areas and VUV 51,200 (US\$483) in rural areas. In per capita terms for female headed households VUV 18,300 (US\$172) per person per month in urban areas and VUV 13,700 (US\$129) per person per month in rural areas.

3. Vanuatu has become one of the fastest growing economies of the Pacific region. The economy has experienced strong and sustained growth mainly driven by tourism, construction, and aid inflows. The per capita Gross Domestic Product (GDP) is estimated at US\$3,100, yet the cost of basic infrastructure services is high and affects the business environment in the country. For instance, Vanuatu ranks 83rd in the “ease of doing business” indicator reported by the World Bank, which analyzes a total of 189 economies, and 81st in “getting electricity” indicator, down from 75th in 2016, mainly due to the high cost associated with obtaining a new connection to the electricity grids.

4. An updated Debt Sustainability Analysis (DSA)³¹ suggests that Vanuatu continues to face a moderate risk of debt distress, a move-up from the low rating in 2013 due to post-Cyclone Pam reconstruction and planned infrastructure projects. While the evolution of debt indicators remains similar to that obtained in the 2015 DSA, the sizeable infrastructure projects pose threats to debt and fiscal sustainability when grants and concessional financing are delayed or become insufficient to cover the investment program. A model-based analysis reaffirms the need for a concerted effort with the private sector and international financial institutions to more clearly advocate for careful selection of projects and the need to develop contingency plans in case expected returns do not materialize, and that financing at concessional terms—in particular through grants—is available. In addition, another extreme weather event in the medium term is likely to raise the country's risk of debt distress, which further reinforces the need to rely on grant financing. Repeated large-scale borrowing to rebuild from disasters is not a viable long-term strategy and more emphasis is needed on risk reduction investments.

³¹ IMF Country Report No. 16/336, 2016 Article IV Consultation: Staff Report; and statement by the Executive Director for Vanuatu



5. **Sector context:** Electricity services in Vanuatu are delivered through three types of models. The models include: (a) independent “main grid systems” in the main urban centers; (b) isolated “mini grids” in lesser population concentrations but where a grid supply system is still a technically and economically competitive option, and (c) decentralized energy service systems. Grid electricity in Vanuatu is supplied by two concessionaires, Union Electrique de Vanuatu Ltd (UNELCO) in Shefa, Malampa and Tafea provinces or Vanuatu Utilities and Infrastructure (VUI) in Sanma province.

6. An estimated 30 percent of the Vanuatu population has access to electricity. Even on the four islands with electricity (Efate, Espiritu Santo, Tanna and Malekula), the share of those without access to electricity remains high: Efate (24 percent), Santo (65 percent), Tanna (86 percent), and Malekula (84 percent).³² Even within the concession areas, about one in five households remain without access to electricity, primarily because of the up-front costs to get connected to the grid. Access to electricity rates drop off considerably in rural areas; the population without access in rural areas ranges from 83-85 percent in Tafea and Shefa provinces, 89 percent in Sanma province, 92 percent in Malampa province and 97 percent in Torba province.³³ Overall, it is estimated that only 20 percent of the rural population has access to electricity, usually through the use of diesel generators or solar systems, such as solar lanterns or plug-and-play solar home systems. The lower population density in rural areas, large distances between customers, lower electricity loads and high connection costs have meant that the extension or building of new electricity grids for supply to peri-urban and rural consumers generally remain uneconomic.

7. The most recent Household and Income Expenditure Survey (HIES) reported over half of the households in Vanuatu do not usually use electricity as the main means of lighting their homes. This number increased to approximately 70 percent in rural areas and decreased to 20 percent in urban areas. The HIES found 42 percent of rural households use kerosene lamps as the main means of lighting, and approximately one-third of all Vanuatu households use such means for lighting, while other sources of lighting include candles (3 percent); wood/coconut shells (2.4 percent); Coleman lamp (1 percent); gas (0.4 percent), and of the total rural households, 20 percent of households reported ‘other’ sources of lighting.³⁴ Of those households using electricity, 91 percent were supplied through the two incumbent utilities (UNELCO and VUI) compared with only 3 percent using household generators and 2 percent receiving their electricity through the provincial government. The Vanuatu socio-economic Atlas found only 6.3 percent of households have a solar system or solar lamp as the main source of lighting. The use of a solar system or solar lamp as the main source of lighting varies across the provinces: 7.5 percent in Torba, 7.2 percent in Sanma, 3.5 percent in Penama, 9.9 percent in Malampa, 7 percent in Shefa, 13.1 percent in Tafea.³⁵

8. There is consumer demand for higher capacity and semi-permanent solar systems that go beyond lighting and provide services for phone charging, radios, water pumps, small fridges, etc. However, affordability is the biggest barrier for consumers to move up to solar home systems with

³² Vanuatu: National Energy Road Map (NERM), 2013

³³ NERM, 2013

³⁴ Vanuatu Household Income and Expenditure Survey 2010, Vanuatu National Statistics Office, 2012

³⁵ Vanuatu Socio-Economic Atlas, 2014



higher power outputs and enhanced user benefits. The average total rural household income is VUV 79,500 (US\$750) per month, of which an average of VUV 69,300 (US\$630) is spent on total expenditures per household per month. Average household monthly cash income as a percentage of total monthly income varies widely between the provinces, with a low of 30 percent in Tafea to 58 percent in Sanma. On average, only 59 percent of consumer's income is in the form of cash.³⁶ This is however, skewed by the higher cash incomes in the main province of Shefa where the capital and majority of government facilities and business activity is located. Table 1 below shows average monthly income, average monthly cash income and net cash incomes in US\$ for the various provinces in Vanuatu. Moreover, access to finance is difficult for rural households who do not have a regular income, may not own land, and cannot demonstrate a credit history. Affordability in the rural areas is low and support is required to achieve energy access targets.

Table 1: Average Monthly Household Income by Province³⁷

| | Torba | Sanma | Penama | Malampa | Shefa | Tafea | RURAL |
|-----------------------------------|--------------|--------------|---------------|----------------|--------------|--------------|--------------|
| Average income (US\$) | 599 | 855 | 616 | 548 | 1,199 | 486 | 841 |
| Average cash income (US\$) | 317 | 496 | 289 | 306 | 971 | 146 | 426 |

9. **SREP Vanuatu Investment Plan for Renewable Energy:** The Scaling-up Renewable Energy Program (SREP) was developed under the CIF umbrella to demonstrate the social, economic and environmental viability of low carbon development pathways in the energy sector. In March 2012, Vanuatu and Solomon Islands were invited to participate in the SREP Pacific Regional Program and to prepare country specific investment plans. The Government of Vanuatu engaged a consultant firm in 2013 to support the government to prepare Vanuatu's country specific investment Plan. The Government of Vanuatu and the (SREP sub-committee endorsed and approved respectively the Investment Plan for Vanuatu in November 2014. The Investment Plan put forward for consideration for funding through the CIF Strategic Climate Fund two projects: (i) investment in two small hydro projects through the Asian Development Bank and (ii) the Vanuatu Rural Electrification Project (VREP) through the World Bank. VREP comprises two components: (i) "plug-and-play" solar systems under a vendor model to consumers in rural and remote areas where micro and mini grids are not feasible (VREP I), and (ii) Solar Home Systems (SHS), and where feasible micro and mini grid development in areas where extension of existing grids is not an option (VREP II). VREP I, developed in parallel with the SREP IP and comprising part of the Rural Electrification Project under the IP, is already under implementation and VREP II is being finalized. The results framework and the financing plan are for to the entire rural electrification program (VREP I and II).

³⁶ Vanuatu Household Income and Expenditure Survey 2010, Vanuatu National Statistics Office, 2012

³⁷ Vanuatu Household Income and Expenditure Survey 2010. Vanuatu National Statistics Office, Government of Vanuatu. December 2012.



Table 2: VREP Financing Plan (US\$ million)

| Project Components | Project cost | IBRD or IDA Financing | Trust Funds | Counterpart Funding* |
|---|--------------|-----------------------|-------------|----------------------|
| VREP I | | | | |
| Electrification of off-grid households, aid posts and community halls | 6.2 | | 3.1 | 3.1 |
| Technical assistance and project management | 1.6 | | 1.6 | |
| VREP II | | | | |
| Provision of Solar Home Systems (SHS) and construction of micro grids | 16.07 | 1.5 | 3.87 | 10.70 |
| Construction of mini grids in rural areas of Vanuatu | 7.3 | 2.5 | 4.3 | 0.50 |
| Project management | 2.0 | | 2.0 | 1.50** |
| Total Costs | | | | |
| Total Project Costs | 34.67 | 4.0 | 14.87 | 15.8 |
| Total Financing Required | 34.67 | 4.0 | 14.87 | 15.8 |

*consumer co-contribution. **GoV in kind contribution.

Project description

10. The Project Development Objective of the Vanuatu Rural Electrification Project is to support increased penetration of renewable energy and increased access to electricity services in the dispersed off-grid areas of Vanuatu. The proposed project would support the Government's initiative to develop a market in Vanuatu for off-grid solar energy systems (Solar Home Systems (SHS) and micro-grids), mini grids powered by renewable energy in rural areas, and strengthen institutions for decentralized electricity services. The project is expected to benefit rural households, public institutions (elementary and secondary schools and health centers) and small businesses that would be connect to the mini-grids, as well as the same entities nationwide through stand alone SHS and micro grids. The project would also contribute to enhance the capacity and capabilities of the Department of Energy.

11. The project is comprised of three components. The first component would finance the expansion of access to reliable electricity service in rural Vanuatu through SHS and micro grid



configurations where mini grid configurations are unlikely to be economically viable and which are not earmarked for mini grids under this or other donor or government projects or are the least cost solution, benefitting approximately 42,000 people and 37 public institutions. SREP will finance SHS and micro grids may include systems for a household use (of varying capability) and will be available for purchase to all rural consumers, a community application for example for a church, electrification of a health center based on its needs and may include solar water pumps or other similar applications. The technical standards (international standards) and the type of products available under this component will be set out in a Product Catalogue which will be reviewed from time to time or in the case of micro grids it may be sourced through tender which will set out the specifications, standards and operations and maintenance arrangements. The project will partly subsidize the retail cost of SHS and micro grids. An amount will be established (initially 33 percent of retail cost) and then may be varied over time depending on the take up rate and the size of the systems. The consumer will arrange his or her portion of the funds for the purchase (initially 66 percent of the retail cost), either by means of cash or micro finance credit.

12. The second component would finance expansion of access to affordable and reliable electricity service in rural Vanuatu through mini grid configurations where there are limited prospects in the medium term to provide electricity services from the main grid systems. This component would support electricity service provision to approximately 550 rural households, which equates to around 2,750 people, and public institutions and businesses. The project will finance the construction of 5 mini grids, based on initial cost estimates. The criteria for selection of sites with potential to support a mini grid is (i) community household numbers greater than 75 households; and (ii) business and public institutional load greater than 50 percent of the total load.

13. The third component would finance three key areas of the project, the first focusing on the vendor and product registration model for Component one, the second focusing on Owners' Engineer for Component two, and the third focusing on project management. In addition, there is an allowance for Government contribution (US\$1.5 million "in kind") that will cover the Government of Vanuatu's direct project related costs, such as arrangements for voluntary land donation and other inter-departmental support.

14. **Transformation.** The project would contribute to the transformation of rural electrification in Vanuatu by catalyzing demand in rural areas, promoting the local supplier market for solar products nationwide, contributing the development of supply chain to and service industry for renewable energy products for the remote communities and demonstrating the feasibility of small scale hybrid mini grids in rural Vanuatu. The successful implementation of the project would not only supplement and enhance rural electrification efforts in Vanuatu, especially through the provision of electricity in areas where the grid extension is not feasible or becomes too costly, but also increasing access to electricity through renewable energy. The proposed mini grids, combined with technical assistance offered under the project, would support the transformation by improving the enabling environment (such as legal and regulatory) to attract private sector investment in the medium to long term. The demand-driven private sector-based model (as opposed to supply-driven Energy Service Company or tender model) for Component 1 (SHS and micro grids) and private sector operations and maintenance model (as opposed to community-based operations) for component 2 (mini grids), would ensure sustainability.



15. **Rationale for SREP financing.** Access to electricity in rural Vanuatu is low (20 percent). The remoteness, lack of economies of scale, and poor infrastructure mean that the cost of providing electricity, including through conventional fuels, in the rural areas is high. The analysis in Section VI.A shows that renewable energy solutions (SHS, micro and mini grids) can be economic and at least cost compared to fossil fuel options. Paragraph 84 (on page 30) sets out the NPV calculations showing that for communities with 50 households or more with significant public institutions, business or commercial loads, mini grids can be economic. The least cost renewable energy options are SHS and micro grids at Paragraph 85 (on page 31).

16. Financial analysis for mini grids shows negative NPVs and FIRR that are lower than the discount rates for the service providers and consumers (paragraph 94 and 95 on page 34 respectively). Paragraph 96 on page 34 shows similar results for SHS and micro grids. Whilst the mini grids generate revenue to the service providers, the revenue is not sufficient to meet the hurdle rates to be financially viable. In addition, the upfront costs of service connections and household wiring (for mini grids) and the costs of SHS and micro grids mean that subsidies are required to overcome the affordability barrier (refer to Paragraph 97 on page 35 and Paragraph 98 on page 36). The project therefore requires substantial funding in the form of grants to be financially viable. Further, the absence of a developed micro-finance industry in the rural areas means that the project will need to rely on subsidies. Access to finance, where available, is also difficult for rural households who do not have a regular income, may not own land, and cannot demonstrate a credit history.

17. Vanuatu has an untapped potential for renewables, especially solar. The project would help demonstrate the viability of renewable energy based mini-grids as the best alternative for electrification of communities in rural Vanuatu. The use of SREP grant funding would be critical to lower the high upfront costs of solar-based renewable energy generation in a dispersed, island nation, thereby making end-use customer tariffs more affordable. The pilot effect of the proposed mini grids would increase the viability of these types of operations to other donors and private sector investors potentially interested in rural electrification. SREP support would also help demonstrate the feasibility of business models to operate renewable energy based rural electrification projects, which would increase the capacity of the private sector to participate in this type of project, either as operators, developers, and/or investors in future projects. SREP support would also help increase the availability of renewable energy in rural areas, therefore reducing the dependency of fossil fuel.

18. The proposed project would also help accelerate the local market for solar home systems, assisting with electrification of areas with widely dispersed population where neither grid extension nor mini grids are cost-effective solutions. SREP support would be crucial to strengthen the emerging private sector led supply and service market for solar in Vanuatu, and build on the initial progress made under VREP I. The use of SREP funding would support the development of a sustainable, private-sector led market for solar products in Vanuatu. The project would directly contribute to increasing and strengthening renewable energy based rural electrification efforts in Vanuatu through mini grids and solar home solutions.



Assessment of Proposed Project with SREP Investment Criteria³⁸

| Criteria | Standalone solar and mini grids |
|--|--|
| Increased installed capacity from renewable energy sources | Approximately 29 percent of grid connected electricity is produced by using renewable energy in the four concession areas: Port Vila, Luganville and in parts of Malekula and Tanna Islands. ³⁹ Grid connected renewable energy includes wind, solar and biodiesel. The Government of Vanuatu has recently completed around 5 biofuel mini grids in rural areas of Vanuatu. The Vanuatu Rural Electrification Project Stage I (0.3MW) and Stage II (4.5MW) would finance about 4.8 MW (solar, battery with back up) installed capacity in rural Vanuatu, generating around 2.7 GWh annually of solar based power. |
| Increased access to energy through renewable energy sources | The Government recognizes that access to electricity is a key driver for social and economic development. The project is aligned with the Government's National Energy Road Map (NERM) 2013 - 2020, which lays the foundation for future energy sector policy and investment in Vanuatu (Refer to Section C of the PAD). The NERM identifies five priority areas and targets for Vanuatu's energy sector. The project will support the achievement of the access (<i>access to secure, reliable and affordable electricity for all citizens (100 percent by 2030)</i>) and the climate change (<i>mitigating climate changes through renewable energy and energy efficiency</i>) objectives of the NERM. Expansion of electricity access will be critical to address the needs of households, health, education centers, and other critical facilities, as well as to support the long term economic and social development of Vanuatu. The proposed mini grids in rural Vanuatu would benefit approximately 550 households (approximately 2,750 people), public institutions and businesses. The SHS and micro-grids would provide energy access to 8,400 households and at least 42,000 people. Combined with activities under VREP I (17,500 households and 87,500 people), the SREP financing will contribute to electrification of approximately 45 percent of households in Vanuatu. |
| Low Emission Development | The project would promote the utilization of sustainable energy in rural areas by providing electricity through hybrid mini-grids powered using renewable energy, solar power with backup biodiesel. The project would also promote the use of solar energy products nationwide through the development of a commercial market for larger standalone solar products in Vanuatu. The CO2 emission savings capacity of the proposed project was estimated using the |

³⁸ For reference: SREP Programming Modalities and Operational Guidelines

https://www.climateinvestmentfunds.org/cif/sites/climateinvestmentfunds.org/files/SREP_Programming_Modalities_and_Operational_Guidelines_final.pdf

³⁹ The amount of renewable energy capacity installed at the end of 2012 reached 4.4MW out of 31.5MW or 14 percent of the total installed generation capacity. Green electricity generation is enhanced further by mixing coconut oil (copra) with diesel in thermal generation, which translates in a cumulated contribution of 29.5 percent from renewable sources in electricity generation as measured in January 2013. Source: Utilities Regulatory Authority, http://www.ura.gov.vu/index.php?option=com_content&view=article&id=38&Itemid=228&lang=en



| Criteria | Standalone solar and mini grids |
|--|--|
| | <p>Guidance Manual: “Greenhouse Gas Accounting Methodology for Energy Access Investment Operations”. The applied methodology is described in the UN’s “Clean Development Mechanism Methodology Booklet” from November 2016 and titled “AMS-III.BB. Electrification of communities through grid extension or construction of new mini-grids” and its appropriateness for this project has been confirmed by the GHG Accounting team. The basic idea is to compare the project related CO₂-emissions to an alternative scenario, where the same amount of electricity is being produced by Diesel generation. Applying the default emission factors for diesel generator systems as described in the document “Greenhouse Gas Accounting Methodology for Energy Access Investment Operations”, the project would help avoid on average 5,300 tCO₂ per annum on the mini grids and standalone solar systems. The savings over the lifetime of the investment, estimated at 20 years, would be approximately 106,000 tCO₂ (about 75 percent of savings come from SHS and micro-grids, 25 percent from mini-grids).</p> |
| <p>Affordability and competitiveness of renewable resources</p> | <p>Renewable energy SHS, micro grids and mini grids are economically viable options, as shown in Section VI of the PAD as summarised under Paragraph 15 and 16 page 57, when compared to the alternative sources of energy such as kerosene, candles and diesel fuels. The discount rates and estimated costs of alternatives are provided. Renewable energy is competitive against alternatives and offers other benefits such as reliability, security and lower pollution (particulate and GHG). The LCOE analysis under Section VI (Paragraph 85 on page 31) of the PAD shows that for communities with less than 75 households’ standalone SHS and micro grids are least cost options, whilst above this mini grids would be least cost.</p> <p>Financial viability and affordability as discussed in Section VI are issues. The cost of capital for consumers is higher than the discount rate used for the economic analysis, the FIRR is less than the cost of capital and hence the NPV is negative. The consumers’ willingness to pay (WTP) is assessed at US0.75/kWh and US1.16/kWh.⁴⁰ This range reflects the applications, for example if only lighting applications using kerosene and candles is considered the WTP is at the lower end, however if the uses such as refrigeration is considered then diesel would be displaced and the WTP would be higher. The LCOE for SHS and micro grids range between US0.90/kWh and \$1.26/kWh whilst for mini grids it is estimated at US1.20/kWh (refer Paragraph 85 on page 31). The main contribution to the costs of the renewable energy options for consumers are in the capital costs of the SHS and micro grids and the service connection and household wiring costs of mini grids. To overcome the affordability barrier, the project proposes to address this through:</p> <ol style="list-style-type: none"> 1. Subsidizing the costs of the SHS and micro grids; and 2. Funding the mini grids and applying the national electricity tariff for the |

⁴⁰ The WTP provided are estimates of current costs of alternatives. The LCOE is determined the costs over the life of the assets. Future costs are sensitive to the discount rates used.



| Criteria | Standalone solar and mini grids |
|--|---|
| | <p>usage.</p> <p>Table 8 in the PAD shows the costs to consumers as percentage of their income after subsidies for SHS are applied. Table shows the costs to consumers if there are to pay the average tariffs for supply through mini grids. These results are considered to be affordable.</p> |
| Productive use of energy | <p>SHS, and micro grids provide a level and quality of service that cannot achieved alternative sources of energy in rural areas. It allows the rural population to engage is productive activities, by saving time involved in sourcing alternatives, and by enabling home based activities such as sewing and weaving, agricultural uses e.g. drying and refrigeration, commercial activities such as lighting and refrigeration for shops, village bungalows, water pumps, lighting and computer labs for schools and refrigeration for medicines in health centres to name a few. Mini grids ensure grid standard electricity supply to support domestic, commercial and industrial applications.</p> |
| Economic, social and environmental development impact | <p>The project is in line with the strategy of the Government for the electricity sector. It would contribute to the expansion of electricity infrastructure for economic and social development using renewable energy. The project would help to: (i) increase quantity and quality of electricity services in remote areas for households, public institutions, and business loads; (ii) generate education benefits (e.g. through the provision of electricity to schools and households, lighting allows children to study at night); (iii) reduce GHG emissions and other local pollutants from using renewable energy sources for power generation; (iv) increase income or productivity by promoting productive uses of electricity in agricultural, commercial and health and education activities; and (v) generate employment opportunities, mainly related to construction, operation and maintenance of the micro and mini grid systems. In addition to the above, the project will contribute to the development of private sector businesses for the supply and maintenance of renewable energy systems, thus ensuring long term sustainability.</p> <p>Further potential benefits, such as potential for increased income generation and increased WTP, social and environmental issues and costs of using solid fuels, diesel, etc., avoided CO2-emissions, demand on time vs productive activity and education for managing like without access to electricity, poor quality of health and education services, lack of security and reduced productive hours, have not been quantified due to the lack of reliable and accurate data.</p> |
| Economic and financial viability | <p>The analysis in Section VI.A shows that renewable energy solutions (SHS, micro and mini grids) are economic and and/or least cost compared to fossil fuel options. Paragraph 84 on page 31 above sets out the NPV calculations showing</p> |



| Criteria | Standalone solar and mini grids |
|---|---|
| | <p>that for communities with 50 households or more with significant public institutions, business or commercial loads, mini grids can be economic. Below this the least cost renewable energy options are SHS and micro grids (Paragraph 85 on page 31).</p> <p>Financial analysis for mini grids shows negative NPVs and FIRR that are lower than the discount rates for the service providers and consumers (Paragraph 94 and 95 on page 34 respectively). Paragraph 96 on page 34 shows similar results for SHS and micro grids. Whilst the mini grids generate revenue to the service providers, the revenue is not sufficient to meet the hurdle rates to be financially viable. In addition, the upfront costs of service connections and household wiring (for mini grids) and the costs of SHS and micro grids mean that subsidies are required to overcome the affordability barrier (refer to Paragraph 97 on page 35 and Paragraph 98 on page 36).</p> <p>The project therefore requires substantial funding in the form of grants to be financially viable.</p> |
| Leveraging of additional resources | <p>SREP contribution of \$6.77M will leverage investments from IDA, NZMFAT, Government in kind contribution and customer contributions under VREP I and VREP II of $(4 + 8.1 + 1.5 + 14.3 = 27.9\text{M})$, 4 times the amount contributed by SREP. The Government will provide US\$1.5 million in kind that will cover the Government of Vanuatu's direct project related costs, such as arrangements for voluntary land donation and other inter-departmental support.</p> |
| Gender | <p>The project aims to increase access to energy services in rural communities. The project's objective is to increase access to electricity services for rural households, including female headed households. Improved access to electricity through renewable energy sources reduces the physical burden associated with organizing alternative energy sources. Access to electricity also frees valuable time, especially for women, widening their employment opportunities (including in the renewable energy supply industry). Access to clean energy can go a long way in improving health and reducing premature mortality, especially among women and children and learning/education opportunities.</p> |

Monitoring and Evaluation

19. Overall monitoring and evaluation of the project activities would be performed by the Department of Energy. The project's key performance indicators area aligned with the indicators required under the SREP core indicators. The regular monitoring and reporting on the agreed project indicators would be conducted by the Department of Energy. The Department of Energy would have the responsibility to collect data and report on the performance indicators on a six-monthly basis for the PDO indicators and for the intermediate outcome indicators at the component level.



Implementation Readiness

20. Country/sector strategies: This project supports the Government of Vanuatu's objectives and targets for increasing access to secure, reliable and affordable electricity of its citizens under the NERM and set out in Vanuatu's SREP Investment Plan 2014. The project will contribute to increased access and affordability of electricity for communities in rural Vanuatu, in line with the key targets for electricity access as identified in the updated NERM: i) by 2030, provide modern electricity access to 100 percent of households in off-grid areas, (ii) electrify 100 percent of public institutions in off-grid areas by 2030, (iii) 100 percent electricity generated from renewable sources, and (iv) 14 percent of electricity generated from biofuels.

21. Implementation arrangements: The DoE within the Ministry of Climate Change and Natural Disaster, will be the Implementing Agency for the Project and therefore have overall responsibility for project management. The DoE is implementing other World Bank financed energy projects, the Energy Sector Development Project, Improved Electricity Access Project and VREP I, and is familiar with the Bank's policies and procedures. Since 2011, the DoE has grown from 1-2 staff to over ten (10) staff. The DoE is recruiting for a number of key positions which will further strengthen the current capacity of the department. In addition, the DoE staff are supported by five consultants funded under World Bank financed projects, including the Project Manager for VREP I.

22. Under Component 1, energy retailers will be registered a vendors to participate in the project. Each vendor will enter into a Subsidy Implementation Agreement (SIA) with DoE on behalf of the Government of Vanuatu. The SIA sets out the rights and obligations of all parties to the agreement, and establishes the legal basis for paying the subsidy. Vendors may register (or deregister) at any time after the project becomes effective and until the project closing date in accordance with the criteria and procedures set out in the Project Operations Manual (POM). The DoE will verify the sales of SHS and supply of micro grids and other qualifying products and record the subsidies provided to end users. The POM will set out the roles and responsibilities, processes and monitoring and evaluation requirements for the Project. Similar to the support provided VREP I, the DoE will engage a consultant to assist with the registration of suppliers (vendors), development of minimum standards for SHS and micro grids, that is also likely to become the national standard, and for the development in an initial Product Catalogue for SHS products. The consultant will also assist with the processes for subsidy disbursement and legal arrangements between with vendors and the GoV.

23. Under Component 2, the DoE will be responsible for inviting communities identified on a long list of potential sites for mini grids to elect to receive electricity through a mini grid and inform them of the objectives and structure of the project. The community engagement will consist of public meetings and face-to-face discussions with communities to discuss energy needs and issues in the community, enable the Department to illustrate the technology, discuss the technology benefits and the implications of the community becoming customers, and to discuss and identify suitable land to house the necessary infrastructure. The objectives of the engagement process are: (i) to understand the energy issues and needs of the community; (ii) inform communities they are eligible to receive a micro or mini grid, and (iii) to ensure that all communities who decide to receive a mini grid a well advised of the benefits, costs, obligations, and financial requirements of participating. The Owners' Engineer will support the Department in the preparation and planning for the community engagement process, support the



design, specification, procurement and supervision for the supply of mini grids. An emphasis will be placed on ensuring that women are engaged, and that all community members are well informed and have a chance to participate. The DoE will be responsible for negotiating land access and preparing necessary safeguard documentation to meet the requirements of the Resettlement Policy Framework (RPF).

24. **Sustainability:** The Government of Vanuatu has demonstrated strong commitment and ownership of the project. The project concept was developed by the Government of Vanuatu through a participative process as part of the SREP Investment Plan preparation in 2014. The IDA financing for the project was approved by the Council of Ministers (COM 56/2015) in May 2015. The main driver for sustainability of the project is the Government's commitment to off-grid electrification to achieve the access and renewable energy targets set out in the NERM. The DoE will benefit from technical assistance from Owner's Engineer. The Owner's Engineer will provide expertise and best practices related to rural electrification and hybrid mini grids.

25. The economic results and financial performance of the project is critical to ensure long term sustainability of the project. Both the economic and financial outcomes are challenging and the components have been designed to support those mini grid installations that are going to have the best prospect of financial sustainability. Further, electrification for households where mini grids are not likely to be economic or financially viable will be through SHS, micro and mini grids as least cost solutions. Financial viability of the mini grids remains an issue, so the mini grids will need to be subsidized while balancing the impacts on the Government, the service providers, the end users (beneficiaries) and the communities. As such, only 5 mini grids are proposed initially. Rollout of mini grids beyond the initial stage will be subject to recalibration and lessons learnt from the piloting phase.

26. A sustainable market for SHS and micro grids created over the life of the project, will create employment and small business opportunities to the wider community of Vanuatu, from establishing a private sector for the supply of SHS in the outer islands and from the generation of long-term maintenance of the larger solar installations. The private sector will also indirectly benefit from the establishment of an accreditation program and the development of national standards and regulations, in strengthening their business and operation practices and deliver and install only safe and compliant systems to the communities.