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Environmental Code of Practice for Solar Home Systems and Solar Micro-Grid Systems (Used Battery Disposal, Health and Safety and Land Permission)

For Vanuatu Rural Electrification Project, Vanuatu

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- Environmental Impact Assessment GoV – Government of Vanuatu

IPP - Indigenous Peoples Plan

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LAB – Lead Acid Battery

Ni-Cad – Nickel Cadmium Battery

NERM – National Energy Roadmap

OP – Operational Policy

POM – Project Operations Manual

PV – Photovoltaic

VERD – Vanuatu Electricity for Rural Development

VREP – Vanuatu Rural Electrification Project

Overview

Introduction

The project development objective (PDO) of the Vanuatu Rural Electrification Project (VREP) is to scale up access to electricity services and support increased penetration of renewable energy in dispersed off-grid areas of Vanuatu.

Of the 50,740 total households in Vanuatu, an estimated 21,500 are in grid-concession areas or in adjacent areas feasible for grid-extension and the remainder are in remote areas where connection to a grid is not possible in the short to medium term. The GoV and the two incumbent concessionaires Union Electrique du Vanuatu Ltd (UNELCO) and Vanuatu Utilities and Infrastructure Ltd (VUI) are implementing the Improved Electricity Access (IEA) Project, funded through the Global Partnership for Output-Based Aid (GPOBA)/World Bank, which provides assistance to low-income consumers who are still not connected or currently share a connection, within the existing grid service areas. The remaining 29,240 households are in areas termed "off-grid". Approximately 10,000 of these households are relatively concentrated and are more likely to benefit from a micro- or mini-grid configuration, powered by local resources, such as hydro and other renewable energy technologies where available, diesel gensets, or hybrids. For the remaining 20, 000 households, access to modern energy in the near or immediate future is dependent upon off-grid power.

The VREP assists the Government of Vanuatu in providing electricity through the following:

VREP I is the provision of subsidised 'plug and play' solar home systems to 17,500 households, 2,000 community halls and 230 aid posts in dispersed rural areas where grid connection is unlikely to be economical and feasible within the next few years. This Phase is currently underway and expected to be completed at the end of 2019.

VREP II has two (2) components: - Component 1 is the provision of subsidised Solar Home Systems (SHS) and solar micro-grids to 37 public institutions and 8,400 rural households. These SHS and solar micro-grids of varying kilowatt capacity will be available to rural consumers to purchase for their households and community facilities such as health centres, churches or schools. Solar micro-grids may connect more than one building to a set of panels. These SHS and micro-grids will be required to meet approved technical standards, installed by accredited technicians and used batteries are required to be safely disposed. Component 2 will be installing initially five (5) mini-grids in five (5) locations throughout Vanuatu. It will target 550 households, 10-12 public institutions (schools and health centres) and some business/commercial operations. The systems installed will be solar photovoltaics (PV) with battery storage with biodiesel generators as back up. Project description and implementation arrangements are included in Annex 1.

This ECOP is the safeguards instrument applicable to VREP I and Component 1 of VREP II and is compliant with World Bank safeguards policies. Environmental and social safeguards for Component 2 of VREP II will be documented and separately managed with support from the Owner's Engineer.

Environmental and Social Impacts

Social Impacts

The impacts are overwhelmingly beneficial. The increased access to electricity services that the proposed project will provide to rural households, community facilities, public institutions and businesses located in dispersed off-grid areas and for VREP I, it will build on the achievements of the completed Lighting Vanuatu Project by providing improved functionality and enhanced benefits. For VREP II, it will build on achievements and lessons learned from VREP I.

There will be no land acquisition since the installation of PVs will take place within existing households and public facilities. There is the potential that micro-grid wiring may traverse third party land, and the beneficiary must secure permission to enable this prior to work starting.

World Bank Indigenous Peoples Policy, OP 4.10, was triggered for VREP 1 due to the potential for the presence of indigenous people (IPs) in the rural areas of the outer islands. However, since the overwhelming majority of the beneficiaries are IPs, the Project has integrated the elements of an Indigenous People's Plan (IPP) in the design of the Project, including consultations for broader community support of the Project, provision of culturally appropriate project benefits in the installation of PV panels in households, and gender-related considerations (e.g., specific consultations with women's groups and uptake of project services by female-headed households). Consultations undertaken during the design of Vanuatu Electricity for Rural Development (VERD), on which VREP I and VREP II are based, indicated strong community support. Further, consultations during the preparation of NERM established affordable electrification of rural households as a key priority. Therefore, the requirements of OP4.10 have been met in project design.

Environmental Impacts

Solar panels will be either installed on rooftops or mounted on poles, where roof orientation is not suitable. As such, there will be no construction related impacts for VREP I and Component 1 of VREP II.

The main environmental issues associated with the Project will be the recycling/disposal of spent storage batteries at the end of their useful lives (3-5years). The World Bank Environmental Assessment Policy OP 4.01 is triggered to ensure proper disposal/recycling of lithium, lead-acid or lead-gel batteries, where used. Since legislation and regulations on disposal of solid wastes, such as lead acid batteries, is in early stage of development, this project-specific ECOP has been developed for the collection, transport, storage and disposal of used batteries. It is anticipated that this project-specific ECOP will supplement and accompany more detailed national legislation and regulations for disposal of solid wastes, including batteries during the Project period. No products will be "qualified" for, and included in, the product catalogue until processes for the collection, transport, storage and disposal of the batteries associated with the products are established in accordance with this ECOP.

The registered vendors will need to ensure that they have procedures in place to meet the requirements of this ECOP whether they are through central or industry established processes or vendor and product specific processes. The Project will adopt the national legislative and regulatory framework once they are established.

Environmental Code of Practice - Objectives

This ECOP has been developed specifically for all equipment to be financed under the VREP, namely solar PV systems of generally in the range of 5 Watts up to the capacity of a micro-grid system. The key environmental issue associated with the project is the appropriate management and disposal/recycling of used Ni-Cad and Lead Acid Batteries. The ECOP also covers health and safety during installation and the avoidance of land conflicts by requiring land owner approvals for any use of third party land.

To ensure effective application of the World Bank's environmental and social safeguard policies and to support the national regulatory requirements, the ECOP provides guidance on the approach to be taken to the collection, transport, storage and disposal of these types of batteries at the end of their useful life. Importantly, the ECOP addresses management of spent/used batteries for a period of time until Vanuatu's waste management legislation and regulations and capacity is improved to a point where the ECOP becomes obsolete. To this end, the ECOP seeks to inform discussion and build awareness around battery management to assist continual improvement in battery management for the country. It is likely that by the time the first batteries under the Project need to be disposed of (3-5 years), that Vanuatu will have an effective regulatory framework (which is already well progressed) and the institutional capacity to effectively manage these batteries.

Legal and Policy Framework

Vanuatu Legislation

Environmental legislation is at an early stage of development in Vanuatu. The Pollution Control Bill was passed in December 2013 and the Waste Management Bill was passed by Parliament in April 2014.

The Pollution Control Act

The Pollution Control Act is designed to control the discharge and emission of pollution ('the introduction by persons, directly or indirectly, of substances or things into the environment which may result in harm to the environment, and hazardous to human health).

The Waste Management Act

The Waste Management Act is designed to provide for the protection of the environment through encouragement of effective waste services and operations. The Act focuses mainly on solid waste which includes the following: garbage, household refuse, rubbish, scraps, electronic waste, trade and industrial waste, in solid form; or any other matter or thing determined in the Act to be waste. The Act does not include human waste except in the form of sludge or any other form intended for final disposal as a waste product. The Act defines waste as 'solid waste; or bulk waste; or any other matter or thing determined from time to time to be waste in accordance with the Act. The Act also specifies the roles and responsibilities of DEPC as a regulator and the designated waste management operators as operators, which includes the Municipalities or Provincial Government Councils. The Act also allows for licensing of private waste operators (either an individual or company) who wishes to operate a landfill site; or a waste dump; or waste facility.

These pieces of legislation represent the beginning of a legal framework to address the environmental degradation impacts of poor pollution control and waste management. Substantive additional work is required to prepare regulations to add more detail to the legislation and to strengthen the capacity of the institutions responsible for effective implementation of the legislation. Some progress is underway in developing an appropriate regulation under the Waste Management Act to manage batteries.

World Bank OP 4.01 - Environmental Assessment.

This operational policy (OP) requires an Environmental Impact Assessment (EIA) to be conducted of the projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable with an objective to improve decision-making process. The OP also classifies the project on the basis of the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts. The requirement to carry out an EIA as part of project preparation can be waived but, for projects with potential adverse impacts, an appropriated level of environmental and social assessment will be carried out before the project implementation. It is expected that by the time the first tranche of batteries needs replacement (at least 3 years after implementation begins), the environmental frameworks will be much stronger. Adopting the precautionary approach however, this ECOP defines minimum requirements.

Environmental Code of Practice Requirements

Batteries and potential environmental impacts

A central component of any remote solar power system such as those used in 'plug and play' systems and proposed under Component I of VREP II of the Project is the use of rechargeable batteries. These batteries store the power generated during the daylight hours for later use. Rechargeable batteries include lithium- ion (Li-ion), nickel metal hydride (NiMH), nickel cadmium (Ni-Cad) and lead acid batteries (LAB).

Lithium ion and nickel metal hydride batteries (as well as standard AA, AAA, C-cell and D-cell etc. dry cell batteries) are suitable for disposal in standard landfill and therefore are not covered by this ECOP. Accordingly, this ECOP applies specifically to LAB and Ni-Cad batteries. These batteries, if improperly transported, stored and disassembled/recycled, can create long lasting environmental impacts due largely to the chemical and heavy metals such as mercury, lead, cadmium and nickel which are central components of these batteries. If released into the environment (via incineration and/or leakage and leeching etc.) these chemicals and heavy metals can create a number of health impacts including headaches, abdominal discomfort, seizures and comas.

The main components of a lead-acid battery are lead (Pb) electrodes and lead dioxide (PbO_2) electrodes immersed in a solution of water and sulphuric acid. These are generally contained in a plastic case made from polypropylene. In addition to lead which can create to a wide range of biological effects (including upon the kidneys, gastrointestinal tract, reproductive system and the nervous system) and is a recognized developmental and reproductive toxicant[1], lead acid batteries also contain sulfuric acid which is highly corrosive and can cause burns and damage to skin, eyes or the respiratory system. Both nickel and cadmium which are the central components to Nickel-Cadmium (Ni-Cad) batteries have potential negative impacts on both the environment and on human health. While the effects of nickel are generally less severe (in the absence of long term exposure to airborne nickel dust) and limited to skin irritations, cadmium is a carcinogen, which can lead to renal dysfunction and bone defects.

Effective management of batteries can ensure that these potential negative impacts are not realized as a result of this Project. Indeed, through the increased awareness activities proposed, it is expected that the project, guided by this ECOP, will have the potential to have long-term positive impacts on communities and public health since many batteries of this type are used by these communities outside this project.

Battery Management Approach

The approach adopted seeks to avoid the potential environmental impacts created by improper management of LAB and Ni-Cad batteries. Mitigation measures proposed comprise two fundamental stages or approaches namely (i) Community and user awareness and (ii) Direct management of used nickel- cadmium (Ni-cad) and lead acid batteries (LABs) by the system suppliers.

Community and user awareness

As part of an initiative of informing the community of the risks associated with batteries under this Project, the DoE will carry out a broad battery awareness campaign. This campaign will not only focus on project participants and beneficiaries. Instead, the campaign will target all community members and as such will result in improved knowledge of the environmental issues associated with spent batteries, whether they are from people's cars, boats, or other power supplies etc. Importantly, the communication campaign will

[1] IBID

include information on all the main battery types, irrespective of whether they are high toxicity (such as NiCad and LAB) or lower toxicity batteries (such as AA, or AAA batteries etc). The type of information to be included in the information campaign is included in Annex 2.

A campaign will be designed by the DoE, however it is expected that it will include initiatives such as:

- Information on the DoE website on disposal of all battery types;
- Appropriate local information campaigns including distribution of flyers and information sheets in local communities, awareness raising at community meetings and notices at shops selling batteries; and
- A media campaign including advertisements and awareness pieces in local newspapers.

This campaign will run for the life of VREP I and VREP II and will address issues such as:

- The differences between the battery types in terms of battery life and reliability;
- The safe handling of batteries including installation, removal, transport, storage and disposal;
- The environmental and health aspects of poor battery disposal; and
- Focused information on the environmental and health issues associated with high toxicity batteries and explanation as to why they must be stored, transported and disposed of in certain ways and therefore why it is in the interests of individuals, the community, the environment (and therefore future generations in communities) that the methods outlined in this ECOP be followed.

Direct management of used nickel-cadmium (Ni-cad) and lead acid batteries (LAB) by the system suppliers

The disposal and management of used batteries from solar PV systems will follow the Government of Vanuatu Waste Management Act and the provisions of this ECOP, which is to require the vendors of the systems to make arrangements to collect used Ni-Cad and LAB batteries and to properly dispose of them.

Notwithstanding this, the direct management process outlined below is focused on Li-ion, nickel-cadmium (Ni-cad) and lead acid batteries (LABs) as these batteries represent the greatest risk to human and environmental health if incorrectly managed.

The vendors will provide a Battery Management Plan which details arrangements for the collection, transport, storage and disposal of batteries for those systems proposed to be eligible under the Project as part of the product registration process. The DoE will assess these processes for compliance with the guidelines set out in this ECOP and may refuse to register vendors' products if they do not comply with the guidelines. A vendor may be refused registration by the DoE under the vendor registration program if the vendor fails to provide evidence on the arrangements for collecting/recycling batteries and redundant solar systems, or failure to compliance with this ECOP.

The Subsidy Implementation Agreement (Legal Agreement) between the vendor the DoE will require the vendors to comply with this ECOP as a condition of participation of the program. The DoE will monitor compliance with the ECOP in accordance with the processes detailed in the POM.

The Department of Environmental Protection and Conservation (DEPC) has a Waste Management and Pollution Control Unit which is responsible for waste and pollution control in Vanuatu.

The DoE, in conjunction with the Waste Management and Pollution Control Unit of the DEPC, will conduct checks on the vendors' compliance with the ECOP. The World Bank Team, as part of its supervision mission of the Project, will conduct random checks on the Project's compliance to battery disposal and management consistent with the national regulations.

The Department of Energy, in consultation with the DEPC is finalizing the regulations for the collection and disposal of hazardous wastes, including LABs which is expected to be in place by the time batteries supplied under this Project require disposal. This ECOP may be superseded by national legislation and detailed regulations on the disposal of batteries, if the requirements of the legislation and regulation meet or exceed the requirements of this ECOP.

Occupational and Community Health and Safety

The systems must be installed by qualified and experienced tradespeople in order to avoid or minimize electrocution and other health and safety issues such as keeping bystanders away from work areas, working at height and working with hazardous materials such as batteries.

The Project Operations Manual sets out the minimum requirements for Vendor qualifications and product standards for work on this Project. The Subsidy Implementation Manual set outs the communications requirements in relation to Electrical Safety.

Permission to use land

Most systems will be installed on the landowner or occupier's property (roof top or pole), and there will be no land related issues. Micro-grids may need to distribute electricity between buildings and may cross third party land. Beneficiaries will be required to seek and confirm permission before works begin.

Specific Requirements under this ECOP

Before working with a battery

Training in proper handling procedures is very important. Key aspects include:

- Consult battery owners' manuals for instructions on battery handling and hazard identification
- Wear personal protective equipment (PPE) such as chemical splash goggles and a face shield
- Wear acid-resistant equipment such as gauntlet style gloves, an apron, and boots
- Do not tuck pant legs into boots because spilled acid can pool in the bottom of your boots and burn your feet
- Place protective rubber boots on battery cable connections to prevent sparking on impact if a tool does accidentally hit a terminal
- Clean the battery terminals with a plastic brush because wire brushes could create static and sparks
- Always remove your watches and jewelry before working on a battery. A short-circuit current can weld a ring or strap to metal and cause severe burns
- Cover maintenance tools with several layers of electrical tape to avoid sparking

Chemical hazards posed by batteries

Sulfuric acid (electrolyte) in batteries is highly corrosive and acid exposure can lead to skin irritation, eye damage, respiratory irritation, and tooth enamel erosion. Following the following principles will assist in managing this risk:

- Never lean over a battery while boosting, testing or charging it
- If acid splashes on your skin or eyes, immediately flood the area with cool running water for at least 15 minutes and seek medical attention immediately
- Always practice good hygiene and wash your hands after handling a battery and before eating. If you handle the lead plates in a battery and do not wash your hands properly, you could be exposed to lead. Signs of lead exposure include mood swings, loss of appetite, abdominal pain, difficulty sleeping, fatigue, headaches and loss of motor coordination.
- The chemical reaction by-products from a battery include oxygen and hydrogen gas. These can be explosive at high levels. Overcharging batteries can also create flammable gases. For this reason, it is very important to store and maintain batteries in a well-ventilated work area away from all ignition sources and incompatible materials. Cigarettes, flames or sparks could cause a battery to explode.
- Before working on a battery, disconnect the battery cables. To avoid sparking, always disconnect the negative battery cable first and reconnect it last. Be careful with flammable fluids when working on a battery-powered system. The electrical voltage created by batteries can ignite flammable materials and cause severe burns. Workers have been injured and killed when loose or sparking battery connections ignited gasoline and solvent fumes during system maintenance.

Safe Battery Movement

Lifting and moving batteries needs to be undertaken with care so as to avoid personal and environmental harm. Key principles include:

- Use proper lifting techniques to avoid back injuries

- Battery casings can be brittle and break easily; they should be handled carefully to avoid an acid spill
- Make sure that a battery is properly secured and upright in the vehicle or equipment
- If a battery shows signs of damage to the terminals, case or cover, replace it with a new one

Battery Disposal

For Lead Acid and NiCad batteries, the supplier will ensure that a system is in place to obtain and properly dispose of these batteries at the time of battery replacement.

Recycling

Lead recycling operations require a high degree of control because of the potential hazards from air emissions and wastewater discharges. There is currently one battery recycler (Recyclecorp) in Port Vila who has been recycling lead acid batteries. Recyclecorp has collection points in Port Vila and Santo and pays for expired lead acid batteries and other metals received from any island. Batteries are collected and stored separately until there is enough for a full container to be shipped overseas. In the past batteries were shipped to Fiji and South Korea for recycling but now Recyclecorp has stopped after being advised that Vanuatu has not signed the Basal Convention. It is understood the process is underway for Vanuatu to sign the Basal Convention and once signed, Recyclecorp will commence exporting used batteries again.. Approximately 90 tonnes or 3-4 containers of used batteries are exported once every year. It is envisaged that the batteries that are collected for recycling will be through this recycler. RecycleCorp has expressed interest in the VREP project and is willing to buy the batteries if they are transported to their collection points in Santo and Vila.

As a preference, LAB batteries are to be recycled at this recycler as it removes the risks associated with further shipment and/or disposal. For batteries held in the islands, it is envisaged that Government will develop the required regulations in order for the used batteries to be collected, stored and shipped to Port Vila or Luganville where they can be exported externally.

Landfill Disposal (Hazardous Waste Facility)

If recycling of batteries is not chosen or possible, disposal in a secure landfill is the next preferred option. The acid should be removed from the casing and neutralized. Empty battery cases must be disposed of carefully because they can still contain significant amounts of lead. Batteries should then be wrapped in heavy duty plastic or encapsulated with concrete. The concrete and plastic serves the purpose of ensuring that lead will not leach out and become mobile in landfill leachate, thus reducing the environmental risk.

The main centers such as Port Vila, Luganville, Tanna and Malekula have landfill sites operated by the local provincial councils that could be used for the disposal for batteries after obtaining approval from the DEPC.

Permission of land

If distribution lines need to transverse third party properties, the Vendor will verify that the beneficiary has obtained written permission from the respective land owner(s). The permission statement(s) will be enclosed with the required subsidy documents when submitted to DoE for subsidy. DoE will verify the statement as part of verification before subsidy payments are made.

Capacity-Building and Monitoring of ECOP Implementation

As part of the capacity building to be provided for implementation of the proposed operations, the vendors and DoE staff will receive training in the ECOP's application. The World Bank will monitor and provide guidance in the implementation of the ECOP. DoE will be responsible, besides other functions, to monitor and supervise the implementation of the ECOP by Vendors. For this purpose, DoE has established a monitoring mechanism as part of the project management system as part of its POM. In addition, DoE may also engage the support of the DEPC for the implementation of the ECOP and compliance with national legislation and regulations.

Disclosure

This ECOP will be shared with all relevant stakeholders, relevant line departments, concerned non-governmental organizations, and development partners. Subsequently, it will be disclosed in English by DoE, and made available on their websites. Copies will also be held at public buildings, such as libraries and offices of Provincial Councils, for the rural communities to access. Copies of the ECOP requiring translation into Bislama will be shared vendors during the vendor registration program to ensure they are fully informed of their obligations. It will also be made available at the World Bank office in Port Vila and on the World Bank website.

ANNEX ONE – PROJECT DESCRIPTION AND IMPLEMENTATION ARRANGEMENTS

Project Description

The Vanuatu Rural Electrification Project (VREP) is comprised VREP I and VREP II and targets dispersed households, community halls, public facilities and business in rural areas where extension of the current grid connection is unlikely to be economical and feasible.

VREP I is a five (5) year program which commenced in 2014 and target 17,500 households, 2,000 not-for- profit (community facilities) and 230 aid posts that are presently unelectrified and are located beyond the economic and feasible grid extension area and are too dispersed across the off-grid area to be considered in future projects for isolated micro-or mini-grid configurations. VREP I has two (2) components:

Component One: Electrification of off-grid households, aid posts and community halls.
The Project is subsidising the retail cost solar photovoltaic (PV) systems by 50 percent. Initially the Project is focusing on solar PV systems of between 5 Watts to 30 Watts peak capacity that are of "plug and play" type, installed easily by the consumer, require little to no maintenance other than replacing batteries, and provide lighting and phone charging capabilities. "Plug and play" systems of higher capacity such as up to 100 Watts have been encouraged provided they meet the product registration criteria for this Project. The Project is not funding smaller systems such as solar lanterns as such systems were funded under the Lighting Vanuatu project. To date, VREP I has two approved vendors and over 2,200 products sold to more than 2,000 households, 158 communities and 3 Aid Posts across 45 islands of Vanuatu.

Component Two: Technical assistance and project management.
The Project requires significant work on ensuring the integrity of the vendor supply chain, and of the products that are supplied to consumers/retailed, consumer awareness and training, collection and disposal of any hazardous or toxic materials, project management and independent verification to ensure the funds allocated under this Project are effectively directed towards achieving the PDO of this Project. The following key activities are financed to address the above:
(i) Vendor and product registration arrangements, communications and microfinance products. The following activities are financed under this component to support the preparation and implementation of the investment activities under Component One: (i) establishment of vendor registration arrangements; (ii) development of product registration arrangements (for a product catalogue); (iii) development of program and product awareness, safety and product care training material for communities, and end users; (iv) establishment of a grievance mechanism for end-user and communities; (v) support with the development of microfinance products to encourage lending in rural areas; and, (vi) development of legislation, regulations and amendments this Environmental Code of Practice (ECOP) for collection, transport and disposal of lithium and lead-acid batteries for rural electrification products under the Project.
(ii) Project management and support. The following activities are to be financed for effective implementation, monitoring and reporting under the Project: (i) capacity building and implementation support to the DoE through technical experts and advisors; (ii) workshops and training for the DoE staff (and other Governmental departments, such as the Ministry of Infrastructure and Public Utilities) involved with off-grid electrification; (iii) execution of awareness programs to rural communities and consumers in Vanuatu; (iv) independent verification of subsidy claims prior to payments; and, (v) monitoring, evaluation and annual reviews of the Project.

The delivery of the 'plug and play' solar systems under VREP I is through registered vendors supplying products on an approved Product Catalogue in accordance with the procedures set out in the Project Operations Manual (POM):

Vendor Registration Program. In order for vendors to participate in the program and be eligible for claiming reimbursements of subsidies, the Project establishes a registration program for vendors. The program, at a

minimum, assess the vendors on their: (i) financial capacity of the business to ensure cash flows are sufficient; (ii) technical ability in providing after sales services to the consumer, such as

maintenance and information on the systems and batteries; (iii) range of products stocked and supply channels and chains; (iv) number of staff and agents and communication links between them; (v) arrangements for collecting/recycling batteries and redundant solar systems, with particular focus on compliance with this ECOP and/or regulations; (vii) training programs in place for staff development and capacity building; and, (viii) geographic reach and existing networks in rural communities and outer islands to ensure that all the target beneficiaries can access the products. The Project encourages collaboration between the main center-based vendors and local communities for the distribution of the products. The vendor registration program is developed as part of project implementation. Each registered vendor enters into a Subsidy Implementation Agreement with DoE, which amongst other things require the vendors to comply with this ECOP.

Product Catalogue. To promote competition between the vendors in Vanuatu, across all regions and island groups, all eligible products supplied by the vendors are listed in a Product Catalogue. The purpose of the catalogue is to present, transparently, to the consumers the range of products available in their area and in the main centers. A vendor must be registered under the vendor registration program (see above) before a product can be listed in the catalogue. Participating vendors are allowed to market any solar system products in the catalogue and procure them from any source in accordance with standard business practice. However, for the product to be eligible under this VREP I, it must be a "plug and play" systems, initially in the capacity range of 5 to 30 Wp. Once consumer awareness and compliance with safeguards has increased, the capacity range was reviewed and adjusted to 100 Watts. The product "qualification" criteria was established during project implementation, covering technical specifications, system performance, product and battery life, warranty, serviceability, product information and recycling needs and arrangements, etc., to enable vendors to register their products.

An Independent Verification Agent as been engaged by the DoE to verify the claims from the vendors, as set out in the POM.

VREP II is also a five (5) year Project commencing in 2017. VREP II is an extension of VREP I and has three (3) components.

Component 1 is supporting 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. This component will target approximately 37 public institutions and 8,400 rural households, which equates to approximately 42,000 people.[2]

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).

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

[2] 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.

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.

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

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 retails 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.

Implementation Arrangements:

The Recipient and Executing Agency for the VREP I and II is the Ministry of Finance and Economic Management (MoFEM), who entered into a Financing Agreement with the World Bank. The Implementing Agency is the Department of Energy (DoE), within the Ministry of Climate Change and Natural Disasters (MCCND). The DoE is currently implementing the Global Partnership for Output Based Aid (GPOBA) project, another World Bank managed Project.

The DoE has contracted a Program Manager to support for the implementation of the VREP I and II under the direction of the Director, DoE, including the oversight of this ECOP.

ANNEX2–InformationforBatteryAwarenessCampaign

Introduction

1. Most homes and businesses contain many pieces of equipment such as portable computers, cell phones, power tools, standby or backup power systems, cameras, security equipment, radios, torches, etc. that depend on batteries to operate. As a result, batteries have become integral to the functioning of our economy and support many aspects of modern lifestyles. These households and businesses use a number of different types of batteries which have different chemistries.
2. Non-rechargeable, single-use batteries used in clocks, toys, cameras and remote controls can be either alkaline and zinc-carbon (AA, AAA, D, C, 9-volt dry cell), mercuric-oxide (button, cylindrical and rectangular) or lithium (AA, C, button, 9-volt). These batteries are also known as "primary" or single- use batteries because they are normally not recycled and are disposed of after use.
3. Rechargeable batteries (also referred to as "secondary" batteries) use lithium-ion (Li-ion), nickel metal hydride (NiMH) or nickel cadmium (NiCd) chemistry. These are found in such products high end products as camcorders, mobile phones, laptops and cordless power tools, shavers, and electric toothbrushes.
4. Lead-acid batteries are the oldest type of secondary batteries. They are used to supply electrical power to cars, trucks, tractors, motorcycles, and boats. Small sealed lead-acid batteries are used for emergency lighting and uninterruptible power supplies.
5. Used batteries, whether primary or secondary, are potentially hazardous, so they need to be stored and handled carefully. Some of the materials inside a battery are toxic and may damage skin and clothes if the battery is damaged or leaking. Used batteries require careful handling to minimize safety hazard such as explosion and fire and good management to avoid pollution of soil, surface water and groundwater by storing them under cover and in a bunded area. The three main types of batteries in common use in solar energy systems are described below:

Lithium Batteries

6. There are two types of lithium batteries in common use: (i) primary (non-rechargeable) metallic lithium (Li) batteries, which are small in size and have a long life and are used to power toys and small electronic devices; and (ii) secondary (rechargeable) lithium ion (Li-ion) batteries, which are one of the lightest rechargeable batteries available and which are found in more expensive products such as laptops, cameras, mobile phones, power tools and now increasingly in solar powered devices. Large lithium batteries are found in other applications such as backup power, electric cars and some newer air planes. Lithium batteries use lithium in its pure metallic form while Li-ion batteries use lithium compounds which are much more stable than the elemental lithium used in lithium batteries.
7. Both types of lithium batteries can be recycled. During collection, they can be mixed with other battery types in the collection container as long as certain packaging requirements are met. Larger lithium batteries (>500g) batteries can be collected but require separate storage from smaller handheld batteries. The risks associated with lithium battery recycling include the potential for a fire or explosion if batteries become over-heated from sun or for example, if they short-circuit.

Nickel Cadmium / Nickel-Metal Hydride Batteries

8. Nickel-Cadmium (NiCd) batteries were the first reasonably priced rechargeable consumer batteries. They are

beingsuperseded bynewrechargeablesNickel-MetalHydride(NiMH)batteries.Nickel-metal

Hydride batteries are related to sealed nickel-cadmium batteries and only differ from them in that instead of cadmium, hydrogen is used as the active element at the anode. The energy density of NiMH is more than double that of Lead acid batteries and 40% higher than that of NiCd. Like NiCd batteries, Nickel-metal Hydride batteries are susceptible to a "memory effect" although to a lesser extent. They are more expensive than Lead-acid and NiCd batteries, but they are considered better for the environment.

Lead-Acid Batteries (LAB)

9. The main components of a lead-acid battery are lead (Pb) electrodes and lead dioxide (PbO_2) electrodes immersed in a solution of water and sulphuric acid. These are generally contained in a plastic case made from polypropylene. While LAB has a history of reliability, is available worldwide, and is widely recycled, it is also bulky and heavy, prone to gassing, and sulphation. The heavy metal element (lead) of the battery makes the battery toxic and improper handling and disposal of the acid and lead can be hazardous to health and the environment.

Why Recycle?

10. Batteries pose a risk to human health and the environment if disposed of inappropriately. They contain heavy metals that are toxic to human health and/or have eco-toxicity impacts if they exceed certain minimum concentrations in the natural environment. Lead, mercury and cadmium are particularly toxic, but other metals such as nickel can also be of concern if they leach into surface or ground water. Batteries also contain valuable metals such as cadmium, lead, zinc, manganese, cobalt and rare earth metals that can be recovered to minimize the use of natural resources and to reduce impacts on the environment which occur in the production, distribution and end-of- life phases of the battery life-cycle.
11. Single-use batteries have significant environmental impacts at every stage of their life cycle. The manufacture of batteries require use of chemicals to purify metals, extraction of resources by mining (with potential destruction of wildlife habitat) and production of power by burning fossil fuels; which in turn contribute to global warming, and creation of air and water pollution. The importation / transport of batteries require yet more infrastructure development and energy usage. In landfills, the chemicals inside batteries can leach from their casings and pollute soil and water with toxic heavy metals if the batteries are not properly recycled.
12. The technology for recycling secondary (rechargeable) batteries are well known and widely deployed in developed and some developing countries. Used LABs are widely collected and recycled (almost 96% collection in North America). NiCad and Lithium batteries are only now being recycled. However, in most developing countries, the economics of battery recycling is not sustainable. The cost of handling batteries (collection, storage, packaging), and transport, especially in rural areas, far exceed the cost of recycling the batteries. As a result, in most developing countries, lacking recycling facilities, used batteries are invariably discarded to the environment. Sometimes used LABs are collected, packaged and exported overseas for recycling, the economics depending on the price of lead and cost of transportation.
13. The technology for recycling primary (single use) batteries though available is not widely used, largely because of cost of recycling and because of battery collection (supply) problems. It is only now being deployed in North America, Europe and other developed countries.

14. Although recycling may not be a near term option, batteries – primary and secondary – should be collected and safely stored for transport to an environmentally safe and secure location for future processing or to a recycling facility.

Battery Comparison Table (II)

Rechargeable (secondary) Batteries

					
Battery Type	**Nickel Cadmium**	**Nickel Metal Hydride**	**Lithium-Ion**	**Lead Acid**	**Sealed Lead Acid**
Common Name(s)	Ni-Cd, Ni-Cad	NiMH, Ni-Li, Ni-Hydride	Li-Ion, Lithium Iron Phosphate	car battery, starting battery, wet cell, deep cycle	SLA, SSLA, valve-regulated, VRLA, Gel
Common Applications	modern off-grid lighting, powertools, cordless phones, professional radios, medical, household*	modern off-grid lighting, laptops, cell phones, household*	laptops, cell phones, handheld electronics	Cars, trucks, and other vehicles, standby/backup systems	off-grid lighting, wheelchairs, backup power systems
Estimated Cycle Life[1]	300-1000	500-1000	500-2000	200-700	300-1000
Advantages	Low cost, rugged, higher energy density than SLA	Higher energy density than Ni-Cd, no cadmium	light weight, high energy density	inexpensive, rugged	inexpensive, rugged
Disadvantages	contains cadmium memory effect	High self discharge higher cost compared to Ni-Cd	highest cost rechargeable, requires protection circuit	Heavy, low energy density, low cycle life, contains lead	Heavy, low energy density, contains lead
Toxicity[1]	Highly toxic- contains cadmium	Low to Moderate	Low	Highly toxic- contains large amounts of lead	Highly toxic- contains large amounts of lead
Disposal	Recycle or Hazardous Waste Disposal	Landfill in small quantities (<10 cells). Recycling recommended.	Landfill in small quantities (<10 cells). Recycling recommended.	Recycle or Hazardous Waste Disposal	Recycle or Hazardous Waste Disposal
Recycling[2]	Cadmium and ferronickel can be recovered which yield a moderate market price.	Recycle to recover nickel. NiMH is the most cost-effective battery to recycle because of the high market value for scrap nickel.	Cobalt and other metals can be recovered which have a high resale value, but the recycling process is more complex (ie more expensive).	The most commonly recycled battery worldwide. Lead and plastic casings can be recovered. Moderate market value for scrap lead and a mature resale market.	The most commonly recycled battery worldwide. Lead and plastic casings can be recovered. Moderate market value for scrap lead and a mature resale market.

[1]Battery University:http://www.batteryuniversity.com/partone-3.htm
Product

[2]Relative market prices for battery scrap metal were obtained from Todd Coy, Toxco battery recyclers, phone conversation, 24 June 2008.

*Commonly found in AA, AAA, 9V, etc sizes for regular household use.