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RURAL ELECTRIFICATION IN VANUATU

DEPARTMENT OF ENERGY

NATIONAL ADVISORY BOARD
on Climate Change and Disaster Risk Reduction
GOVERNMENT OF VANUATU

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FOREWORD

Energy is one of the most important inputs for economic growth and human development. Energy access as a means for productive use is of key importnace for rural communitites to earn a decent living.

This document presents a NAMA on Rural Electrification in Vanuatu through electrification with Renewable Energies. It is designed to support Vanuatu in achieving its strategies relevant to access to energy including rural development and to complement the country's on-going activities in this respect. Therefore, the overall target of the NAMA is to suport Vanuatu in achieving the vision and goals defined in: (i) the National Energy Road Map: "to increase electricity access of rural population and extend the existing grid to reach an increasing number of people: and (ii) National Climate Change and Disaster Risk Reduction Policy: "to be a nation whose community, environment and economy are resilient to the impacts of climate change and disaster risks".

During recent years, NAMAs have become a focus of climate change mitigation negotiations in the UNFCCC process. The NAMA modality can provide the essential holistic framework to overhaul a complete sector when framed within the context of sustainable development and beyond pure mitigation aspects. The focus on the sustainability of the entire sector is essential for achieving lasting results.

Moreover, the understanding of the NAMA concept is still evolving, and there is relatively little on-the-ground experience with respect to turning the concept into concrete actions. In this regard, UNDP's MDG-Carbon Programme has supported the development of this NAMA in order to help Vanuatu to achieve a transformative change and bring about rural development as a long-term goal.

The outcomes of this NAMA with regards to Sustainable Development, GHG Emission Reductions and Green Growth are strongly interrelated building blocks as a pathway of a change framework that shall ensure that the NAMA is fully embedded in national development goals.

The NAMA design will provide the country with an accurate and credible information framework by applying a robust but simple MRV system for sustainable development impacts and GHG emissions reductions. The calculation of GHG emission reductions are based on a CDM methodology while the MDG Carbon Sustainable Development Evaluation Tool will allow to quantify and monitor the sustainable development benefits.

This NAMA on Rural Electrification in Vanuatu through electrification with Renewable Energies is designed as an encouraging holistic framework that will help Vanuatu to move towards a low-carbon pathway while advancing long-term sustainable development benefits.

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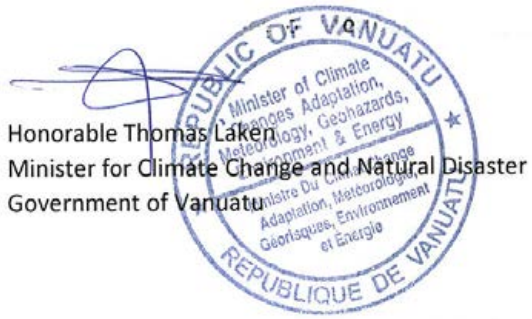

Honorable Thomas Laken
Minister for Climate Change and Natural Disaster
Government of Vanuatu

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Executive Summary

Access to modern energy services is a prerequisite for sustainable development. In Vanuatu, only one third of households have access to electricity, most of which are connected to the government regulated grid in the two main urban areas (Port Vila and Luganville). Yet 75 per cent of Vanuatu's households live in rural areas, where only one in six homes, under half of the schools (42 per cent), and one in four health facilities have some self-generated electricity (mainly fossil fuel based). Hence Vanuatu has, at 17 per cent, about the same level of rural electrification as the most underdeveloped countries of Sub-Saharan Africa.

The Government of Vanuatu is well aware of these needs and challenges, and is developing effective responses in association with development partners to address the issues. This is being done through key government policy statements and national action plans which include the Government's Priority and Action Agenda (PAA) 2006-2015, the National Energy Road Map (NERM), and the Scaling-up Renewable Energy in Low Income Countries Programme (SREP).

The NAMA represents an opportunity for sustainable development for Vanuatu, and at the same time an opportunity for low carbon development. The government can build on the existing policy framework, which targets the implementation of various policies, plans and actions aimed at mitigating GHG emissions while achieving sustainable development, so as to define a comprehensive and coherent NAMA development framework for Vanuatu.

The NAMA differs from traditional funding mechanisms which promote rural electrification and renewable energy projects. Interventions under the NAMA framework are prioritized in line with the socio-economic development objectives of the host country. The NAMA is designed with sustainable development benefits in mind and the design includes a focus on interventions which allow for income- generating activities which can create business opportunities for individuals, households and communities. The NAMA will spur the development of an environment which facilitates transformative change in the energy sector through an attractive regulatory and policy environment that incentivizes the private sector.

The overall target of the NAMA is to support Vanuatu in achieving the goal defined in the National Energy Road Map (NERM), namely to provide access to electricity to all households in Vanuatu. The NAMA will reduce GHG emissions through the replacement of fossil fuels with renewable energies. The NAMA will also contribute to Sustainable Development (SD) benefits, such as improvement of the situation of groups with specific vulnerabilities, women and the poor.

The NAMA covers two interventions. Under Intervention 1, micro grids will be established. Rural communities/ tourism and agricultural facilities/health centres/schools are the focus of these micro grids due to their demand for electricity for lighting, cooling and appliances. The micro grids will use renewable energy sources (solar, wind, hydro) and will provide electricity for lighting, radio and phone charging for households, and for service and production activities in Rural Productivity Zones (RPZs).

Intervention 2 will support extension of existing electricity grids on different islands. Households, public institutions and tourism/commercial consumers in the proximity of lines will be connected. Electricity will be provided for lighting, audio/TV, mobile phone charging, coastal fishing (refrigeration of the fish catch), tourism facilities (lodges), agricultural facilities (preparing, processing and packaging produces) or the production of handicrafts

In its first phase, the NAMA aims to establish five micro grids under Intervention 1 and support the extension of five electricity grids in Intervention 2. This will provide electricity to around 1,000 households and around 4,700 people. Over the 15-year lifetime of the NAMA, emission reductions will reach around 13,500 tons of CO2.

Capacity-building will be a key component in the implementation of the NAMA. Special emphasis will be given to identifying and supporting the development of income-generating activities in the Rural Productivity Zones (RPZs), as this is the key to positive rural development. Another important component will be technical support during the identification and implementation of the different projects under the two interventions, as the aim is to implement technically sound projects with low operating costs.

The baseline scenario for this NAMA consists of two components, a GHG baseline and a sustainable development (SD) baseline. Setting the baseline scenario in this way allows all effects to be properly assessed and quantified through the monitoring activities described in the Measurement, Reporting and Verification (MRV) system. In the MRV, the UN Framework Convention on Climate Change's (UNFCCC) "Small-scale Methodology: AMS-I.L.: Electrification of rural communities using renewable energy, Version 03.0" will be used to monitor GHG emission reductions.

The total cost of the NAMA is estimated at around US$5.5 million. This includes support to cover the investment costs of the two interventions as well as extensive capacity-building efforts. Cyclone Pam, which hit Vanuatu in March 2015, has curtailed the ability of Vanuatu to contribute to the financing of the NAMA. In total, the Vanuatu government is committed to providing around 12 per cent of the required funding and the private sector is expected to contribute around 6 per cent. The remaining 82 per cent is expected to come from NAMA donors.

Implementation of the NAMA will be led by the Ministry of Climate Change and Natural Disasters as the NAMA Coordinating Authority (NCA). The National Advisory Board (NAB) will be appointed as NAMA Approver/Focal Point to the UNFCCC. The role of NAMA Implementing Entity (NIE) will be taken by the Department of Energy (DoE) in cooperation with the Project Management Unit (PMU).

The NAMA will receive capacity development support over a period of five years. Initial efforts will focus on securing national and international funding as well as establishing the institutional structure. The first five projects in each of the two interventions will be prepared and implemented in the years 2016 and 2017. Upon availability of additional funding, further projects can be implemented in the two interventions. After the implementation of the interventions, the NAMA will operate over a period of 15 years.

Acronyms

ADB	Asian Development Bank
ACTIV	Alternative Commodities Trade in Vanuatu
BAP	Bali Action Plan
CCDR	Climate Change and Disaster Reduction Policy
CDM	Clean Development Mechanism
CNO	Coconut Oil
COP	Conference of Parties
DoE	Department of Energy
DSPPAC	Department of Strategic Policy Planning and Aid Coordination
ECOP	Environmental Code of Practice
EE	Executing Entity
FSM	Federated States of Micronesia
GCF	Green Climate Fund
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GNI	Gross National Income
GoV	Government of Vanuatu
GPOBA	Global Partnership on Output-Based Aid
GS	Gold Standard
GWh	Gigawatt hours
ICT	Information and Communications Technology
INDC	Intended Nationally Determined Contribution
IRCCNH	Increasing Resilience in Climate Change and Natural Hazard
IRENA	International Renewable Energy Agency
IPP	Independent Power Producer
JICA	Japanese International Cooperation Agency
kWh	Kilowatt hours
kWp	Kilowatt peak
LCDS	Low Carbon Development Strategy
LDC	Least Developed Country
LEDS	Low Emissions Development Strategy

LV	Low Voltage
M3P	Melanesia's Million Miracle Programme
MCCNH	Ministry of Climate Change and Natural Hazards
MDG	Millennium Development Goal
MDRR	Mitigation Disaster Risk Reduction
MFEM	Ministry of Finance and Economic Management
MLNR	Ministry of Land and Natural Resources
MIPU	Ministry of Infrastructure and Public Utilities
MSE	Micro or Small Enterprise
MSL	Minimum Service Level
MRV	Measurement, Reporting and Verification
MW	Megawatt
NA	National NAMA Approver
NAB	National Advisory Board on Climate Change and Disaster Risk Reduction
NAMA	Nationally Appropriate Mitigation Action
NC	National Communication
NCA	NAMA Coordinating Authority
NDA	National Designated Authority
NDMO	National Disaster Management Office
NEE	NAMA Executing Entity
NERM	National Energy Road Map
NIE	NAMA Implementing Entity
NGO	Non-governmental Organization
O&M	Operation and Maintenance
OBA	Output Based Aid
ODS	Ozone Depleting Substances
PAA	Priority and Action Agenda
PMU	Project Management Unit
PNG	Papua New Guinea
PPA	Power Purchase Agreement
PPP	Public-Private Partnership
PV	Photovoltaic
RE	Renewable Energy
RESCO	Renewable Energy Service Company
RMI	Republic Marshall Islands

RoV	Republic of Vanuatu
RPZ	Rural Productivity Zone
SD	Sustainable Development
SHS	Solar Home System
SMEs	Small and Medium-sized Enterprises
SPC	Secretariat of the Pacific Community
SREP	Scaling-up Renewable Energy in Low Income Countries Programme
UN	United Nations
UNDP	United Nations Development Programme
UNELCO	Union Électrique du Vanuatu Limited
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
URA	Utilities Regulation Authority
VANGO	Vanuatu Association of Non-Governmental Associations
VAT	Value Added Tax
VHT	Vanuatu Humanitarian Team
VMGD	Vanuatu Meteorology and Geo-Hazards Department
VREP	Vanuatu Rural Electrification Project
VT	Vatu (Vanuatu currency)
VUI	Vanuatu Utilities & Infrastructure Ltd
WB	World Bank
WWF	World Wildlife Fund

1 Introduction

1.1 Rural Electrification and Development

Access to modern energy services is a prerequisite for sustainable development. Yet, as many as 1.3 billion people worldwide lack access to electricity. Between 2011 and 2013, the total number of people globally without access to electricity remained essentially unchanged (REN21, 2014). In many rural areas of developing countries, the costs of providing access to electricity are economically prohibitive and cannot be recovered within the economic lifetime of the electrification project.

The global initiative Sustainable Energy for All,1 launched by the UN Secretary-General, Ban Ki-moon, in 2011, is encouraging the international development community in its efforts to improve energy access and thereby reduce energy poverty.

By increasing access to affordable lighting, communications and refrigeration, improved public health, and energy for productive activities, renewable energy systems offer an unprecedented opportunity to accelerate the expansion of energy access in remote and rural areas while at the same time contributing to the transition to modern energy services. Renewable energy can expand access to modern energy services in developing countries, both rapidly and cost effectively. As more attention turns to issues of energy access, as prices decline, and as new business models emerge, it is becoming apparent that rural energy markets in developing countries offer significant business opportunities, and products are being tailored specifically to meet the needs of these markets (REN21, 2014).

The impacts of access to adequate lighting, the means for food preservation (cooling) and information and communications technologies (ICTs) are significant. A study in Rwanda found that once grid electricity was available, four out of five households switched completely from traditional lighting sources (GTZ and SenterNovem, 2009). Money saved from switching from conventional (kerosene fuelled) to solar lamps has been found to be commonly spent on better food, education and farming. Children were spending an average of an extra hour per night studying.

Food preservation is essential in hot climates, with cooling being the preferred conservation method. A study using data from five South American countries showed that refrigeration is a high priority for people of all income groups and a priority appliance for the poorest 20 per cent.

Information and communications technologies (ICTs), such as radio, televisions and computers, require electricity for their operation and can give people access to information (such as political activities, human rights, the market value of goods and produce, education, livelihood options, etc.) (Practical Action, 2014).

At least as important as the impact of energy access on the quality of people's lives are the opportunities it creates for the world's poorest people to earn a living. There is a direct connection between energy access and poverty reduction based on the ability to earn a decent livelihood by using energy as a means of production. There are a variety of opportunities, ranging from having light to keep a shop open longer to providing cooling space in a freezer to running a pump to irrigate land.

1 See http://www.se4all.org.

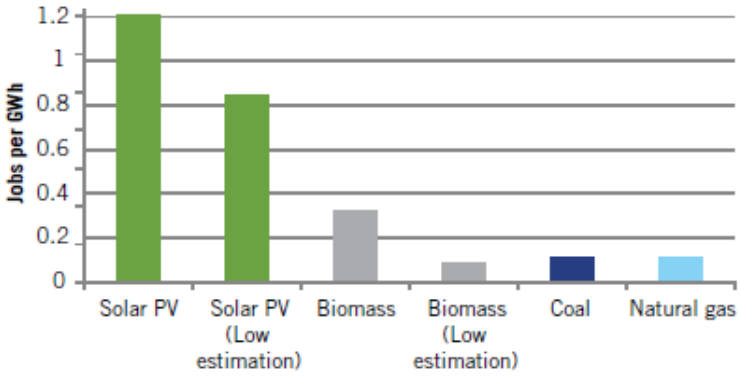
The Poor People's Energy Outlook (Practical Action, 2014) identifies four principal ways in which poor people earn a living, and all of those are affected by energy access:

- earning a living off the land;
- running small and medium-sized enterprises (SMEs);
- being employed; and
- earning by supplying energy to others.

Agriculture is one of the most significant contributors to the ability of poor people to earn a living and is one of the areas where energy can have the greatest impact by improving existing earnings. Energy plays a key role along the entire agricultural production chain, improving productivity, producing better-quality products, and earning more from adding value to produce. Improved agricultural processing and storage/cooling are energy services that expand incomes for farmers while creating employment in the SME sector. SMEs can lower costs, improve efficiency, broaden the services offered, and improve returns via more affordable, more reliable and higher quality energy supplies.

The supply of energy also represents an important employment sector with growth potential in and of itself. Increasing the number and quality of suppliers is an obvious prerequisite for successfully increasing access to energy supplies and services. The figure below shows the potential for job creation through investment in renewable energy technologies.

Figure 1. Estimated Jobs Created per GWh



Source: Practical Action, 2014.

Renewable energy technologies often feature very low running costs, but high capital costs. Additionally, there are challenges of local-level maintenance, availability, and awareness of the technologies, which remain barriers to increased uptake. In order to increase rural renewable electrification it is essential to establish and strengthen institutional, financial, legal and regulatory support mechanisms for renewable energy deployment. In turn, these mechanisms can help by improving access to financing, developing the necessary infrastructure, and building awareness about renewable energy and the challenges posed by the lack of access to sustainable sources of energy. As sector-transforming instruments, Nationally Appropriate Mitigation Actions (NAMAs) have the potential to increase access to energy for rural populations in developing countries.

1.2 Nationally Appropriate Mitigation Actions

NAMAs are voluntary, non-binding policy instruments that provide a framework for pursuing a country's socio-economic and development goals, while contributing towards global greenhouse gas mitigation efforts. NAMAs were first introduced at the 13th Conference of Parties to the Kyoto Protocol (COP13) in Bali in 2007. Many developing countries are taking steps to develop and implement NAMAs; NAMAs can help countries achieve their growth objectives and participate in the global climate change mitigation agenda. NAMAs help governments leverage national and international support to achieve appropriate, effective and transformational GHG mitigation and sustainable development targets for the country and within communities. COP 19 in 2013 saw the introduction of Intended Nationally Determined Contributions (INDCs), which were to be submitted by all parties, developed and developing, to the United Nations Framework Convention on Climate Change (UNFCCC). The INDCs are for the period following 2020 and detail the actions the parties will take to address climate change. The types of actions (e.g. mitigation, adaptation) and the means of implementation to be included are yet to be determined. The exact relationship of INDCs and NAMAs is thus also yet to be determined, but both incorporate short-/medium-term goals, with NAMAs also acting as an implementation tool to translate short-/medium-term goals into action by outlining the means and vehicle/action plan to implement them (GIZ/UNEP, 2014).

1.3 NAMA as an Opportunity for Vanuatu

Renewable energy offers the unique opportunity to accelerate access to electricity through small-scale, off-grid and stand-alone projects, often with simple and cost-effective solutions. Additionally, renewable energy systems in rural communities provide income-generating opportunities to the local population.

Financing, whether in terms of high upfront costs or lack of access to credit, remains one of the most significant challenges for renewable energy, particularly off-grid renewable energy. A NAMA provides an opportunity to facilitate the flow of financing for renewable energy.

In Vanuatu, a renewable energy NAMA that is designed within the appropriate policy environment and required regulatory framework, and which has a sufficient level of technical and financial support could be a catalyst for transformational change in the energy sector.

The proposed renewable energy NAMA for Vanuatu focuses on rural electrification, thus addressing multiple SD objectives—poverty alleviation, local job creation, alternative income generation, provision of income equality opportunities, improved energy access and better health, educational and environmental conditions.

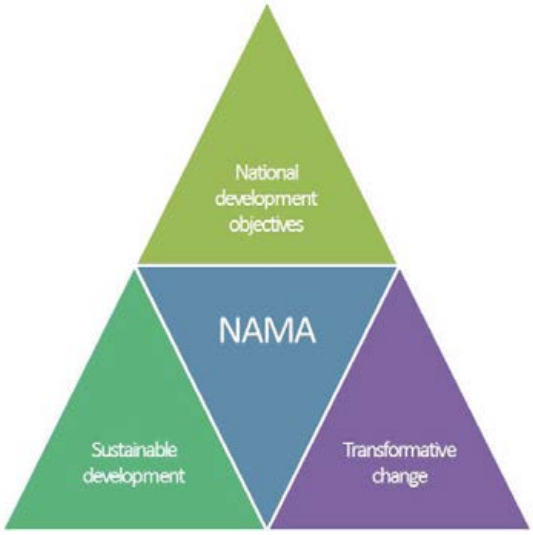
The guiding principle for the design of the Rural Electrification with Renewable Energy NAMA is to increase or provide access to electricity across the country's rural communities. The objective is to increase the total installed electricity generation capacity through a set of renewable energy projects which will be facilitated by specific policy and financial instruments.

By promoting these projects, the NAMA will increase the proportion of renewable energy in the energy mix, help strengthen public–private partnerships, increase and improve access to electricity for the majority of the population and fuel sustainable growth in the most rural and remote areas of the country.

The NAMA differs from traditional funding mechanisms which promote rural electrification and renewable energy projects mainly because of three key components, summarized in Figure 2:

- **Alignment with national development objectives**: The interventions under a NAMA framework must be compatible with the host country's policy and development objectives.
- **Focus on sustainable development**: The NAMA is designed with sustainable development benefits in mind. The design includes a focus on interventions which allow for income-generating activities which can create business opportunities for individuals, households and communities.
- **Facilitates transformative change**: The NAMA will spur the development of an environment which facilitates a transformative change in the energy sector. An enticing regulatory and policy environment which incentivizes the private sector will be created. Initial interventions will catalyse private sector development and the creation of local jobs. The business models associated with the NAMA interventions will be easily replicable in other communities across the country.

Figure 2. NAMA Components



In Vanuatu, only one third of households have access to electricity, most of which are connected to the government regulated grid in the two main urban areas (Port Vila and Luganville). Yet 75 per cent of Vanuatu's households live in rural areas, where only one in six rural homes, under half of the schools (42 per cent), and one in four health facilities have some self-generated electricity (mainly fossil fuel based) (Climate Investment Fund, 2014). Hence Vanuatu has—at 17 per cent—about the same level of rural electrification as the most underdeveloped countries of Sub-Saharan Africa.

Outside the Union Électrique du Vanuatu (UNELCO) and Vanuatu Utilities & Infrastructure (VUI) concession areas, a coordinated public system to provide off-grid electricity is completely lacking. Communities are small, remote and widely dispersed, and the low population density drives up both the capital cost of off-grid electricity installation, and the costs of ongoing maintenance. Taking into account these considerations, a renewable energy NAMA will identify renewable energy opportunities in Vanuatu that are expected to deliver the maximum results in terms of energy access and sustainable development.

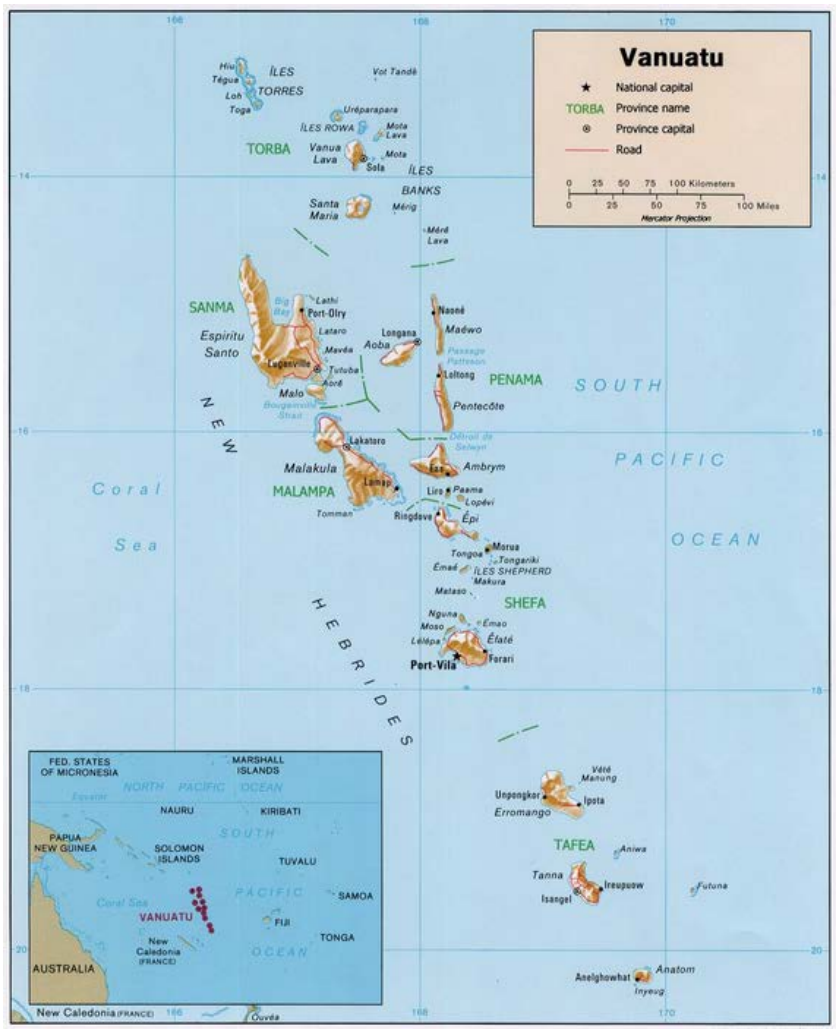
The Government of Vanuatu is well aware of these needs and challenges and is developing effective responses in association with development partners to address the issues. This is being done through key government policy statements and national action plans which include the Government's Priority and Action Agenda (PAA) 2006-2015 (GoV, 2006), the National Energy Road Map (NERM) (GoV, 2013) and the SREP Investment Plan for Vanuatu (Climate Investment Fund, 2014). In fact, the Government can build on the existing policy frameworks and renewable energy initiatives, whose targets include the implementation of various policies, plans and actions aimed at mitigating GHG emissions while achieving sustainable development, in order to define a comprehensive and coherent NAMA development framework for Vanuatu.

2 Background to Vanuatu

2.1 Geography

Vanuatu is an island nation in the South Pacific, spread over more than 80 islands, of which 65 are inhabited. Fourteen of the islands have a surface area larger than 100 km^2, the largest is Espirito Santo with 3,955 km^2. Espirito Santo also features the country's highest elevation, the 1,879 m high Mount Tabwemasana. The north to south distance between the outermost islands is roughly 1,300 km.

Figure 3. Map of Vanuatu



Source: Perry-Castañeda Library Map Collection, available from https://www.lib.utexas.edu/maps/australia/vanuatu_rel98.jpg.

The climate of Vanuatu is tropical, with a cooler dry season between April and September, and a hotter and more humid season starting in October. The average daily temperature ranges from 20°C to 32°C. The country is

highly vulnerable to natural disasters, such as cyclones, flooding, earthquakes, landslides, tsunamis and volcanic eruptions.[2]

The effects of rising sea levels and climate change are visible in the islands and villages on some of the low-lying islands have been relocated in the recent past. The risks of cyclones, coastal flooding, coastal erosion, heavy rainfall events and droughts are predicted to increase over time(SIDSnet, 2012).

The inhabitants of Vanuatu are called Ni-Vanuatu, the latest census in 2009 showed a total population of approximately 234,000 in more than 47,000 households. The large majority (more than 75 per cent) of the population lives in rural areas in scattered, mostly small communities (Vanuatu National Statistics Office, 2009).

The largest city is the capital Port Vila on Efate island, where roughly 19 per cent of the total population lives (about 44,000 in 2009). The second largest city is Luganville on Espirito Santo island, with less than 15,000 inhabitants.

2.2 Economy

Vanuatu is included in the UN list of Least Developed Countries (LDCs)[3]. GNI per capita was US$3,130 in 2013.[4] The economy features a low inflation rate and stable GDP growth rates (2.0 per cent in 2013 with a rate of 3.2 per cent expected for the period of 2014 – 2017)[5]

The four mainstays of the economy are agriculture, tourism, offshore financial services, and raising cattle. There is substantial fishing activity, although this serves mainly the population's own consumption. Exports include copra, kava, beef, cocoa, and timber, and imports include machinery and equipment, foodstuffs, and fuels[6]. The limited value of the exported goods, combined with the high dependency on imports resulted in a merchandise trade deficit of US$217.1 million in 2011. In 2012, Vanuatu achieved a service trade surplus of US$175.9 million.[7]

2.3 The Political System

Vanuatu was a jointly governed Anglo-French "condominium" until 1980 when it became an independent country. The Republic of Vanuatu is a parliamentary democracy with the Prime Minister being the head of government and its President having primarily ceremonial responsibilities. The Prime Minister is elected by the Parliament, which in turn is elected by the people every four years.

In addition to the national government, local communities are important political units, with community chiefs being the leading figure at the village level.

The legal system is based on British common law and French civil law. The constitution also provides for the establishment of village or island courts presided over by chiefs to deal with questions of customary law (GoV, 1988).

2 http://en.wikipedia.org/wiki/Vanuatu.
3 http://www.un.org/en/development/desa/policy/cdp/ldc/ldc_list.pdf.
4 http://data.worldbank.org/country/vanuatu.
5 http://data.worldbank.org/country/vanuatu.
6 http://en.wikipedia.org/wiki/Vanuatu.
7 https://data.un.org/CountryProfile.aspx?crName=Vanuatu.

2.4 MDGs

In 2000, world leaders adopted the United Nations Millennium Declaration and, along with it, the Millennium Development Goals (MDGs), which were to be met to reduce extreme poverty by 2015. The 2013 Pacific regional MDGs tracking report (PIFS, 2013) showed that Vanuatu is off-target in meeting only one of the seven MDGs with overall mixed progress for four goals and two on track. Table 1 summarizes progress.

Table 1. Summary of the Likelihood of Specific MDGs Reaching their 2015 Targets

Goals and indicators	Summary of Progress	Target/Goal achievable?
Goal 1: Eradicate extreme poverty and hunger	TARGET 1.A: Decline in poverty/hardship. Economy largely sheltered from global financial crisis. Inflation also relatively low. Hardship reduced in the capital city of Port Vila and outer islands but a marked increase in Luganville, Vanuatu's second largest city.	On track
	TARGET 1.B: Vanuatu's working-age population continues to grow at a faster rate than the growth in total employment. Likely to continue if labour market unable to absorb relatively high annual number of new entrants. Unemployment rising, especially among youths.	Off track
	TARGET 1.C: High prevalence of underweight children due to poor dietary practices, lack of knowledge of importance of breastfeeding and improper weaning practices. Food poverty down.	Off track
Goal 2: Achieve universal primary education	Following a decline in the 1990s, net enrolment and survival rates have improved since 2000. Literacy rates also up significantly since 1990. Vanuatu initially faced difficulties in making progress in primary education one of the constraints being the costs of maintaining the dual education system¾separate streams for English and French¾as the language of instruction. With the assistance of development partners, the Government introduced free primary level education up to Year 6.	Overall mixed progress
Goal 3: Promote gender equality and empowerment of women	Close to gender parity in education but low economic participation. Women's roles in the economy have changed little since 1989, most being involved in traditional areas such as teaching, nursing, clerical work etc. Reasons women are underrepresented in different levels of government are complex¾ they include the reluctance, even direct opposition, of both men and women to recognize women's right to decision-making positions, as a result of deep-rooted traditional and religious beliefs. Attitudes are slowly changing, most noticeably at the municipal level where Luganville, for example, has a female mayor.	Overall mixed progress
Goal 4: Reduce child mortality	Vanuatu is making good progress. Census results indicate declining under-five and infant mortality rates since 2000. Vanuatu administers simple and affordable high impact child health interventions such as exclusive breastfeeding for the first six months, oral rehydration solution for diarrhoea, antibiotics for pneumonia, immunization, vitamin A supplementation and child spacing. Government recognizes the need to build on, scale up or expand existing programmes to sustain the good progress made, particularly in remote rural communities.	Overall on track

Goals and indicators	Summary of Progress	Target/Goal achievable?
Goal 5: Improve maternal health	TARGET 5.A National target is to have no more than three maternal deaths per year. In 2005, Vanuatu reported four maternal deaths, although authorities suspect underreporting, and from 2006 to 2009, authorities estimated six maternal deaths a year. The decline in skilled birth attendance, still high teen fertility rates, and relatively low antenatal coverage are areas of concern. To lower the level of maternal deaths, Vanuatu recognizes that upscaling and expanding existing maternal health interventions are crucial.	Mixed progress
	TARGET 5.B Vanuatu's contraceptive use has increased but remains comparatively low. The unmet need recorded in 1998 was relatively high and while there are no recent data, this is likely to have continued, given the relatively high teen fertility. Antenatal coverage is comparatively low. The Government is using the UNDP MDG Acceleration Framework to improve progress in this area.	Off track
Goal 6: Combat HIV/AIDS, malaria and other diseases	TARGET 6.A Until the end of 2011 the cumulative total of reported cases of HIV/AIDS, malaria and other diseases was six, of which two have died, with one new case reported in 2011.	On track
	TARGET 6.B All the people living with HIV/AIDS and requiring antiretroviral therapy are receiving the drugs free.	On track
	TARGET 6.C.I Through concerted control efforts by the Government and development partners, the burden of malaria has declined significantly over the past 20 years.	On track
	TARGET 6.C.II The Government has implemented a highly successful campaign to combat TB. Treatment success rates are high.	On track
Goal 7: Environmental sustainability	TARGET 7.A Commercial logging, including illegal activities, exacts a heavy toll on forests. "Slash and burn" practices are prevalent. Although minimal, use of Ozone Depleting Substances (ODS) has increased since 2000. Vanuatu has yet to fully ratify the Montreal Protocol on Substances that Deplete the Ozone Layer.	Off track
	TARGET 7.B However, Vanuatu has established a large number of protected areas.	Off track
	TARGET 7.C Proportion of the population using an improved drinking water source and the proportion using an improved sanitation facility have both increased since 1990.	Off track
	TARGET 7.D 30 per cent of residents of the urban centres of Port Vila and Luganville were living in a slum a decade ago (HIES, 2006). Actual rate probably higher as the definition of urban does not include many informal settlements just outside the urban boundaries.	Off track

Source: PIFS, 2013.

According to the UNDP Human Development Report 2014, Vanuatu's Human Development Index score was 0.616[8] in 2013, and its world ranking was 131 of 187 countries. The 2007 survey data showed that in Vanuatu 31.2 per cent of the population were multi-dimensionally poor, while an additional 32.6 percent were near multidimensional poverty. The intensity of deprivation in Vanuatu, which is the average of deprivation scores experienced by people in multidimensional poverty, was 43.1 per cent. (UNDP, 2014d)

2.5 The Energy Sector: The Current Situation

2.5.1 Overview

The situation in the energy sector in Vanuatu is influenced by two main factors, the high dependency on fuel imports and the geographical setting.

Like most other Pacific Island states, Vanuatu has no fossil fuel resources in its territory, so it has to import all fuel for mobile or stationary use. Diesel oil accounts for the largest share of fuel imports (63.3 per cent), with a volume of 33 million litres during 2012. Half of the fuel demand comes from the transport sector, but diesel oil is also the main fuel for electricity generation in Vanuatu. Over 80 per cent of all electricity generated is from diesel fuel, which is imported by the Pacific Petroleum Company and brought by tankers from Australia or Singapore. The country's renewable energy sources are substantial, although not yet made use of to their potential (GoV, 2013).

With its population distributed over 65 islands, spread over more than 12,000 km^2, distribution of energy services is both technologically challenging and costly. This results in very low electrification rates and high fuel prices.

The result of these factors is that energy services are available only to a small share of the population, and at high prices. The retail price for diesel is among the highest in the region, which is partly due to taxes, as prices before tax are about the same as in comparable countries in the region. Prices are closely linked to the world market price and thus regularly adjusted. Retail prices also vary within the country as distribution costs rise in step with the distance of the retail market from the main harbour in Port Vila.

2.5.2 Electricity Tariffs

The Utilities Regulation Authority (URA) is responsible for regulation of the electricity sector, including regulating prices. The electricity pricing structure, including reference price, price adjustment formula and adjustment timing and tariff structure are set out in concession agreements between the Government and concessionaires. The adjustment formula enables prices to be amended in the period between fundamental tariff reviews, to incorporate changes in input prices, such as for fuel, labour and materials.

Conditions for undertaking a full review of tariffs are also set out in the concession agreements, and include factors such as more than five years having passed since the last revision, significant changes in parameters or taxes, or agreement between the parties to modify aspects of the tariff formula or customer classes.

Tariffs are adjusted as costs change through a factor (P) which is essentially the price per kWh plus a charge based

8 1.0 indicates very high human development.

on the power demand subscribed by the user. The factor P represents the tariff cost factor, which provides for varying costs. This factor is updated as costs change. The URA set P at 55.56 during the May, 2014 review.

For example, the tariff in the UNELCO grid for low usage residential customers is tiered. Up to consumption of 60 kWh per month, consumers pay only one third of P. Households consuming more than 120 kWh pay triple P for each kWh above 120 kWh. This tiered tariff supports low-income families.

The table below gives an overview on tariff systems in the UNELCO and VUI concession areas.

Table 2. UNELCO and VUI Electricity Tariff Structure

UNELCO		
Customer Group	**Price per kWh (Vatu)**	**Monthly Fixed Charge**
Small Domestic Customers	Up to 60 kWh=0.34 x P 61 to 120 kWh=1.21 X P Over 120 kWh=3.00 X P	None
Other Low Voltage customers	1.21 X P	5 X P per subscribed kVA
Business Licence Holders¾Low Voltage	0.87 X P	20 X P per subscribed kVA
Sports Fields	1.00 X P	None
Public Lighting	0.54 X P	None
High Voltage Users	0.70 X P	25 X P per subscribed kVA
VUI		
Interim Low Voltage	Up to 60 kWh=0.38 X P 61 to 120 kWh=0.97 X P 121 to 180 kWh=1.80 X P Over 180 kWh=1.10 X P	None
Sports Fields	1.00 X P	None
Public Lighting	0.54 X P	None
High Voltage Users	0.70 X P	25 X P per subscribed kVA

Source: URA, 2010.

In the Espiritu Santo concession area, VUI has a tariff that is lower than UNELCO's, due to a high percentage of lower cost generation from hydro. Whereas UNELCO tariffs are adjusted monthly, VUI has a fixed tariff that is valid for 12 months.

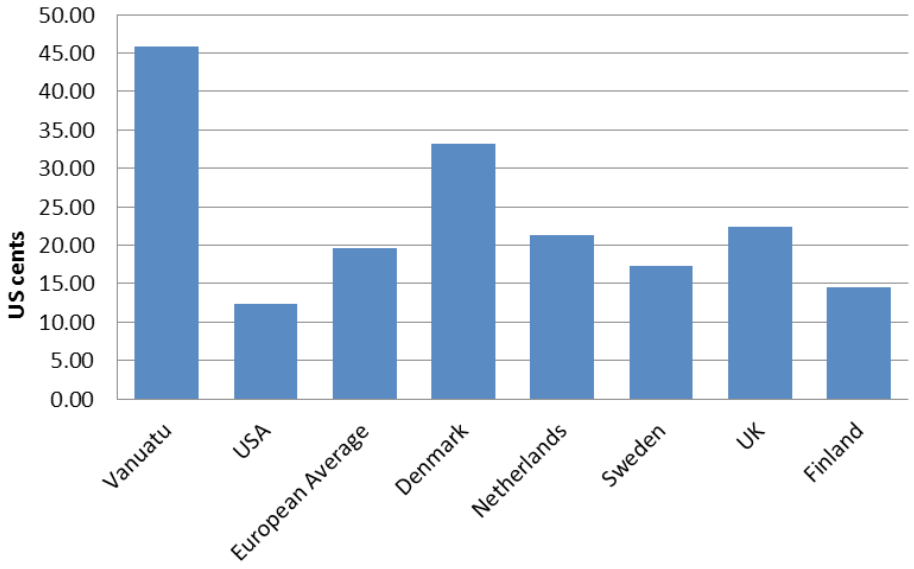
The price for electricity is closely connected to the one for diesel, because of the high share of diesel fuelled electricity generation. Currently consumers in Vanuatu pay among the highest retail electricity prices in the world. The base price (P) for customers in the current concession areas was set at VT47.71 per kWh for May 2015, which then equalled 45.85 US cents .[9] <OK now?>Prices for consumers with demand below 60 kWh per month are subsidized by charging higher prices for high demand customers (GoV, 2013). The low demand tariff is

9 http://www.ura.gov.vu/attachments/article/68/Electricity Tariff May 2015.pdf.

currently was set at VT16.22/kWh or 15.59 US cents in May 2015.[10] This subsidized price is only a little lower than the EU average retail price for household customers of 18.12 EUR cents or 19,57 US cents (VaasaETT, 2015), but considerably above the average price of electricity in the USA of 12.29 US cents per kWh (US Energy Information Administration, 2015, Table 5.3).

The table below compares the average electricity price in Vanuatu with average prices in the USA and Europe as well as with prices of selected European countries.

Figure 4. Electricity Price Comparison April 2015[a]



[a] Prices are as of April 2015 except for Vanuatu, for which the base tariff for May 2015 is given. Exchange rates used to derive the prices in US dollars are US$1 = VT104.05, €1 = US$1.08.11

Sources: URA, 2015; VaasaETT[12].

The electricity market in Vanuatu currently consists of two vertically integrated companies, which in their respective concession areas carry out all electricity generation, transmission, distribution, supply, and customer services. In 2010, the Electricity Supply Act was amended to enable any person to generate electricity and sell wholesale electricity to the concessionaires. In June 2014 the Utility Regulation Authority (URA) issued preliminary guidelines for Independent Power Producers (IPPs) and Power Purchase Agreements (PPAs), opened them up for public consultation (URA, 2014a), but there has been no final decision on these guidelines up to now. In July 2014, URA issued a final decision on implementing feed-in tariffs and net metering for renewable energy in Port Vila (URA, 2014b).

10 The price for each consumer group is calculated by multiplying P by the price factor listed in Table 2. For household consumers with consumption of up to 60 kWh per month, the factor is 0.34, therefore, the price in May 2015 is set at VT16.22/kWh.
11 http://www.oanda.com/currency/converter/, exchange rates for 1 April 2015.
12 VaasaETT indicates prices in capital cities for 23 European countries, consisting of 22 EU countries and Serbia.

2.5.3 Electricity Access

Whereas for the urban population in Port Vila and Luganville electricity access is available through local electricity grids, outside these urban areas there is no or only very limited access to electricity. Of the 75 per cent of rural dwellers, only 17 per cent (IRENA, 2015) have access to any form of electricity other than battery powered mobile lamps or radios.

Apart from physical geographical constraints, the main barriers to extension of electricity grids and to the implementation of local stand-alone-grid solutions are economic ones. The small number of households per community, combined with large distances between the communities, results in high upfront installation costs that cannot be recovered through operation in a commercially viable time span.

The economic barriers mentioned above are heightened by the limited ability to pay for energy services in rural communities. In general the rural population has very little disposable income. IRENA assumes that the average rural dweller has less than US$1 cash income per day (IRENA, 2015). The rural household average spending on kerosene for lighting is estimated at VT18,000 /year (approx. US$175) <ie US$1=VT94.74 2014 rate was US$1=VT97.07>(Walton, 2014).

In the urban centers electricity grids are operated by private utilities. There are currently four main grids (Efate, Espirito Santo, Tanna and Malekula) established in Vanuatu, which are operated by UNELCO and VUI. A grid is planned to be established on Ambae in Penama province and Vanua Lava Island in the Banks group under the proposed biofuel project (coconut oil and diesel). The island of Maewo has a small grid network as part of the Talise micro-hydro power project.

Table 3. Electricity Grids in Vanuatu

Island	Efate	Espirito Santo	Tanna	Malekula	Ambae	Banks Group (Vanua Lava)	Maewo
Operator	UNELCO	VUI	UNELCO	UNELCO	Penama Provincial Government	Torba Provincial Government	Talise Community
No of customers	10,338	2,302	682	526	125	75	80
Installed capacity (MW)	26.5	4.1	0.5	0.5	0.1	0.07	0.075
Annual sales (MWh)	52,243	7,600	509	620	-	-	Commissioned only during late 2014
Energy sources	Diesel, Wind, Biofuel & Solar	Hydro + Diesel	Diesel + Solar	Biofuel + Diesel	Biofuel + Diesel	Biofuel + Diesel	Hydro

Sources: http://www.unelco.com.vu/en/profile/localisation; IRENA, 2013.

In the stakeholder workshops the general opinion of all stakeholders was that the quality of service in these electricity grids is very high, and despite an average retail price of more than 60 US cents per kWh for a household customer (GoV, 2013), which is the highest in the Pacific region, customer satisfaction among households and commercial customers is high. Both utilities are subsidiaries of international energy companies (UNELCO of Gaz de France in France and VUI of Pernix in the USA), and they are seen by national stakeholders in the energy sector as highly professional, both from a technical as well as from an economic perspective.

2.5.4 Independent Power Producers

The main private players are the two utilities operating in Vanuatu, Union Électrique du Vanuatu (UNELCO) and Vanuatu Utilities & Infrastructure (VUI), which are described in more detail below. In addition, there are several technology providers active in the market in Vanuatu, most of them supplying small solar home systems or solar lanterns to household customers. There is no in-country technological capacity for the development of larger energy projects, such as stand-alone-grids, hydro power plants or wind farms.

According to the SREP investment plan and the IRENA assessment, one of the barriers to the expansion of renewable energy in Vanuatu is the existing regulatory framework which does not provide for IPPs to have power purchase agreements (PPAs) with concession holders, or for concession holders to include the cost of power purchased under these PPAs in tariff calculations. The current arrangements (such as those specified under the Electricity Supply Act) permit IPPs to generate electricity and supply it outside the concessions or to the concessionaires. However, concessionaires are not currently obliged to purchase electricity from IPPs, and there is not yet a framework for IPPs to access existing networks and for concessionaires to pass through costs of such power purchases into tariffs.

While a regulator exists, anecdotal reports suggest that the opportunities for the development of IPPs have been frustrated by a number of factors, the major one being the length of time it takes to agree a PPA between developers and the utility; this has been reported as one of the key hurdles around the long discussed Efate geothermal project. The possibility of effective private sector engagement in the electricity market has yet to be demonstrated.

2.5.5 Renewable Energy[13]

Vanuatu is rich in various renewable energy resources, but so far only a very small share of the potential is utilized. The following sections describe the current capacities installed for the various technologies.

Geothermal Energy

In 2010 the Vanuatu Government commissioned technical assistance through the World Bank that investigated the potential for geothermal on Efate. The report from that study was favourable and was accepted by the government in 2012. Based on the improved economics and the results of the technical assistance, in January 2013 KUTh Energy of Australia received a 30 year Exclusive Production License to develop geothermal energy on Efate. Before test drilling can commence, a power purchase agreement with UNELCO is a prerequisite. Negotiations on the PPA will include the Vanuatu Government, the URA and of course UNELCO, but to date, no agreement had been reached. If the resource is confirmed (phase 1 is the test drilling), phase two is expected to be the construction of a 4 MW net

13 IRENA, 2015.

capacity plant with construction starting within three years of signing the PPA. That would be followed by phase 3, which includes a second 4 MW plant.

Bio-Energy

In the late 1990s and early 2000s, Vanuatu was the regional leader in the development of coconut oil (CNO) for fuel, both as a direct replacement for diesel fuel and for blending with diesel fuel or kerosene for general diesel engine use. Due to changes in the market for CNO and also the introduction of a tax on biofuels, the cost of the blended fuel rose above that of diesel fuel. The general use of blended CNO and diesel fuel rapidly declined and currently the primary use of CNO as fuel is by UNELCO, which uses a blend of diesel fuel and coconut oil at two of its diesel generating stations. The raw materials are supplied by local coconut growers but UNELCO does the processing itself, mainly for reasons of quality assurance.

Currently there is no commercial use of biogas or biomass resources apart from CNO.

Solar Energy

Grid-Connected solar

Currently only 70 kWp of solar PV is installed on the UNELCO Port Vila grid. Another 20 kWp is on line for UNELCO in Malekula and also 40 kWp is connected to the VUI grid in Luganville with 20 kWp at the Northern District Hospital, 10 kWp at the Samma Provincial Headquarters and 10 kWp at the Collège de Santo.

In April 2014 the URA announced its preliminary decision on Net Metering and Feed-in Tariffs and requested public input. The proposed rules allow low voltage non-commercial customers to connect their privately owned solar installations to the grid—provided that the technical standards set by URA are met for the connection. A monthly access fee of VT1,638.60 or ~US$ 18 and the nominal fixed charge will be levied for each meter. Any surplus energy delivered to the grid will not be credited but can be applied against the access fee at a feed-in tariff of VT12.59 per kWh. No negative bills will be possible so any energy delivered to the grid in excess of usage will result in a zero meter reading and no energy bill, but the excess will be provided to UNELCO without credit or payment.

For commercial and high voltage customers, bi-directional metering would be used with a feed-in tariff of VT18.89 paid for all solar input. That amount would be deducted from the bill for all power used by the customer, but again negative bills will not be provided, making it more difficult to earn more through the feed-in tariff.

Off-grid solar

The majority of households in Vanuatu remain off the grid. Solar has been shown in other parts of the Pacific to be a reliable and cost effective approach to basic electrification for rural areas and is falling in price as large scale solar becomes a part of industrialized country grids. In Vanuatu, there have been several significant off-grid solar electrification projects based on solar home systems (SHS) that were primarily intended to provide basic lighting and radio services along with a modest capability for charging batteries for small devices such as portable lights, small tools and mobile phones. The success rate of such programmes has been quite poor, largely due to a lack of regular maintenance and of the means to spread the cost of battery replacements over their 5-7 year life rather than bearing the high replacement cost when the battery fails as has been the situation in the past.

Wind Energy

The only wind turbines in operation in Vanuatu are the eleven 275 kW Vergnet wind turbines installed by UNELCO at Devil's Point near Port Vila with a total capacity of 3,025 kW. The wind farm was funded through the European Investment Bank (EIB). In August 2012, the wind farm contributed 13.4 per cent of UNELCO's generation.

Hydro Energy

As of 2013, the only utility connected hydroelectric plant in Vanuatu was on Espritu Santo. It serves as part of the VUI generation mix. It is a run-of-river type facility with a 1.2 MW capacity that was provided through sponsorship from the Japan International Cooperation Agency (JICA). Besides this utility scale facility, a number of micro villages or facility specific pico-hydro units are in operation and have high replication potential.

2.5.6 Key Players

The following public and private institutions are actively involved in the development and operation of the energy sector in Vanuatu.

Ministry of Climate Change and Natural Hazards

The Ministry for Climate Change and Natural Hazards (MCCNH) was established in April 2013as part of the Government's efforts to streamline Vanuatu's climate change response. The ministry includes the Vanuatu Meteorological and Geo-hazards Department (VMGD), the National Disaster Management Office (NDMO), the Department of Energy (DoE), the Department of Environment and the Project Management Unit (PMU). The Ministry and the NAB are mandated with coordinating all government and non-government initiatives addressing climate change and disaster risk reduction in the country.

Department of Energy

The Department of Energy (DoE) was established in 2011 under the new Ministry of Climate Change and Natural Hazards (MCCNH)as a successor to the former Energy Unit in the Ministry of Lands and Natural Resources.

The DoE is responsible for central coordination of the development of the energy sector in Vanuatu. This includes the existing electricity grids, the petroleum sector and energy efficiency issues, but the DoE is also responsible for the development of electricity access in rural areas. It has currently a staff of 11 people.

Other government ministries involved in the electricity sector include:

- Ministry of Land and Natural Resources (MLNR)—responsible for administering the Geothermal Energy Act under which the government grants licenses for geothermal prospecting and production
- Ministry of Infrastructure and Public Utilities (MIPU)—responsible for all the public infrastructure of the government
- Ministries of Education and Health—involved in a programme of solar energy packages for social institutions
- Ministry of Finance and Economic Management (MFEM)—oversees, with the Prime Minister's Office, the Vanuatu Infrastructure Strategic Plan.

National Advisory Board

The National Advisory Board on Climate Change and Disaster Risk Reduction (NAB) is a committee made up of government and non-government members. Its primary purpose is to: "act as Vanuatu's supreme policy making and advisory body for all disaster risk reduction and climate change programmes, projects, initiatives and activities"[14]. As such it is the main governmental stakeholder in the proposed NAMA.

The NAB is co-chaired by the Director of the Vanuatu Meteorology and Geo-Hazards Department (VMGD) and the Director of the National Disaster Management Office (NDMO). Members are senior-level representatives from key sectoral government agencies, and NGO representatives, including a representative of the Vanuatu Humanitarian Team (VHT) Network, the Vanuatu Climate Adaptation Network and the Vanuatu Association of Non-Governmental Associations (VANGO). Members are nominated in the first instance by the Directors of the VMGD and the NDMO at an official NAB meeting.[15]

Project Management Unit (PMU)

The Government of Vanuatu has established institutional arrangements for joint governance of climate change and disaster risk reduction through the NAB and a Project Management Unit (PMU) within the MCCNH. The PMU is responsible for coordinating all Vanuatu's climate change related programmes and projects and aligning the climate change initiatives with development strategies, including the annual and medium-term government budgets. The PMU is also responsible for ensuring that climate change programmes and projects are carried out within their specified timeframes and for ensuring activities meet the necessary public participation and stakeholder requirements.

The PMU also has the authority to act as a Financial Management Agent for externally funded programmes and projects and will thus, on behalf of the NAB and the MCCNH, be responsible for project financial management and administration.

The Utilities Regulation Authority (URA)

The Utilities Regulation Authority (URA) was established in 2008 as an independent body acting as a mediator between the Government and the private utilities. Its main mandate is the regulation of the utilities operating the current concession areas, but it is also responsible for regulatory issues outside these areas, and thus for new rural electrification activities.

Besides the regulating the concessions, the URA oversees and applies the provisions of the Electricity Supply Act. Its most recent achievement has been the development of provisions regulating the private feed-in of solar power into the electricity grid.

Electricity Utilities

The electricity sector consists of two private operators, Union Électrique de Vanuatu (UNELCO) and Vanuatu Utilities & Infrastructure (VUI), each of which undertakes generation, distribution, dispatch, billing and settlement

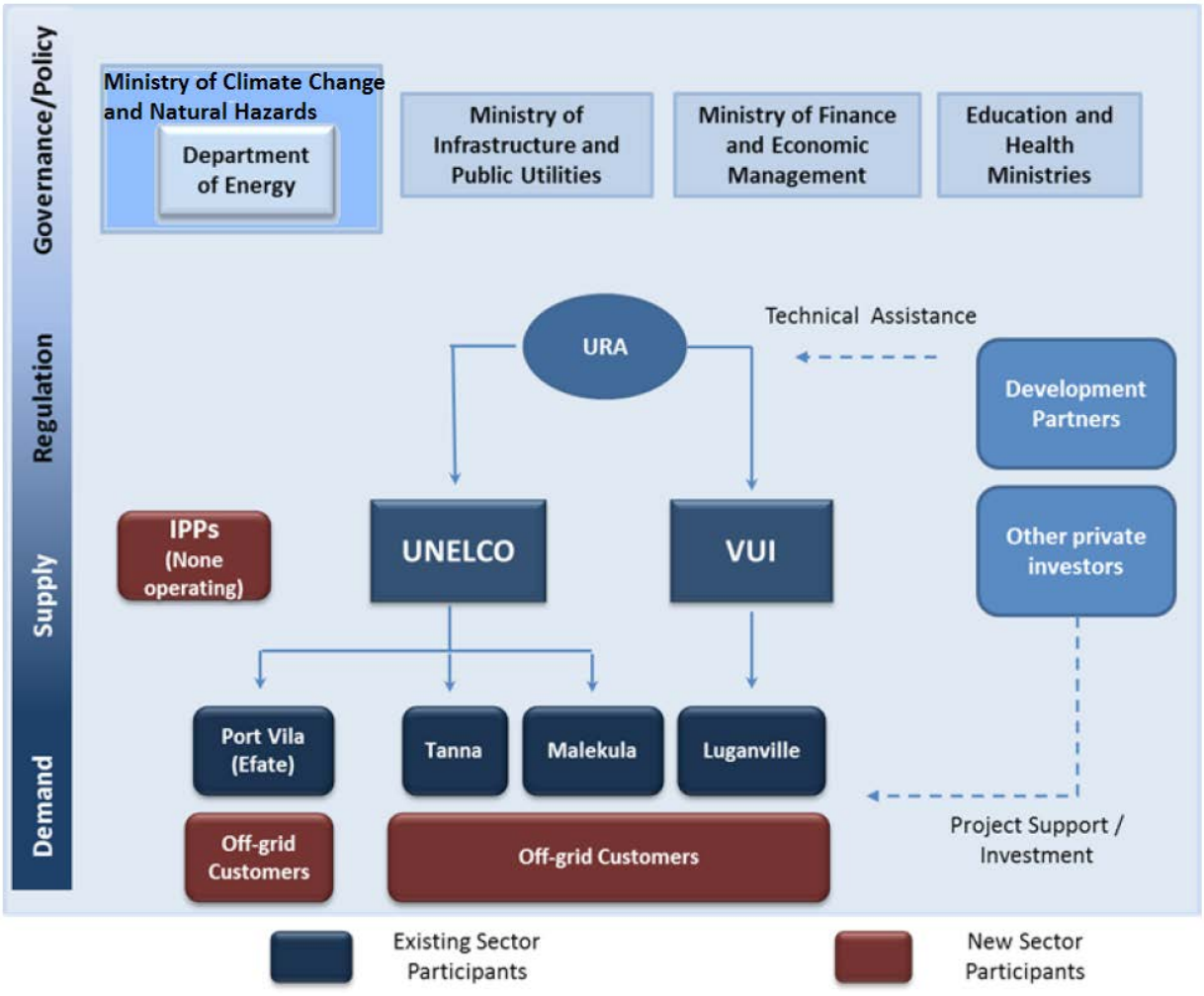
14 http://www.nab.vu/sites/all/files/what_is_the_nab_presentation_0.pptx.
15 http://www.nab.vu/what-nab-1.

for consumers within its area. UNELCO, which has been operating in Vanuatu's electricity sector since 1939, was the sole concessionaire before the expiry of the Luganville concession in December 2010. At that time, the Government of Vanuatu decided to operate a competitive tender process for the concession. The Government entered into negotiations with VUI (its preferred concessionaire), and to ensure continuity of supply to consumers, signed a Memorandum of Understanding (MoU) with VUI to operate the Luganville network. Subsequent legal action by UNELCO over the tender process has meant that a concession agreement has not been signed and the MoU remains in place pending a Court decision on the matter.

Other Organizations

Pacific Petroleum imports petroleum products into Vanuatu from New Caledonia and sometimes from Fiji. A non-governmental organization (NGO), Vanuatu Renewable Energy and Power Association (VANREPA), has been active since 2003 in bringing power to rural areas, managing renewable energy projects for donors and selling solar lighting kits and energy-efficient stoves through Green Power, a retail spinoff. There are several small private enterprises involved in renewable energy (RE) equipment supply and installation.

Figure 5. Organizational Structure of the Electricity Sector



Source: GoV, 2013, updated by authors.

2.5.7 Ongoing initiatives in Rural Electrification

The Vanuatu Government started to work on the implementation of the National Energy Road Map through a number of initiatives involving several donors. All of these initiatives involve rural electrification.

The main activities of the Vanuatu government are currently as shown in Table 4.

Table 4. Summary of Current Initiatives on Rural Electrification

	GPOBA[a]	World Bank	M3P	SREP
Full name of initiative	GPOBA Grid Based Electricity Access Project	Vanuatu Rural Electrification Project (VREP)	Melanesia's Million Miracle Programme	Scaling Up Renewable Energy in Low Income Countries Programme
Short description	The Project aims to assist eligible low income consumers to connect to the existing electricity grids in Port Vila, Tanna, Malekula and Luganville.	Project aims at providing access to electricity services for 17,500 rural households, 230 aid posts and 2,000 community halls located in dispersed off-grid areas, reaching 85 per cent of the off-grid households. Project will cover 50 per cent of installation costs.	Electric lighting through solar lanterns for 200 households in two communities, with further scaling up envisaged if additional funds are available.	Objective is to pilot and demonstrate the economic, social and environmental viability of development pathways in the energy sector by creating new economic opportunities and increasing energy access through the use of renewable energy
Connection to NAMA Interventions	Intervention 2	—	—	Interven-tion 1 & 2
Target area	UNELCO and VUI concession areas	All off-grid areas in Vanuatu	Two communities in Tanna (White Sand and Port Resolution)	All off-grid areas in Vanuatu
Financing	US$4.85 million	US$4.7 million	US$110,00	US$14 million
Total budget	US$5.36 million	US$4.7 million	—	US$34.2 million
Financing institution	Australian Aid and World Bank	New Zealand and World Bank	Secretariat of the Pacific Community (SPC)	ADB & WB Group
Timeline	Start of roll-out: March 2014	Implementation started in 2014, roll-out over five years	Implementation starts Q4/2014	Approval of Project Preparatory Technical Assistance June 2015
Project implementing unit	Department of Energy (DoE)	Department of Energy (DoE)	Department of Energy (DoE)	Department of Energy (DoE)
Involved private parties	UNELCO, VUI	Equipment suppliers	Equipment suppliers, Alternative Commodities Trade in Vanuatu (ACTIV)	Private sector vendors and RESCOs

[a] *Global Partnership on Output-Based Aid.*

Sources: WB, 2014a; WB, 2014b; Climate Investment Fund, 2014.

2.6 Policy Analysis

The legal framework of the energy industry in Vanuatu is primarily based on the following legislation and contracts.

- Electricity Supply Act (RoV, 2000)
  This is the main legal act for the energy sector in Vanuatu. It was last amended in 2011 and defines the regulatory framework mainly for the concessionaires in the energy sector. However, it is also applicable to electricity providers outside the current concessions.
- Utilities Regulatory Authority Act (URA Act) (RoV, 2007)
  This act (last amended in 2011) defines the role and responsibilities of the URA.
- Geothermal Energy Act (RoV, 2006)
  This act regulates the rights and responsibilities of holders of a licence for utilization of geothermal energy.
- The Environment Management and Conservation Act[16]
  This act mandates and regulates Environmental Impact Assessments for projects and development activities, which could have a negative impact on specified parts of the environment.
- Concessions for Electricity Supply.[17]
  - The concession for the Generation and Public Supply of Electric Power in Port Vila;
  - The MOU for management and operation of Luganville electricity network;
  - The concession contract for the Generation and Public Supply of Electric Power in Tanna island;
  - The concession contract for the Generation and Public Supply of Electric Power on Malekula Island.

The Electricity Supply Act regulates the granting of concessions and the protection of the rights of concessionaires, and recognizes the role of the URA in overseeing these areas. Concession contracts between the Government and concessionaires set out the rights and obligations of the parties, including delegating exclusive responsibility for provision of electricity services within specified areas, and specifying rules regarding service coverage, the quality of service to be provided, and the maximum tariffs that may be charged. Electricity supply in Vanuatu is predominantly handled by private utilities through concession contracts granted by the Government through a competitive bidding process. The tender and contract award process follows guidelines published by the Vanuatu Ministry of Finance and Economic Management. All the ministries and departments are obliged to comply with the procurement guidelines and the Act. Under concession agreements, the Government gives concessionaires the right to operate existing assets and invest in new assets within (and outside) the concession area, but upon expiry of the agreement, the assets located within the concession area revert to Government ownership, with any residual value of concessionaire funded assets payable by the Government to the former concessionaire.

The URA published preliminary regulatory guidelines for Independent Power Producers and Power Purchase Agreements in spring 2014 (URA, 2014a). The guidelines were open for comments until 4 July 2014. Based on these comments, the URA was supposed to produce a revised version of the guidelines, but no revised version has been presented up to now.

16 http://mol.gov.vu/index.php/en/acts-and-laws/187-environment-and-conservation-acts.
17 http://www.ura.gov.vu/index.php?option=com_content&view=article&id=52&Itemid=91&lang=en.

Vanuatu is free of income tax at both the corporate and individual levels. The country prides itself on being friendly to investment, with no capital gains tax or foreign exchange controls. There is also no corporation tax and no inheritance tax. Most of the revenue is raised from business registration charges and licence fees. . The majority of Government revenue is raised by levying trade and a 12.5 per cent Value Added Tax (VAT) on goods and services. There are also import duty exemptions for equipment and free trade agreements are providing further tax benefits. The Department of Energy also supports renewable energy (RE) companies by offering duty exemptions on RE equipment imported into Vanuatu on a case by case basis in coordination with the Department of Strategic Policy Planning and Aid Coordination (DSPPAC) and the Rates and Taxes Office in the Department of Customs and Inland Revenue.

In the past, no consistent energy policy or strategy existed in Vanuatu. Those Renewable energy policies and projects that were implemented were fragmented and often driven by proposals from development partners. This approach was not successful, and in response, the government developed a comprehensive National Energy Road Map (NERM) which was launched in April 2014 (GoV, 2013).

The NERM clearly identifies the issues in the energy sector, as described above, as a challenge to the country's economy, and as restricting economic and social development. Therefore the government has announced the following vision to guide all efforts to improve the energy sector:

> *"To energize Vanuatu's growth and development through the provision of secure, affordable, widely accessible, high quality, clean energy services for an Educated, Healthy, and Wealthy nation."* (GoV, 2013, p.5)

Based on this vision, five priorities for the development of the energy sector were identified. They are set out in Table 5.

Table 5. Priorities of the National Energy Road Map

Priority	Description
Petroleum Supply	• Reduce reliance on imported diesel and petroleum products through efficiency improvements in the transport sector and through investment in renewable energy in the power generation sector • Strengthen legislative and regulatory framework • Hedge fuel costs (physical storage and financial hedges) • Improve efficiency and reliability of fuel distribution within Vanuatu by shifting away from deliveries of fuel in drums and towards the use of regular bulk deliveries to outer islands
Access	• Increase the rate of connections to electricity, which currently stands at an estimated 27% (16.7% of rural homes, 25% of health centers, 42% of schools)
Affordability	• Address consumers' current ability to pay for connection and on-going tariffs • Explore options (financial and technical) to increase affordability for both on-grid and off-grid consumers • Promote least cost investment in the electricity sector • Introduce price monitoring for petrol, kerosene, and diesel fuels • Introduce price regulation for LPG
Energy Security	• Achieve a greater diversity of energy sources • Provide a framework for investment • Develop a petroleum energy security policy and work with industry to optimize petroleum storage capacity and shipping schedules to ensure national energy security is maintained

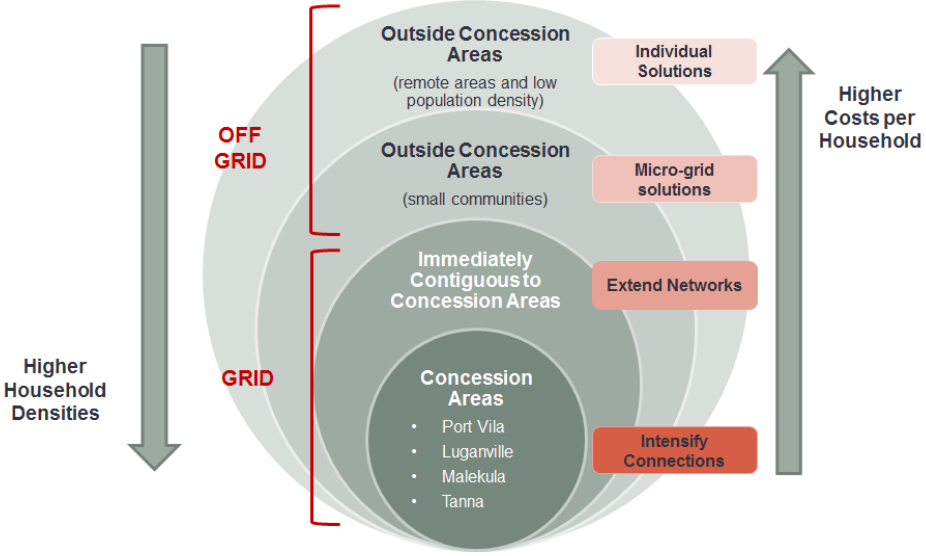
Priority	Description
Climate Change	• Examine options for increasing renewable energy and improving energy efficiency and conservation

Source: GoV, 2013.

In the NERM, access to electricity is identified as one of the country's five development priorities, from remote rural areas to those who are already serviced by a utility under an existing concession. The goal of NERM is to increase electricity access for the rural population and extend the existing grid to reach an increasing number of people.

Figure 6 shows the various area types and the possible solutions for electrification under consideration. As distance from towns and concession areas increases, household density decreases. This increases costs per household of electricity provision. For the concession areas in the four towns (Port Vila, Luganville, Malekula and Tanna) the aim is to intensify grid connections and extend the network to neighbouring areas. Outside the concession areas, electricity access will be given through micro grid solutions and individual (household) solutions.

Figure 6. Strategic Framework for Increasing Electricity Access



Source: GoV, 2013.

The NERM sets clear targets for electricity access. Nowadays, 68 per cent of the households in concession areas are already connected to the grid. This rate will increase to 90 per cent in 2020 and 100 per cent in 2030. Households in close proximity to concession areas currently have no access to electricity. Their connection rates will increase to 90 per cent in 2020 and 100 per cent in 2030. All households without access to grids ("off- grid" households) will have access by 2020. Half of public institutions have access to electricity now and this will rise to 100 per cent by 2020. By 2030, all households and public institutions in Vanuatu will have access to electricity. Details of the planned development are shown in Table 6 below.

Table 6. Electricity Access Targets

	Current	2015	2020	2030
Households withinn grid concession areas ~18,500 HH	68% (12,500 HH)	75%	90%	100%
Households close to concession areas - grid extensions ~3,000 HH	0%	33%	90%	100%
"Off-grid" Households ~31,500 HH	<10%	TBD	100%	100%
- Individual home systems Permanent electricity solutions**				
- Basic power products**				
Public Institutions (grid and off-grid)	50%	90%	100%	100%

* *Total number of households ~53,000 based on 2010 Census Updatae and national average 4.5 persons/HH*
** *Individual home systems refers to solar panel installations and basic internal wiring that can supply several lights and charging facilities for phone, TV, ratio, etc.*
*** *Basic power products refer to the cash-and-carry Pico lighting and charging products sold through retail shops and other establishments.*
Source: GoV, 2013.

In the NERM, the government recognizes the importance of taking into account the affordability of energy services, and considers a least-cost approach, serving different areas with different access solutions. In addition, reducing electricity prices is emphasized.

The government clearly states in the plan that renewables shall be used if they are the least-cost option and concludes that "*…rather than an agenda of promoting renewable energy driven solely by global climate change concerns as an end in itself, increasing the share of renewable energy substantially in Vanuatu - on and off grid – is expected to be the least cost way to developing the sector*". The NERM notes in passing that subsidy schemes are necessary to increase the competitiveness of renewables and to lower electricity tariffs, while maintaining the financial viability of service providers.

The targets set for renewable energy are shown in Table 7. By 2020, the share of renewable energy generation should reach 65 per cent, which is more than treble the current figure (19 per cent).

Table 7. Renewable Energy Targets*

	Current	2015	2020
% renewable generation	19%	40%	65%
Diesel efficiency improved by:	—	10%	20%
Energy Efficiency	—	Comprehensive data collection established, set realistic targets and begin energy efficiency initiatives	

* *Renewable energy targets are based on the projected MWh of supply froma 4MW geothermal plant installed by 2015 and an additional 4 MW geothermal unit (bringing the total geothermal capacity to 8 MW) and 1.2 MW and 2.2 MW hydro plants in Santo and Malekula by 2020. Diesel efficiency refers to meeting the Pacific benchmark for diesel generation units operated by the utilities. No diesel efficiency estimations are available for private generators used int he manufacturing and industrial industries.*
Source: GoV, 2013.

It is clearly signalled that the private sector should be integrated into the development of renewable energy services in the country. The NERM emphasizes the need for regulation of Public Private Partnerships (PPPs) for the implementation of renewable energy projects or network extensions. The URA has issued two preliminary decisions for public consultation. Besides the draft guidelines on IPPs mentioned above, it published a proposal in April 2014 to introduce a feed-in tariff and net-metering scheme for renewable energy in Port Vila, and aims to provide an incentive for private parties to generate renewable electricity on a small scale.

In January 2015, the Draft Vanuatu Climate Change and Disaster Risk Reduction Policy was published for consultation (GoV, 2015). In this, the Government of Vanuatu committed to six key priorities to direct the country's climate change and disaster risk reduction efforts. These priorities are split into systems and themes:

- Systems
  - Governance
  - Finance
  - Knowledge and Information
- Themes
  - Climate Change Adaptation and Disaster Risk Reduction
  - Low Carbon Development
  - Response and Recovery

The policy was put out for comment until recently and is expected to be adopted in Summer 2015

The analysis of the policy environment in Vanuatu shows that the necessary policy framework for the NAMA is present. One of the key barriers for implementation of rural electrification initiatives in Vanuatu is a lack of sovereign funding at the national and provincial level. In addition, the rural communities have very little disposable income (see) which in turn affects their ability to pay for energy services. What is recommended is to finalize the regulatory guidelines for Independent Power Producers and Power Purchase Agreements, which were supposed to be finalized in 2014. Furthermore, it is recommended that the Government—when considering new concession areas for utilities operating in Vanuatu—mandates utilities to operate in both urban and rural areas, which would allow the utility to cross-subsidize the tariff to achieve maximum sustainability.

3 NAMA Targets and NAMA Baseline

3.1 NAMA Objectives and Targets

The overarching target of the Vanuatu NAMA is to provide off-grid electrification for households, public buildings and institutions as well as businesses. The NAMA is intended to help the Government of Vanuatu to achieve the targets described in the National Energy Road Map (NERM), which are:

- Achieve a connection rate of 100 per cent for households close to concession areas by grid extensions;
- Achieve 100 per cent electrification for off-grid households through micro grids and individual solutions (Solar Home Systems).

Energy poverty, as a factor reducing a society's welfare and development potential is a priority target of international development politics, also reflected in the Millennium Development Goals (MDGs).

Without access to electricity many daily activities are either more time-consuming or limited to times of daylight. Thus electricity access has the potential to generate free time and prolong daily activity. It also has the potential to trigger business activities connected to the availability of electricity. Such activities can range from the provision of simple services such as providing cooling/freezing space or mobile phone charging to the establishment of Rural Productivity Zones (RPZ) (UNDP, 2014a). The concept of RPZs is explained in Box 1. In any case, access to electricity is key to establishing and strengthening the private sector.

The NERM aims at increasing the share of renewable energies to 65 per cent by 2025 (from 19 per cent in 2010) (GoV, 2013). As the interventions will focus on renewable energies, the NAMA will support the achievement of this target.

The NAMA will also contribute to achieving some of the positive environmental and social impacts listed in the NERM through the implementation of measures set out in the Road Map. These impacts include (GoV, 2013, p. 15):

- Reduced local noise and air pollution near existing diesel generation plants;
- Fewer local oil spills through reduced consumption of petroleum;
- Improvement of the situation of groups with specific vulnerabilities, women and the poor, and the incorporation of an element of equity;
- Sustainable, affordable electricity supply that meets the needs of the poor and those living in remote areas.

The NAMA objectives and targets also align well with the recommended actions and activities under the IRENA Renewables Readiness Assessment which include creating a sustainable institutional approach for the operation and maintenance (O&M) of mini-grid systems and local capacity-building in off-grid renewable energy technologies. The proposed innovative community-based cooperative model, including the NAMA's capacity-building aspects, is

elaborated in section 6.1. It is also envisaged that a standard, modular design for solar mini grids that can fit a wide range of requirements will be explored and developed as part of the NAMA interventions as recommended by the IRENA assessment.

A key factor in achieving the targets in the NAMA is the private sector. In the NERM, the government states that the private sector "is expected to play a key role in implementation and also financing major elements of the sector-wide least cost investment program" (GoV, 2013, p. 8). In the electricity sector, the private sector is already very active and Vanuatu has—in contrast to most other countries in the Pacific Region (Dornan, 2014)—privately-operated electricity grids, which is an excellent starting point for further expansion of the role of the private sector.

Increased private sector involvement of the will stimulate the creation of s new employment opportunities. Case studies summarized in an IRENA study show the job creation potential of a NAMA (IRENA, 2012).[18] The creation of long-term job opportunities and equal opportunities for women and men is one of the objectives under this NAMA.

The interventions selected for implementation under this NAMA were all evaluated against their potential contribution to sustainable development. Sustainable Development Indicators were defined for each of the interventions. Details can be found in section 9.2.

As well as its contribution to sustainable development, the NAMA aims at the avoidance of GHG emissions, providing opportunities for a cleaner development pathway. Provision of access to electricity through newly installed generation capacity does not necessarily result in physical reductions of GHG emissions, but avoids future GHG emissions if these new generation capacities are based on renewable energies. It is commonly agreed, both by the climate and the development community, that increasing access to energy is an important and legitimate development target. Additionally, the controlled implementation of new generating capacity can contribute to a shift in the energy system from conventional fossil fuels to renewable energy sources. Most importantly the baseline scenario in most Least Developed Countries (LDCs), a status quo with very limited electricity generation capacity, cannot be seen only from an energy point of view, but has to take into account the development perspective as well. It is an accepted fact that the low GHG emission levels from the energy sector in LDCs are not caused by especially environmentally friendly generation systems, but reflect the limitations caused by the low development status of these countries.

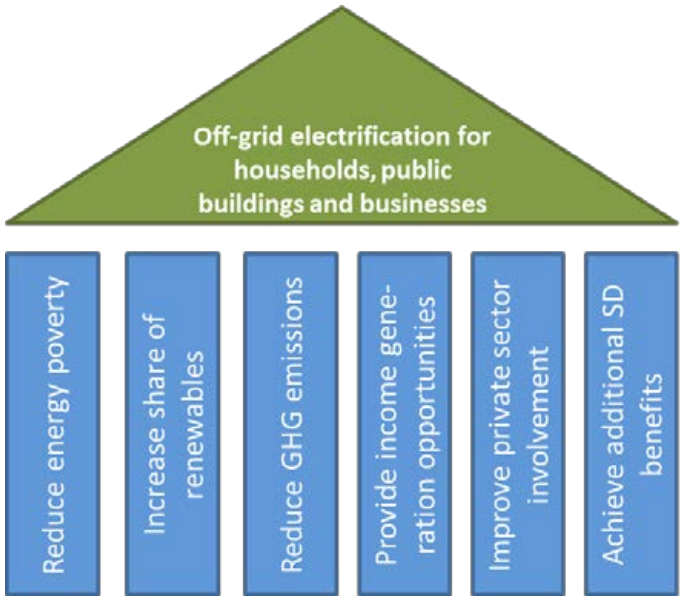
The conceptual approach which takes these limitations into account is called the "suppressed demand" approach. It takes into consideration the fact that low energy (electricity) demand levels may not be caused by efficiency or environmental factors, but may simply be based on the low level of development of the country, which limits demand. The practical response to such a situation therefore is to calculate the energy baseline not on the basis of the status quo, but on an especially defined Minimum Service Level (MSL), which reflects what a household's energy demand would be without development restrictions.

The NAMA will also contribute to the achievement of the MDG goals. Goal 1 (eradicate extreme poverty and hunger) will be supported by providing new income generating activities in rural areas. As all NAMA interventions are based on renewable energies, Goal 7 (ensure environmental sustainability) will be strongly supported. Finally, it is in the nature of a NAMA, where international donors are cooperating with national governments on development, that it supports Goal 8 (develop a global partnership for development).

18 The South African Renewables Initiative, which is part of a NAMA, predicts the creation of 35,000-40,000 new jobs. A NAMA in the renewable energy sector in Grenada sees good potential for jobs for the local population in battery-based solar systems.

The following graph summarizes the targets and objectives of the NAMA.

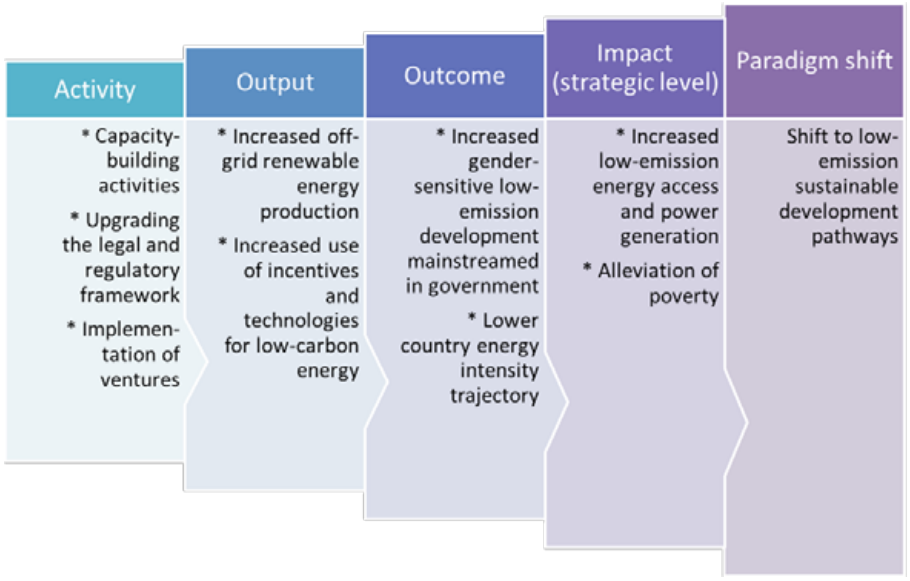
Figure 7. NAMA Targets and Objectives



3.2 Alignment of the NAMA Objectives and Targets with the National Strategies and Transformative Change

The transformative change implicit in the NAMA can best be seen through the application of a theory of change approach. The theory of change approach "defines all building blocks required to bring about a given long-term goal. This set of connected building blocks—interchangeably referred to as outcomes, results, accomplishments, or preconditions—is depicted on a map known as a pathway of change/change framework, which is a graphic representation of the change process" (Center for Theory of Change, 2013). Using this approach will help to ensure that the NAMA focuses not just on emissions reductions but also on achieving sustainable development, national development goals and transformative change. This approach is also aligned with the Green Climate Fund (GCF) results framework. The overall targets for the NAMA can be seen in the following figure.

Figure 8. Theory of Change Approach to NAMA Targets



The transformative change must also occur in a fashion which is aligned with national development goals. The overarching objectives and targets of Vanuatu as a country are defined in the National Energy Road Map (NERM). According to this document, adopted in 2004, the target is to "***energise Vanuatu's growth and development through the provision of secure, affordable, widely accessible, high quality, clean energy services for an Educated, Healthy, and Wealthy nation***" (GoV, 2013).

The following table summarizes how NAMA objectives will contribute to achieving the targets defined in Vanuatu's relevant policy documents.

Table 8. Relevance of NAMA Objectives to the National Strategies and Targets for Rural Electrification

NAMA objective	National strategy & target
Support off-grid electrification	• Achieve a connection rate of 100 per cent for households close to concession areas by grid extensions; • Achieve 100 per cent electrification for "off-grid" households through micro grids and individual solutions (Solar Home Systems) (NERM).
Achieve GHG emission reductions	Vanuatu Climate Change and Disaster Risk Reduction Policy (CCDR) (Awaiting Cabinet Approval).
Contribute to Sustainable Development (SD) Benefits	• Reduced local noise and air pollution near existing diesel generation plants; • Fewer local oil spills through reduced consumption of petroleum; • Improvement of the situation of groups with specific vulnerabilities, women and the poor and the incorporation of an element of equity; • Sustainable, affordable electricity supply that meets the needs of the poor and those living in remote areas. (NERM).

NAMA objective	National strategy & target
Promote private sector involvement	• Private sector "is expected to play a key role in implementation and also financing major elements of the sector wide least cost investment program" (NERM).

3.3 NAMA Baseline Scenario

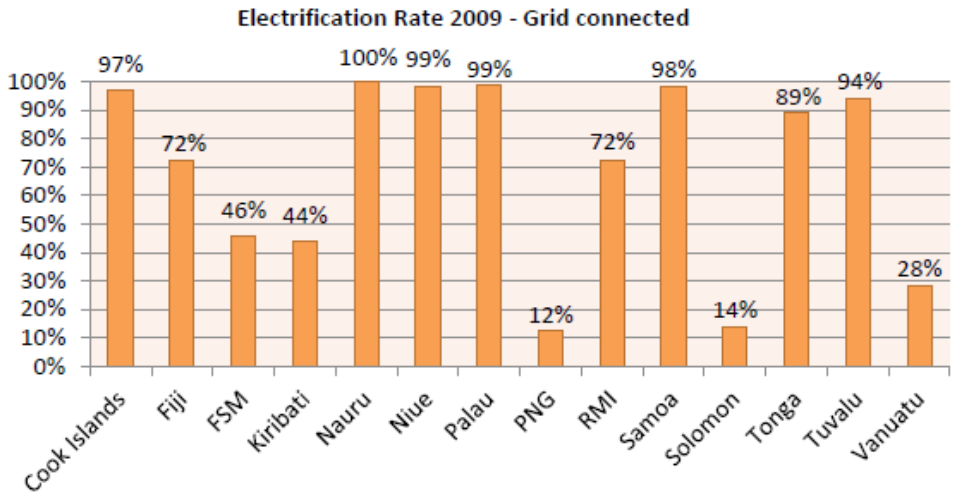
The baseline is a current or an expected business-as-usual (BAU) scenario. Baselines are defined for the areas where the NAMA will have high positive impact, such as:

- Improved access to electricity in rural areas;
- GHG emissions; and
- Sustainable development.

3.3.1 Baseline of Rural Electrification Rate

Among Pacific Island states, Vanuatu has one of the lowest electrification rates. Only 28 per cent of all households were grid connected in 2009, when many other states in the region had connection rates close to 100 per cent (see Figure 9). The most recent estimates suggest that household access has risen modestly, to 33 per cent (IRENA, 2015). Most of the grid connections in Vanuatu are limited to two islands, Efate and Espirito Santo.

Figure 9. Pacific Island Countries Grid Connection Rates, 2009



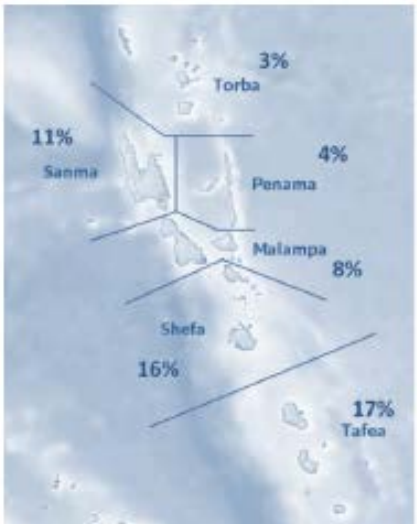
Source: M3P, 2013.[19]

For rural areas, the situation in Vanuatu is even worse. IRENA estimates that only 17 per cent of rural households have

19 FSM – Federated States of Micronesia, PNG – Papua New Guinea, RMI – Republic Marshall Islands<spell out?>

access to electricity (IRENA, 2015).

Figure 10. Electrification Rates by Province[a]



[a] *Excluding Efate, Tanna, Malekula and Espirito Santo Islands.*
Source: GoV, 2013.

The electricity supply in Vanuatu faces two main problems.

- The geographic and demographic situation in Vanuatu makes supplying electricity a challenge. Only 25 per cent of the entire population (234,000 people in 2009) live in urban centres (Port Vila and Luganville), while 75 per cent live in rural areas (IRENA, 2015). This brings serious challenges for supplying households with electricity.
- The financial situation of the population in Vanuatu makes it difficult for them to pay for investment in electricity supply. In 2013, the average income of a five person household in Vanuatu was slightly less than US$900 per year, the 75 per cent of the inhabitants living in rural areas have on average less than US$ 1 per day of cash income (IRENA, 2015).

Experience in the development of rural electrification and renewable energy development in Vanuatu has shown that major improvements in access to electricity are only achieved through donor-funded activities, such as Lighting Vanuatu, funded by AusAID and the grid-connected PV project in Luganville Santo, funded by ADB. IRENA concludes that "rural electrification is done on an ad-hoc basis and depends on available donor funding" (IRENA, 2013).

It can be concluded that under the baseline scenario the existing situation will continue with only marginal improvements in grid connections and rural electrification. Households will mostly continue to use petroleum for lighting and will have no opportunity to supply their basic needs for electricity (radio, charging of mobile phones, etc.). Larger consumers such as health centres or community buildings will be supplied with off-grid electricity generated by diesel generators. No microgrids will be installed, due to the high upfront investment costs.

The baseline scenario must also take into consideration the issue of suppressed demand. To take account of suppressed demand, the Executive Board of the Clean Development Mechanism recommended that 'the baseline may include a scenario where future anthropogenic emissions by sources are projected to rise above current levels due to specific circumstances of the host Party'. This principle can be specifically applied to the methodology

AMS-I.L: "A suppressed demand situation is applicable when a minimum service level20 to meet basic human needs21 was unavailable to the end user of the service prior to the implementation of the project activity. Hence, these guidelines are applicable when basic human needs were not met. For example, in the pre-project scenario, households may have had only very few kerosene lamps in place that were only operated for short time periods, thereby only partially meeting the basic lighting demand of the household" (UNFCCC, 2012).

In Vanuatu's situation, the application of the concept of suppressed demand translates into a baseline scenario where all people have their basic human needs met through the use of the fossil fuel technologies previously mentioned.

3.3.2 Baseline of GHG Emissions

The baseline scenario must also take into consideration the issue of suppressed demand. To take account of suppressed demand the parties to the UNFCCC asked the Executive Board of the Clean Development Mechanism to explore the possibility of including in the baseline a scenario where future anthropogenic emissions by sources are projected to rise above current levels, due to the specific circumstances of the host party (UNFCCC, 2012). This principle can be specifically applied to the methodology AMS-I.L:

"A suppressed demand situation is applicable when a minimum service level[22] to meet basic human needs[23] was unavailable to the end user of the service prior to the implementation of the project activity. Hence, these guidelines are applicable when basic human needs were not met. For example, in the pre-project scenario, households may have had only very few kerosene lamps in place that were only operated for short time periods, thereby only partially meeting the basic lighting demand of the household" (UNFCCC, 2012).

Significant GHG emissions arise from the use of fossil fuels in the baseline scenario. The emission factors included in the CDM methodology AMS-I.L. were determined in a conservative manner through the application of emissions factors gathered from a variety of sources such as information from CDM projects, research and the Intergovernmental Panel on Climate Change (IPCC) (Pöyry Management Consulting, 2011).

As per AMS-I.L., the following are the baseline emission factors for each tranche of the annual amount of renewable electricity consumed per consumer during the crediting period:

a. For the first 55 kWh of renewable electricity consumed by each consumer the baseline emission factor is 6.8 tons of carbon dioxide per MWh (tCO_2/MWh);

b. For facility consumption of more than 55 kWh but equal to or less than 250 kWh, the baseline emission factor is 1.3 (tCO_2/MWh);

20 Defined as: a service level that is able to meet basic human needs. In some situations, this service level may not have been provided prior to the implementation of the CDM project activity, indicating suppressed demand with a consequent future emissions increase due to income effect, rebound effect or other technical factors, such as limited availability of a service (e.g. connection to a very weak grid) or low quality of a service (e.g. ;delete "aversion to"pollution caused by kerosene lanterns).

21 For the purpose of these guidelines, these include physical and physiological needs such as basic housing, basic energy services (including lighting, cooking, drinking water supply and space heating), sanitation (waste treatment/disposal) and transportation.

22 Defined as a service level that is able to meet basic human needs. In some situations, this service level may not have been provided prior to the implementation of the CDM project activity, indicating suppressed demand with a consequent future emissions increase due to income effect, rebound effect or other technical factors such as limited availability of a service (e.g. connection to a very weak grid) or low quality of a service (e.g. aversion to pollution caused by kerosene lanterns).

23 Defined for the purpose of the guidelines to include physical and physiological needs such as basic housing, basic energy services (including lighting, cooking, drinking water supply and space heating), sanitation (waste treatment/disposal) and transportation.

c. For facility consumption beyond 250 kWh, the baseline emission factor is 1.0 (t CO_2/MWh.

The distinct emission factors for these three levels of energy consumption take into consideration the baseline technologies used to meet basic household lighting energy needs (i.e. 15W bulbs x 5 hrs/day x 365 days = 55 kWh); more extended household energy needs/micro enterprise needs (i.e. 100W fan or TV x 5 hrs/day x 365 days = 183 kWh), and the needs of public buildings and/or small, medium and micro enterprises (SMMEs) (Pöyry Management Consulting, 2011).

In light of the challenges for the NAMA actors in monitoring electricity generation at each facility, a simplified and conservative baseline emission factor is chosen. For both interventions this will be 1.0 tCO_2/MWh.

3.3.3 Baseline of Sustainable Development Indicators

As discussed in section 2.1, electrification is one of the preconditions for development, especially in rural areas, and brings many additional benefits besides the electricity itself. Thus, the NAMA will contribute to improve several of the so-called sustainable development indicators. (Note that environment-related indicators, such as GHG emission reductions, are not included here.)

Quantification of the baseline is in most of these cases more appropriately done on the local level, in particular in locations where the NAMA activities will take place. However, if the overall situation of the focus areas of the NAMA (their location in remote, off-grid areas) is taken into consideration, it is assumed that the baseline for them is zero. Therefore the need for and impact of the NAMA activities are high.

Table 9. Indicators for SD Baseline

Domain	Indicator
Environment	Climate change adaptation and mitigation. GHG emissions from combustion of the fossil fuels for electricity generation will be reduced/avoided.
Social	Improvement of health and healthcare conditions due to electrification of clinics and health centres. Improved livelihood of the poor/poverty alleviation through: • Enhanced productivity/efficiency arising from provision of electricity; • Creation of income-generating activities (jobs) and more business opportunities; • Reduction of expenditure on electricity (e.g. charging of phones).
Growth and Development	Access to clean and sustainable energy, reduced use of fossil fuels (diesel and paraffin) and establishment of new sales points for renewable energy and energy efficient (RE & EE) technology; Education-improved learning conditions due to electrification of the schools.
Economic	• Creation of income-generating activities (enterprises); • Creation of jobs, for men and women.

One of the key pillars of rural development is the overall social and economic progress of rural society, and one way progress can be made is by encouraging rural entrepreneurship. An increase in rural businesses (services and products) can help tackle unemployment, improve access to services and increase average household income. For example, the generation of income-making opportunities through micro-enterprises can help women and rural youth to gain financial independence. The aim is to provide access to energy first and foremost to these micro enterprises to establish income-generating activities involving the private sector, NGOs, development organizations, self-help groups and micro-credit initiatives, which in turn will help ensure the sustainability of the energy system. This in turn creates a situation where the overall economic progress of the community makes additional energy available for social initiatives (e.g. healthcare and education) and subsequently to households. The success of this model is based on the community's ability to generate sufficient income to pay for the energy consumed, which in turn ensures the operation and maintenance of the energy system.

3.3.4 Expected and targeted impacts of Intervention 1 – Micro Grids[24]

The values below are used in the following sections for estimation of NAMA impacts on GHG emission reduction and reaching the SD indicators. The values are for the five micro grid projects to be implemented.

Table 10. Expected and Targeted Impact of Intervention 1

Installed capacity	175 kWp
Annual electricity production	246,000 kWh
Annual GHG saving/avoidance	246 tons of CO_2
Number of health care institutions electrified	5
Number of educational institutions (schools) electrified	5
Number of households electrified	300
Number of persons	1,500
Number of women-run enterprises	2
Number of new enterprises	5
Number of new jobs	20
Number of new jobs for women	10

3.3.5 Expected and targeted impacts of Intervention 2 – Grid Extension

The values below are used for the estimation of the NAMA impacts on GHG emission reductions and reaching the SD indicators described in the sections below. The values are for the five grid extensions to be implemented.

24 There is no clear differentiation between mini grids and micro grids in the literature, both terms being used more or less interchangeably. As the term "micro grids" is common in Vanuatu, it is used in this document.

Table 11. Expected and Targeted Impact of Intervention 2

Additional capacity connected	465 kW
Annual electricity production	650,000 kWh[25]
Annual GHG saving/avoidance	650 tons of CO_2
Number of households served	715
Number of persons	3,180
Number of new enterprises	5
Number of new women-run enterprises	2
Number of new jobs created	20

3.4 NAMA Target Summary

A summary table of the NAMA targets for GHG emissions reductions and SD can be seen in the following table.

Table 12. NAMA Target Summary

Target	Indicator
Reduce GHG emissions	Target emissions reductions of 13,440 tCO_2 for Interventions 1 and 2 over the full 15 year lifetime of the NAMA.
Contribute to sustainable development	• 1,015 households electrified • 4,680 people connected to electricity • 40 new jobs created • 10 new companies founded • Four new women-run enterprises founded

25 Estimated using http://re.jrc.ec.europa.eu/pvgis/.

4 NAMA Interventions

The NAMA interventions were selected in a consultative process with key stakeholders in Vanuatu. During a workshop in April 2014, ideas, based on key policy documents, such as the National Energy Roadmap (NERM), on potential interventions, were presented to key stakeholders in Vanuatu. The three potential interventions, which were identified and finalized during the discussions with stakeholders, are :

- Intervention 1: Installation of micro grids in off-grid areas with concentrated electricity demand (around communities/health centers/schools);
- Intervention 2: Extension of grids to neighbouring communities;
- Intervention 3: Individual solutions for households.

These potential interventions were presented in the NAMA Study, which was finalized in September 2014. During a mission in February 2015, these potential interventions were reviewed again with the Government. Based on the consultations with the Government, it was decided that the NAMA will focus on the following two interventions:

- Intervention 1 (micro grids)
- Intervention 2 (grid extension)

It was also agreed that the individual solutions for households will not be part of the NAMA as these are being addressed under other initiatives.

The two interventions are described in the following sections.

4.1 NAMA Intervention 1 – Micro Grids

4.1.1 Activities under Intervention 1

New micro grids will be installed based on renewables (mainly focusing on solar PV). Back-up power supply is envisaged to be provided by batteries (preferred) and/or diesel generators.

The intervention envisages promoting the community based cooperative model (similar to those being planned by some private renewable energy service companies—RESCOs—in Vanuatu), based on the most successful approaches in the Pacific using a combination of external and local support. The Department of Energy will have ownership of the systems and equipment procured and installed under the intervention. Day-to-day operation of the Solar PV micro grid will be delegated to the rural community cooperatives.

External technical support will be provided by a contractor or by a locally trained person supported by the Department of Energy (DoE). Appropriate training and capacity-building on operation and maintenance (O&M) will be provided to the local persons by the DoE in association with the external contractors. The arrangements will also include invoicing and collecting the electricity bills and reasonable O&M fees. It is envisaged that the private sector vendors, electricity utilities and RESCOs will be contracted to assist the DoE in the sustainable operation and maintenance of the micro grids installed under the project.

- These micro grids can focus on supplying electricity for lighting, cooling and appliance for rural communities, tourism and agricultural facilities, health centres and schools
- Micro grids also allow commercial users to connect to the system and to offer services, such as, for example, charging stations for mobile phones and internet access to rural co-operatives, shops, warehouses, agricultural facilities, rural business centres with charging stations for mobile phones and internet access.
- Feed-in tariff systems need to be elaborated, defining the micro grid operator's pricing and take-off requirements.
- Providing electricity for income generating activities, health centres and/or schools in rural locations can boost local productivity and human development, as pupils will be able to study later in the evening once lighting becomes available.

Box 1. Rural Productivity Zones (RPZs)

The concept of the Rural Productivity Zone (RPZ) is based on the paradigm of an integrated approach to sustainable rural development. It consists of setting up an Energy System and Associated Infrastructure in a rural area to provide power for a range of activities that leads to income enhancement and social development. The resulting economic activities lead to money being generated, which in part goes into paying for the investment, operation and maintenance of the energy system and infrastructure. In this manner RPZs increase the ability of consumers to make consumer payments, by allowing for more community level income generation. In addition to economic activities RPZs offer the potential to create social infrastructure for healthcare and education, which builds a sense of ownership and supports local capacity development, leading to the community's sustainable development. (UNDP, 2014a)

4.1.2 Eligibility Criteria

In order to be able to receive funding under the NAMA, any micro grid needs to meet the eligibility criteria set out in Table 13.

Table 13. Eligibility Criteria for Intervention 1[26]

Eligibility criterion	Description
Location	All islands
Technology	Energy supply: the mini grid will be operated with renewable energies (solar (PV), wind, hydro power).
	Battery: Batteries are recommended for a steady electricity supply.
	Backup: Fossil-fuel back-up systems are allowed. However, the share of electricity from renewable energies must be at least 75 per cent.
Connections	The mini grid must connect a minimum of 20 households.
Service level[26]	Domestic users: the minimum service level provided to domestic users needs to include at least two sources of lighting, radio and phone charging.
Income generation activities	Income-generation activities: the mini grid must include opportunities for income-generation activities. Such activities may include, but not be limited to: • Coastal fishing (refrigeration of fish catch) • Tourism facilities (lodges) • Agricultural facilities (preparing, processing and packaging produce) • Handicrafts (lighting for women/women associations to make handicrafts) • Commercial establishments (small shops, warehouses, etc.)
Implementation	Micro grids must be operational within 18 months of contract award.
Commitment	Communities are a key partner in the implementation of micro grids. Communities need to demonstrate commitment to be eligible for NAMA funding.
Funding	The maximum grant funding to be applied for is 90 per cent of investment costs.

The first projects identified for financing under the NAMA (details of which can be found in section 7.1) all meet these eligibility criteria. Therefore, the eligibility criteria are mainly designed to facilitate the selection of additional Intervention 1 projects seeking funding.

26 To provide electricity over 24 hours per day is the preferred service level. However, as a 24 hour operation requires expensive back-up capacity during the night (batteries, diesel generators) operators will come to an agreement with their consumers on the actual times electricity will be provided.

4.1.3 Approval Structure

The selection of the micro grids to be financed under the NAMA will be carried out in the steps set out in Table 12. .

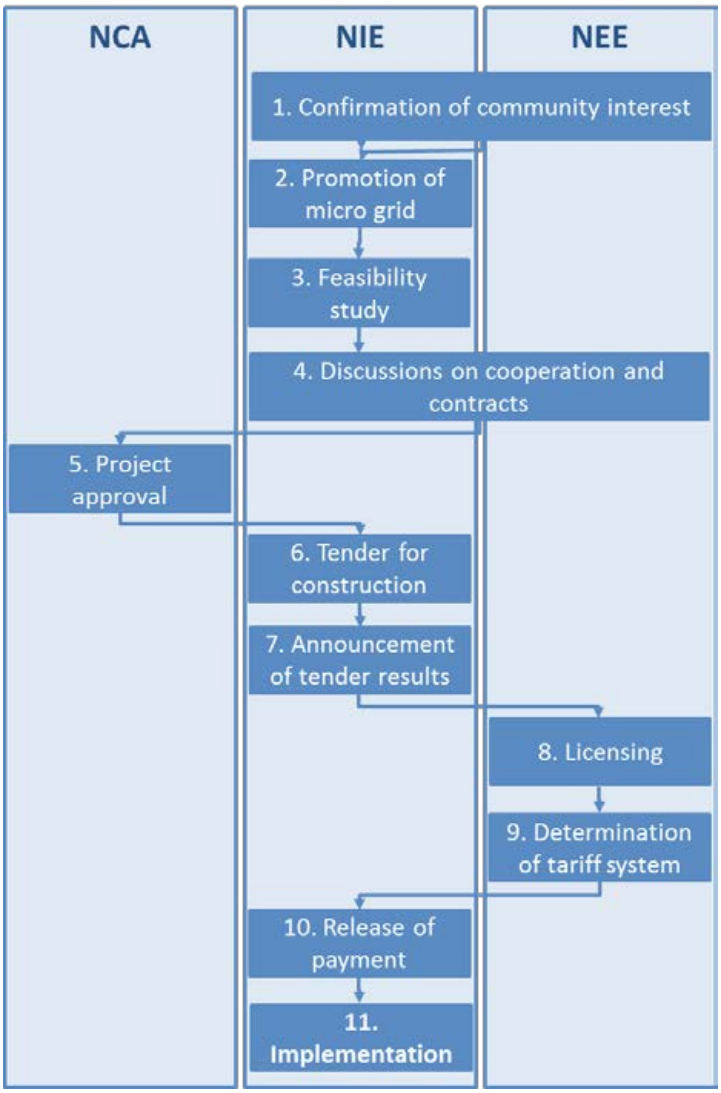
Table 14. Approval Structure for Intervention 1

Nr.	Step	Description
1	Confirmation of community interest	The NAMA Implementing Entity (NIE) will contact communities, where the micro grid will be implemented, to confirm their interest in taking part in the implementation and operation of the micro grid (details on the business model and the role of communities can be found in 4.1.4)
2	Promotion of micro grid	The planned implementation of the micro grid will be promoted by the NIE in the villages to be covered by the grid. Information will be given to households and institutions about the service level they can receive and associated costs. Existing companies and potential operators of income-generating activities will be informed about the planned electricity supply and associated costs. The result of this step is a list of potential connections in the different categories (households, public and commercial establishments, income generating facilities).
3	Feasibility study	A feasibility study is carried out defining details of the micro grid, including: • List of consumers likely to be connected; • Required capacity; • Draft plan of the micro grid; • Estimated investment costs; • Tariff structure.
4	Discussions on cooperation and contracts	Discussions will be held between the NIE and community about the roles and responsibilities of each partner in the construction and operation of the micro grid. Once discussions are finalized, a cooperation contract will be elaborated and signed.
5	Project approval	Each micro grid will be presented to the NAMA Coordinating Authority (NCA) and has to achieve approval by the National NAMA Approver and Focal Point (NA), that is the National Advisory Board on Climate Change and Disaster Risk Reduction (NAB) (see section 5.2). Once approval is given by the NA, each micro grid is presented to the NAMA donor(s) for approval.
6	Tender for construction	After approval by the NAMA donor(s), a tender will be announced to procure the required equipment and services through a private renewable energy (RE) company for each micro grid. It is recommended that tenders for different micro grids are bundled together in order to achieve economies of scale.
7	Announcement of tender results	Tender results are announced, and the name of the private RE company selected for construction of the micro grid and information on the funding required is forwarded to the NAMA donor.
8	Licensing	The private RE company winning the tender will apply for a business licence to the Rates and Taxes Office, the Department of Customs and the Inland Revenue

Nr.	Step	Description
9	Determination of tariff system	The NAMA Executing Entity (NEE) (i.e. the Department of Energy) will coordinate with URA on fixing the tariff for the micro grid as per applicable procedures.[27]
10	Release of payment	Payment is released by the NAMA donor to the NIE and then forwarded to the NEE.
11	Implementation	Construction of the micro grid is carried out.

The following flow diagram shows the approval process and the stakeholders involved.

Figure 11. Approval Process for Intervention 1



4.1.4 Actors

There are different potential business models, which can be used for the preparation and operation of micro grids. UNDP MDG Carbon's Guidance Paper on Finance Structure and its Management for a Rural Electrification NAMA presents these different models and describes the advantages and disadvantages of each of them (UNDP, 2014b).

The Public-Private Partnership (PPP) business model (which in the case of Vanuatu would involve the Government of Vanuatu, community cooperatives and the private sector) is the selected option for intervention 1 (micro grids). A PPP business model results in the micro grids being operated as private businesses in this case in association with rural community cooperatives. The model assumes that it is possible to establish the micro grids in rural communities where the private sector is willing to operate and where the public partner wishes a more experienced party to handle all energy service activities. The RPZs are also expected to be run by private sector companies, individuals or community organizations. The service providers will ensure that the RPZ business owner has reliable access to electricity and is in charge of running the business (e.g. refrigeration of fish, tourism facilities, etc.).

Under a PPP, the community or state partner plays one role while the private sector partner plays another:

- The public partner has title/ownership of the assets (the generation and distribution system); and
- The private party operates, maintains and manages the energy services.

Facilitating the development of PPPs is one of the main tasks of the international advisor through his/her role in NAMA capacity development.

It is to be noted that overseas private companies willing to invest in Vanuatu must obtain a Foreign Investment Application Certificate from the Vanuatu Investment Promotion Authority (VIPA) before starting a business in Vanuatu. The Vanuatu Chamber of Commerce and Industry provides guidance on the steps and procedures for starting a new business in Vanuatu.[28]

As described in section 5.1.1, for the implementation of the micro grids, a PPP model using a combination of external and local support has been designed. Under this model, the Government of Vanuatu, through the Ministry of Climate Change and Natural Disasters, is to cooperate with community cooperatives and private sector vendors and RESCOs.

Under the envisaged PPP model, the Government of Vanuatu (DoE) will have ownership of all the assets under Intervention 1. A private company/RESCO will apply for and obtain a business licence[29] either from the Rates and Taxes Office in the Department of Customs and Inland Revenue to register for business activity in the municipalities of Port Vila and Luganville,[30]or from one of the six Provincial Councils—of Shefa, Sanma, Malampa, Penama, Tafea and Torba—are responsible for issuing business licences in their provinces.

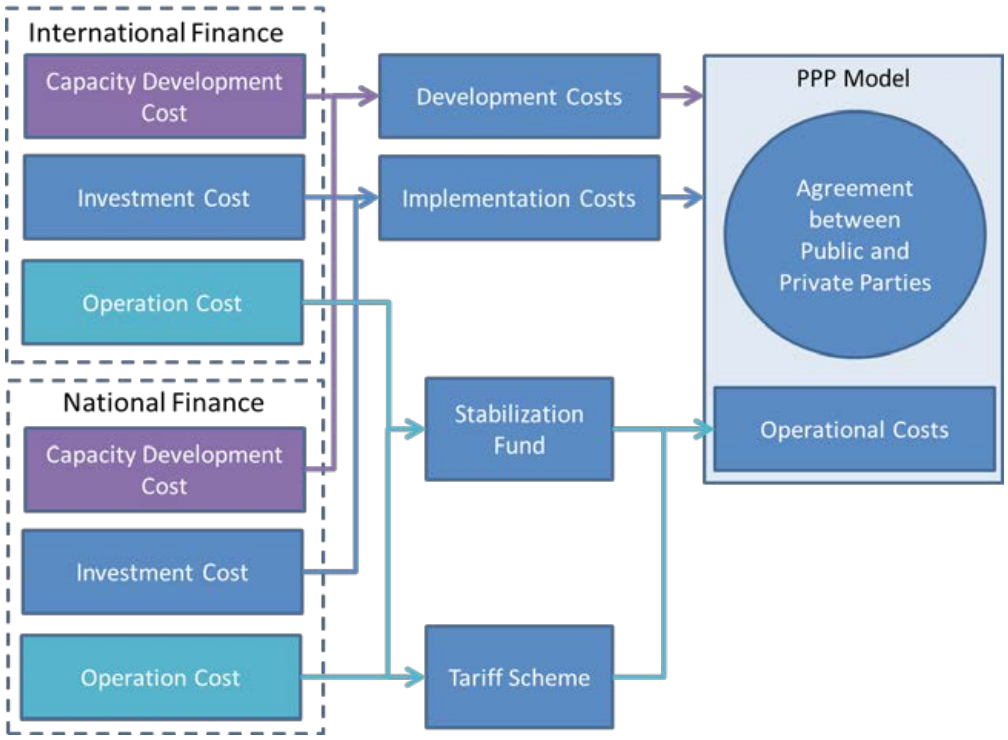
A project steering committee will be established to ensure efficient and effective operation of the micro grid and will consist of one representative each from the community where the micro grid is being implemented, the Department of Energy (DoE)and the private company/RESCO selected for implementation and operation of the micro grid.

27 Please see NEE under Chapter 6.2 NAMA Institutions.
28 http://vcci.com.vu/resources/starting-a-new-business/.
29 It is not necessary to have a business licence unless your turnover is or expected to be to be more than VT4 million (approx. US$ 40,000).
30 http://customsinlandrevenue.gov.vu/index.php/en/forms-top-menu.

The DoE will coordinate with URA on tariff fixing aspects for the micro grid. This will include revising the tariff from time to time and ensuring a reasonably acceptable profit margin (as specified by URA) for the private company/ RESCO in order to allow them to operate profitably and to secure the long-term sustainability of the initiative.

The electricity will be distributed via a low voltage micro grid, which directly distributes single-phase AC power to each household. Each household will be provided with a consumer connection, which will include basic lighting kit and a ready-board with prepaid meter, surge protection and power sockets. The RPZ facilities will be provided with a three-phase AC power supply and metering/surge protection, to meet the electricity demand of the various pieces of equipment in the RPZ. Consumers will pay for residential electricity via prepaid metering and for electricity used at the RPZ facilities through consumption meters. The private company/RESCO operating the micro grid in association with the DoE will also explore opportunities to tie up with private enterprises in the vicinity (such as telecommunications companies, agriculture produce processing units, tourism facilities and so on), to which they might sell electricity. A stabilization fund to support micro grid consumers in the early phases of NAMA implementation will be set up to provide funding for payment of electricity bills (see section 8.3).

Figure12. Economic Flow Diagram for the PPP Business Model



4.2 NAMA Intervention 2 – Grid Extension

4.2.1 Activities under Intervention 2

The existing grids on the main islands in Vanuatu (Port Vila, Luganville, Malekula and Tanna) and smaller distribution networks in Banks Islands, Ambae and Maewo form the basis for grid extensions to households, public institutions and tourism/commercial consumers in the proximity of lines. The connection of new consumers will lead to

emission reductions as electricity generated from the grid will be less carbon-intensive than energy sources traditionally relied on at the household level. Investments are envisaged for line extensions only, not for additional production capacity in the existing grids.

- Connections will enable households to meet their daily lighting needs as well as thier limited needs for audio/TV and mobile phone charging.
- Consumers in the tourism sector can either provide lighting and cooling services to their guests or can replace existing diesel units for electricity generation.
- Commercial consumers can offer additional services to their clients and can thereby increase opportunities to earn income.
- Agricultural facilities attached to households or small plantations can make use of the electricity for preparing, processing and packaging produce.
- Connections will also provide lighting for associations of women and women at home to make handicrafts during the hours of darkness.
- New commercial users can connect and offer services such as rural production facilities and warehouses, rural business centres with charging stations for mobile phones and internet access, etc.

4.2.2 Eligibility Criteria

In order to be able to receive funding under the NAMA, any grid extension needs to meet the following eligibility criteria.

Table 15. Eligibility Criteria for Intervention 2

Eligibility criterion	Description
Location	All islands with existing electricity grids
Connections	The grid extension must connect a minimum of 20 additional households.
Service level[30]	Domestic users: the minimum service level provided to domestic users needs to include at least two sources of lighting, radio and phone charging.
Income-generation activities	Income-generation activities: the micro grid must include opportunities for income-generation activities. Such activities may include, but not be limited to : • Coastal fishing (refrigeration of fish catch); • Tourism facilities (lodges); • Agricultural facilities (preparing, processing and packaging produce). • Handicrafts (lighting for women to make handicrafts); • Commercial establishments (small shops, warehouses etc.).
Implementation	Micro grids must be operational within 18 months of contract award.

31 To provide electricity for 24 hours per day is the preferred service level. However, as a 24 hour operation requires expensive back-up capacity during the night (batteries, diesel generators), operators will come to an agreement with their consumers on the actual times electricity will be provided.

Eligibility criterion	Description
Commitment	Communities are a key partner in the implementation of micro grids. Communities need to demonstrate commitment to be eligible for NAMA funding
Funding	The maximum grant funding to be applied for is 80 per cent of investment costs.

The first projects identified for financing under the NAMA (details can be found in section 7.2 and Annex1) all meet these eligibility criteria. Therefore, the eligibility criteria are mainly designed to facilitate the selection of additional Intervention 2 projects seeking funding.

4.2.3 Approval Structure

The selection of the grid extensions to be financed under the NAMA will be carried out in the steps set out in Table 14.

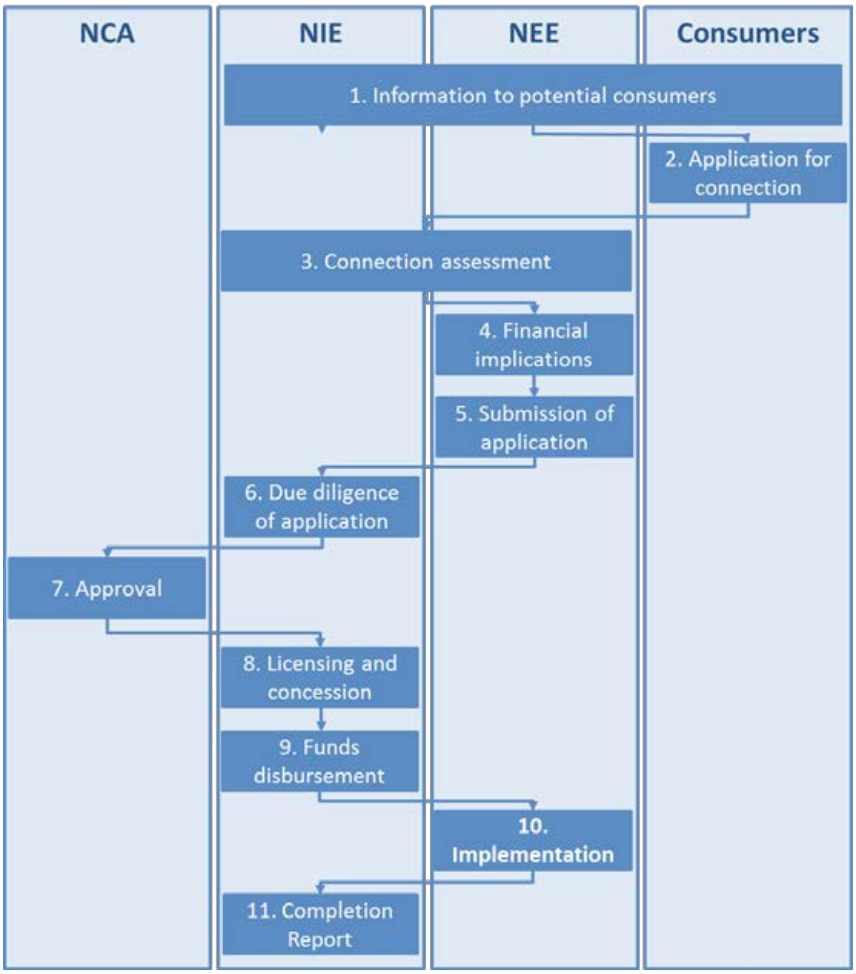
Table 16. Approval Structure for Intervention 2

Nr.	Step	Description
1	Information to potential consumers	Information about planned grid extensions is disseminated by the NIE in association with the NEE to potential consumers near existing grids. This information includes a description of technical solutions, a rough first estimate of costs, subsidies and other support available from the Government, and the financial contribution required from households.
2	Application for connection from consumers	Interested consumers apply for connections from the utility. Application documents might include identification documents, plan of the premises to be connected, proof of ownership, etc.
3	Connection Assessment	Technical assessment carried out by technicians of NEE in association with NIE.
4	Financial Implications	Cost estimate is elaborated by NEE.
5	Submission of Application	Application for funding under the NAMA is handed in at NIE.
6	Due Diligence of Application	Application is verified against eligibility criteria (see above) by NIE.
7	Approval	If eligibility criteria are met, application is forwarded to NCA for approval. NCA approval based on availability of funding.
8	Licensing and Concession	The NEE will apply (in cases of new utilities) for a business licence with the Rates and Taxes Office in the Department of Customs and Inland Revenue. The NEE will apply for a concession contract as per the URA guidelines (as set out in the Electricity Supply Act). The guidelines set out the rights and obligations of the parties, including the conditions for delegating exclusive responsibility for provision of electricity services within specified areas, and the rules regarding service coverage, the quality of service to be provided, and the maximum tariffs that may be charged for the services.
9	Funds Disbursement	Funds will be released by the NIE to the electricity supplier.

Nr.	Step	Description
10	Implementation	Implementation is taking place.
11	Completion Report	Confirmation of finalization is sent by the NEE to the NIE.

The following flow diagram shows the approval process and the stakeholders involved.

Figure 13. Approval Process for Intervention 2



4.2.4 Actors

The grid extensions will be carried out in existing electricity grids. Hence, the operators of these grids (UNELCO, VUI, the Penama and Torba Provincial Governments, and Talise village community) will play the major role in implementation of these projects.

5 NAMA Management Structure

5.1 Bases for Institutionalizing the NAMA

The coordination and management of the NAMA requires an institutional structure, which should meet the following requirements.

- It must be embedded in national and sectoral policies and strategies.
- It must be capable of effective communication and reporting as required by international agencies, such as the UNFCCC.
- It must provide an interface to international bilateral and multilateral NAMA funding entities, such as the Green Climate Fund.
- It must be able to ensure proper management of financial flows between the NAMA funding entities and the recipients.
- It must be able to ensure the achievement of NAMA targets in terms of electrification, GHG mitigation and sustainable co-benefits.
- It must be able to allow transparent monitoring of GHG emission reductions and the Sustainable Development indicators.

The recommended institutional structure of the NAMA is based on the following principles.

- Ensuring the strong involvement of national stakeholders to create country ownership and political commitment.
- Using existing and experienced entities' organizational systems, which are already in place and thus allow for prompt and smooth implementation of the NAMA.
- Ensuring that the institutional structure is appropriate for the receipt of international private and/or public donor funding.

5.1 NAMA Institutions

The institutional structure for the NAMA shall include the following institutional bodies at the country level:

- a National NAMA Approver and Focal Point (NA);
- a NAMA Coordinating Authority (NCA);
- a NAMA Implementing Entity (NIE);
- NAMA Executing Entities (NEEs).

National NAMA Approver and Focal Point (NA)

The national NAMA Approver or Focal Point shall inter alia:

- approve NAMAs which shall be registered at the UNFCCC;
- report to the Ministry of Climate Change and Natural Disasters (MCC) about international developments and the status of the national NAMA portfolio, and follow the guidance of the MCC in international negotiations;
- provide guidance to sectoral NAMA coordinating entities (on access to climate finance, financial flows, MRV etc.);
- issue procedures for the accounting of emission reductions so as to avoid double counting of reductions made by the various implemented NAMAs;
- support the preparation of the National Communication, the Biennial Update Reports, Summary of GHG Reductions and other communications with the UNFCCC.

Up to now, no NAMA Approver/Focal Point has been nominated to the UNFCCC. In discussions within the Government of Vanuatu it was decided that the **National Advisory Board** on Climate Change and Disaster Risk Reduction **(NAB)** will take this role.

NAMA Coordinating Authority (NCA)

The NAMA Coordinating Authority (NCA) is the entity which coordinates the proposed NAMA on rural electrification. Its main tasks are:

- act as primary contact for international donor(s);
- host NAMA related meetings;
- carry out planning and direct NAMA activities;
- approve
  - NAMA targets
  - the process for the submission of project applications and the disbursement of funds (in close collaboration with the NAB/ the NAMA Focal Point and the NIE);
- support inter-governmental actions on capacity building and improve dialogue between and the engagement of key stakeholders;
- support inter-governmental actions on MRV;
- approve and update eligible interventions;
- approve annual monitoring reports prepared by the NIE (covering inter alia the number of projects implemented, the calculation of emission reductions etc.);
- supervise the financial flows from donors to beneficiaries,
- write NAMA procedures/policies and validate these procedures/policies with stakeholders.

The NAMA Coordinating Authority will receive funding from the capacity development budget line. Given the close inter-linkage of activities, so that delay or non-performance of one activity could lead to wider failures, the performance of the NAMA Coordinating Authority is crucial. Therefore, the NAMA Approver (the NAB) will have the mandate to recommend to the NAMA donor(s) the suspension of funds allocated through the budget in the case

of non-performance by the NAMA Coordinating Authority. The NAMA Coordinating Authority should be given notice of non-performance at least six months before suspension of funds.

The role of the NAMA Coordinating Authority (NCA) will be taken by the Ministry of Climate Change (MCC).

NAMA Implementing Entity (NIE)

The NIE will be responsible for handling the financial flows from funding entities to the beneficiaries. The NAMA Implementing Entity (NIE) is the main operative body of the Rural Electrification NAMA in Vanuatu.

The main tasks of the NIE are to:

- ensure the transfer and disbursement of funds from the donors to the recipients based on an agreed set of criteria (e.g. money will be held in a trust account with limited access, money will be disbursed only after the project has been implemented, etc.);
- prepare reports to the NCA/donor(s) about e.g.,
  - the use of funds
  - the number of projects implemented
  - targets achieved etc.;
- support capacity-building for institutions and companies involved in the implementation of the NAMA (e.g. micro grid operators and equipment suppliers);
- development of technical standards for equipment/installations used under the NAMA;
- coordination of promotion and awareness-raising campaigns and of support for the implementation of the NAMA;
- integration of the private sector into NAMA implementation;
- coordination of monitoring activities and preparation of monitoring reports for all interventions;
- facilitation and coordination of verification through the external entity designated for this task;
- reporting to the NCA in fulfilment of reporting requirements to the donor; and
- cooperation with internal and external financial auditors.

The NIE needs to be able draw on expertise with a strong background and good track record in financing. Therefore, it makes sense to recruit external experts to provide support to the NIE on technical financial issues.

The **Department of Energy (DoE) and the Project Management Unit (PMU)** within the Ministry of Climate Change will operate as the NAMA Implementing Entity (NIE). The PMU has a lot of experience with the implementation of projects supported by international donors and partners and should have the capacity to meet the requirements of the Green Climate Fund (GCF). The DoE has the technical experts required for the implementation of a NAMA on rural electrification.[32]

32 Depending on the progress made so far, receiving accreditation with the Green Climate Fund might take time for the NIE. In case longer timelines for accreditation of the NIE, accredited trustees can be appointed, to enable the implementation of the NAMA to progress rapidly. Examples of potential trustees are UNDP, the Acumen Fund and the KfW.

The NIE shall be audited at least bi-annually and will be notified by the NCA of any shortcomings found in the audits.

NAMA Executing Entities

The NAMA Executing Entities (NEEs) are the companies and/or institutions which implement projects under the two interventions. Each NEE will:

- implement projects in compliance with the rules of each intervention;
- inform the NIE about the performance of their projects; and
- collect data for monitoring purposes (requirements will be communicated by the NIE based on the MRV criteria).

For Intervention 1 (micro grids), the executing entities (NEEs) will be the DoE and private RE companies. Given the involvement of two different kinds of entities (state and private) as NAMA executing agencies, it is important to identify and differentiate their roles and responsibilities. Because of the historical background of the electricity sector in Vanuatu, including the fact that private utilities have been operating in Vanuatu, the Government perceives that there is a strong need for it to start owning the assets in the energy sector. It believes that owning the assets under the micro grid intervention could kick-start this process and establish a useful precedent.

Hence, under Intervention 1, the assets will be owned by the Government and private RE companies under the supervision of the DoE, which will be involved in on-ground implementation, operation and maintenance of the micro grids.

Intervention 2 (grid extension) will be executed by the private electricity utilities, who will thus be the NEEs. As discussed earlier, UNELCO operates concessions that supply power to Port Vila, Malekula, and Tanna. Another private company, VUI, has been operating the Luganville (Santo) concession since January 2011. The Government also wants to encourage interested new private utilities to participate in the grid extension interventions. The Ambae and Banks grids (potential grid extension sites identified under this NAMA) are currently being managed by the Penama and Torba Provincial Councils respectively. The Talise village community is responsible for the Maewo grid.

Contractors and Consultants

Contractors and consultants will play a critical role in implementation and operation of the NAMA and associated ventures. The service providers must be selected in a process which applies international standards and which carries out tenders and evaluations on transparent quality and cost bases. The contractors and consultants will be contracted directly with the NCA. As previously indicated, the tenders for the service providers will be prepared by the NIE. Open and competitive tenders will incentivize participation of the private sector, by ensuring fair competition and secured payments. Contracts with contractors and consultants should be based on the payment-on-deliverables principle. If so decided by the NCA, awards for early delivery or penalties for late delivery can be applied (typically +/- 10 per cent of contract value).

Box 2. The Green Climate Fund (GCF)

The GCF was created in 2010 at 16th Conference of Parties to the UNFCCC (COP) in Cancun. The Parties created the GCF to increase the predictability and efficiency and address the adequacy of climate change finance under the UNFCCC. The GCF is an operating entity of the financial mechanism of the UNFCC, and will be accountable to and function under the guidance of the COP. The Fund and its independent Secretariat are located in Songdo, South Korea.

All developing countries which are parties to the UNFCCC are eligible to access the GCF. The Fund will finance activities to enable and support enhanced action on:

- Adaptation;
- Mitigation (including reducing emissions from deforestation and forest degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries, i.e. REDD-plus);
- Technology development and transfer (including carbon capture and storage);
- Capacity-building; and
- Preparation of national reports by developing countries.

The fund will also have a private sector facility which enables it directly and indirectly to finance private sector activities.

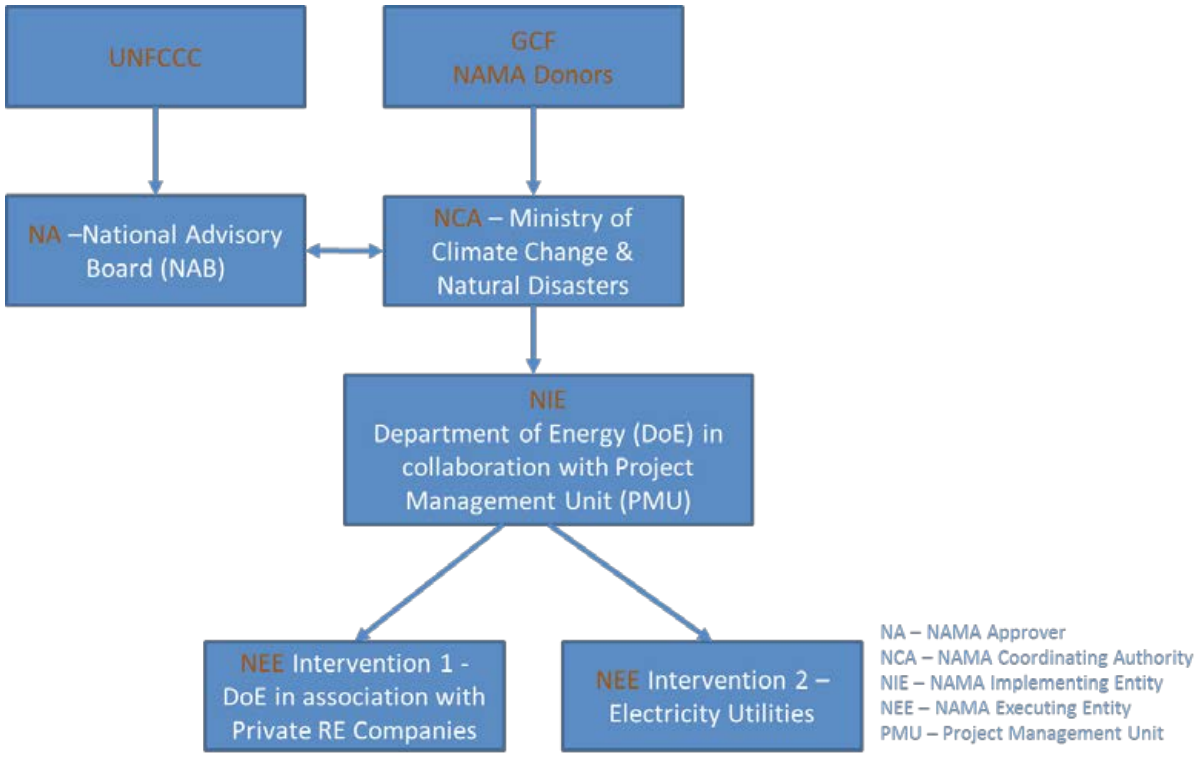
At a GCF project/programme level, there are three main stakeholders. The stakeholders and their roles can be seen in the table below.

Table 17. GCF Stakeholders

Stakeholder	Role/Responsibility
NDA	• Main point of communication for the GCF Secretariat • Principal signing authority on behalf of the national government • Providing letter of no objection for national/regional GCF proposals
Implementing entity	• Required to be accredited by the GCF • Origination and preparation of a funding proposal • Subsequent project/programme management of the necessary stages of the implementation process until its conclusion • Reporting obligations
Executing entity	• Project owners or entities directly responsible for the operational implementation and execution of the project/programme • Accountable to the relevant implementing entity

The following organizational diagram illustrates the recommended institutional structure of the NAMA described above. The Ministry of Climate Change (MCC) will be the core stakeholder in the NAMA due to its experience and functions. Bilateral funding entities or donors will be in direct contact with the M CC. Implementation of the NAMA will be managed by the DoE and the PMU, which are both under the MCC. The financial flows are described in chapter 7.5.

Figure 14. NAMA Organizational Diagram



6 Institutional and Sectoral Capacity Development Needs

The NAMA capacity development (CapDev) programme is designed to ensure a smooth launch of the NAMA and contribute to the successful implementation of its activities.

The proposed NAMA capacity development programme will **consist of two components**:

- Component 1 will target **support for the launch and implementation** (e.g. definition of processes, preparation of documentation) of the NAMA and will provide capacity-building for the governmental entities involved (such as the NIEs or NA).
- Component 2 will focus on **awareness-raising about the NAMA** once implementation has begun and will provide;
  - general capacity development to create a common awareness of the NAMA; and
  - specific stakeholder-oriented capacity-building.

The capacity development programme will be led by international consultant(s) with the support of national experts. The first component will be carried out by international/national consultants only. In the second component NCA and NIE staff who have been trained in the first component will start to provide seminars/training and workshops.

6.1 Component 1: Capacity Development for NAMA Launch and Implementation

The CapDev programme for launch and implementation will support:

- establishing a NAMA working network and processes (technical and financial project cycle), including staff training;
- devising NAMA related regulations and designing the contractual conditions;
- preparing NAMA project documentation (application forms, call and tender documents, procurement rules, monitoring, evaluation and reporting forms, etc.)

This component is concerned solely with activities which have to be performed by the NAMA Coordinating Authority and the NAMA Implementing Entities as further explained under section 5.2. Capacity development for implementation will be carried out by international/national consultants only.

Implementing NAMA network, processes and financial cycle

This part of the CapDev programme will

- facilitate establishment of the NAMA entities and and explain the roles that stakeholders will play within the NAMA structures through multilateral and bilateral meetings and workshops.

During this phase, the **NIE** will receive assistance through the following types of technical training:

- train the trainer programmes about the objectives, benefits and procedures of the NAMA (the NIE will then be able to offer training to the general public, EEs, banks and equipment suppliers);
- case study training for project approval and verification;
- training on MRV for GHG emission reductions and SD co-benefits;
- training in developing an infrastructure protection plan for renewable energy facilities, to increase the climate resilience of the community;
- designing designation of authority and time frames for process steps within the NIE;
- training on reporting to the NCA.

- identify staff for NAMA positions within involved organizations, provide individual turn-key know how and trainings to entities and individual personnel;
- prepare communication structure and informing procedures, and contact lists for the network; and
- prepare the financial processes cycle.

Regulations and Contractual Conditions

This part of the CapDev programme will:

- draft, in close cooperation with the Government, amendments to the existing regulations and new regulations, as required;
- assist in the approval of the new regulations by holding consultative meetings with responsible authorities;
- draft contractual conditions and documents setting out the relationships between the NAMA stakeholders, as required (e.g. to distribute responsibilities between the ministries);
- **the support contract** to be signed by the NIE and the Executing Entities will be **designed by the NIE** (with the support of the capacity-building programme) and will contain at least:
  - name and address of the legal entity asking for support;
  - a description of the equipment to be purchased by the Executing Entities;
  - amount of subsidy to be given;
  - reference to the legal framework for this NAMA and the relevant approval procedures;
  - the period for finalizing the purchase of equipment and issuing invoices to the NIE;
  - reporting requirements by the NEEs; and
  - payment conditions.

Preparing NAMA project documentation

This part of the CapDev programme will help to:

- prepare the documents (application forms, call and tender templates, evaluation and reporting forms, etc.);
- prepare the procedures for practical implementation (procurement rules, monitoring manual, evaluation, cross-check, approval and reporting structures, etc.); and

- ensure that the relevant forms and procedures are subject to consultation with potential end users and are sufficiently robust to secure practicability, avoid bureaucracy and eliminate corruption.

6.2 Component 2: Awareness-raising and Marketing

This CapDev component will consist of general and specific activities.

General activities

A countrywide generic marketing/awareness-raising strategy for the NAMA will create a common understanding of the benefits of rural electrification, renewable energies and energy efficiency, and explain the NAMA's objectives and procedures.

Organizing NAMA Launch Event

The launch event will be the countrywide kick off for the NAMA and will inform people about its objectives, stakeholders and timelines. The launch event will include a press briefing and will provide some informal networking opportunities.

Designing/Maintaining the NAMA Website

The web page is one of the main communication tools of the NAMA providing information about:

- the qualification criteria for projects;
- case studies;
- best practice;
- success stories;
- templates;
- news and achievements of the NAMA; and
- donors.

Coordinating General NAMA Information Events

In addition to the launch event, four general information events will be organized per year (for the first three years of the NAMA) which will present the idea of RE and energy efficiency, and this specific NAMA, its objectives and opportunities, and explain the NAMA procedures.

Support in Business Development

Focus will be given to supporting new entrepreneurs in developing their income-generating activities. This will include support on technical issues, such as production techniques, as well as general business development issues, such financing of production, product selection, client selection and market access.

Preparing/Disseminating NAMA Marketing Material

Typical materials will include leaflets, pens, notepads, a best practice guide, folders, banners, etc.

Cooperation with public and private media

There will be continuous information to the media about the implementation and outcomes of the NAMA.

Stakeholder-Targeted Activities

These marketing/awareness-raising strategies will ensure widespread participation in the NAMA.

This chapter only refers to capacity-building activities, tailored to the needs of the stakeholders (with the exception of the NCA and NIEs, whose capacity-building programme is already covered under component 1 and under the generic activities of component 2) and provided by international experts. The main stakeholders of the NAMA are described in section 6.2 on NAMA Institutions.

National NAMA Approver

The NA (i.e. the NAB) acts as interface with the international authorities on climate change policies. Its most important task with regard to the NAMA is to avoid double counting of emission reductions. Therefore the NA's specific capacity-building will focus on:

- the exchange of know-how with other countries which are implementing or have implemented industrial energy efficiency NAMAs; and
- the MRV system of the NAMA.

Executing Entities

Executing Entities are the companies which will invest in the NAMA interventions (the micro grids or grid extension) by buying the technology, equipment, and related services. Workshops and presentations on NAMA objectives, eligibility, procedures, etc. will be provided to these companies.

Suppliers and installers of RE technologies. General information on the NAMA's business potential will be provided to interested companies.

7 Costs and Finance

This chapter provides details about the financial requirements and the financial mechanisms which will be used in the NAMA. First, the financial requirements for both interventions are described. Next, the financial requirements for capacity development are set out. Then, the mechanisms for national and international finance are elaborated. Finally, the indicative NAMA financing needs and the financing provided through the different mechanisms are detailed.

7.1 Costs of Intervention 1

The Government of Vanuatu has identified five priority sites for solar PV micro grid implementation. When selecting these sites, the following criteria were applied:

- the intervention aligns well with objectives under the NERM and the Priorities and Action Agenda (PAA);
- it aligns with the Government of Vanuatu's priorities on providing affordable and sustainable access to energy for off-grid communities;
- it will connect rural off-grid communities with clusters of households in need of energy services;
- the interests of local governments in supporting the implementation of the projects will be satisfied;
- it offers good potential for income generating opportunities; and
- it fosters equitable distribution among different islands.

The following table summarizes the relevant information on each of the five priority sites:

Table 18. Micro grid Pilot Sites

Province Name	Tafea	Tafea	Malampa	Penama	Tafea
Island	Tanna	Tanna	Malekula	Pentecost	Aniwa
Area Council	Whitesands	Whitesands	North West Malekula	Central Pentecost	South Aniwa
Village Name	Ipikel	Ipkangien	Unmet + Uri	Loltong	Ikaukau
Population serviced	358	127	662	237	125
No. of households	61	27	130	51	29

Province Name	Tafea	Tafea	Malampa	Penama	Tafea
Potential income generating activities	Coastal Fishing, Tourism, Handicrafts, Agricultural Produce (Peanuts, Coffee and Cocoa)	Coastal Fishing, Tourism, Handicrafts, Agricultural Produce (Peanuts, Coffee and Cocoa)	Coastal Fishing, Tourism, Agricultural Produce (Kava, Copra, Logging)	Coastal Fishing, Tourism, Women's Handicrafts Association, Agricultural Produce (Kava, Copra, Logging)	Coastal Fishing, Tourism, Handicrafts, Agricultural Produce (Orange Juice)
Other facilities connected	Health Centre, Dispensaries, Church, Schools, Shops, Cooperatives, Private Enterprises	Health Centre, Dispensaries, Church, Schools, Shops, Cooperatives, Private Enterprises	Health Centre, Dispensaries, Church, Schools, Shops, Cooperatives, Private Enterprises	Health Centre, Dispensaries, Church, Schools, Shops, Cooperatives, Private Enterprises	Dispensaries, Church, Schools, Shops, Cooperatives, Private Enterprises
Source of energy	Solar PV	Solar PV	Solar PV	Solar PV	Solar PV
Backup system	Battery and/or Diesel	Battery and/ or Diesel	Battery and/or Diesel	Battery and/or Diesel	Battery and/or Diesel
Installed capacity	34.5 kW	22.2 kW	62.1 kW	28.5 kW	26.7 kW
Estimated annual consumption	49 MWh	31 MWh	88 MWh	40 MWh	38 MWh
Investment costs (US$)	423,528	260,403	782,500	349,726	309,088

In Annex 1 maps for each of the five pilot micro grids can be found. The detailed calculations for estimated installed capacity and cost can be found in Annex 3. Calculations of required installed capacity and estimated annual consumption are based on a calculation model provided by Grue + Hornstrup.[33] Cost estimates are based on figures provided in the SREP Investment Plan and the ADB feasibility study under the energy access project (ADB, 2013), which assume an average of US$10,500 for each installed kW of solar PV. These costs include all components necessary for a micro grid, such as solar PV unit, batteries and micro grid. For connecting households, costs are calculated at USS 1,000 per household for connection and basic wiring costs.

Based on the cost estimates for each of the five pilot micro grids, total investment costs will be US$2.1 million.

33 Grue + Hornstrup A/S (www.g-h.dk).

7.2 Costs of Intervention 2

The Government of Vanuatu has identified five priority sites for grid extension. When selecting these sites, the following criteria were applied:

- the intervention aligns well with objectives under the NERM and the PAA;
- it aligns with the Government of Vanautu's priorities on providing affordable and sustainable access to energy for off-grid communities;
- it will connect rural off-grid communities with clusters of households in need of energy services;
- the interests of local governments in supporting the implementation of the projects will be satisfied;
- it offers good potential for income generating opportunities; and
- it fosters equitable distribution among different islands.

The following table summarizes the relevant information on each of the five potential sites:

Table 19. Grid Extension Pilot Sites

Province Name	Penama	Torba	Tafea	Sanma	Penama
Island	Ambae	Banks	Tanna	Santo	Maweo
Area Council	East, Lolowai to St Patrick's College (2 km)	Vanua Lava, Sola to Mosina (4 km)	Lowkotai, Launapkamei, Lenasiliang, Lownel Apen, Leninik (5 km)	Belchief Point to Matanras (21 km)	Nasawa to Vonda (3 km)
Name of grid operator	Penama Provincial Government	Torba Provincial Government	UNELCO	VUI	Talise Community
To be connected	Secondary school & junior college	10 Communities	10 Communities	12 Communities	2 Communities
Population serviced	500	400	700	1,500	80
No of households	45	100	200	350	20
Potential income generating activities	Power to school & junior college facilities including computer labs and staff quarters	Coastal Fishing, Tourism, Agricultural Produce (Coconut, Coffee and Cocoa)	Coastal Fishing, Tourism, Handicrafts, Agricultural Produce (Peanut, Coffee and Cocoa)	Cattle Farms, Coastal Fishing, Tourism, Agricultural Produce (Coconut, Tropical Fruits)	Tourism, Agricultural Produce (Kava and Coffee)

Province Name	Penama	Torba	Tafea	Sanma	Penama
Other facilities connected	Church	Health Centre, Dispensaries, Church, Schools, Shops, Cooperatives, Private Enterprises	Health Centre, Dispensaries, Church, Schools, Shops, Cooperatives, Private Enterprises	Health Centre, Dispensaries, Church, Schools, Shops, Cooperatives, Private Enterprises	Health Centre, Dispensaries, Church, Schools, Shops, Cooperatives, Private Enterprises
Additional capacity connected (kW)	60.9	67.2	107.9	210.3	18.1
Estimated Investment costs for Grid Extension (US$)[34]	95,000	200,000	325,000	875,000	95,000

In Annex 1 maps for each of the five grid extension can be found. The detailed calculations for the estimates of the installed capacity and cost can be found in Annex 3<OK>. Calculations of required installed capacity and estimated annual consumption are based on a calculation model provided by Grue + Hornstrup.[35] Cost estimates are based on figures provided in the ADB feasibility study under the energy access project SREP Investment Plan (ADB, 2013), which assume an average of US$25,000 for each kilometre of grid extension. This includes costs for grid extension, but not for additional capacity (all potential sites have sufficient additional generation capacity to supply the envisaged additional number of consumers). For households, the estimated costs are US$1,000 per household for connection and basic wiring costs.

Based on the cost estimates for each of the five pilot micro grids, total investment costs will be US$1.6 million.

7.3 The Stabilization Fund

In Vanuatu there is an existing tariff system, in which tariffs are calculated based on costs. This tariff system will be applied in both the micro grids and the grid extensions. As the NAMA interventions are focused on rural areas, there is a risk that consumers (households, companies, institutions) will not have sufficient financial capacity to cover their electricity bills. This risk is especially valid in the first phase of NAMA implementation, when households for example might face difficulties in budgeting for their future electricity bills and new companies for example will still be struggling to set up their operations and will need funds for buying machines or procuring raw materials. A lack of capacity on the part of consumers to pay for the operating <?>costs could lead to serious financial problems for the operators of the micro grids and grids.

34 Based on an average cost of US$25,000/km of grid extension based on ADB feasibility study for grid extension in Santo.
35 Grue + Hornstrup A/S (www.g-h.dk).

To overcome these problems, a Stabilization Fund will be established. The Stabilization Fund will support consumers in the early phases of NAMA implementation by providing funds to pay electricity bills. Money will be pledged to the Stabilization Fund by NAMA donors and the Government of Vanuatu. A fund size of US$ 700,000 is recommended; the fund will be managed by the NCA.

The fund will operate as follows.

- Consumers will apply to the NCA for money from the Stabilization Fund. The application will be based on a simple template (to be elaborated by the NCA) including the following information:
  - Name of applicant;
  - Contact details;
  - Services requested (lighting, phone charging, radio, etc.);
  - Income situation;
  - Requested support.
- The support given by the Stabilization Fund will be for a maximum of 50 per cent of monthly electricity costs over a maximum of three years.
- The aim of the Stabilization Fund is to support only those consumers who do not have the financial means to pay for basic electricity services.
  - For households, these basic services are lighting, phone charging and radio. No support will be given for additional services, such TVs or computers.
  - For income-generating activities, only newly founded companies/activities will be eligible for support.
- Decisions on each application will be made by the NCA.

If sufficient funding is available in the Stabilization Fund, support can be extended from the first 10 projects to further projects implemented in the two interventions.

Funding for the Stabilization Fund will be from both the NAMA donor and the Government of Vanuatu. For the initial US$700,000, the contribution of the NAMA donor will be US$600,000, with the Government of Vanuatu contributing the remaining US$100,000.

It is envisaged that the fund will support the interventions for up to six years (depending on necessity). The initial funding of US$700,000 will support the operation of the interventions for at least three years. After three years, the fund will be reassessed. If further funding is required, the Government of Vanuatu will either provide additional funds or will make sure that donors replenish Stabilization Fund to secure funding for the remaining three years.

7.4 Capacity Development and NAMA Operating Costs

In order for the NAMA to be successfully implemented, capacity development needs must be met through the provision of capacity-building activities and additional personnel must be hired for the management of the NAMA. Most of the capacity-building activities will be provided in the first three years of NAMA implementation, which are seen as the critical phase.

The following additional positions will be created for management of the NAMA:

- NAMA Team Leader: oversees the implementation of the NAMA programme;
- Micro grid expert: is responsible for the implementation of Intervention 1 (micro grids);
- Grid extension expert: is responsible for the implementation of Intervention 2 (grid extension);
- Technical expert: supports the implementation of the two interventions in technical matters.

All these positions will be created in the NIE. To create and increase the capacity of the staff to be hired, international experts will be involved in the first phase of the NAMA. The positions that will need to be filled by international experts are those of NAMA expert and rural electrification expert.

Their task will be to increase the capacity of the NAMA implementation team.

The following table gives an overview of the costs associated with capacity development and the operation of the NAMA. The table shows costs for the first three years (per year and the total over years 1-3) and also indicates the likely costs for the further operation of the NAMA in years 4-5. In this NAMA document, especially for NAMA financing, only the costs in years 1-3 are considered.

Table 20. Capacity Development and NAMA Operational Costs

				Year 1		Year 2		Year 3		Year 4-5		Total
No	Cost component	Units	Unit rate	No of units	Costs	No of units	Costs	No of units	Costs	No of units	Costs	Year 1-5
1	Human Resources											
1.1	Local Salaries/Consultants											
	NAMA Team Leader	Month	2,200	12	26,400	12	26,400	12	26,400	24	52,800	132,000
	Mini grid expert	Month	1,200	12	14,400	12	14,400	12	14,400	24	28,800	72,000
	Grid extension expert	Month	1,200	12	14,400	12	14,400	12	14,400	24	28,800	72,000
	Technical expert	Month	1,200	12	14,400	12	14,400	12	14,400	24	28,800	72,000
1.2	International Salaries/Consultants											
	NAMA Expert	Month	12,000	12	144,000	12	144,000	6	72,000	12	144,000	504,000
	Rural electrification expert	Month	10,000	12	120,000	12	120,000	6	60,000			300,000
	Subtotal Human Resources				333,600		333,600		201,600		283,200	1,152,000
2	Travel											
2.1	International travel	Flight	2,000	5	10,000	5	10,000	5	10,000	5	10,000	40,000
2.2	National travel	Travel	200	15	3,000	15	3,000	15	3,000	20	4,000	13,000
2.3	Per diems											
2.3.1	Abroad	Per diem	150	15	2,250	15	2,250	10	1,500	20	3,000	9,000
2.3.2	Local	Per diem	100	40	4,000	40	4,000	30	3,000	50	5,000	16,000
	Subtotal travel				19,250		19,250		17,500		22,000	78,000
3	Equipment											
3.1	Furniture, computer equipment	Place	2,500	6	15,000							15,000
	Subtotal equipment				15,000							15,000
4	Local office											
4.1	Office rent	Month	800	12	9,600	12	9,600	12	9,600	12	9,600	38,400
4.2	Consumables	Month	200	12	2,400	12	2,400	12	2,400	12	2,400	9,600
4.3	Other services (tel/fax, electricity,...	Month	200	12	2,400	12	2,400	12	2,400	12	2,400	9,600
	Subtotal local office				14,400		14,400		14,400		14,400	57,600
5	Other costs services											
5.1	Publications				5,000		5,000		5,000			15,000
5.2	Feasibility studies mini grids	Project	50,000	3	150,000	2	100,000					250,000
5.3	Expenditure verification				10,000				10,000		10,000	30,000
5.4	Costs of conferences/seminars											
	NAMA Launch Event				5,000							5,000
	NAMA Awareness Raising Events	Event	1,000	4	4,000	4	4,000	2	2,000			10,000

				Year 1		Year 2		Year 3		Year 4-5		Total
No	Cost component	Units	Unit rate	No of units	Costs	No of units	Costs	No of units	Costs	No of units	Costs	Year 1-5
5.5	Website/marketing material											
	Website/website management				2,000		1,000		1,000		1,000	5,000
	Marketing materials				6,000		3,000		3,000		3,000	15,000
	Subtotal other costs services				182,000		113,000		21,000		14,000	330,000
	Contingency (5%)				28,213		24,013		12,725		16,680	81,630
	Project administration (5%)				28,213		24,013		12,725		16,680	81,630
	Total Costs				620,675		528,275		279,950		366,960	1,795,860

7.5 National and International Finance

Financial flows and management are a cornerstone of any NAMA, as they tie together many of the main NAMA components. In the context of this NAMA, the main focus will be on how to build and integrate a reliable and transparent structure of financial governance into the NAMA and how to manage the financial flows and the controls required to ensure a sustainable use of funds. The basis of this NAMA is a co-financed effort between the Government of Vanuatu and international partners/NAMA donors. Therefore, this NAMA considers two primary tracks of finance, national finance and international finance.

National Finance: For the purpose of this NAMA, national finance is defined as financial flows or capital directly influencing the ventures and incentives designed under the NAMA, and which are within the operational control of the national Government. In this NAMA, it is proposed that national finance will include the following financial flows:

- The Government of Vanuatu will contribute:
  - 10 per cent of investment costs as investment support to Intervention 1;
  - local salaries, national travel costs, equipment and office costs for capacity-building (as already described in the previous section);
  - an initial US$100,000 for the Stabilization Fund and additional funds, if required;
- payments received from consumers (both households and companies); and
- payments received from the operators of the micro grids and grid extensions.

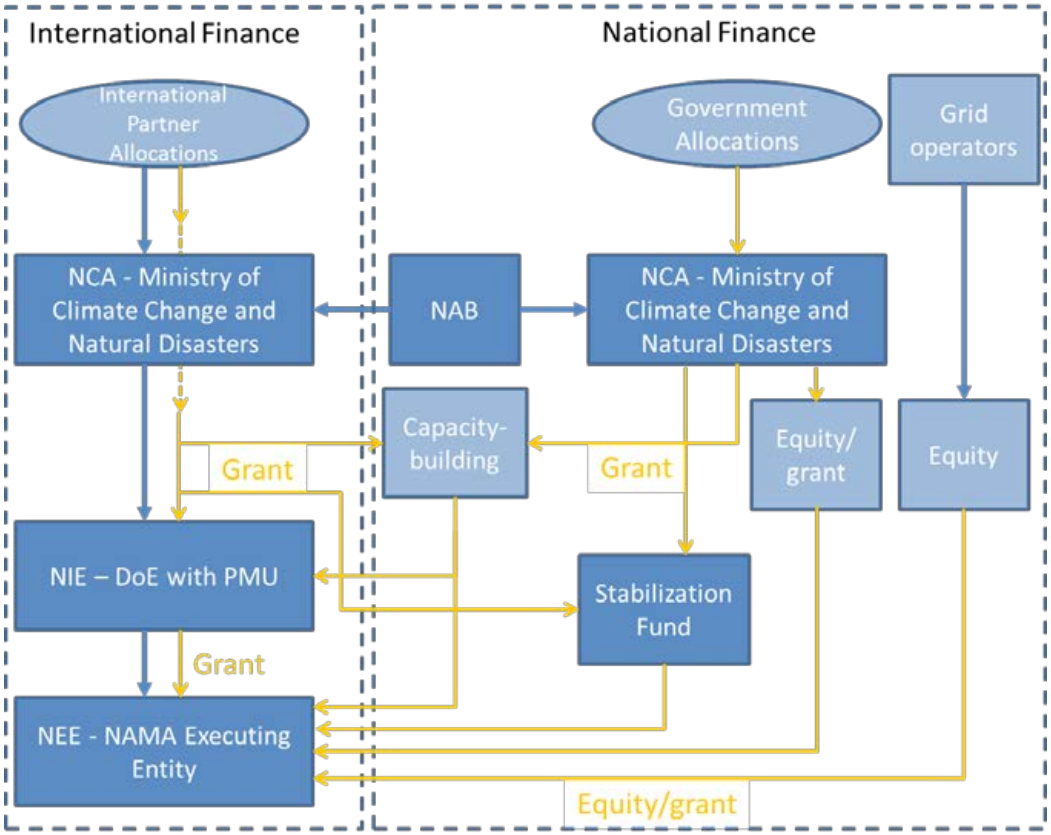
International Finance: For the purpose of this NAMA, international finance is defined as financial flows or capital directly influencing the interventions designed under the NAMA and which originate from and are controlled by international partners (consisting of multilateral financing institutions and/or multilateral/bilateral programmes). The NAMA donor(s) is/are expected to contribute:

- 90 per cent of the investment costs of Intervention 1 as investment support;
- 100 per cent of the investment costs of Intervention 2 as investment support;
- US$600,000 for the Stabilization Fund;
- the majority of funding for capacity-building (mainly covering the cost of international experts, international travel, feasibility studies and verification).

For each of the tracks of finance, there are two components: 1) the management and governance of capital and 2) the disbursement of funds. This means that there must be established bodies to provide for strategy, oversight and governance, implementation and operation. Figure 15 is a flow chart showing the flow of funds from both sources.

Since the NAMA is based on the principle of Output Based Aid (OBA), it is very important that the expectations of the NAMA stakeholders and their outputs are clearly and realistically defined at the start of NAMA implementation. There should be some flexibility in budgeting and in the completion of outputs, taking into account overall performance as well as minimum performance.

Figure 15. Flow Chart of National and International Finance



International contributions will be directly channeled to the NIE. Part of the money will be given as grants to NEEs, part will be used for capacity-building. National financing will contribute through equity and grants to financing the investments of NEEs and supporting capacity- building efforts. Private sector players (national or international) will contribute with equity to the financing of NEE activities.

Based on the cost estimates for Intervention 1 (see section 8.1), Intervention 2 (see section 8.2) and capacity-building (see section 8.4), the following table gives an overview of total NAMA implementation costs as well as the contribution of national and international sources.

For Intervention 1 it is assumed that the average grant requested for each of the mini grids is 90 per cent, leaving 10 per cent to be financed by the Government of Vanuatu. The entire grant component is supposed to come from the NAMA donor(s).

For Intervention 2 it is assumed that the average grant requested for each of the grid extensions is 70 per cent, leaving 30 per cent to be financed by the grid operators. The entire grant component is supposed to come from the NAMA donor.

In the capacity development and NAMA operating cost component, the Government of Vanuatu is assumed to be able to contribute funding to cover local salaries, national travel costs, equipment and office costs. The remainder is assumed to be financed by the NAMA donor.

Table 21. Cost Contributions to NAMA Financing (US$)

	Vanuatu Government	Private sector	NAMA donor(s)
Intervention 1	210,000	—	1,890,000
Intervention 2	—	320,000	1,280,000
Capacity Development and NAMA Operating Costs	449,600	—	1,346,460
Total	659,600	320,000	4,516,460

8 NAMA Measurement, Reporting and Verification

As a NAMA is an instrument of output based aid, the results of implemented NAMAs need to be amenable to Measurement, Reporting and Verification (MRV) in order to to attract donors and to guarantee the sustainable success of the interventions.

The methodology for monitoring the effects of NAMAs needs to follow the general principles of transparency, consistency, comparability, completeness and accuracy. This applies to all the components to be monitored. The objective of the MRV framework is to provide a credible and transparent approach for quantifying and reporting GHG emission reductions.

An MRV framework includes the following elements:

1. *System boundary definition*
   The system boundary encompasses significant anthropogenic GHG emissions by sources under the control of the project participant that are reasonably attributable to the NAMA intervention as a project activity.
2. *Baseline scenario*
   The baseline scenario is the scenario for a project activity that reasonably represents the anthropogenic emissions by sources of GHG that would occur in the absence of the proposed project activity, i.e. the NAMA intervention.
3. *Project activity scenario*
   The project activity scenario is a NAMA intervention¾in this instance a micro grid or grid extension¾and the related anthropogenic emissions by sources of GHG that occur due to the project activity.
4. *Emissions reduction calculation*
   The GHG emissions reduction achieved by the project activity will be determined as the difference between the baseline emissions and the project emissions.
5. *Monitoring*
   Defines the parameters to be monitored.
6. *Reporting and verification*
   Defines the reporting requirements and verification procedures.

8.1 Measurement and Monitoring of GHG Emission Reductions

The GHG emission reductions which will be achieved by the NAMA interventions micro grid or grid extension are calculated by comparing actual (project) emissions with the emissions under a baseline scenario. The MRV, including GHG emission calculation, for the NAMA interventions—Intervention 1 (micro grids) and Intervention 2 (grid extension)—are given in detail in the next section.

8.1.1 MRV in NAMA Intervention 1 – Micro Grids

Assumption:

A micro grid is characterized by short distances between the source of electricity generation and electricity consumer, thus the grid losses are minor and can be neglected. All the generated electricity under the NAMA intervention will be consumed, thus the generated electricity is equal to the consumed electricity.

System boundary:

The project activity is defined by the intervention of a micro grid, thus the project boundary encompasses the micro grid, the source of electricity generation and the consumer of the electricity. The next figures show the system boundary under the baseline perspective and under project activity perspective.

Figure 16. System Boundary – Baseline Scenario Micro Grid

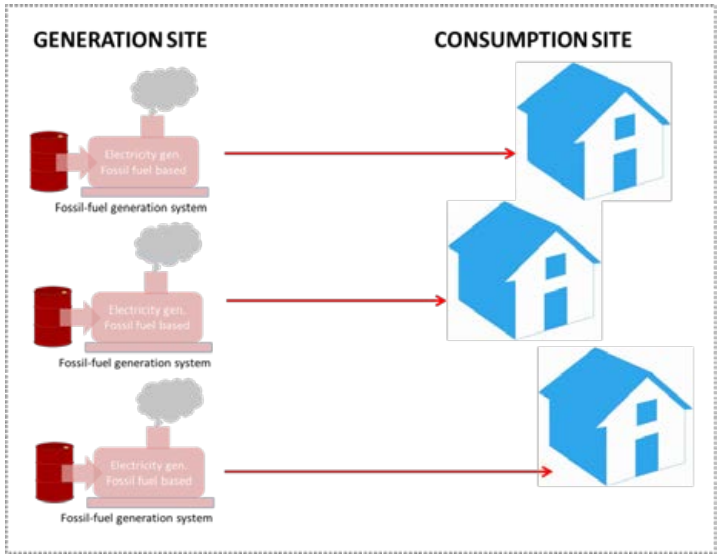
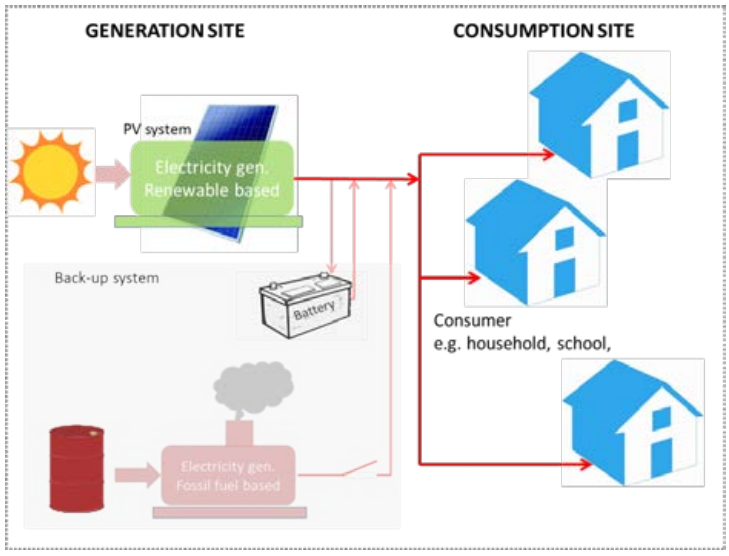


Figure 17. System Boundary – Project Scenario Micro Grid



Overview of emission reduction calculation:

The avoided GHG emissions due to the NAMA intervention are calculated:

$$ER_y = \sum_{R=1}^{n} EG_{R,y} * EF_{CO2}$$

Where:

Parameter	Description	Unit
ER_y	Emission reductions over the time period y	tCO_2e
$EG_{R,y}$	Electricity generated and delivered by renewable electricity generation system ***R*** to the micro grid connected consumer over time ***y***.	MWh
R	Renewable energy system, where the electricity generated and delivered to connected consumer of the micro grid over time y.	-
N	Total number of renewable energy systems, where the electricity generated and delivered to connected consumer of the micro grid over time y.	-
EF_{CO2}	Fossil fuel emission default factor=1.0 tCO_2/MWh	tCO_2/MWh
Y	Period of time defined by the project participant	-

The details of the calculation approach will be given in the following sections.

Baseline emission scenario:

In absence of the NAMA Intervention 1—micro grid including electricity generation systems as project activity, the generated electricity would rely on fossil fuel based off-grid electricity generation systems only.

A fossil fuel based off-grid electricity generation system, such as a diesel generator, emits carbon dioxide into the atmosphere due to the fossil fuel combustion within the motor, which drives the generator to produce electricity. Therefore the generated electricity is directly linked to carbon dioxide (CO_2) emissions that can be expressed as the emission factor (tCO_2/MWh).

Following the UNFCCC Small-scale Methodology AMS-I.L "Electrification of rural communities using renewable energy" Version 03.0, a default emission factor of 1.0 t CO_2/MWh will be applied for fossil fuel based generated and consumed electricity.

The baseline emissions are calculated as follows:

$$BE_y = \left(\sum_{R=1}^{n} EG_{R,y} + \sum_{F=1}^{m} EG_{F-Baseline,y} \right) * EF_{CO2}$$

Where:

Parameter	Description	Unit
BEy	Baseline emissions over time period y	tCO_2
$EG_{R,y}$	Electricity generated and delivered by renewable electricity generation system ***R*** to the consumer over time ***y***.	MWh

Parameter	Description	Unit
$EG_{F\text{-}Baseline,y}$	Electricity generated and delivered by fossil fuel based electricity generation system ***F*** to the consumer over time ***y***.	MWh
R	Renewable energy system, where the electricity generated and delivered to the connected consumer over time y.	-
F	Fossil fuel based energy system (backup), where the electricity generated and delivered to the connected consumer over time y.	-
N	Total number of renewable energy systems, where the electricity generated and delivered to the connected consumer over time y.	-
M	Total number of fossil fuel based energy systems (backup), where the electricity generated and delivered to the connected consumer over time y.	-
EF_{CO2}	Fossil fuel emission default factor = 1.0 tCO_2/MWh	tCO_2/MWh
Y	Period of time defined by the project participant	-

Project emission scenario:

The project activity is presented by the micro grid including the electricity generation system(s) based on renewable sources and potentially a fossil fuel based backup system(s). Fossil-fuel backup systems are allowed; however, the share of electricity from renewable energies must be at least 75 per cent. Therefore for each monitoring period y the following condition needs to hold:

$$\sum_{R=1}^{n} EG_{R,y} * 0.75 > \sum_{F=1}^{m} EG_{F-\mathrm{Pr}oject,y}$$

Where:

Parameter	Description	Unit
$EG_{R,y}$	Electricity generated and delivered by renewable electricity generation system ***R*** to the micro grid connected consumer over time ***y***.	MWh
$EG_{F\text{-}Project,y}$	Electricity generated and delivered by fossil fuel based electricity generation backup system ***F*** to the micro grid connected consumer over time ***y***.	MWh
R	Renewable energy system, where the electricity generated and delivered to connected consumer of the micro grid over time y.	-
F	Fossil fuel based energy system (backup), where the electricity generated and delivered to connected consumer of the micro grid over time y.	-
N	Total number of renewable energy systems, where the electricity generated and delivered to connected consumer of the micro grid over time y.	-
M	Total number of fossil fuel based energy systems (backup), where the electricity generated and delivered to connected consumer of the micro grid over time y.	-
Y	Period of time defined by the project participant	-

Project emissions:

The generated electricity of the RE systems, which can be based on hydro, solar or wind as source, causes no greenhouse gas emissions. Thus the project emissions are considered to be zero.

In case of installed fossil fuel based electricity generation backup system(s) that generate and deliver electricity to the connected micro grid consumer, the project emissions are calculated as follows:

$$PE_y = \sum_{F=1}^{m} EG_{F-\mathrm{Project},y} * EF_{CO2}$$

Where:

Parameter	Desription	Unit
$PE_{,y}$	Project emissions over the time period y	tCO_2
$EG_{F\text{-}Project,y}$	Electricity generated and delivered by fossil fuel based electricity generation backup system F to the micro grid connected consumer over time y.	MWh
EF_{CO2}	Fossil fuel emission default factor = 1.0 tCO_2/MWh	tCO_2/MWh

Emission Reductions

Emission reductions are the difference between the baseline emissions and project emissions after implementing the NAMA intervention micro grid with RE system(s). Therefore:

$ER_y = BE_y - PE_y$

Where:

Parameter	Desription	Unit
ER_y	Emission reductions over the time period y	tCO_2
BE_y	Baseline emissions over the time period y	tCO_2
$PE_{,y}$	Project emissions over the time period y	tCO_2

Based on the formula given under the baseline and project emission scenario:

$$ER_y = \left(\sum_{R=1}^{n} EG_{R,y} + \sum_{F=1}^{m} EG_{F-Baseline,y} \right) * EF_{CO2} - \sum_{F=1}^{m} EG_{F-\mathrm{Project},y} * EF_{CO2}$$

The generated electricity of the fossil fuel based energy system(s) (backup) within the project scenario is equal to the baseline scenario, because in the absence of the NAMA intervention, micro grid, the consumer will use fossil fuel based electricity as backup. Therefore:

$$\sum_{F=1}^{m} EG_{F-Baseline,y} = \sum_{F=1}^{m} EG_{F-\mathrm{Project},y}$$

thus the emission reduction formula can be simplified:

$$ER_y = \sum_{R=1}^{n} EG_{R,y} * EF_{CO2} + \sum_{F=1}^{m} EG_{F-\mathrm{Pr}oject,y} * EF_{CO2} - \sum_{F=1}^{m} EG_{F-\mathrm{Pr}oject,y} * EF_{CO2}$$

$$ER_y = \sum_{R=1}^{n} EG_{R,y} * EF_{CO2}$$

Conclusion:

The emission reduction calculation due to NAMA intervention micro grid requires the following steps.

i. Applicability criteria check:
The share of electricity from renewable energies must be at least 75 per cent. Therefore for each monitoring period y:

$$\sum_{R=1}^{n} EG_{R,y} * 0.75 > \sum_{F=1}^{m} EG_{F-\mathrm{Pr}oject,y}$$

ii. Calculation of GHG emission reductions

$$ER_y = \sum_{R=1}^{n} EG_{R,y} * EF_{CO2}$$

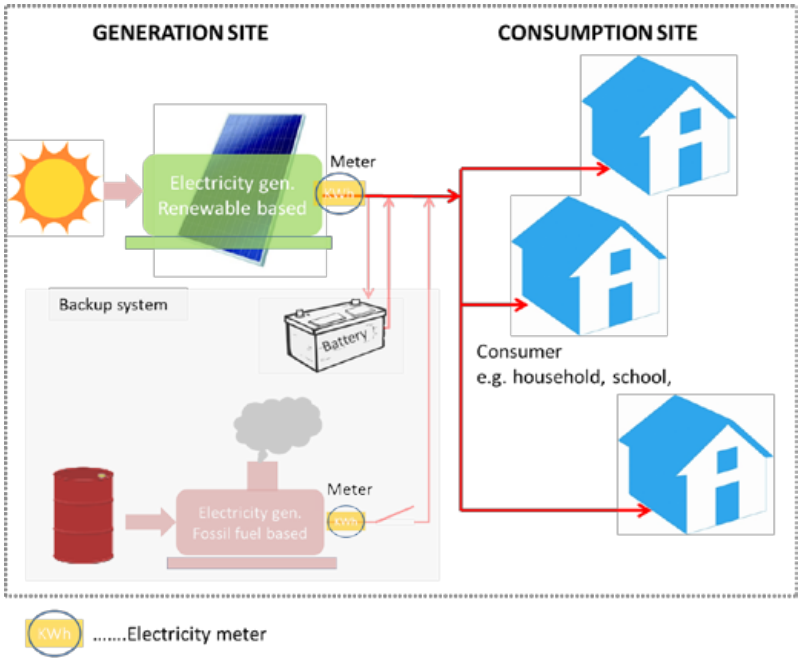
Where:

Parameter	Description	Unit
ER_y	Emission reductions over time period y	tCO_2e
$EG_{R,y}$	Electricity generated and delivered by renewable electricity generation system ***R*** to the micro grid connected consumer over time ***y***.	MWh
$EG_{F\text{-}Project,y}$	Electricity generated and delivered by fossil fuel based electricity generation backup system ***F*** to the micro grid connected consumer over time ***y***.	MWh
R	Renewable energy system, where the electricity generated and delivered to connected consumer of the micro grid over time y.	-
F	Fossil fuel based energy system (backup), where the electricity generated and delivered to connected consumer of the micro grid over time y.	-
N	Total number of renewable energy systems, where the electricity generated and delivered to connected consumer of the micro grid over time y.	-
M	Total number of fossil fuel based energy systems (backup), where the electricity generated and delivered to connected consumer of the micro grid over time y.	-
EF_{CO2}	Fossil fuel emission default factor = 1.0 t CO_2/MWh	tCO_2/MWh
Y	Period of time defined by the project participant	-

Measurement and monitoring

As all the electricity generated by the energy generation system (R, S) will be consumed by the connected micro grid consumer only the generation site needs to be monitored via electricity meter.

Figure 18. Monitoring of Generated and Consumed Electricity



Each electricity generation system R or F of the micro grid needs to be equipped with a calibrated electricity meter to monitor the generated electricity $EG_{R,y}$ or $EG_{F\text{-}Project,y}$, supplied to the consumer of the micro grid over the time y.

Therefore following monitoring parameters are relevant:

Parameter	Description	Unit
$EG_{R,y}$	Electricity generated and delivered by renewable electricity generation system *R* to the micro grid connected consumer over time *y*.	MWh
$EG_{F\text{-}Project,y}$	Electricity generated and delivered by fossil fuel based electricity generation backup system *F* to the micro grid connected consumer over time *y*.	MWh
R	Renewable energy system, where the electricity generated and delivered to connected consumer of the micro grid over time y.	-
F	Fossil fuel based energy system (backup), where electricity is generated and delivered to the connected consumer of the micro grid over time y.	-

The data meter reading of the electricity meter(s) should be recorded at least weekly by the duty operator on a data sheet. A data sheet, compiled monthly, should be stored in a safe place, including a description of the measuring instrument, its identification and calibration certificate.

In case of emergencies or conditions under which the responsible entity is not able to monitor the electricity

generation and consumption, the period of the emergency, the start of normal operation and details of the emergency should be reported.

Reporting

The GHG emission reductions achieved due to NAMA interventions should be reported by the responsible entity regularly and should include:

- a description of the calculation approach that is used to quantify GHG emissions;
- the measurement method applied and the parameters monitored;
- characteristics of the measurement instrument (type, installation date, identification, calibration);
- values of the parameters monitored, including supporting evidence (measurement records);
- identification of any uncertainty or variability associated with quantifying GHG emissions.

Table 22. Monitored GHG Parameters—Intervention 1

Data/parameter	$EGR_{,y}$
Unit	MWh
Description	Electricity generated and delivered by renewable electricity generation system R to the consumer connected to the micro grid over time y
Value	On average 50 MWh/year/micro grid
Source of data	Measured electricity generated by the micro grid
Measurement methods	Each electricity generation system of the micro grid needs to be equipped with a calibrated electricity meter to monitor the generated electricity supplied to the consumer of the micro grid

Data/parameter	$EGF\text{-}Project_{,y}$
Unit	MWh
Description	Electricity generated and delivered by fossil fuel based electricity generation backup system F to the micro grid connected consumer over time y
Value	Estimated 0 MWh/year/micro grid
Source of data	Measured electricity generated by the fossil fuel based electricity generation backup system
Measurement methods	Each fossil fuel based electricity generation backup system of the micro grid needs to be equipped with a calibrated electricity meter to monitor the generated electricity supplied to grid

8.1.2 MRV in NAMA Intervention 2 – Grid Extension

Assumption:

The extension of the existing grid to new consumers is characterized by short distances, thus the grid losses are minor and will be ignored. The calculation of the emission reductions will be based on:

- UNFCCC—Tool to calculate baseline, project and/or leakage emissions from electricity consumption—Version 1 (available from http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v1.pdf/history_view).
- UNFCCC—Tool to calculate the emission factor for an electricity system—Version 4 (available from http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-07-v4.0.pdf/history_view).

For the calculation of the grid emission factor only the operating grid emission factor will be taken into account. But the NAMA implementer can also calculate and consider the build margin for the calculation of the grid emission, in accordance with the requirements under the "UNFCCC—Tool to calculate the emission factor for an electricity system" at a later stage.

System boundary:

The NAMA intervention is defined by the extension of the existing grid and the newly connected consumers to this grid, including the existing power generation sources. The next figures show the system boundary under the baseline perspective and under project activity perspective.

Figure 19. System Boundary – Baseline Scenario Grid Extension

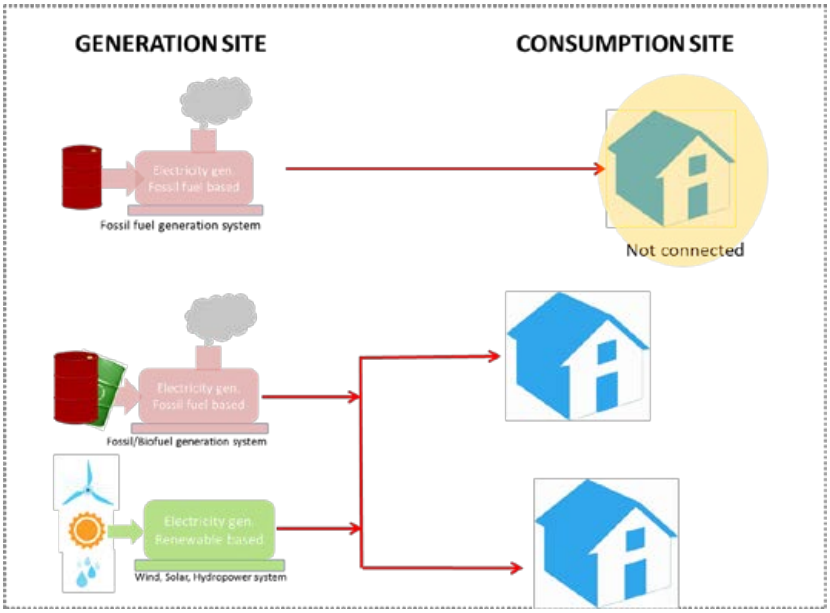
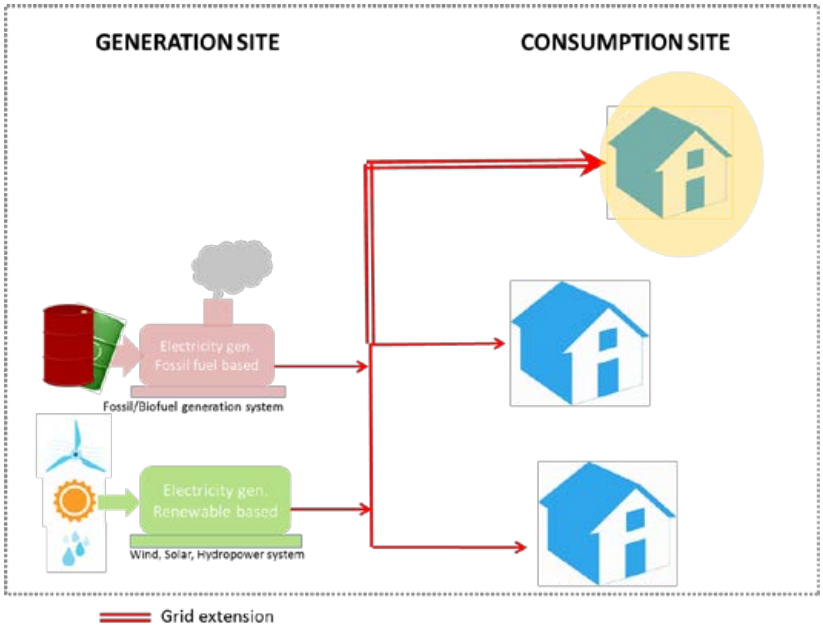


Figure 20. System Boundary – Project Scenario Grid Extension



Overview of emission reduction calculation:

The GHG emissions avoided due to the NAMA intervention are calculated as follows :

$$ER_y = \sum_{i=1}^{n} EC_{i,m,y} * \left(EFC_{CO2} - EF_{m,grid-CO2} \right)$$

Where:

Parameter	Description	Unit
ER_y	Emission reductions over the time period y	tCO_2e
$EC_{i,m,y}$	Consumed electricity, by the new consumer i, connected to the grid extension m, over the time period y.	MWh
EFC_{CO2}	Fossil fuel emission default factor for consumption= 1.3t CO_2/MWh	tCO_2/MWh
$EF_{m,grid-CO2}$	The average emission factor rate of the grid m	tCO_2/MWh
y	Period of time defined by the project participant	-

Details of the calculation approach will be given in the following sections.

Baseline emission scenario:

In absence of the NAMA Intervention 2—Grid Extension, the electricity consumed by a new consumer (e.g. household) would rely only on fossil fuel based off-grid electricity system(s) instead of a connection to an existing grid electricity generation system, including renewable and fossil fuel based electricity generation sources.

$$BE_y = \sum_{i=1}^{n} EC_{i,m,y} * EFC_{CO2}$$

Parameter	Description	Unit
BEy	Baseline emissions over the time period y	tCO_2
$EC_{i,y}$	Consumed electricity, over the time period y, by the new connected consumer i, due to grid extension m, which otherwise would consume fossil fuel based off grid electricity only.	MWh
EFC_{CO2}	Fossil fuel emission default factor for consumption=1.3[36]tCO_2/MWh	tCO_2/MWh
i	New connected consumer, due to grid extension	
m	Identified grid for extension	
y	Period of time defined by the project participant	-

Project emission scenario:

The project activity is presented by the connection of new consumers to the existing electricity grid. The project emissions are calculated as follows:

$$PE_y = \sum_{i=1}^{n} EC_{i,m,y} * EF_{m,grid-CO2}$$

Where:

Parameter	Description	Unit
$PE_{,y}$	Project emissions over the time period y	tCO_2
$EC_{i,m,y}$	Consumed electricity, by the new consumer i, connected to the grid extension m, over the time period y.	MWh
$EF_{m'grid^-CO2}$	The average emission factor rate of the grid m	tCO_2/MWh

Calculation of the average emission factor rate of the grid m:

The calculation average emission factor is based on total fuel consumption and electricity generation of the system in line with option B of the UNFCCC Tool to calculate the emission factor for an electricity system:

$$EF_{m,grid-CO2} = \frac{\sum_{j=1}^{n} FC_{j,y} * NCV_{j,y} * EF_{CO2,j,y}}{EG_y}$$

36 This value is in line with Scenario B2: Electricity consumption from an off-grid captive power plant of the UNFCCC- Tool to calculate baseline, project and/or leakage emissions from electricity consumption – Version 1 http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v1.pdf/history_view.

Parameter	Description	Unit
$EF_{m,grid\_CO2}$	The average emission factor rate of the grid m	tCO_2
$FC_{j,m,y}$	Amount of fuel type j consumed in the electricity grid m in year y (mass or volume unit)	e.g. Litre, kg
$NCV_{j,y}$	Net calorific value (energy content) of fuel type i in year y (GJ/mass or volume unit)	GJ/mass or volume unit
$EF_{CO2,j,y}$	CO_2 emission factor of fuel type j in year y	tCO_2/GJ
EG_y	Net quantity of electricity generated and delivered to the grid m by all power units in year y (MWh)	MWh
j	All fuel types combusted in power sources in the electricity grid m in year y	MWh
y	Reference year for the data vintage.	

Emission Reductions

Emission reductions are the difference between the baseline emissions and project emissions after implementing the NAMA intervention Therefore:

$ER_y = BE_y - PE_y$

Where:

Parameter	Description	Unit
ER_y	Emission reductions over the time period y	tCO_2
BE_y	Baseline emissions over the time period y	tCO_2
$PE_{,y}$	Project emissions over the time period y	tCO_2

Based on the formula given under the baseline and project emission scenario:

$$ER_y = \sum_{i=1}^{n} EC_{i,m,y} * EFC_{CO2} - \sum_{i=1}^{n} EC_{i,m,y} * EF_{m,grid-CO2}$$

the emission reduction formula can be simplified:

$$ER_y = \sum_{i=1}^{n} EC_{i,m,y} * \left(EFC_{CO2} - EF_{m,grid-CO2}\right)$$

Conclusion:

The emission reduction, due to the NAMA intervention grid extension is calculated as follows:

$$ER_y = \sum_{i=1}^{n} EC_{i,m,y} * \left(EFC_{CO2} - EF_{m,grid-CO2}\right)$$

Where:

Parameter	Description	Unit
ER_y	Emission reductions over the time period y	tCO_2e
$EC_{i,m,y}$	Consumed electricity, by the new consumer i , connected to the grid extension m, over the time period y	MWh
EFC_{CO2}	Fossil fuel emission default factor for consumption= 1.3 tCO_2/MWh	tCO_2/MWh
$EF_{m,grid-CO2}$	The average emission factor rate of the grid m	tCO_2/MWh
y	Period of time defined by the project participant	-

Measurement and monitoring

The following data or information needs to be measured and monitored.

Consumption: all consumers newly connected to the existing grid m need to be:

- equipped with an appropriate electricity meter to measure the electricity consumption of the consumer :or
- use appropriate default values for the consumption for each consumer group.[37]

Generated electricity by grid energy sources:

The energy generation sources need to be equipped with a calibrated electricity meter to monitor the net generated electricity EG_y supplied to the consumers.

Fuel input

The following information needs to be collected to determine the total emissions caused by the existing grid over the period of time y:

- identification of fuel type via delivery note or other reliable evidence;
- net calorific value (NCV) for each used fuel type, using one of the following data sources:
  - values provided by the fuel supplier's invoices
  - measurements by the project participant
  - IPCC default values at the upper limit of the uncertainty at a 95 per cent confidence interval as provided in Table 1.2 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories(IPCC, 2006).
- If the fuel supplier has only provided gross calorific value (GCV) 90 per cent of the GCV can be used to derive the NCV. The CO_2 emission factor for each fuel type used, taken from one of the following data sources;
  - values provided by the fuel supplier's invoices

37 E.g. Default electricity consumption values for different consumer groups can be found within the Gold Standard Suppressed Demand Methodology Micro-scale Electrification and Energization (http://www.goldstandard.org/wp-content/uploads/2013/05/GS-Electrification-Energization-Meth.pdf).

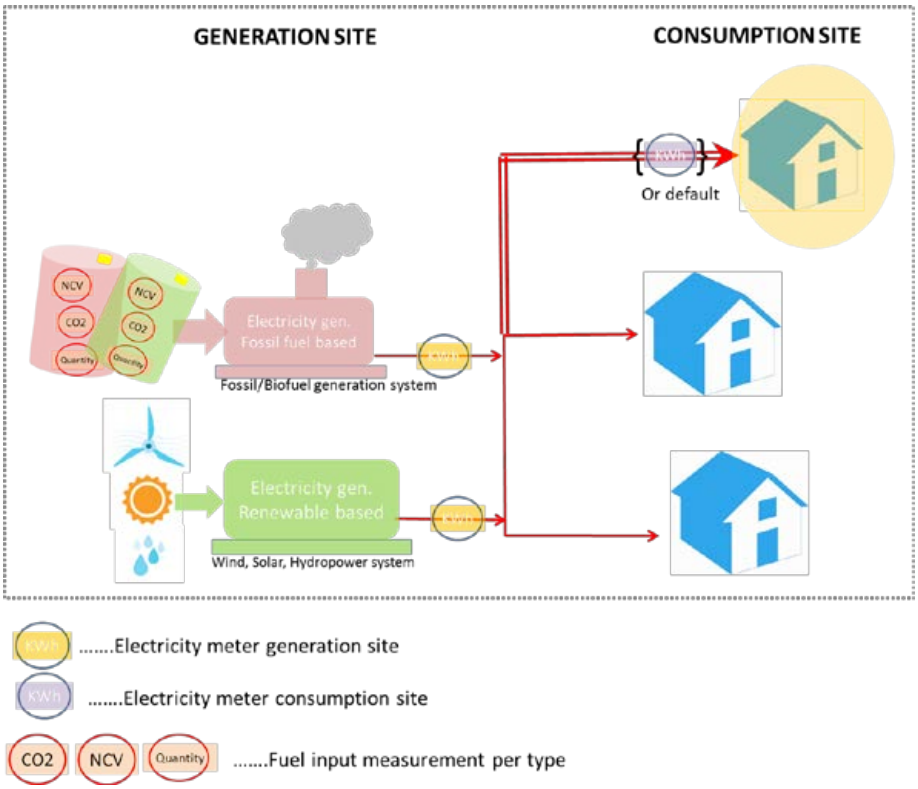
  - measurements by the project participant
  - IPCC default values at the upper limit of the uncertainty at a 95 per cent confidence interval as provided in Table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories(IPCC, 2006).
- the quantity of combusted fuel per type used for grid electricity production via delivery note, stock records or other reliable evidence.

Therefore following monitoring parameters are relevant:

Parameter	Description	Unit
$EC_{i,m,y}$	Consumed electricity, by the new consumer i, connected to the grid extension m, over the time period y. .	MWh
$EC_{j,m,y}$	Amount of fuel type j consumed in the electricity grid m in year y (mass or volume unit)	e.g. Litre, kg
$NCV_{j,y}$	Net calorific value (energy content) of fuel type i in year y (GJ/mass or volume unit)	GJ/mass or volume unit
$EF_{CO2,j,y}$	CO_2 emission factor of fuel type j in year y	tCO_2/GJ
EG_y	Net quantity of electricity generated and delivered to the grid m by all power units in year y (MWh)	MWh

The monitoring of the parameters mentioned above is illustrated in the next figure.

Figure 21. Monitoring of Generated and Consumed Electricity and Fuel Input Data



The data meter reading of the electricity meter(s) should be recorded at least weekly by the duty operator on a data sheet. A monthly data sheet should be stored in a safe place including a description of the measuring t instrument, its identification and calibration certificate.

Fuel input data, e.g. delivery notes, should be collected and stored at a centralized location.

In case of emergencies or conditions under which the responsible entity is not able to monitor the electricity generation and consumption, the period of the emergency, the start of normal operation and details of the emergency should be reported.

Table 23. Monitored GHG Parameters—Intervention 2

Data/parameter	$EC_{i,m,y}$
Unit	MWh
Description	Consumed electricity, by the new consumer i, connected to the grid extension m, over the time period y
Value	On average 130 MWh/year/micro grid
Source of data	Measured electricity consumed
Measurement methods	Consumers need to be equipped with appropriate electricity meters to measure their electricity consumption

Data/parameter	$EC_{j,m,y}$
Unit	Litre, kg, etc
Description	Amount of fuel type j consumed in the electricity grid m in year y (mass or volume unit)
Value	-
Source of data	Measured by grid operator
Measurement methods	Measured by grid operator, method depending on type of fuel

Data/parameter	$NCV_{j,y}$
Unit	GJ/mass or volume unit
Description	Net calorific value (energy content) of fuel type i in year y (GJ/mass or volume unit)
Value	-
Source of data	Values provided by the fuel supplier in invoices, measurements by the project participant or IPCC default values
Measurement methods	Depending on source of data

Data/parameter	$EFCO2_{,j,y}$
Unit	tCO2/GJ
Description	CO2 emission factor of fuel type j in year y
Value	-
Source of data	Values provided by the fuel supplier in invoices, measurements by the project participant or IPCC default values
Measurement methods	Depending on source of data

Data/parameter	EGy
Unit	MWh
Description	Net quantity of electricity generated and delivered to the grid m by all power units in year y (MWh)
Value	-
Source of data	Electricity measurements
Measurement methods	The energy generation sources need to be equipped with calibrated electricity meters to monitor the net generated electricity EGy supplied to the consumers.

8.2 Measurement and Monitoring of Sustainable Development Benefits

In addition to GHG emissions, the MRV system for this NAMA will monitor the impact of the NAMA interventions on selected Sustainable Development (SD) indicators.

The selection of the SD indicators was done using the Sustainable Development Evaluation Tool (SD Tool) developed by UNDP (UNDP, 2014c). The tool divides the SD indicators into four different domains: environment; social; growth and development; and economic.

The tool requires that for each intervention that an indicator (such as air pollution, biodiversity, health, etc.) is selected. The impact of the intervention on the chosen indicator can then be identified and explained, and the effects (positive, negative or both) pinpointed. Whether monitoring has been undertaken is also indicated.

8.2.1 Sustainable Development Benefits of Intervention 1 - Micro Grids

The indicators selected for **Intervention 1 – micro grids**, in each of the four SD domains, are as follows:

		Intervention 1		
Domain	**Indicator**	**Selected (Yes/No)**	**Identified impacts**	**Monitoring done (Yes/No)**
Environment	Air pollution/quality	Yes	Reduced indoor pollution	No
	Water pollution/quality	No		No
	Soil pollution/quality	No		No
	Others (Noise/visibility)	No		No
	Biodiversity and Ecosystem balance	No		No
	Climate change adaptation and mitigation	No		No
Social	Health	Yes	Improvement of health and health care conditions	Yes
	Livelihood of poor, poverty alleviation, peace	Yes	Poverty reduction	Yes
	Affordability of electricity	No		No
	Access to sanitation and clean drinking water	No		No
	Food security (Access to land and sustainable agriculture)	No		No
	Quality of employment	No		No
	Time savings/time availability due to project	Yes	Improved productivity and economic diversification	No
	No child labour	No		No
Growth and Development	Access to clean and sustainable energy	Yes	People less dependent on fossil fuels, having access to RE electricity	Yes
	Education	Yes	Better learning conditions	Yes
	Empowerment of women	Yes	More jobs to women	Yes
	Access to sustainable technology	No		No
	Energy security	Yes	Improved energy security	No
	Capacity-building	Yes	Increased knowledge sharing and capacity among rural communities	No
	Equality (quality of jobs given, job condition for men/women)	No		No
Economic	Income generation/expenditure reduction/Balance of payments	Yes	Enhanced productivity, efficiency, more business opportunities Expenditures for electricity	No
	Asset accumulation and investments	No		No
	Job Creation (number of men and women employed)	Yes	Job creation	Yes

Table 24. SD Indicators for Intervention 1

For the sake of simplicity, only a few indicators are to be monitored. The indicators selected are represented by the following parameters.

Table 25. Monitored SD Parameters for Intervention 1

Nr.	Parameter
1	Number of health clinics electrified
2	Number of households electrified
3	People with access to RE electricity
4	Number of schools electrified
5	Number of new women-run enterprises
6	People with new income-generating activities (businesses)
7	Number of new jobs (total)
8	Number of new jobs for women

Baseline SD scenario:

Since the NAMA targets off-grid regions of the country, the baseline values are assumed to be zero in the ex-ante estimation. However, in situations when there will be an electricity source before project implementation (e.g. diesel generator), this will be taken into account in the monitoring.

Table 26. Project SD Scenario and Targeted SD Benefits

Nr.	Parameter	Unit	Baseline value	Project value
1	Number of health clinics electrified	clinics	0	5
2	Number of households electrified	household	0	300
3	People with access to RE electricity	person	0	1,500
4	Number of schools electrified	school	0	5
5	Number of new women enterprises	enterprises	0	2
6	People with new income-generating activities (businesses)	enterprises		5
7	Number of new jobs (total)	person	0	20
8	Number of new jobs for women	women	0	10

Measurement, monitoring and reporting

The SD benefits achieved due to the NAMA interventions should be measured continuously, and reported by the responsible entity/intervention implementer regularly. Hard or soft copies of the reports should be kept at a safe

centralized point, and be archived.

Table 27. Monitored SD Parameters¾Intervention 1

Data/parameter	Number of health clinics electrified
Unit	Clinics
Description	Number of health clinics electrified by the micro grid
Value	1
Source of data	Intervention implementer´s records
Measurement methods	Micro grid connection and electricity provision contract between the intervention implementer and the clinic

Data/parameter	Number of households electrified
Unit	Households
Description	Number of households electrified by the micro grid
Value	300
Source of data	Intervention implementer´s records
Measurement methods	Micro grid connection and electricity provision contract between the intervention implementer and households

Data/parameter	People with access to RE electricity
Unit	Persons
Description	People with access to RE electricity due to the micro grid
Value	1,500
Source of data	Intervention implementer´s records, in cooperation with the local community (local census, local survey)
Measurement methods	Counting

Data/parameter	Number of schools electrified
Unit	Schools
Description	Number of schools electrified by the micro grid
Value	5
Source of data	Intervention implementer´s records

Measurement methods	Micro grid connection and electricity provision contract between the intervention implementer and the school

Data/parameter	Number of new women's enterprises
Unit	Women's enterprises
Description	Number of new companies run by women due to the micro grid
Value	2
Source of data	NAMA implementer´s records
Measurement methods	Micro grid connection and electricity provision contract between the intervention implementer and women-run businesses, and survey undertaken in cooperation with the local community

Data/parameter	New income-generating activity (enterprises)
Unit	Enterprises
Description	New income-generating activity (businesses) due to the micro grid
Value	5
Source of data	Intervention implementer´s records, in cooperation with the local community
Measurement methods	Micro grid connection and electricity provision contract between the intervention implementer and businesses, and survey undertaken in cooperation with the local community

Data/parameter	Number of new jobs (total)
Unit	Persons
Description	Number of new jobs (total) due to the micro grid
Value	20
Source of data	NAMA implementer´s records
Measurement methods	NAMA implementer´s records on number of new employees generated internally within institution and reports on numbers of new employees from intervention implementers and other relevant stakeholders

Data/parameter	Number of new jobs for women
Unit	Women
Description	Number of new jobs for women due to the micro grid
Value	10
Source of data	NAMA implementer´s records

Measurement methods	NAMA implementer´s records on number of new female employees generated internally within institution and reports on numbers of new employees from intervention implementers and other relevant stakeholders

Further details on the monitoring frequency and responsibilities can be found in the attached MS Excel sheet.

		Intervention 2		
Domain	**Indicator**	**Selected (Yes/No)**	**Identified impacts**	**Monitoring done (Yes/No)**
Environment	Air pollution/quality	Yes	Reduced indoor pollution	No
	Water pollution/quality	No		No
	Soil pollution/quality	No		No
	Others (Noise/visibility)	No		No
	Biodiversity and Ecosystem balance	No		No
	Climate change adaptation and mitigation	No		No
Social	Health	Yes	Improvement of health	No
	Livelihood of poor, poverty alleviation, peace	Yes	Poverty reduction	Yes
	Affordability of electricity	No		
	Access to sanitation and clean drinking water	No		
	Food security (Access to land and sustainable agriculture)	No		No
	Quality of employment	No		No
	Time savings/time availability due to project	Yes	Improved productivity and economic diversification	No
	No child labour	No		No
Growth and Development	Access to clean and sustainable energy	Yes	People less dependent on fossil fuels, having access to electricity	Yes
	Education	Yes	Better learning conditions	Yes
	Empowerment of women	Yes	More jobs to women	Yes
	Access to sustainable technology	No		No
	Energy security	Yes	Improved energy security	No
	Capacity-building	Yes	Increased knowledge sharing and capacity among rural communities	No
	Equality (quality of jobs given, job condition for men/women)	No		No
Economic	Income generation/expenditure reduction/Balance of payments	Yes	Enhance productivity, efficiency, more business opportunities Expenditures for electricity	no
	Asset accumulation and investments	No		No
	Job Creation (number of men and women employed)	Yes	Job creation	Yes

8.2.2 Sustainable Development Benefits of Intervention 2—Grid Extension

The indicators selected for **Intervention 2—grid extensions**, in each of the four SD domains, are as follows:

Table 28. SD Indicators for Intervention 2

For the sake of simplicity, only a few indicators are to be monitored. The indicators selected for Intervention 2 are represented by the following parameters.

Table 29. Monitored SD Parameters for Intervention 2

Nr.	Parameter
1	Number of health clinics electrified
2	Households having access to electricity services
3	People with access to electricity services
4	Number of schools electrified
5	Number of new women's enterprises
6	People with new income-generating activities (businesses)
7	Number of new jobs (total)

Baseline SD scenario:

Since the NAMA targets off-grid regions of the country, the baseline values are assumed to be zero in the ex-ante estimation. However, in situations when there will be an electricity source before project implementation (e.g. a diesel generator), this will be taken into account in the monitoring.

Table 30. Project SD Scenario and Targeted SD Benefits

Nr.	Parameter	Unit	Baseline value	Project value
1	Number of health clinics electrified	Clinics	0	5
2	Households having access to electricity services	Household	0	715
3	People with access to electricity services	Person	0	3180
4	Number of schools electrified	School	0	5

5	Number of new women's enterprises	women enterprises	0	2
6	People with new income-generating activities (businesses)	entrepreneurs	0	5
7	Number of new jobs (total)	Jobs	0	20

Measurement, monitoring and reporting

The SD benefits achieved due to the NAMA intervention should be measured continuously, and reported regularly by the responsible entity.

Hard or soft copies of the reports should be kept at a safe centralized point and be archived.

Table 31. Monitored SD Parameters—Intervention 1

Data/parameter	Number of health clinics electrified
Unit	Clinics
Description	Number of health clinics electrified by the grid extension
Value	1
Source of data	Intervention implementer´s records
Measurement methods	Micro grid connection and electricity provision contract between the intervention implementer and the clinic

Data/parameter	Households having access to electricity services
Unit	Households
Description	Number of households electrified by the grid extension
Value	715
Source of data	Intervention implementer´s records
Measurement methods	Micro grid connection and electricity provision contract between the intervention implementer and households

Data/parameter	People with access to electricity
Unit	Persons
Description	People with access to electricity due to the grid extension
Value	3,180
Source of data	Intervention implementer´s records, in cooperation with the local community (local census, local survey)
Measurement methods	Counting

Data/parameter	Number of schools electrified
Unit	Schools
Description	Number of schools electrified by the grid extension
Value	5
Source of data	Intervention implementer´s records
Measurement methods	Connection and electricity provision contract between the intervention implementer and the school

Data/parameter	Number of new women's enterprises
Unit	Women enterprises
Description	Number of new companies run by women due to the grid extension
Value	2
Source of data	NAMA implementer´s records
Measurement methods	Connection and electricity provision contract between the intervention implementer and women's businesses, and survey undertaken in cooperation with the local community

Data/parameter	People with new income-generating activities (businesses)
Unit	Entrepreneurs
Description	New income-generating activity (businesses) due to the grid extension
Value	5
Source of data	Intervention implementer´s records, in cooperation with the local community
Measurement methods	Connection and electricity provision contract between the intervention implementer and businesses, and survey undertaken in cooperation with the local community

Data/parameter	Number of new jobs (total)
Unit	Persons
Description	Number of new jobs (total) due to the grid extension
Value	20
Source of data	NAMA implementer´s records

Measurement methods	NAMA implementer´s records on number of new employees generated internally within institution and reports on numbers of new employees from intervention implementers and other relevant stakeholders

Further details on the monitoring frequency and responsibilities can be found in the attached MS Excel sheet.

8.3 Support

The support provided as part of the NAMA will also need to be measured. Support will be provided in many forms: capacity-building, technology transfer and financial. As the bulk of support will come in the form of financing, it is the financial support which should be measured.

Table 32. Monitored Support

Data / Parameter:	FSinternational
Data unit:	US$
Description:	International financial support spent per activity
Measurement procedures (if any):	All finances disbursed need to be tracked as per the standard governmental tracking procedures.
Monitoring frequency:	Measured continuously and recorded at least monthly

Data / Parameter:	FSnational
Data unit:	US$
Description:	National financial support (i.e. subsidies) spent per activity
Measurement procedures (if any):	All finances disbursed need to be tracked as per the standard governmental tracking procedures.
Monitoring frequency:	Measured continuously and recorded at least monthly

8.4 MRV Management

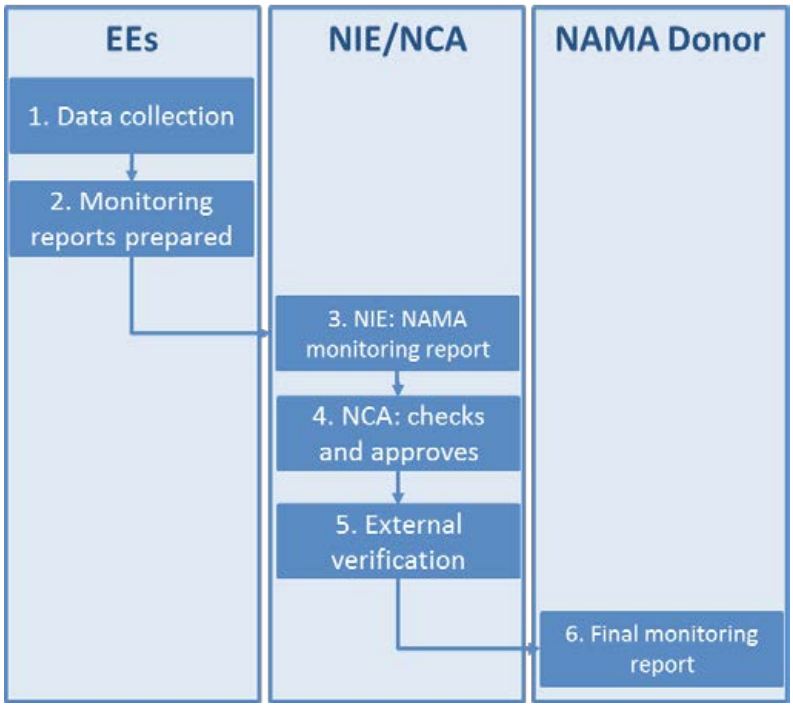
Responsibilities and process workflow

The main responsibility for the MRV system lies with the managing institution, which may delegate some of the tasks to the project implementers (PPPs, grid operators, equipment suppliers).

The process should unfold in the following sequence.

- The NEEs collect data according to the monitoring plan (as part of their approved application) and ensure they

fulfil all related requirements such as record keeping and quality control.



- The NEEs report the monitoring results to the NIE in an annual report.
- The NIE collects all monitoring reports, combines them in a central monitoring database and summarizes the results in a NAMA monitoring report.
  This report contains information on GHG emission reductions, progress in the SD indicators, and the financial performance of the NAMA activities.
- The NCA checks and approves the annual monitoring report.
- The NIE arranges for an external verification entity to verify the annual monitoring report.
- The final monitoring report together with the verification report of the external verifier is submitted to the NAMA donor(s).

The following figure illustrates the process.

Figure 22. The MRV Process

8.5 Reporting Forms

The NAMA Coordinating Authority is charged with creating reporting form templates. These forms will include at a minimum the following information:

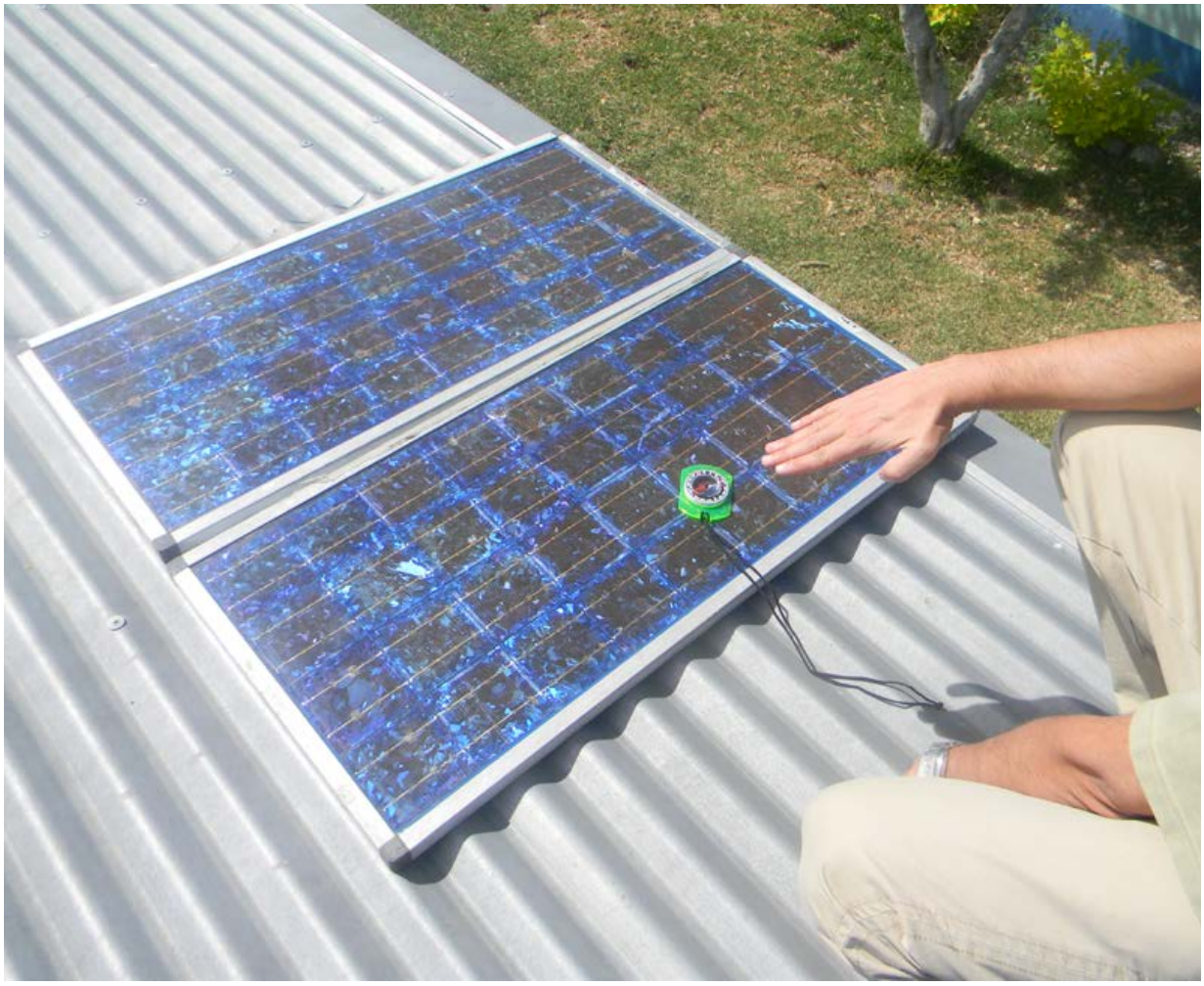
- details about the venture;
- NEE contact details;
- description of the measuring system;

- data parameters measured;
- the default values applied;
- sampling plan details; and
- calculations of emission reductions.

The reporting form template will be provided by the NAMA Coordinating Authority to the NEEs. The completed forms will be submitted annually to the NAMA Coordinating Authority by the NEEs.

8.6 Verification

The goal of verification is to have an independent third party auditor ensure that the NAMA is operating as planned and that the measuring and reporting system is being implemented as planned. The verification also ensures that emissions reductions and SD benefits are real and measurable.



38 Accredited entities are listed in CDM, 2015.

9 NAMA Implementation Plan

The implementation of the NAMA will be carried out in three main steps. As a first step, the institutional structure for NAMA implementation proposed in this document needs to be established. In parallel, funding from both international and national sources needs to be secured. Once these first two steps are finalized, implementation of the two interventions can start.

9.1 Establishing the Institutional Structure for NAMA Implementation

The institutional structure proposed in chapter 6 of this document needs to be established as a basis for the interventions. The benefit of the proposed structure is that all players already exist and no new body needs to be created. What needs to be confirmed are the roles each of the stakeholders will play.

It is suggested that implementation starts with a first meeting of the NAB, acting as a kind of supervisory board for the NAMA. It is recommended that additional stakeholders (such as grid operators) are invited to meetings of the NAB in relation to the NAMA to secure representation of key stakeholders relevant for the NAMA's implementation. In the first meeting, the distribution of roles (NAMA Approver – NA, NAMA Coordinating Authority – NCA, NAMA Implementing Entity – NIE) as well as the distribution of tasks should be confirmed. If fine-tuning is necessary, this should be discussed in the NAB.

9.2 Securing Donor Support and Domestic Funding

Early stage consultations with donors are essential for securing sufficient donor funding. Informal distribution of information on the NAMA concept should start immediately, even before a final version of the NAMA document is available. Formal approaches to potential donors should start as soon as the NAMA document is finalized.

Potential donors that already actively fund NAMAs are the German and British governments through the NAMA support facility[39], Global Environmental Facility (GEF)[40] through its executing agencies, the Green Climate Fund (GCF)[41], other EU Governments, and Japan through the Japan International Cooperation Agency (JICA)[42].

A secured budget for the domestically funded component will provide a strong signal to potential donors of a commitment to NAMA implementation. Therefore, it is essential that the domestic contributions to the interventions (co-funding of investment costs for micro grids in Intervention 1, capacity-building) are secured within the state budget.

39 http://www.nama-facility.org/start.html.
40 http://www.thegef.org/gef/.
41 http://news.gcfund.org/ .
42 http://www.jica.go.jp/english/index.html .

9.3 Implementation of Interventions 1 and 2

Once the institutional structure is in place and funding (both national and international) is secured, implementation of the interventions can start. The process of implementation will be as described in detail in sections 4.1.3 and 4.2.3. The following table gives a summary of the implementation timeline.

The timeline shows the first five years of the NAMA, the period during which there will be capacity-building support. The first five projects in each of the interventions will be prepared and implemented in the years 2016 and 2017. Upon availability of additional funding, further projects (Annex 2) can be implemented under the two interventions. There is no limitation on the number of projects implemented under each of the interventions.

Table 33. Implementation Timeline

	2015		2016				2017				2018				2019				2020	
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Establishment of Institutional Structure																				
National and International Financing																				
Intervention 1																				
Confirmation of interest of communities																				
Promotion of micro grid																				
Feasibility study																				
Discussions on cooperation and contracts																				
Project approval																				
Tender for construction																				
Announcement of tender results																				
Release of payment																				
Implementation																				
Intervention 2																				
Information to potential consumers																				
Application for connection from consumers																				
Connection Assessment																				
Financial Implications.																				
Submission of Application																				
Due Diligence of Application																				
Approval																				
Funds Disbursement																				
Implementation																				

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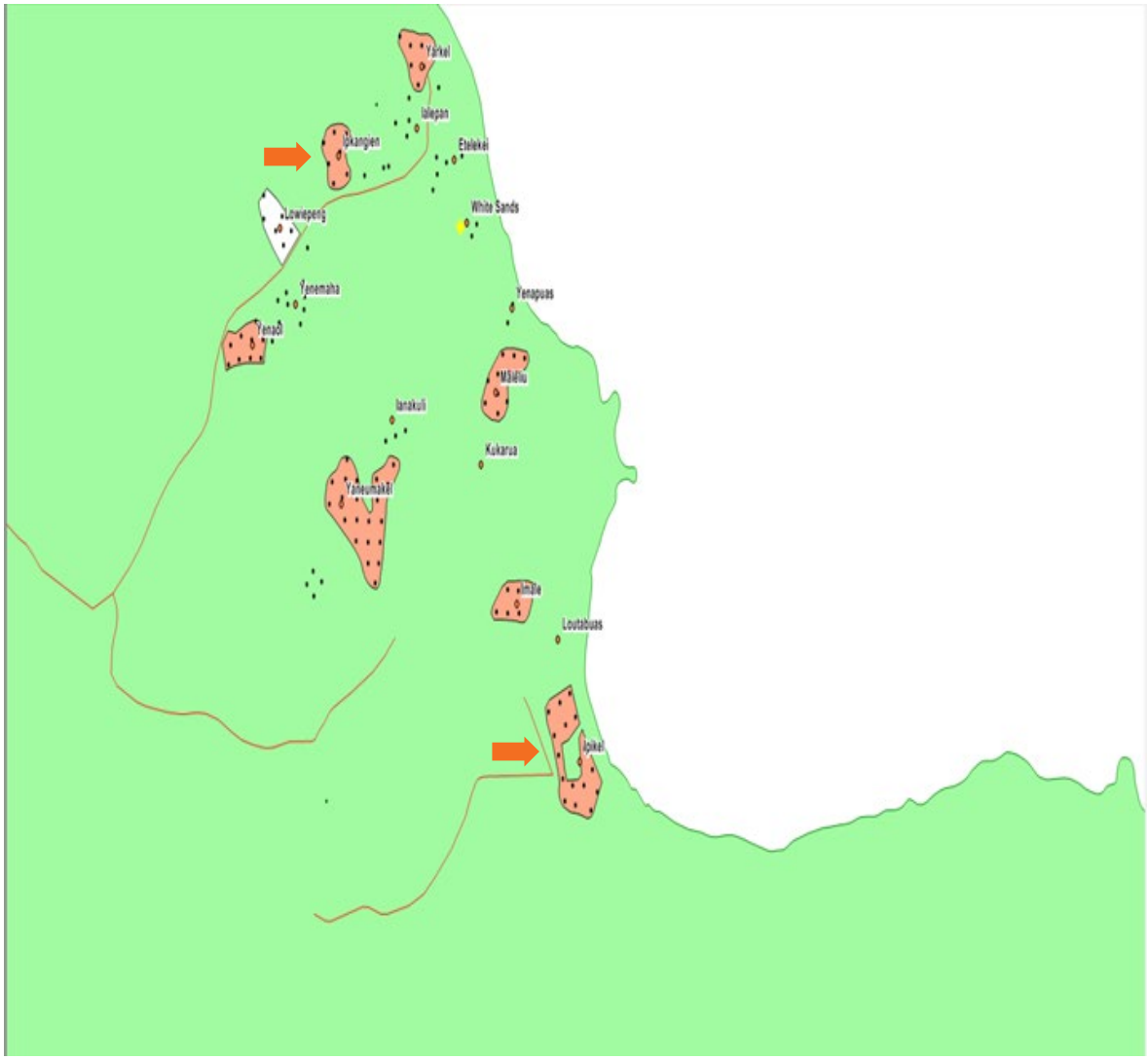
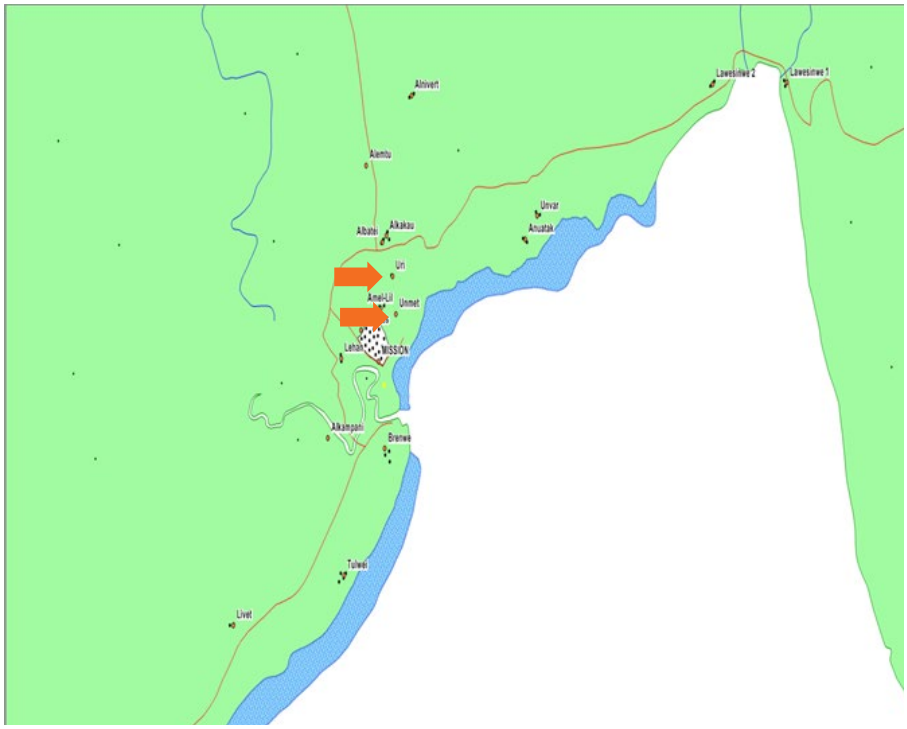
Annex 1: Maps of Proposed Project Sites

Intervention 1—Micro Grids

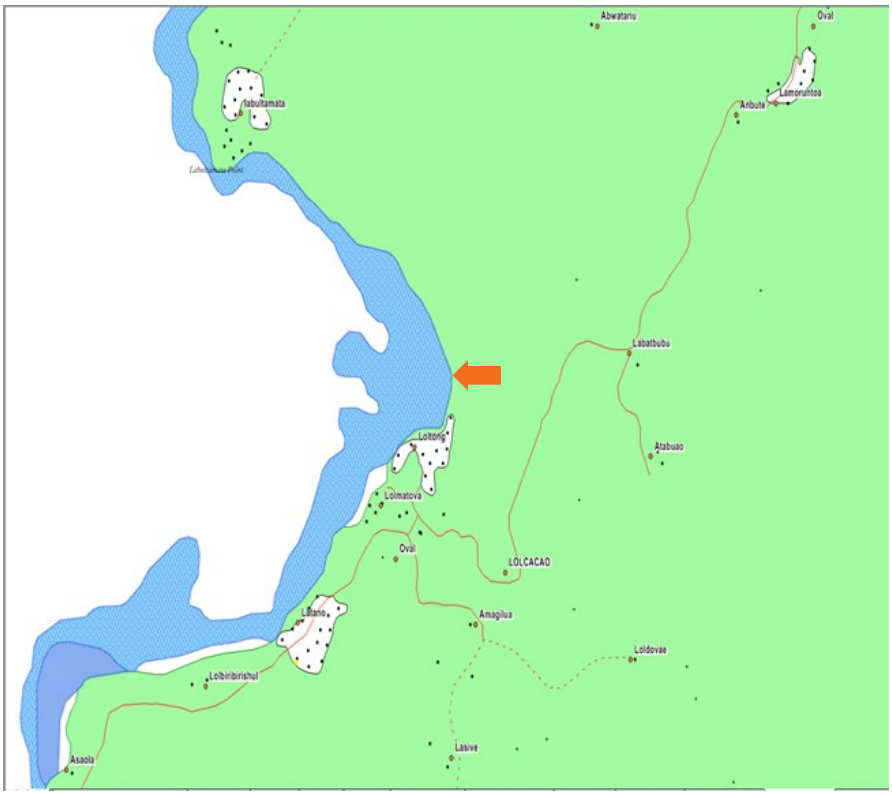
East Tanna – Solar PV Micro Grid: Council – White Sands; Villages (2 sites) – Ipikel & Ipikangein



West Malekula – Solar PV Micro Grid: Council – North West Malekula; Villages: Unmet and Uri (combined as one site)



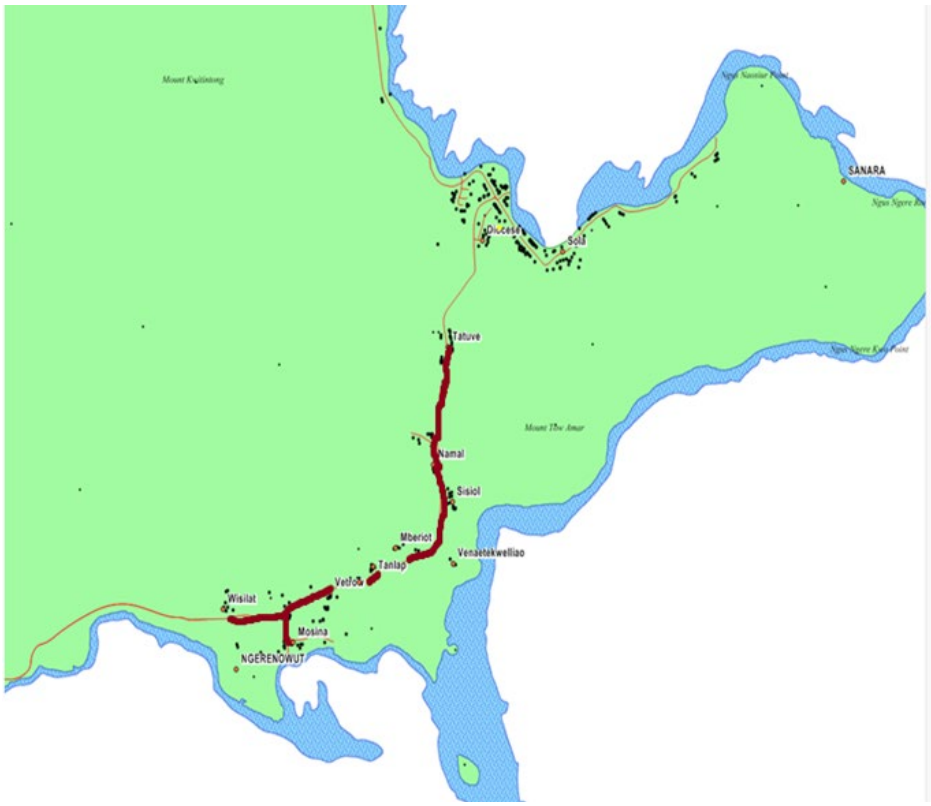
Central Pentecost– Solar PV Micro Grid: Council – Central Pentecost; Village: Loltong



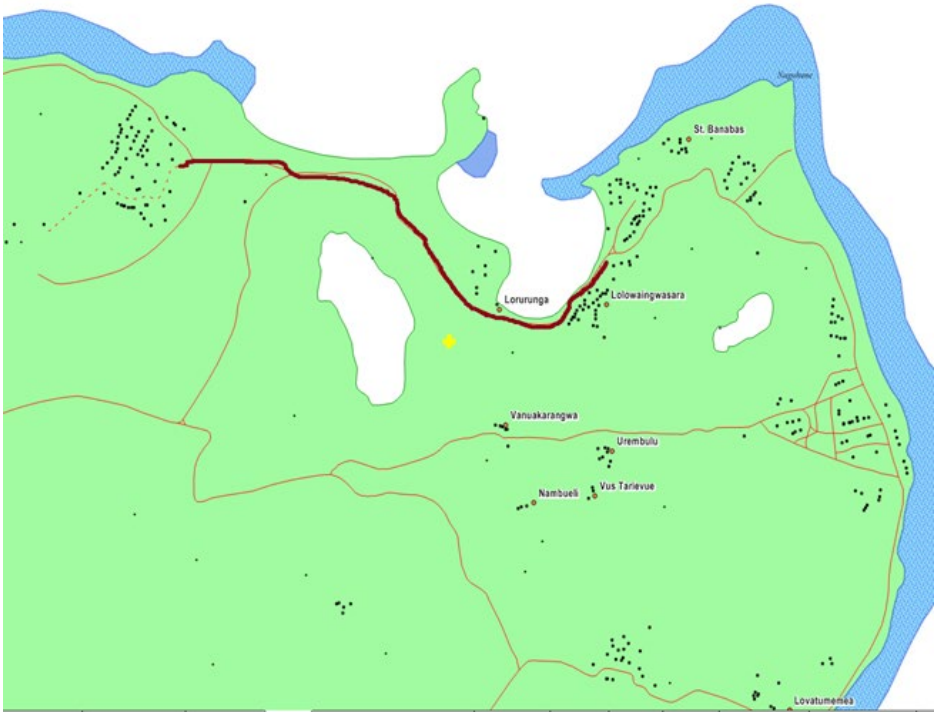
South Aniwa– Solar PV Micro Grid: Council – South Aniwa; Village: Ikaukau

Intervention 2—Grid Extension

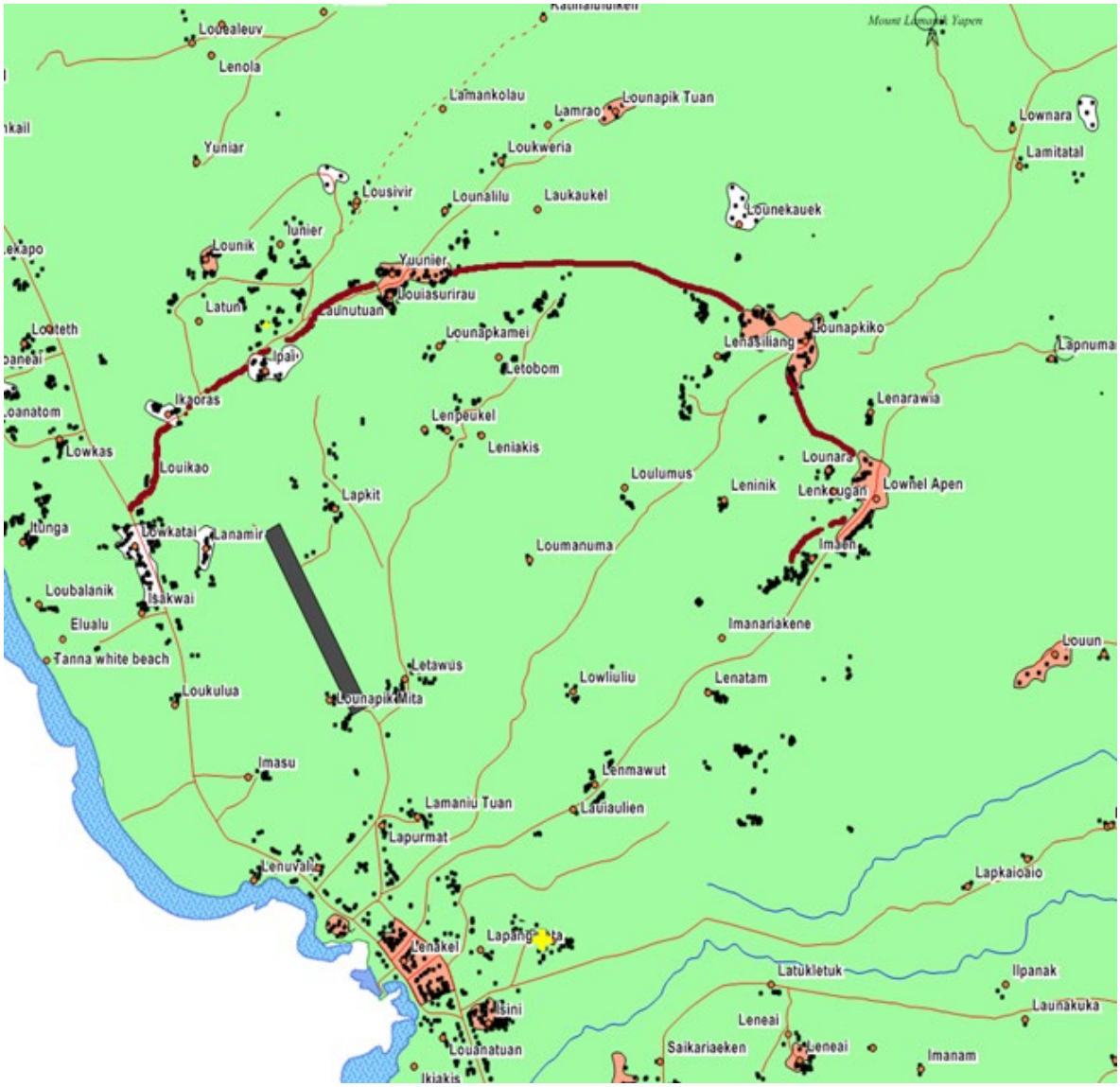
Banks Coverage: Grid Extension - Vanua Lava Island (Sola to Mosina) - Estimated distance 4 km



East Ambae coverage: Grid Extension - East (Lolowai to St Patrick's College) - Estimated distance 2 km

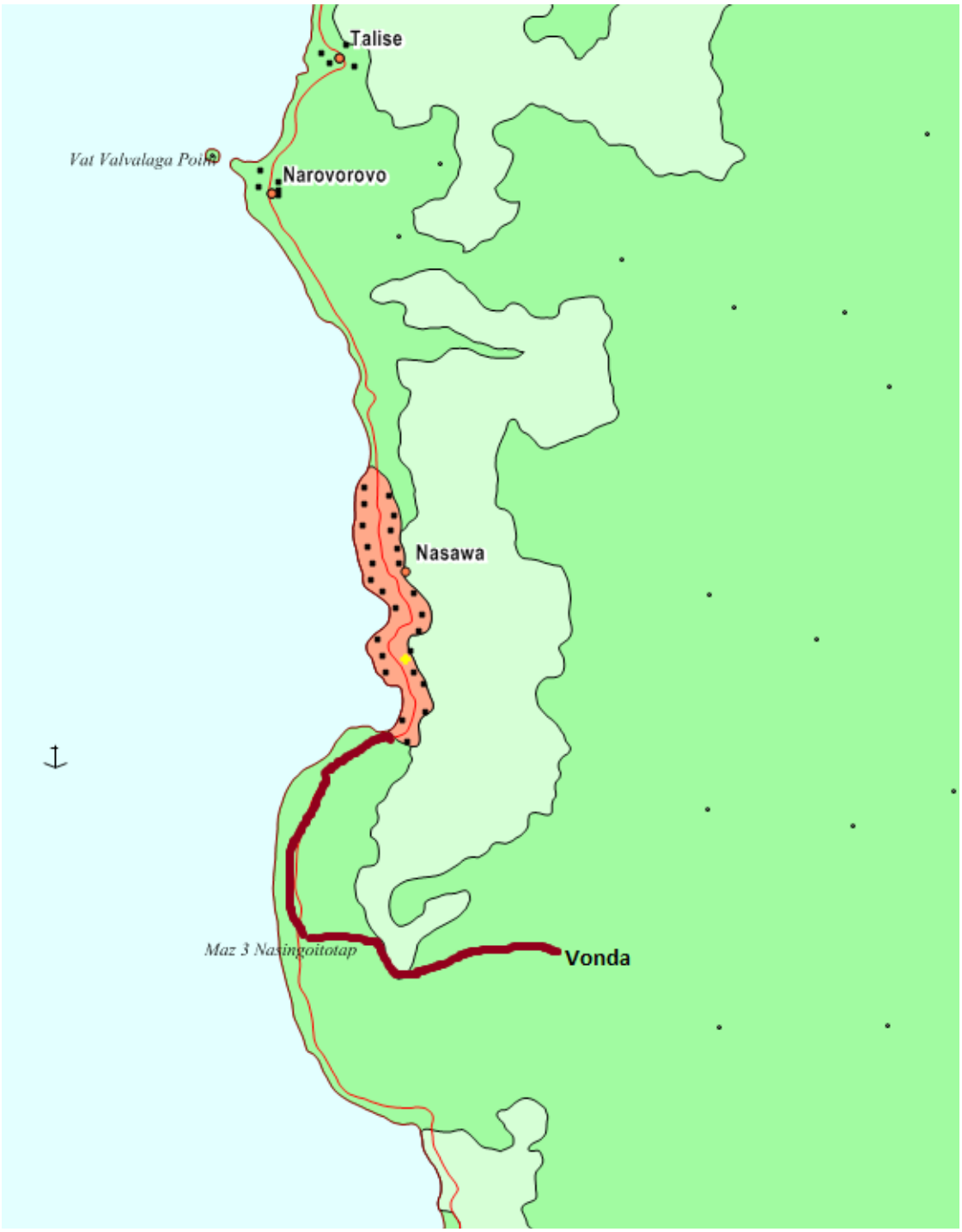


Tanna: Grid Extension- Lowkotai, Launapkamei, Lenasiliang, Lownel Apen, Leninik – Estimated distance 5 km



South Santo Grid Extension - Belchief Point to Matanras - Estimated distance 21km

Maweo Grid Extension - Nasawa to Vonda - Estimated distance 3 km



Annex 2: Soft Pipeline of Additional Projects

Intervention 1 - Micro Grids

Island	Province	Community	No. of Households
Epi	Shefa	Laman Bay	95
Paama	Malampa	Liro	84
MotaLava	Torba	Western Mota Lava	253
Aneityum	Tafea	Anelkauhat	85
Pentecot	Penama	Melsisi	50

Intervention 2 - Grid Extension

Island	Province	Community	No. of Households
Santo	Sanma	Sara, Hoghabor, Port Olry (Other Village that spreads along the east coast of Santo)	500+
Ambae	Penama	Ambaebulu J.S.S & Urebulu Community	24+
Vanua Lava	Torba	Arep Junior Sec. School and Sola Hospital	14+
Tanna	Tafea	Kuataparen, Ianapkasu, Itap	50-100
Santo (Aore Island)	Sanma	Aore resorts	10-20

Annex 3: Estimated Installed Capacity for Solar PV Micro Grids

Province: TAFEA
Island: Tanna
Area/Council: White Sands
Village/Community: Ipikel

Number of Households	61				
Item	No.	Unit Cap. (W)	Total Cap. (W)	Av. Hour Load (24hr)	Daily Demand (Wh)
Solar PV Micro Power House					
Parasitic load	1	300	300	100%	7200
Lighting (11W CFL)	5	11	55	100%	1320
Community House					
Lighting (11W CFL)	8	11	88	50%	1056
LED TV	1	70	70	50%	840
Refrigerator/ Freezer	4	500	2000	40%	19200
Tourist Lodges (3 nos)					
Lighting (11W CFL)	15	11	165	50%	1980
Lighting (22W CFL)	5	100	500	50%	6000
LED TV	1	70	70	50%	840
Refrigerator/ Freezer	1	500	500	40%	4800
Kettle	1	1000	1000	10%	2400
Agri Facilities/Health center/Church/School					
Lighting (11W CFL)	20	11	220	100%	5280
Computer & Printer	1	150	150	30%	1080
Agri Facility Needs	3	1000	3000	30%	21600
Health Centre Needs	2	500	1000	30%	7200
Church & School Needs	2	100	200	30%	1440
Community Households					
Lighting Per Home (2x each 11W CFL)	122	11	1342	69%	22143
Radio / Music Player (35 W)	61	35	2135	50%	25620
Cell Phone Charger (5 W)	61	5	305	40%	2928
Total Demand			**13100**		**132927**
Peak Sun Hours (hr)					5.5
Net System Losses (%)					23%
Variation from Average Day (%)					10%
Design Capacity (kWp)					34.5
Estimated Cost (US$) Per KW installed (as per SREP IP)					10500
Estimated Project Cost (US$)					362528

Province: TAFEA
Island: Tanna
Area/Council: White Sands
Village/Community: Ipkangien

Number of Households	27				
Item	No.	Unit Cap. (W)	Total Cap. (W)	Av. Hour Load (24hr)	Daily Demand (Wh)
Solar PV Micro Power House					
Parasitic load	1	300	300	100%	7200
Lighting (11W CFL)	3	11	33	100%	792
Community House					
Lighting (11W CFL)	6	11	66	50%	792
LED TV	1	70	70	50%	840
Refrigerator/ Freezer	3	500	1500	40%	14400
Tourist Lodges (2 nos)					
Lighting (11W CFL)	10	11	110	50%	1320
Lighting (22W CFL)	5	100	500	50%	6000
LED TV	1	70	70	50%	840
Refrigerator/ Freezer	1	500	500	40%	4800
Kettle	1	1000	1000	10%	2400
Agri Facilities/Health center/Church/School					
Lighting (11W CFL)	15	11	165	100%	3960
Computer & Printer	1	150	150	30%	1080
Agri Facility Needs	2	1000	2000	30%	14400
Health Centre Needs	1	500	500	30%	3600
Church & School Needs	1	100	100	30%	720
Community Households					
Lighting Per Home (2x each 11W CFL)	54	11	594	69%	9801
Radio / Music Player (35 W)	27	35	945	50%	11340
Cell Phone Charger (5 W)	27	5	135	40%	1296
Total Demand			**8738**		**85581**
Peak Sun Hours (hr)					5.5
Net System Losses (%)					23%
Variation from Average Day (%)					10%
Design Capacity (kWp)					22.2
Estimated Cost (US$) Per KW installed (as per SREP IP)					10500
Estimated Project Cost (US$)					233403

Province: MALAMPA
Island:Malekula
Area/Council: North-West Malekula
Village/Community: Unmet + Uri

Number of Households	130				
Item	No.	Unit Cap. (W)	Total Cap. (W)	Av. Hour Load (24hr)	Daily Demand (Wh)
Solar PV Micro Power House					
Parasitic load	1	300	300	100%	7200
Lighting (11W CFL)	5	11	55	100%	1320
Community House					
Lighting (11W CFL)	10	11	110	50%	1320
LED TV	2	70	140	50%	1680
Refrigerator/ Freezer	4	500	2000	40%	19200
Tourist Lodges (5 nos)					
Lighting (11W CFL)	25	11	275	50%	3300
Lighting (22W CFL)	15	100	1500	50%	18000
LED TV	5	70	350	50%	4200
Refrigerator/ Freezer	5	500	2500	40%	24000
Kettle	5	1000	5000	10%	12000
Agri Facilitiess/Health center/Church/School					
Lighting (11W CFL)	25	11	275	100%	6600
Computer & Printer	2	150	300	30%	2160
Agri Facility Needs	3	1000	3000	30%	21600
Health Centre Needs	2	500	1000	30%	7200
Church & School Needs	2	100	200	30%	1440
Community Households					
Lighting Per Home (2x each 11W CFL)	260	11	2860	69%	47190
Radio / Music Player (35 W)	130	35	4550	50%	54600
Cell Phone Charger (5 W)	130	5	650	40%	6240
Total Demand			**25065**		**239250**
Peak Sun Hours (hr)					5.5
Net System Losses (%)					23%
Variation from Average Day (%)					10%
Design Capacity (kWp)					62.1
Estimated Cost (US$) Per KW installed (as per SREP IP)					10500
Estimated Project Cost (US$)					652500

Province: PENAMA
Island:Pentecost
Area/Council: Central Pentecost
Village/Community: Loltong

Number of Households	51				
Item	No.	Unit Cap. (W)	Total Cap. (W)	Av. Hour Load (24hr)	Daily Demand (Wh)
Solar PV Micro Power House					
Parasitic load	1	300	300	100%	7200
Lighting (11W CFL)	4	11	44	100%	1056
Community House/Women Handicraft Association					
Lighting (11W CFL)	8	11	88	50%	1056
LED TV	1	70	70	50%	840
Refrigerator/ Freezer	4	500	2000	40%	19200
Tourist Lodges (2 nos)					
Lighting (11W CFL)	10	11	110	50%	1320
Lighting (22W CFL)	5	100	500	50%	6000
LED TV	1	70	70	50%	840
Refrigerator/ Freezer	1	500	500	40%	4800
Kettle	1	1000	1000	10%	2400
Agri Facilitiess/Health center/Church/School					
Lighting (11W CFL)	10	11	110	100%	2640
Computer & Printer	1	150	150	30%	1080
Agri Facility Needs	2	1000	2000	30%	14400
Health Centre Needs	1	500	500	30%	3600
Church & School Needs	1	100	100	30%	720
Community Households					
Lighting Per Home (2x each 11W CFL)	102	11	1122	69%	18513
Radio / Music Player (35 W)	51	35	1785	50%	21420
Cell Phone Charger (5 W)	51	5	255	40%	2448
Total Demand			**10704**		**109533**
Peak Sun Hours (hr)					5.5
Net System Losses (%)					23%
Variation from Average Day (%)					10%
Design Capacity (kWp)					28.5
Estimated Cost (US$) Per KW installed (as per SREP IP)					10500
Estimated Project Cost (US$)					298726

Province: TAFEA
Island:Aniwa
Area/Council: South Aniwa
Village/Community: Ikaukau

Number of Households	29				
Item	No.	Unit Cap. (W)	Total Cap. (W)	Av. Hour Load (24hr)	Daily Demand (Wh)
Solar PV Micro Power House					
Parasitic load	1	300	300	100%	7200
Lighting (11W CFL)	4	11	44	100%	1056
Community House/Women Handicraft Association					
Lighting (11W CFL)	6	11	66	50%	792
LED TV	1	70	70	50%	840
Refrigerator/ Freezer	3	500	1500	40%	14400
Tourist Lodges (2 nos)					
Lighting (11W CFL)	10	11	110	50%	1320
Lighting (22W CFL)	5	100	500	50%	6000
LED TV	1	70	70	50%	840
Refrigerator/ Freezer	1	500	500	40%	4800
Kettle	1	1000	1000	10%	2400
Agri Facilitiess/Health center/Church/School					
Lighting (11W CFL)	18	11	198	100%	4752
Computer & Printer	1	150	150	30%	1080
Agri Facility Needs	4	1000	4000	30%	28800
Health Centre Needs	1	500	500	30%	3600
Church & School Needs	1	100	100	30%	720
Community Households					
Lighting Per Home (2x each 11W CFL)	58	11	638	69%	10527
Radio / Music Player (35 W)	29	35	1015	50%	12180
Cell Phone Charger (5 W)	29	5	145	40%	1392
Total Demand			**10906**		**102699**
Peak Sun Hours (hr)					5.5
Net System Losses (%)					23%
Variation from Average Day (%)					10%
Design Capacity (kWp)					26.7
Estimated Cost (US$) Per KW installed (as per SREP IP)					10500
Estimated Project Cost (US$)					280088

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