NAMA Study
Rural Electrification in Vanuatu

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Acronyms

BAP	Bali Action Plan
CDM	Clean Development Mechanism
CNO	Coconut Oil
COP	Conference of Parties
DoE	Department of Energy
ECOP	Environmental Code of Practice
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GNI	Gross National Income
GPOBA	Global Partnership on Output-Based Aid
GS	Gold Standards
ICT	Information and communication technology
INDC	Intended Nationally Determined Contribution
IPP	Independent Power Producer
JICA	Japanese International Cooperation Agency
LCDS	Low Carbon Development Strategy
LDC	Least Developed Country
LEDS	Low Emissions Development Strategy
MSE	Micro or small enterprise
MRV	Monitoring, Reporting and Verification
NAB	National Advisory Board on Climate Change and Disaster Risk Reduction
NAMA	Nationally Appropriate Mitigation Action
NC	National Communication
NDMO	National Disaster Management Office
NERM	National Energy Roadmap
NGO	Non-governmental organisation
PPA	Power Purchase Agreement
PPP	Public Private Partnership
UNDP	United Nations Development Programme
UNELCO	Union Electrique du Vanuatu Limited
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

URA	Utility Regulation Authority
VANGO	Vanuatu Association of Non-Governmental Associations
VHT	Vanuatu Humanitarian Team
VMGD	Vanuatu Meteorology and Geo-Hazards Department
VREP	Vanuatu Rural Electrification Project
VUI	Vanuatu Utilities Infrastructure Ltd
WWF	World Wildlife Found

1 Executive Summary

Vanuatu is an island nation located in the South Pacific Ocean with its territory spread over more than 80 islands and approximately 234,000 inhabitants. Its energy sector is characterized by a high dependency on fuel imports and with its population distributed over 65 islands, spread over more than 12,000 square kilometres, distribution of energy services is both technologically challenging and costly. This results in very low electrification rates and high fuel prices.

This NAMA Study on Renewable Energy in Vanuatu aims at showing ways to support the country in the implementation of the National Energy Roadmap (NERM). One of the priorities in the NERM is to increase electricity access, both in areas close to existing grids and in off-grid areas. By 2030, all households and public institutions in Vanuatu are supposed to have access to electricity. The NAMA shall help in achieving the following targets:

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

In terms of Sustainable Development (SD) indicators, focus will be as follows:

- Improvement of air quality;
- Improvement of health situation;
- Improvement of livelihood of poor;
- Improvement of learning conditions, access to radio and internet;
- Job creation.

In close cooperation with key stakeholders, the following interventions were identified under this NAMA:

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

For each of these 3 interventions, procedures for application and approval as well as eligibility criteria were defined. The management structure proposes that the role of NAMA Coordinating Authority (NCA) is taken over by the National Advisory Board (NAB) and that the Department of Energy (DoE) is acting as NAMA Implementing Entity (NIE).

Total cost of the NAMA interventions is estimated at around USD 17 million, with USD 11.2 million to be covered by the NAMA donor, USD 5.3 million by private sector and households and USD 0.35 by the Vanuatu government. There is already commitment from donor for around USD 9.6 million, which leaves a financing gap to be covered by the NAMA donor of around USD 1.6 million.

2 Introduction

2.1 Rural Electrification and Development

Access to modern energy services is a prerequisite to sustainable development. Yet, as many as 1.3 billion people world-wide lack access to electricity. Between 2011 and 2013, the total number of people globally without electricity access remained essentially unchanged[1]. In many rural areas of developing countries, the costs of providing access to electricity are economically prohibitive and cannot be recovered through normal operation.

The global initiative "Sustainable Energy for All"[2], launched by the UN Secretary-General Ban Ki-moon in 2011, is spearheading the international development community in its efforts to improve energy access in order to reduce energy poverty.

By increasing access to affordable lighting, communication, 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[3].

The impacts of access to adequate lighting, means for food preservation (cooling) and access to information and communication 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[4]. Money saved from switching from conventional (kerosene fueled) 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.

In hot climates food preservation is essential, as farm, fish and animal products do not stay fresh for long, and food production is often seasonal. Cooling is the preferred preservation method, as the produce is not significantly changed by the process. Data from five South American countries with high electrification rates show that refrigeration is a high priority for people of all income groups. Along with television, a refrigerator is a priority appliance for the poorest 20%[5].

Information and communications technologies (ICTs) are now established as key tools for alleviating poverty. ICTs (such as radio, televisions, computers) are by their nature heavily dependent on energy and those without it lack access to information that could make a difference in their lives: information about the composition and delivery of services from public

[1] REN21 2014

[2] http://www.se4all.org

[3] REN21 2014

[4] GTZ and SenterNovem (2009)

[5] Practical Action (2014)

institutions, about political activities and their human rights, about the market value of their goods and produce and about education and livelihoods options[6].

At least similarly important as the impact of energy access on people's quality of live are the opportunities created 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 for production. There are a variety of opportunities, ranging from having light to keep a shop open longer to providing cooling space in a freezer, or running a pump to irrigate land.

The Poor People's Energy Outlook[7] 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 a micro or small enterprise (MSE),
- being employed, and
- earning from 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 in terms of improving existing earnings. Energy plays a key role along the entire agricultural production chain, improving productivity, producing better-quality products, and earning more from produce. Improved agricultural processing and storage/cooling are energy services that expand incomes for farmers while creating employment in the MSE sector. MSEs can lower costs, improve efficiency, broaden service offering, and improve returns via more affordable, reliable, and 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 to successfully increasing access to energy supplies and services. Figure 1: Estimated jobs created per GWh
shows the potential for job creation through investment in renewable energy technologies.

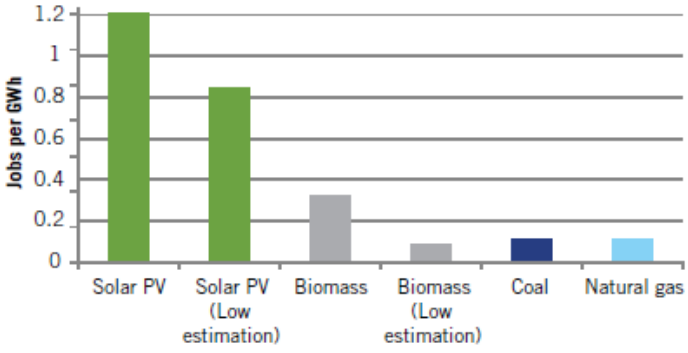

Figure 1: Estimated jobs created per GWh (Source: Practical Action 2014)

[6] Practical Action (2014)

[7] Practical Action (2014)

Renewable energy technologies often feature very low running costs, but high capital costs, challenges of village-level maintenance, availability and awareness of the technologies 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 concepts, Nationally Appropriate Mitigation Actions (NAMAs) have the potential to increase access to energy for the rural population in developing countries.

2.2 Nationally Appropriate Mitigation Actions

History

Nationally Appropriate Mitigation Actions (NAMAs) were first introduced at the 13th edition of the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC). The Bali Action Plan (BAP)[8] that was signed at the outcome of the COP stated that, in order to have "*Enhanced national/international action on mitigation of climate change…*" developing countries should push forward "*Nationally appropriate mitigation actions…in the context of sustainable development, supported and enabled by technology, financing and capacity-building, in a measurable, reportable and verifiable manner*". The BAP also stipulated that developed countries should take "*Measurable, reportable and verifiable nationally appropriate mitigation commitments or actions, including quantified emission limitation and reduction objectives…while ensuring the comparability of efforts among them, taking into account differences in their national circumstances*". Therefore, while a national reporting framework for measurable, reportable and verifiable (MRV) mitigation action already existed through the National Communication (NC) process related to the UNFCCC, NAMAs must be subject to NAMA-level MRV processes as well[9].

The following COP meetings further helped to refine the NAMA concept. The Copenhagen Accord[10], signed during COP 15, for example, first introduced the term "supported NAMA" to refer to NAMAs seeking international support for their implementation. It also stated that supported NAMAs should be subject to internationally agreed MRV standards. Subsequently, the Cancun Agreements[11], adopted by Parties during COP16, distinguished between internationally supported actions and domestically (or unilaterally) supported actions, depending on whether they were implemented with or without international support. The Cancun Agreements stated that, "developing country Parties will take nationally appropriate mitigation actions…aimed at achieving a deviation in emissions relative to 'business as usual' emissions in 2020", but that "developed country Parties shall provide enhanced financial, technological and capacity building support for the preparation and implementation of nationally appropriate mitigation actions of developing country Parties". Moreover, "internationally supported mitigation actions will be measured, reported and verified domestically and will be subject to international measurement, reporting and verification in accordance with guidelines to be developed under the Convention";

[8] UNFCCC, 2007

[9] UNEP, UNEP Risø 2013

[10] UNFCCC, 2009

[11] UNFCCC, 2010

while "domestically supported mitigation actions will be measured, reported and verified domestically in accordance with general guidelines to be developed under the Convention". This was a major breakthrough in defining a common mitigation framework, as it was the first time that a common "goal" was agreed upon for all developing countries in order to mitigate their GHG emissions[12]. Moreover, it defined that general guideline for domestic and international MRV of respectively unilateral and supported NAMA should be developed under the UNFCCC. Finally, the Cancun Agreements established that the UNFCCC should set up "*a registry to record nationally appropriate mitigation actions seeking international support and to facilitate matching of finance, technology and capacity-building support for these actions*".

Further decisions adopted during COP 17 (held at Durban in 2011) provided additional explanations on the international MRV requirements and provisions about the establishment of the NAMA Registry, clarifying that it "*should be developed as a dynamic, web-based platform managed by a dedicated team in the secretariat*". The prototype Registry at the UNFCCC[13] was finally put in place in 2012 and was presented at COP 18 (held in Doha in 2012). During COP18, Parties also agreed to establish a work programme to further clarify and define the diversity of NAMA types and initiatives. The work programme would include: information to enhance understanding of NAMAs (including estimated mitigation impacts of NAMAs, underlying assumptions and methodologies for estimating mitigation impacts, and sectors and gases covered); need for support for the preparation and implementation of NAMAs; and the role of the Registry in matching NAMAs with international support[14].

Finally, COP 19 (held in Warsaw in 2013) was generally regarded as one of the COPs that ended with less advancement, and that in fact concluded with a lower level of ambition than it started with. In relation to NAMAs, formal decisions[15] and information provided in the negotiations and side events confirmed this impression of sluggish and unambitious advancement in the formal work stream, and reinforced the growing consensus that NAMAs will have to be further developed and defined through independent Parties' efforts and individual initiatives, rather than via strict and commonly agreed UNFCCC decisions. The Warsaw decisions on the 'guidelines for domestic measurement, reporting and verification of domestically supported nationally appropriate mitigation actions by developing country Parties' confirmed the view that MRV of domestic NAMAs is fully at the discretion of the respective countries[16]. The principle of the guidelines is that they are '*general, voluntary, pragmatic, non-prescriptive, non-intrusive and country driven*'. Parties are invited to use the guidelines on a voluntary basis. Hence, the guidance given on how to set up MRV systems for domestic NAMAs are minimal in content and purposely very generic and vague. Furthermore, the COP 19 decision '*strongly encourages*' developed country Parties included in Annex II to the Convention (i.e., Western Europe, USA, Japan, Australia and New Zealand) and '*other developed country Parties in a position to do so*' to provide the necessary financial, technical and capacity-building support to '*interested*' developing country Parties.

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[12] UNEP, UNEP Risø 2013

[13] https://unfccc.int/cooperation_support/nama/items/7476.php

[14] UNEP, UNEP Risø 2013

[15] FCCC/SBI/2013/L.8

[16] FCCC/SBSTA/2013/L.28

Defining NAMAs

In summary, while NAMAs should be interpreted and looked at as one of the most promising voluntary instruments for reducing GHG emissions of developing countries at scale with a lot of flexibility in terms of interventions that can be included. NAMAs could include overall country strategies, sector-specific policies, sub-sectoral programmes, or even just projects of various sizes.

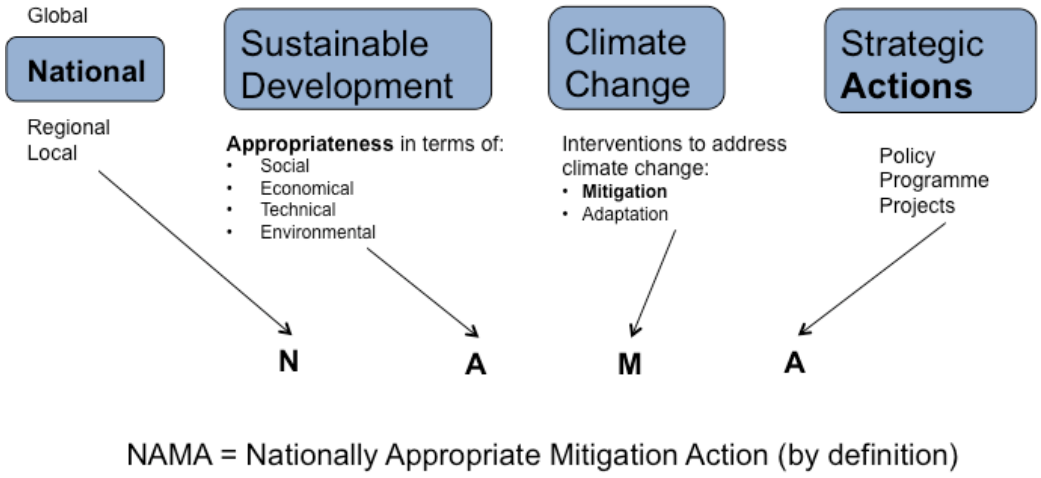

Figure 2: NAMA Definition

NAMA interventions will therefore support and align with sustainable development as interpreted by the relevant stakeholders, including any existing Low Emissions / Low Carbon Development Strategy (LEDS/LCDS) when applicable. Since NAMA interventions would benefit from this alignment with existing policies and priorities, they will often be driven by the broader development ideas. Aligning NAMAs with national development plans and policies entails, in turn, alignment with economic development plans and national budgeting: a NAMA should reflect and ultimately be built into these plans. The objective of a NAMA must go beyond the desired GHG ER impact and achieve significant sustainable development goals that can benefit the country and its inhabitants as a whole[17].

Even though NAMAs are often praised as an innovative new instrument of climate policy, the basic concepts are well known and established in developed countries in form of national climate and environmental policies. . The new elements are the transformation to the special needs and circumstances in developing countries, and the international financial and technical support for their implementation from developing partners.

NAMA as an Opportunity for Vanuatu

Nationally Appropriate Mitigation Actions (NAMAs) were conceived as a voluntary and non-binding policy tool aimed at providing a broader level framework to pursue the particularities of a country in terms of socio-economic objectives, and as well contribute to global GHG mitigations. NAMAs can be seen as a flexible, context-specific policy tool to achieve economic

[17] UNDP, UNFCCC, UNEP, UNEP Risø 2013

and sustainable development priorities while contributing to scaled-up mitigation at country level. NAMA interventions, designed with suitable policy and regulatory changes will serve as a catalyst in promotion of private sector involvement.

Many developing countries are already taking steps towards the development and use of NAMAs as instruments for taking part in the global mitigation agenda, leveraging national and international support for more ambitious, effective and transformational climate actions; and achieving broader national development goals. National governments, multilateral organisations, development partners, non-governmental organisations (NGOs) and others are already collaborating to ensure that NAMAs not only contribute to urgent efforts to limit the increase of GHG emissions, but that they yield tangible results in terms of sustainable development at national and local levels (i.e., poverty alleviation, local job creation, income generation opportunities, alternative livelihoods, improved energy access, better health and environmental conditions, etc.).

It is evident that NAMAs represent a sustainable development opportunity for Vanuatu, and a mitigation opportunity at the same time. In fact, the government can build on the existing policy framework, which targets at implementing 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.

The country has low electrification rate, and access to clean energy sources is limited. A NAMA framework that promotes implementation of renewable energy interventions will address multiple issues in the country. Thereby, 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 NAMA interventions are in concept different from prevalent funding mechanisms to promote renewable energy projects in the following manner:

- Alignment with country objectives: The interventions under the NAMA framework are prioritized in line with objectives of the host country in terms of socio-economic development.
- Sustainable income generation opportunities: The renewable energy access in the communities provides an opportunity for the rural population to be involved into alternative income generation opportunities, such as food processing, handloom, handicraft due to availability of time and lighting systems.
- Business opportunities: NAMA interventions will create sustainable options for businesses for individuals and communities. NAMA interventions may be implemented based on either an entrepreneurship model or a community owned enterprise model. The community based model would create sense of ownership among communities and make them self-sufficient in the longer run. The entrepreneurship model will promote creation of a business sector due to its replicable nature in the country and region.
- Replicable business models: NAMA interventions expedite the achievement of the socio economic objectives planned in the country by providing right catalytic elements such as

private sector involvement, job creation, etc. The business models can be easily replicated to other communities in the same country.

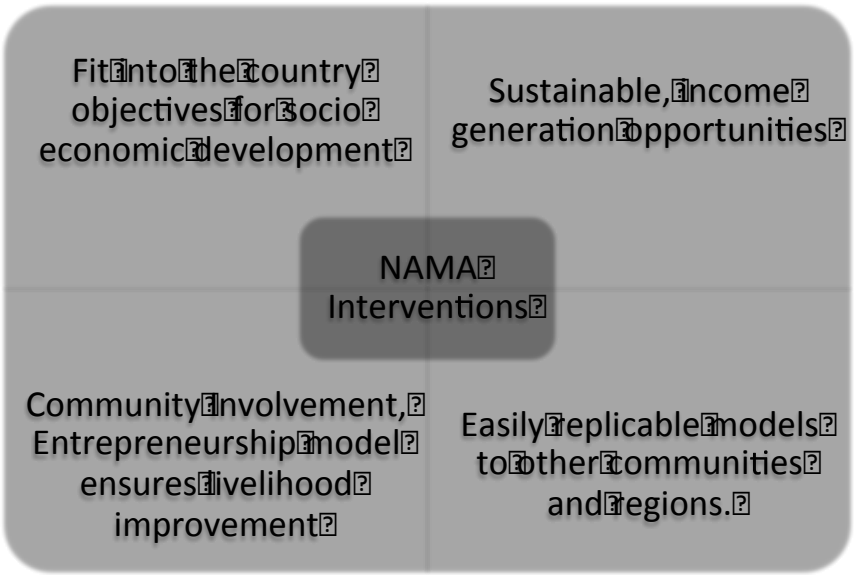

Figure 3: Why NAMA interventions score over traditional funding models

Steps in NAMA development

The development of NAMA for Vanuatu is carried out in three following steps:

1. NAMA Conceptualization: This is the initial step in NAMA development. It involves preparation of a draft NAMA concept (key interventions) based on the existing policy documents and stakeholder consultations. Based on this draft concept, the interventions for the NAMA are selected. The NAMA concept is developed in chapter 4.1.
2. NAMA Design: This step involves designing the components of NAMA framework in reference to the selected interventions in the previous step. The NAMA design is discussed in subsequent chapters.
3. NAMA Implementation and Operationalization: This step involves implementation of pilot scale interventions and adjustment of NAMA design based on pilot experience.

The objective of this NAMA study is to elaborate the NAMA concept with the selection of the interventions planned in Vanuatu and to develop a draft design of the NAMA. The full design of the Vanuatu NAMA will be developed under a separate assignment.

3 National Context

3.1 Country Background

Geography

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

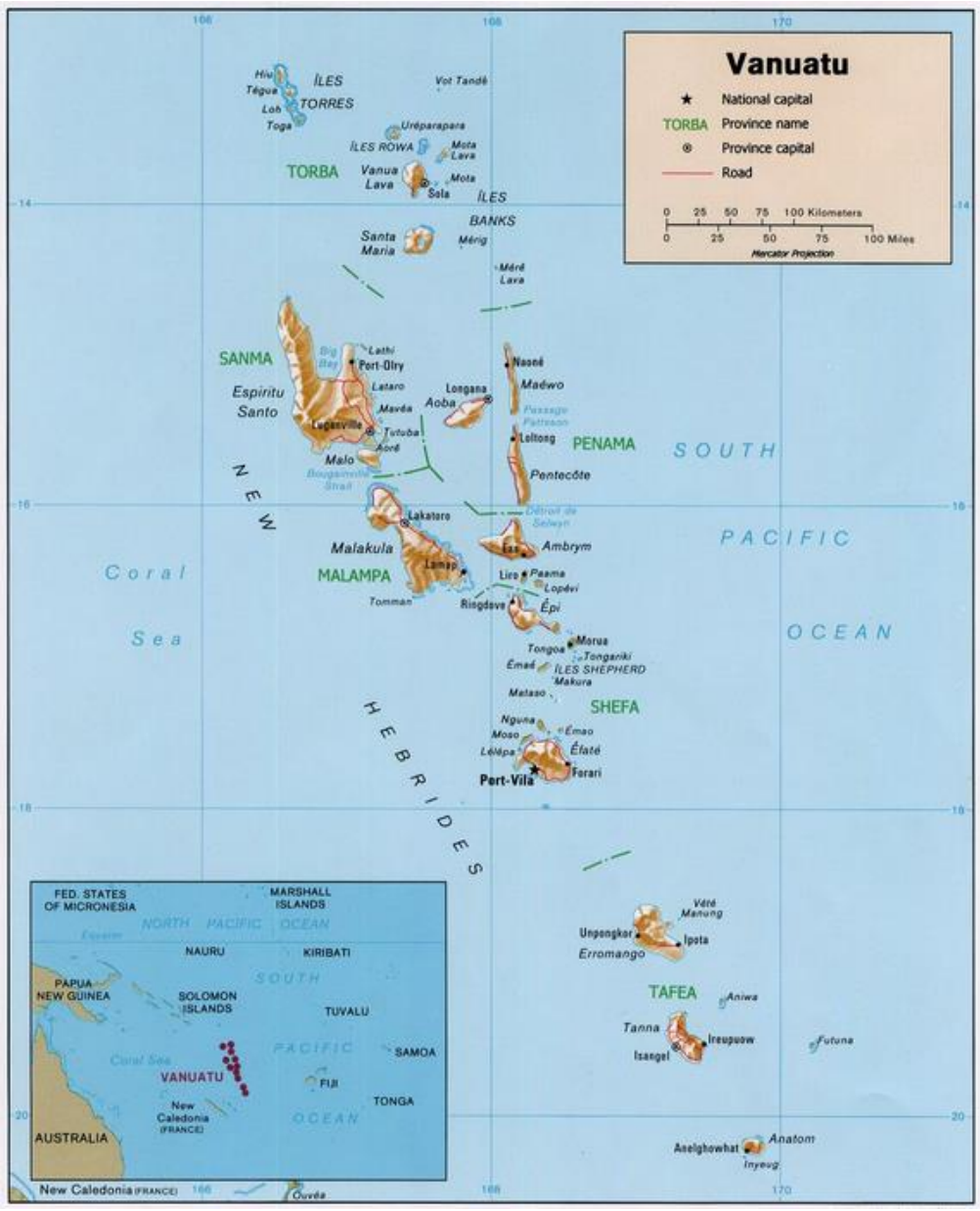

Figure 4: Map of Vanuatu
Source: http://www.lib.utexas.edu/maps

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° to 32°C[18]. The country is highly vulnerable to natural disasters, such as cyclones, flooding, earthquakes, landslides, tsunamis and volcanic eruptions[19].

Although most islands in Vanuatu are well above sea level, impacts of sea level rise and climate change are visible in the islands. Villages have been re-located in low lying islands of Vanuatu in the recent past. Over time risks of cyclones, coastal flooding, coastal erosion, heavy rainfall events and droughts are predicted to increase[20].

The inhabitants of Vanuatu are called Ni-Vanuatu, the latest census in 2009 shows a total population of approximately 234,000 in more than 47,000 households. The large majority (more than 75%) of its population lives in rural areas with widespread, mostly small communities[21].

The largest city is the capital Port Vila on Efate island, where roughly 19% of the total population live. The second larger city is Luganville on Espirito Santo island, with less than 20,000 inhabitants.

Economy

Vanuatu is included in the UN list of Least Developed Countries (LDCs)[22]. The GNI per capita was 3,130 USD in 2013[23]. The economy features a low inflation rate and stable GDP growth rates (2.8%)[24].

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[25].

The limited value of the exported goods, combined with the high dependency on imports results in a negative balance of payments (-127 mio USD in 2011)[26]. Increasing income from tourism is expected to narrow or even close this gap.

While more than half of the urban population is employed, the census data shows that less than 20% of the population in rural areas earns its living from employment[27].

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[18] http://en.wikipedia.org/wiki/Vanuatu

[19] EuropeAid http://ec.europa.eu/europeaid/where/acp/country-cooperation/vanuatu/vanuatu_en.htm

[20] http://www.sidsnet.org/msi_5/docs/nars/Pacific/Vanuatu-MSI-NAR2010.pdf

[21] Vanuatu National Statistics Office 2009

[22] http://www.un.org/en/development/desa/policy/cdp/ldc/ldc_list.pdf

[23] World Bank http://data.worldbank.org/country/vanuatu

[24] UN Country Profile http://data.un.org/CountryProfile.aspx?crName=Vanuatu

[25] http://en.wikipedia.org/wiki/Vanuatu

[26] http://data.un.org/CountryProfile.aspx?crName=Vanuatu

Political Situation

Vanuatu was a joint Anglo-French governed "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, the local community structures are an important political institutions, with community chiefs being the leading figure on 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[28].

3.2 Energy Sector – current situation

In this chapter the current situation of the energy sector in Vanuatu is analyzed. The national strategy and targets are described in chapter 3.3.

Overview

The situation on the Energy Sector in Vanuatu is influenced by two main parameters, 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, thus has to import all fuel for mobile or stationary use. Diesel oil accounts for the largest share of fuel imports (63.3%), with a volume of 33 million litres. 50% of the fuel demand comes from the transport sector, but diesel oil is also the main fuel for electricity generation in Vanuatu. Over 80% 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 utilized according to its potential[29].

With its population distributed over 65 islands, spread over more than 12,000 square kilometres, 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, andat high prices. The retail price for diesel is amongst the highest in the region which is partly due to taxes, as prices before tax are about the same as in comparable countries

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[27] Vanuatu National Statistics Office 2009

[28] Constitution of the Republic of Vanuatu, http://gov.vu/Constitution_of_Vanuatu0c9f.pdf?download=22%3Alawsconstitutionofvanuatu

[29] Vanuatu National Energy Roadmap 2014

in the region. Prices are closely linked to the world market price and thus regularly adjusted. The retail prices also vary within the country as costs for distribution rise along with the distance of the retail market from the main harbour in Port Vila.

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 average price for household customers in the current concession areas was 54.55 Vatu per kWh in July 2014, which equals 58.92 USD cents. Prices for consumers with a demand below 60 kWh per month are subsidized by higher prices for high demand customers[30]. The low demand tariff is currently set at 18.89 Vatu/kWh or 20.24 USD cents. This subsidized price is only a little lower than the EU average retail price for household customers (20.47 EURO cents or 27.93 USD cents)[31] and considerably above the average price of electricity in the USA (12.09 USD cents per kWh).

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.

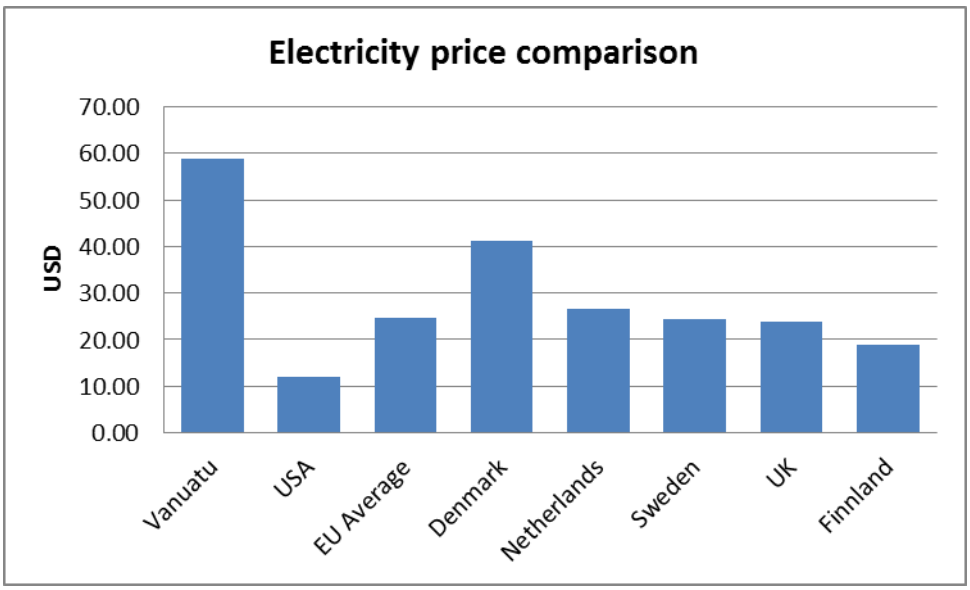

Figure 5: Electricity price comparison[32]

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 explicitly enable any person to generate electricity and sell wholesale electricity to the concessionaire. In June 2014 the Utility Regulation Authority (URA) issued preliminary guidelines for Independent Power Producers (IPPs) and Power Purchase Agreements (PPAs), open for public consultation.

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[30] Vanuatu National Energy Roadmap

[31] HEPI 2013, http://www.energypriceindex.com/wp-content/uploads/2013/10/HEPI_October-2013.pdf

[32] Sources: http://www.ura.gov.vu/index.php?option=com_content&view=article&id=106&Itemid=219&lang=en, VaasaETT: Household Energy Price Index for Europe, US Energy Information Administration, Electric Power Monthly. Exchange rates: 1 USD = 92.58 Vatu, 1 € = 1.35081 USD

Legal context

The legal framework of the energy industry in Vanuatu is primarily based on the following legislation and contracts[33]:

- Utilities Regulatory Authority Act (URA Act)[34]
  This act (last amended in 2011) defines the role and responsibilities of the URA.
- Electricity Supply Act[35]
  This is the main legal act for the Energy Sector in Vanuatu. It has last been 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.
- Geothermal Energy Act[36]
  This act regulates the rights and responsibilities for holders of a license for geothermal energy utilization.
- The Environment Management and Conservation Act[37]
  Regulates the requirements to carry out Environmental Impact Assessments for projects and development activities, which have a negative impact on certain parts of the environment (listed in the Act).
- Concessions for Electricity Supply[38]:
  - Concession for the Generation and Public Supply of Electric Power in Port Vila
  - MOU for management and operation of Luganville electricity network
  - Concession contract for the Generation and Public Supply of Electric Power in Tanna island
  - Concession contract for the Generation and Public Supply of Electric Power in Malekula island

The URA has published preliminary guidelines "*In the matter of developing regulatory guidelines for Independent Power Producers and Power Purchase Agreements*"[39] These guidelines were published in spring 2014 and contain proposed regulatory guidelines for Independent Power Producers (IPPs) and Power Purchase Agreements (PPAs). The guidelines were open for comments until 4 July 2014. Based on these comments, URA will produce a revised version of the guidelines, which are expected for fall 2014.

Key Players

[33] URA 2014 http://www.ura.gov.vu/attachments/article/100/U-0003-14%20Preliminary%20Guidelines%2020140606.pdf

[34] http://www.ura.gov.vu/attachments/article/52/URA_Act_No11_of_2007_and_2011_Amendment.pdf

[35] http://www.ura.gov.vu/attachments/article/52/ElectricitySupplyAct+March2011Amendments.pdf

[36] http://faolex.fao.org/docs/texts/van51735.doc

[37] http://mol.gov.vu/environment-acts.php

[38] http://www.ura.gov.vu/index.php?option=com_content&view=article&id=52&Itemid=91&lang=en

[39] http://www.ura.gov.vu/attachments/article/100/U-0003-14%20Preliminary%20Guidelines%2020140606.pdf

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

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 programs, projects, initiatives and activities". 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 - a representative of Vanuatu Humanitarian Team (VHT) Network, Vanuatu Climate Adaptation Network and he Vanuatu Association of Non-Governmental Associations (VANGO). Members are nominated in the first instance by the Directors of VMGD and NDMO and appointed by NAB Co-Chairs at an official NAB meeting.[40]

Department of Energy

The Department of Energy (DoE) was established in 2011 under the new Ministry of Climate Change Adaptation, Meteorology, Geohazards, Environment and Energy, 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. [41]

Utilities Regulation Authority

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, thus for new rural electrification activities.

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

Private companies

The main private players in Vanuatu are the two utilities operating in Vanuatu, Union Electrique du Vanuatu Limited (UNELCO) and Vanuatu Utility Infrastructure (VUI), which are described in more detail below. Besides these, there are several technology providers active in the market in Vanuatu, most of them providing 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.

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[40] http://www.nab.vu/what-nab-1

[41] IRENA: Issues Report for Vanuatu

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% rural dwellers, only 17% (World Bank estimate[42]) 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 result in high upfront installation costs that cannot be recovered through operation in a commercially viable time span.

The economic barrier mentioned above is even increased by the poor ability to pay for energy services in rural communities. In general the rural population has very little dispensable income. IRENA assumes that the average rural dweller has less than USD 1 cash income per day[43]. The rural household average spending on kerosene for lighting is estimated at 18,000 Vatu/year (approx. 190 USD)[44].

In the urban centers electricity grids are operated by private utilities. There are currently four grids established, which are operated by UNELCO and VUI.

Island	Operator	No of customers	Installed Capacity (MW)
Efate	UNELCO	10,338	26.5
Espirito Santo	VUI	2,339	4.1
Tanna	UNELCO	682	0.5
Malekula	UNELCO	526	0.5

Table 1: Electricity grids in Vanuatu

In the stakeholder workshop the general opinion of all stakeholders was that the quality of service in these electricity grids is very high, and even though, with an average retail price of more than 60 USD cent per kWh for a household customer[45], which are 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 GdF in France and VUI of Pernix in the US) 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.

[42] IRENA 2014, Renewables Readiness Assessment

[43] IRENA 2014, Renewables Readiness Assessment

[44] DFAT 2014, Lighting Vanuatu ICR

[45] Vanuatu National Energy Roadmap

Renewable Energy[46]

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

Geothermal Energy

The Vanuatu Government commissioned a 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, 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 pre-requisite. Negotiations on the PPA will include the Vanuatu Government, the URA and of course UNELCO but as of early 2014, no agreement had been reached. If the resource is confirmed (phase one is the test drilling), phase two is proposed to be the construction of a 4 MW net capacity plant with construction starting within three years of signing the PPA. That development 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 CNO (Coconut Oil) 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 addition 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 who uses a blend of diesel fuel and coconut oil at two of its diesel generating stations. The raw materials are from 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 kW at the Northern District Hospital, 10 kW at the Samma Provincial Headquarters and 10 kW at the College de Santo.

In April 2014 the URA announced its preliminary decision relative to 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 Vatu 1638.60 or ~USD 18) and the nominal fixed charge will be assessed 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 VUV 12.59 per kWh. No negative bills will be possible so any energy delivered to the grid

[46] IRENA 2014, Renewables Readiness Assessment

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, bidirectional metering would be used with a feed-in tariff of 18.89 Vatu 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 so earning more through the feed-in tariff than is the UNELCO charge to the customer for that month (including all fees and energy charges) will not be possible.

Off-grid solar

The majority of households in Vanuatu remains 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 industrialised 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 some means to spread the cost of battery replacements over their 5 to 7 year period of life rather than having a high cost occur after the battery fails as it 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% of UNELCO's generation.

Hydro Energy

As of 2013, the only utility connected hydroelectric plant in Vanuatu was on Espritu Santo and 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 of 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.

3.3 National targets and strategy

In the past decades, no consistent energy policy or strategy did exist in Vanuatu. Renewable Energy policies and projects implemented were fragmented and often driven by proposals from development partners. This approach has not proven to be successful, and as a response to that, the government has developed a comprehensive National Energy Roadmap (NERM) which was launched in April 2014[47].

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

> *"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."*

Based on this vision five priorities for the development of the energy sector were identified:

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 petroleum energy security policy and work with industry to optimize petroleum storage capacity and shipping schedules to ensure national energy security is maintained
Climate Change	▪ Examine options for increasing renewable energy and improving energy efficiency and conservation

Table 2: Priorities of the National Energy Road Map
Source: NERM 2014

[47] Vanuatu National Energy Roadmap 2014

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 of 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 to provide electricity. For the concession areas in the 4 towns (Port Vila, Luganville, Malekula and Tanna) it is aimed at intensifying grid connections and extending the network to neighbouring areas. Outside the concession areas, electricity access will be given through micro-grid solutions and individual (household) solutions.

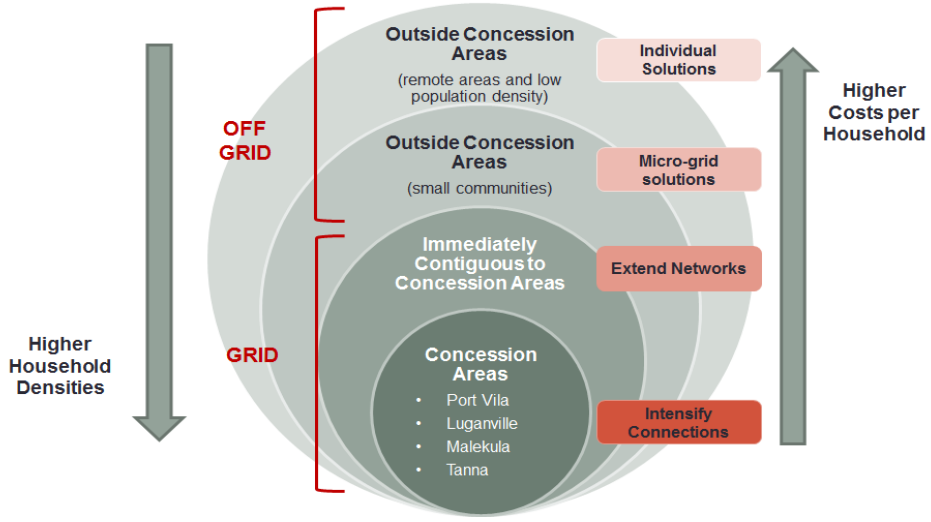

Figure 6: Strategic framework for scale-up of electricity access
Source: NERM 2014

The NERM sets clear targets for electricity access. Nowadays, 68% of the households in concession areas are already connected to the grid. This rate will be increase to 90% in 2020 and 100% in 2030. Households in proximity to concession areas currently have no access to electricity. Their connection rates will be increased to 90% in 2020 and 100% in 2030. All households without access to grid solutions ("off grid" households) will have access by 2020. 50% of public institutions have access to electricity nowadays, the rate will be increased to 100% by 2020. By 2030, all households and public institutions in Vanuatu will have access to electricity. Details about the planned development are shown in the table 2 below.

	Current	2015	2020	2030
Households within 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 Update and national average of 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, radio etc.;

*** Basic power products refer to the cash-and-carry Pico lighting and charging products sold through retail shops and other establishments.

Table 3: Electricity Access targets
Source: NERM 2014

In the NERM, the government recognizes the importance of taking into account the affordability of energy services, and considers a least cost approach, serving the different areas with different access solutions. Besides this, an emphasis is also given to the reduction of electricity prices.

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 vaguely mentions that subsidy schemes are necessary to increase the competitiveness of renewables and lower electricity tariffs, while maintaining the financial viability of service providers.

The targets set for renewable energy are shown in Table 4. By 2020, the share of renewable energy generation should reach 65%, which is more than triplicating the current figure (19%).

	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 from a 4 MW 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 in the manufacturing and industrial industries.

Table 4: Renewable Energy targets
Source: NERM 2014

There is a clear signal towards integrating efforts from the private sector into the development of renewable energy services in the country. The NERM emphasizes the need for regulation on 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 one on IPPs mentioned above, the proposal published in April 2014 introduces a feed-in tariff and net-metering scheme for renewable energy in Port Vila, and basically aims at providing an incentive for private parties to generate renewable electricity at small scale.

3.4 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. More specifically, the NAMA shall help the government of Vanuatu in achieving the targets described in the National Energy Roadmap (NERM), which are:

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

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

Without electricity access many daily activities are either more time consuming or limited to times of daylight. Thus electricity access has the potential to generate free time for the people and prolong the daily hours of 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)[48]. In any case, access to electricity is key to establishment and strengthening of the private sector.

The NERM lists a number of examples of environmental and social impacts to be achieved with the implementation of measures defined in the Roadmap. These impacts include:[49]

- Reduced local noise and air pollution near existing diesel generation plants;
- Less incidences of local oil spills through reduced consumption of petroleum;
- Improvement of the situation of groups with specific vulnerabilities, women and 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.

A key factor in achieving the targets in the NAMA is the private sector. In the NERM, the government apprehends this situation and 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*"[50] In the electricity sector, the private sector is already very active and Vanuatu has – in contrast to most other countries in the Pacific Region[51] – privately operated electricity grids, which is an excellent starting point for further expansion of the role of the private sector.

An increased involvement of the private sector is closely connected with the opportunity of creating new employment opportunities. Case studies summarized in an IRENA study show the potential of additional workplaces, which can be created by a NAMA.[52] The creation of long-term job opportunities as well as creating equal opportunities for women and men is one of the objectives under this NAMA.

The interventions to be selected for implementation under this NAMA will all be evaluated against their contribution towards sustainable development. The Sustainable Development Indicators will be defined for each of the interventions, details can be found in paragraph 4.4.

Besides the contribution towards sustainable development, the second main objective of the NAMA is the reduction of GHGs. Provision of access to electricity through newly installed generation capacity does not necessarily result in physical reductions of GHG emissions. However it is commonly agreed both by the climate and the development community that the

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[48] UNDP: Integrated Sustainable Rural Development: Renewable Energy Electrification and Rural Productivity Zones, 2014. Rural Productivity Zones (RPZ) consists of setting up an energy system and associated infrastructure in a rural area that provides power for a range of activities that leads to income enhancement and social development. The energy system is usually a micro- or mini-grid, ideally powered with renewable energies. The associated infrastructure can be rural community/data centers, industrial sheds or rural cooperatives.

[49] Government of Vanuatu: Vanuatu National Energy Road Map, page 15

[50] Government of Vanuatu: Vanuatu National Energy Road Map, page 8

[51] Matthew Dornan: Access to Electricity in Small Island Developing States of the Pacific: Issues and Challenges, 2014

[52] IRENA „Handbook on Renewable Energy Nationally Appropriate Mitigation Actions (NAMAs) for Policy Makers and Project Developers": The South African Renewables Initiative, which is part of a NAMA, expects that 35,000 to 40,000 new jobs will be created through the initiative. A NAMA in the renewable energy sector in Grenada sees good potential for jobs for local population in battery-based solar systems.

increase of energy access is an important and legitimate development target. Additionally, the controlled implementation of new generation 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) as 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 agreed 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 in these countries.

The conceptual approach to take these limitations into account is summarized as the "suppressed demand" approach. This takes into consideration that low energy (electricity) demand levels are not caused by efficiency or environmental causes, but are simply based on the low development status of the country. Demand is limited or suppressed by these development restrictions. The practical approach 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 a household's energy demand without development restrictions.

For the purpose of the Vanuatu Rural Electrification NAMA, it is suggested to follow the concept and default values for baseline calculation set up by the Gold Standard[53], as this is known as one of the most conservative approaches amongst the various carbon standards. Details for baseline selection and calculation are described in chapter **Error! Reference source not found.**.

As the described approach allows for ex ante setting of the baseline, only the actual electricity generation effected by NAMA activities as well as the actual emissions caused by this generation need to be monitored in order to provide for an appropriate calculation of emission reductions. Details of this calculation and monitoring are described in chapter 0.

[53] www.goldstandard.org. The Gold Standard was founded in 2004 by the World Wildlife Found (WWF) and is considered as the most stringent carbon certification scheme worldwide. The GS allows the use of methodologies approved under the CDM, but allows only small-scale projects. Additionally, the GS has specific requirements for project development and registrations and unlike other standards, the GS has a special focus on intensively involving stakeholders and considering sustainable development indicators in the approval process.

4 NAMA Interventions

4.1 NAMA Concept

First step in defining the NAMA interventions was the development of a NAMA concept. This was done based on an analysis of the current situation in Vanuatu and reviewing the plans of the government in terms of rural electrification and renewable energies. A key document in this analysis was the NERM with the strategic framework for scale-up of electricity access in Vanuatu. Based on this, 4 potential interventions were identified:

- Increasing connections in existing grid areas (Port Vila, Luganville, Malekula and Tanna)
- Extension of grids to neighboring communities
- Installation of micro-grids in areas with concentrated electricity demand
- Individual solutions for households

The table below shows the 4 potential interventions and instruments applicable for these interventions.

Interventions	Existing concession areas	Grid extension	Off grid electrification		NAMA applicability
			Micro-grids	Individual Home Systems	
Legislative Measures					
Enhanced Legislative Framework	✓	✓	✓	✓	
PPP regulations	✓	✓	✓		
Financial / Subsidies					
Incentives for utilities					
Subsidy for household connections	✓				+
Subsidy for grid extensions / accession	✓	✓			

Incentives for households Rural Lighting Subsidy Scheme				✓	+
Public Institutions Electrification Scheme				✓	+
Support of Pico Solar Market				✓	+
Incentives for coconut oil production	(✓)	(✓)	✓	✓	+
Feed in tariff	✓	(✓)	(✓)		+
Technical Assistance					
Micro grid development			✓		+
Maintenance support			✓	✓	+
Capacity Building	✓	✓	✓	✓	+

Table 5: Potential interventions and instruments for the NAMA – target areas

Not all instruments are applicable for all target groups, households, public institutions and tourism/commercial. The table below shows the proposed instruments for each of the target groups.

Instruments	Households	Public institutions	Tourism / Commercial
Legislative Measures			
Enhanced Legislative Framework	✓	✓	✓
PPP regulations	✓	✓	✓
Financial / Subsidies			
Incentives for utilities Subsidy for household connections Subsidy for grid extensions / accession	 ✓ ✓		 ✓ ✓
Incentives for households Rural Lighting Subsidy Scheme	 ✓		
Public Institutions Electrification Scheme		✓	

Support of Pico Solar Market	✓		
Incentives for coconut oil production	✓		✓
Feed in tariff	✓	✓	✓
Technical Assistance			
Micro grid development	✓	✓	✓
Maintenance support	✓	✓	✓
Capacity Building	✓	✓	✓

Table 6: Potential interventions and instruments for the NAMA – target groups

4.2 NAMA Interventions

The potential interventions were discussed at a stakeholder workshop in Port Vila and in bilateral meetings with key stakeholders. At the workshop it was decided to pursue the following 3 interventions:

Intervention 1 – Installation of micro-grids in areas with concentrated electricity demand (around health centers/schools)

New micro-grids will be installed based on renewables (focus on solar, small hydro in areas where resources are available). Diesel can be used as additional energy source for back-up to be able to provide continuous supply of electricity. Micro-grids will be installed and operated in Public Private Partnerships (PPPs) between utilities and communities.

- Health centers/schools are the focus of these micro-grids due to the demand in electricity for lighting, cooling and medical equipment
- Micro-grids allow commercial users to connect and offer services such as rural business centers with charging stations for mobile phones and internet access, rural production facilities and warehouses, etc.
- Feed-in tariff systems need to be elaborated, defining pricing and take-off requirements by the micro-grid operator
- Providing electricity to health centers or schools in rural locations can boost human development, as kids will be able to study later in the evening with availability of lighting.

Intervention 2 – Extension of grids to neighboring communities

The existing grids in Port Vila, Luganville, Malekula and Tanna build the basis for extensions to households, public institutions and tourism/commercial consumers in the proximity of lines. The connection of new consumers leads to emission reductions as electricity generation in the grid is less carbon-intensive than on household level. Investments are only envisaged for line extensions, not for additional production capacities in the existing grids.

- Connections will enable households to meet their daily lighting needs as well as limited needs of audio/TV and cooling.
- Consumers in 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 increase their opportunities to earn income.

Intervention 3 – Individual solutions for households

Solar Home Systems (SHS) will be used to provide electricity to households distant to existing grids and new micro-grids. Systems include panel, controller and battery and allow users to consume electricity also in the evening and at night due to the storage capacity.

- SHS will provide lighting needs (small versions) and the possibility to charge mobile phones (larger versions).
- SHS replace existing kerosene lamps, thereby reducing the dependence on fossil fuels and reducing operation costs.
- Availability of lighting will increase human development as kids and adults will be able to study in the evening as well.

4.3 Gap Analysis

The table below analyses the gaps for each of the 3 interventions and instruments necessary to overcome the gaps.

Intervention	Gaps	Instruments
Intervention 1 – Installation of micro-grids in areas with concentrated electricity demand (around health centers/schools)	• Potential operators of micro-grids (PPPs) lack financial capacity to finance start-up/investment costs • Communities, which will be partners in PPPs, lack capacity and experience in operating micro-grids • Unclear situation where micro-grids could be implemented • Legislative background for the operation of micro-grids, which balances public and private interest, is missing • Households lack information on possibilities of electricity generation and feeding excess electricity to the grid • Framework to regulate feeding electricity to grid is missing	• Investment support and/or loan schemes to finance investment into micro-grids • Capacity building to identify suitable locations for micro-grids • Capacity building activities to train communities in operating micro-scale electricity grids • Adaption of legislative environment to allow households/businesses to feed electricity into the grids
Intervention 2 – Extension of grids to neighboring communities	• Grid operators don't have the financial means to extend grids to areas with low density of consumption • Households lack financial funds to connect to grids	• Investment support to cover investment costs for extensions • Investment support to cover connection costs of households
Intervention 3 – Individual solutions for households	• Households lack financial funds to purchase Solar Home Systems (SHS) • Lack of know-how on the correct operation and maintenance of SHS	• Investment support • Loan schemes for households to purchase SHS • Capacity building activities to train households on correct operation and maintenance of SHS

Table 7: Gap analysis

There is a natural conflict between the different interventions as electricity consumers can be served by various means. Households for example can be served by grid extensions, micro-grids or individual solutions. However, solutions involving a larger grid should always have priority over smaller grids or individual solutions. The bigger the grid, the easier it is to integrate larger scale electricity generation units into the grid, such as wind power plants or hydro power units. The smaller grids, the more difficult it is to balance generation based on renewable energies and electricity demand.

4.4 Sustainable Development (SD) indicators

The selection of the Sustainable Development (SD) indicators was done based on the Sustainable Development Evaluation Tool (SD Tool) provided by UNDP[54]. The SD Tool defines 4 different SD domains:

- Environment
- Social
- Growth and Development
- Economic

The tool requires for each of the Interventions to decide whether an indicator (such as air pollution, biodiversity, health, etc.) is selected, identify the impact, add an explanation on the chosen indicator, define the effect (positive, negative, both) and indicate whether monitoring is done. The table below summarizes the indicators selected for each of the Interventions and each of the 4 SD domains. Details on why indicators were chosen and whether the impacts will be monitored can be found in chapter 9.1.

[54] UNDP: Sustainable Development Evaluation Tool, 2014

		Intervention 1		Intervention 2		Intervention 3	
Domain	Indicator	Selected (Yes/No)	Identified impacts	Selected (Yes/No)	Identified impacts	Selected (Yes/No)	Identified impacts
Environment	Air pollution/quality	Yes	Better air quality, less emissions etc	Yes	Better air quality, less emissions etc	Yes	Better air quality, less emissions etc
	Water pollution/quality	No		No		No	
	Soil pollution/quality	No		No		No	
	Others (Noise/visibilty)	Yes	Noise problems through back-up diesel generators	No		No	
	Biodiversity and Ecosystem balance	No		No		No	
Social	Health	Yes	Improvement of health situation	Yes	Improvement of health situation	Yes	Improvement of health situation
	Liveleihood of poor, poverty alleviation,peace	Yes	Improvement of livelihood of poor	Yes	Improvement of livelihood of poor	Yes	Improvement of livelihood of poor
	Access to Sanitation and cean drinking water	No		No		No	
	Food security (Access to land and sustainable agriculture)	No		No		No	
	Time savings/time availability due to project	Yes	Ability to work in the evening	Yes	Ability to work in the evening	Yes	Ability to work in the evening
Growth and Development	Access to clean and sustainable energy	Yes	People less dependent on petroleum	Yes	People less dependent on petroleum	Yes	People less dependent on petroleum
	Education	Yes	Better learning conditions, access to radio and internet	Yes	Better learning conditions, access to radio and internet	Yes	Better learning conditions, access to radio and internet
	Empowerment of women	No		No		No	
	Access to sustainable technology, Capacity development	No		No		No	
	Equality (quality of jobs given, job condition for men/women)	No		No		No	
Economic	Income generation/expenditure reduction/Balance of payments	Yes	Enhance productivity, efficiency, more business opportunities	Yes	Enhance productivity, efficiency, more business opportunities	Yes	Enhance productivity, efficiency, more business opportunities
	Asset accumulation and investments	No		No		No	
	Job Creation (number of men and women employed)	Yes	Job creation	Yes	Job creation	Yes	Job creation

Table 8: SD Indicators selected for the three interventions

4.5 Ongoing initiatives

The Vanuatu government started to work on the implementation of the National Energy Roadmap through a number of initiatives with several donors. All of these initiatives are involving rural electrification. These initiatives are initial steps of the Vanuatu government in the different interventions and are currently focusing on Intervention 2 (grid extension) and Intervention 3 (individual solutions for households).

The main activities of the Vanuatu government are currently as follows:

	GPOBA	World Bank	M3P
Full name of initiative	GPOBA Grid Based Electricity Access Project	Vanuatu Rural Electrification Project (VREP)	Melanesia's Million Miracle Programme
Short description	Project aims at connecting 4,375 households to existing grids. Project covers both connection and household wiring at subsidized cost (around	Project aims at providing access to electricity services for 17,500 rural households, 230 aid posts and 2,000 community halls located	Electric lighting through solar lanterns for 200 households in 2 communities, with further scaling up envisaged if additional funds are available.

	80%).	in dispersed off-grid areas. Thereby, the project is reaching out to 85% of the off-grid households. Project will cover 50% of installation costs.	
Intervention	Intervention 2	Intervention 3	Intervention 3
Target area	UNELCO and VUI concession areas	All off-grid areas in Vanuatu	2 communities in Tanna (White Sand and Port Resolution)
Financing	USD 4.85 million GPOBA (financed through Australian Aid) USD 0.51 user contributions	USD 4.7 million (Financed by New Zealand through the World Bank)	USD 110,000
Total budget	USD 5.36 million	USD 4.7 million	n.a.
Financing institution	Australian Aid and World Bank	New Zealand and World Bank	Secretariat of the Pacific Community (SPC)
Timeline	Start of roll-out: March 2014	Implementation starts in 2014, rollout over 5 years	Implementation starts Q4/2014
Project implementing unit	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)

Table 9: Summary of current initiatives on rural electrification

4.6 Areas not covered by NAMA

In order to have clarity about the interventions planned under the NAMA it is important to note which areas will not be covered by the NAMA:

- Connections in existing grid areas: there are well-operated grids in the 4 service areas. As of now, there are 68% of households in the service areas connected to the grid. Additional connections can be made by the operators on a step-by-step basis. Also, there is financing from the World Bank available to support installation costs. The 15 year timeframe (up to 2030) is sufficient to achieve a connection rate of 100% without additional interventions under a NAMA
- Renewable energy projects with an installed capacity of more than 2 MW: there are a number of larger scale renewable energy projects in wind, hydro and geothermal waiting for implementation. Due to the size of these projects (several MW), their electricity needs to be fed into existing grids, as only these have the size to take the additional capacities. Feed-in tariffs are existing, which are a major cornerstone for any grid-connected investment.

5 NAMA Baseline Scenario

5.1 Scenario analysis

Among all Pacific Island states, Vanuatu is among those countries with the lowest electrification rate. Only 28% of all households are grid connected, whereas in many other regions of the Pacific Islands, connection rates are close to 100% (see Figure 7). Most of grid connections are on two islands, Efate and Espirito Santo.

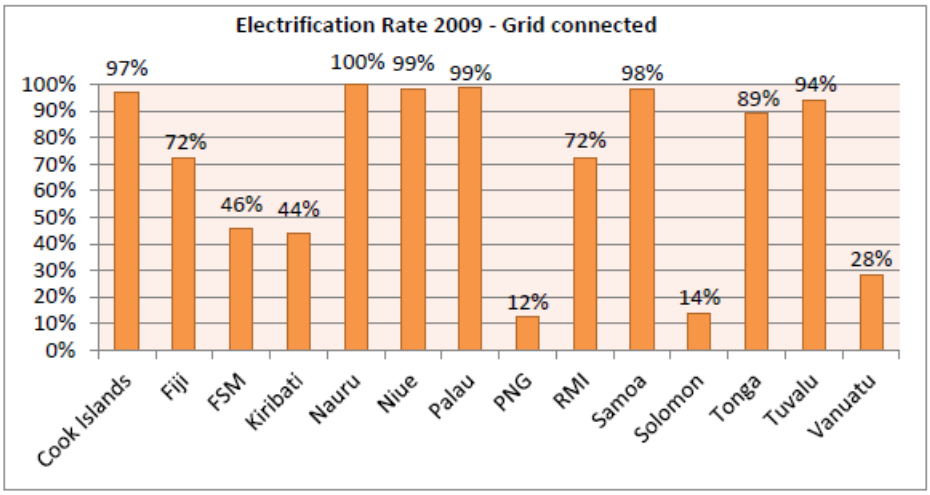

Figure 7: Pacific Island Countries grid connection rates, 2009[55]

For rural areas, the situation is even worse. It is estimated that on average only 5% of the population have access to basic electrification[56]. The factor is different on various islands, as can be seen from the figure below.

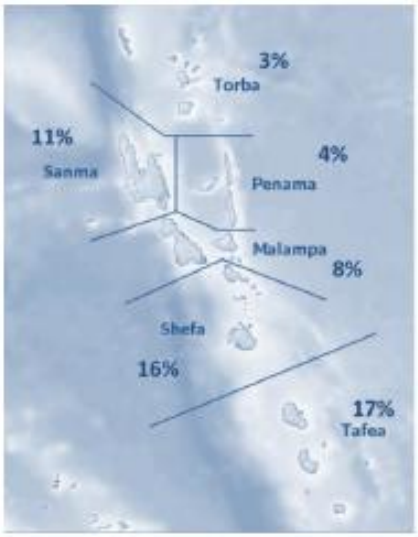

Figure 8: Electrification Rates by Province (excluding Efate, Tanna, Malekula, Espirito Santo islands)

[55] Melanesia's Million Miracle Programme (M3P): Promoting Universal Access to Modern Energy Services in Vanuatu, 2013

[56] Melanesia's Million Miracle Programme (M3P): Promoting Universal Access to Modern Energy Services in Vanuatu, 2013

The electricity supply in Vanuatu is facing two main issues:

- The geographic and demographic situation in Vanuatu makes electricity supply a challenge. Only 25% of the entire population (234,000 people in 2009) live in urban centres (Port Vila and Luganville), but 75% of the population live in rural areas.[57] 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 investments into electricity supply. In 2013, the average income of a five person household slightly less than USD 900 per year, 75% of the inhabitants live in rural areas and have less than USD 1 per day of cash income.[58]

Experience in the development of rural electrification and renewable energy development in Vanuatu has shown that major improvements in the access to electricity are only achieved if donor-funded activities are implemented in the country (Examples: Lighting Vanuatu, funded by AusAID[59], grid-connected PV project in Luganville Santo, funded by ADB[60], etc.). IRENA concludes that "*rural electrification is done on an ad-hoc basis and depends on available donor funding*".[61]

It can be concluded that the baseline is the continuation of the existing situation with only marginal improvements in grid connections and rural electrification. Households will 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 centers or community buildings will be supplied with off-grid electricity generated by diesel generators. No micro-grid will be installed due to the high upfront investment costs.

5.2 GHG emissions baseline of the NAMA scenario

The GHG emissions baseline takes into consideration the suppressed demand situation in Vanuatu, and therefore does not use the actual GHG emissions from electricity consumption, but bases the calculation on a pre-defined Minimum Service Level (MSL). The approach and default values of the Gold Standard *Suppressed Demand Methodology for Micro-scale Electrification and Energization*[62] are used.

The methodology defines MSL consumption values for different consumer groups, which are listed in Table 10 below.

Consumer Group	MSL consumption value

[57] IRENA: Pacifi c Lighthouses – Renewable energy opportunities and challenges in the Pacifi c Islands region – Vanuatu, 2013

[58] IRENA Issues Report for Vanuatu, 2014

[59] Melanesia's Million Miracle Programme (M3P): Promoting Universal Access to Modern Energy Services in Vanuatu, 2013

[60] IRENA: Pacifi c Lighthouses – Renewable energy opportunities and challenges in the Pacifi c Islands region – Vanuatu, 2013

[61] IRENA: Pacifi c Lighthouses – Renewable energy opportunities and challenges in the Pacifi c Islands region – Vanuatu, 2013

[62] http://www.goldstandard.org/wp-content/uploads/2013/02/GS-Electrification-Energization-Meth.pdf

	(kWh per day)
Household	3.0
Health Center	8.6
Dispensary	4.1
School	10.0
Kindergarten	4.4
Public Administration Building	4.4
Trading Place	11.0

Table 10: MSL consumption values (Gold Standard)

The emission factor defined by the methodology is based on the assumption that a diesel generator is used, and amounts to **1.3 kg CO_2/kWh**.

The NAMA is supposed to calculate the baseline emissions ex-ante, using the most recent census data on numbers of households and other consumer groups without electricity access.

Details to be elaborated in full NAMA

5.3 SD indicators baseline of the NAMA scenario

The baseline used for monitoring the NAMA's achievements towards Sustainable Development is suggested to be based on a static status quo approach, taking into consideration all recent donor funded electrification activities (such as Lighting Vanuatu). As all recent electrification is donor funded, there is no intrinsic development path showing increasing electrification rates. A static approach for this baseline component is therefore feasible.

Details to be elaborated in full NAMA

5.4 Gap analysis and readiness test of institutional setup, policy / regulatory, and financial needs to meet NAMA objectives and targets

Vanuatu has well-established organisations, which are currently involved in the implementation of donor-based projects in the energy and electricity sector and which are potential candidates to play a role in the institutions setup of the NAMA. The key institutions are:

- Utility Regulation Authority (URA)
- National Advisory Board on Climate Change and Disaster Risk Reduction (NAB)
- Department of Energy (DoE)

In the following paragraphs, the potential role of each entity is analyzed.

Utility Regulation Authority (URA)

The URA is 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, thus for new rural electrification activities. It was created to promote the consumers interest and to increase access to safe, reliable and affordable electricity and water services.

Due to its role and position, the URA cannot play an active part in the organizational structure of the NAMA. It needs to take a middle position between government, utilities and consumers and as such cannot represent the government only in the implementation of the NAMA.

However, the URA will play an important role in the NAMA, as both grid extensions and micro-grids will be important components of the NAMA. It will overview issues like tariff setting in new micro-grids or implementation of systems according to existing safety standards.

National Advisory Board on Climate Change and Disaster Risk Reduction (NAB)

The National Advisory Board on Climate Change and Disaster Risk Reduction (NAB) is a committee made up of government and non-government members and includes all major players in the energy sector in Vanuatu. The NAB sits in the Meteorology and Geo-hazards Department (VMGD).

Due to its structure, the NAB is perfectly placed to overview the implementation process of the NAMA. As there are government and non-government institutions represented in the Board, it will have the capacity and experience to steer the NAMA and be the first counterpart of the NAMA donor.

The NAB is very lightly structured and has no permanent staff. Due to the tasks associated with the implementation of the NAMA, additional staffing will be necessary.

Department of Energy (DoE)

The Department of Energy 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.

The DoE is already the implementing agency/unit for a number of donor programs. As such, it has experience in the preparation, implementation and monitoring of energy related programs. Due to this experience and its staffing, the DoE is the best suited institution for management, operation and monitoring of the NAMA.

Current staff includes the following positions:[63]

- Director
- Program Manager
- On-grid electrification officer
- Off-grid electrification officer

[63] IRENA: Issues Report for Vanuatu, 2014

- Energy Efficiency and Conservation officer
- Petroleum officer
- Finance and Procurement officer
- Administration Assistant
- 3 project staffs

Currently 2 people are working on the focus of the NAMA (on- and off-grid electrification),. To be able to manage the workload under the NAMA, additional staff will be required. Due to the high number of applications for funding expected, a minimum of 4 additional people will be required (1 grid extension, 1 micro-grids, 2 off-grid). Due to the technical complexity of micro-grid projects, it is advisable to hire an additional technician. For the operation of the NAMA, an additional person will be necessary to carry out work under the MRV. This brings the additional staff requirement to 6 people.

6 NAMA Management Structure

6.1 Actions to institutionalize the NAMA

For the development and implementation of the NAMA in Vanuatu, an institutional structure is required. The structure should be able to achieve a successful preparation and implementation of the NAMA, which includes the following main functions

- Embed the NAMA in the national policy framework
- Take into consideration country specific characteristics
- Ensure achievement of the NAMA targets
- Act as an interface to international NAMA donors
- Manage the financial flows between the NAMA donors and the recipients
- Carry out monitoring of GHG emission reductions and SD indicators

There are various approaches on how to arrange the organizational NAMA structure in a country. A recent study by UNDP Risoe[64] proposed two broad options for organizing the coordination of a NAMA:

1. Distributed responsibility for development and implementation with central coordination to provide guidance on integrating climate policy into development planning, guidance on the identification and development of NAMAs, and collating information on progress in implementing NAMAs.
2. A central institution responsible for the identification, development and implementation of NAMAs.

As Vanuatu is working with a number of institutions on the implementation of projects related to rural electrification and renewable energies, a division of responsibilities between institutions is advisable. Combining all responsibilities for developing and implementing a NAMA in one institution might limit the efficient implementation of the NAMA itself and the coordination with other activities.

The institutional structure of the NAMA needs to include the following institutional bodies:[65]

- NAMA Coordinating Authority (NCA)
- NAMA Implementing Entity (NIE)

NAMA Coordinating Authority (NCA)

The NAMA Coordinating Authority (NCA)[66] is the interface to the international donors and takes a role of a board of governors. Its main tasks are:

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[64] UNEP Risoe: Institutional aspects of NAMA development and implementation, 2014

[65] This structure follows suggestions from UNEP Risoe, which proposes the implementation of a National Coordinating Authority (NCA) as the centrally located entity for the development of the NAMA and the interface to international institutions and the NAMA donors. This is similar to the "NAMA's Coordinating and Managing Entity (NCME)" proposed in the UNFCCC/UNEP/UNDP Paper "Guidance for NAMA Design – Building on Country Experience". The term "NAMA Implementing Entity" which is used in UNFCCC's NAMA Registry, is used in this study to define the entity responsible for the implementation of the NAMA.

- Counterparty for the donor(s)
- Coordination of NAMA formulation and implementation processes
- Communication with private sector in implementing NAMAs
- Approval of certain interventions (Intervention 1)
- Guidance for the accounting of emissions reductions to avoid their double counting for related NAMAs
- Approval of annual monitoring reports
- Overview and management of financial flows between donors and beneficiaries

The National Advisory Board (NAB) in Vanuatu is suggested to take the role of the NCA under the NAMA. The composition of the NAB with representatives from government/government agencies and NGOs makes it a perfect candidate to coordinate and overview the implementation of the NAMA.

The NAB has the possibility to invite observers and visitors to attend the meetings. It is strongly recommended that representatives of the private sector (electricity suppliers, equipment suppliers, financing institutions,…) are invited to meetings to ensure proper participation of the private sector in the implementation of the NAMA.

NAMA Implementing Entity (NIE)

The NAMA Implementing Entity (NIE) is the main operative body and will take responsibility for the implementation of the NAMA. The NIE reports to the NCA.

The main tasks of the NIE are:

- Checking and approval of applications for funding under the NAMA
- Matchmaking platform for communities and private companies for the establishment of PPPs to implement micro-grids (Intervention 1)
- Development of technical standards for equipment/installations used under the NAMA
- Capacity Building for institutions and companies involved in the implementation of the NAMA (e.g. micro-grid operators, equipment suppliers,…)
- Coordination of promotion and awareness raising campaigns and coordinates to support 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 to this task.
- Reporting to the NCA to fulfill reporting requirements towards the donor
- Approval of certain interventions (Interventions 2 and 3)

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[66] The activities under the NAMA are closely linked with the concept of Intended Nationally Determined Contributions (INDCs). This concept was developed during COP 19 in Warsaw and requests countries to report until March 2015 their planned contributions as an input to the Meeting of Parties in Paris in 2015. In relation to mitigation, developing countries need to provide "*information relevant to their enhanced action to implement the Convention*". Part of this information will be made available through the NAMA.

It is suggested that the Department of Energy (DoE) takes the role of the NAMA Implementing Entity.

Details to be elaborated in full NAMA

Apart from the institutional bodies, which need to be positioned in the NAMA structure, there are also other players in the NAMA:

Micro-grid Operators

- Are established as Public Private Partnerships (PPP) between communities and private partners (in most cases electric grid operators)
- Apply for NAMA support by submitting an application to the NIE
- Receive funding from the NAMA donor
- Are responsible for the implementation and operation of micro-grids
- Provide monitoring and reporting to the NIE

Households

- Apply for NAMA support by submitting an application to the NIE
- Receive funding from the NAMA donor

The following graph shows the interaction between the various players in the implementation of the NAMA:

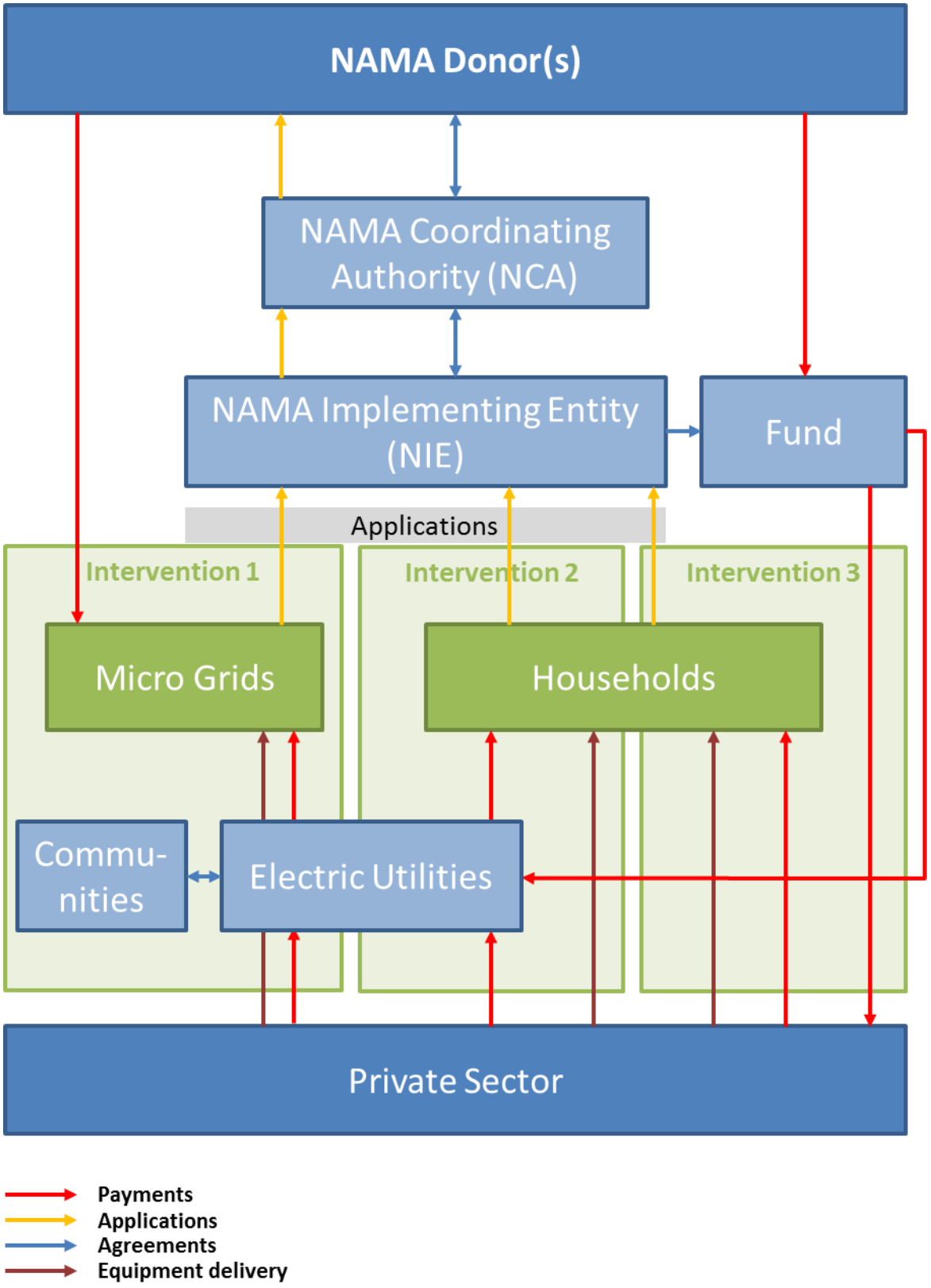

Figure 9: Organizational structure of the Vanuatu NAMA

6.2 NAMA operational & management system

The NAMA needs to be based on a profound operational and management system. All components and tasks need to be described in an operational manual, showing also clear responsibilities for the individual tasks. The NIE is responsible for the overall NAMA management, it is the central coordination entity for all activities.

For each of the 3 interventions, procedures and eligibility criteria are defined. These can be found in the following paragraphs.

Procedures

The following processes will be applied on the 3 interventions:

Intervention 1 – Micro-grids

The challenge with the implementation of micro-grids will be to bring together the private sector interested in investing into micro-grids with communities interested in implementation and operation of micro-grids. The best structure for such a co-operation is a Public Private Partnership (PPP). The NIE will have an important role in identifying interesting locations for micro-grids and facilitating negotiations between private sector and communities. Procedures are as follows:

1. NIE, with the support of external consultants, will prepare a list of potential locations for micro-grids. The locations have to fulfill the eligibility criteria for micro-grids (criteria see below). NIE will also investigate the interest of communities to participate in the implementation and operation of a micro-grid.
2. NIE will share the results with interested (potential) operators of electricity grids
3. NIE will facilitate discussions and negotiations between private sector and communities
4. PPPs will formally apply with NIE for support in implementing a micro-grid project. Applications need to meet the eligibility criteria defined for micro-grids.
5. NIE will verify applications and if eligibility criteria are met, recommend the micro-grids to NCA for funding.
6. NCA will discuss the application in a board meeting and hold a voting on supporting the micro-grid. Upon successful voting, the application will be forwarded to the NAMA donor.
7. PPP will apply for a concession for the area to be covered by the micro-grid (see chapter 6.3).
8. The NAMA donor releases payment to the PPP
9. The micro-grid is implemented by the PPP
10. Confirmation of finalization is sent by PPP to NIE (confirmation form is provided)

The following graph visualizes the process for Intervention 1:

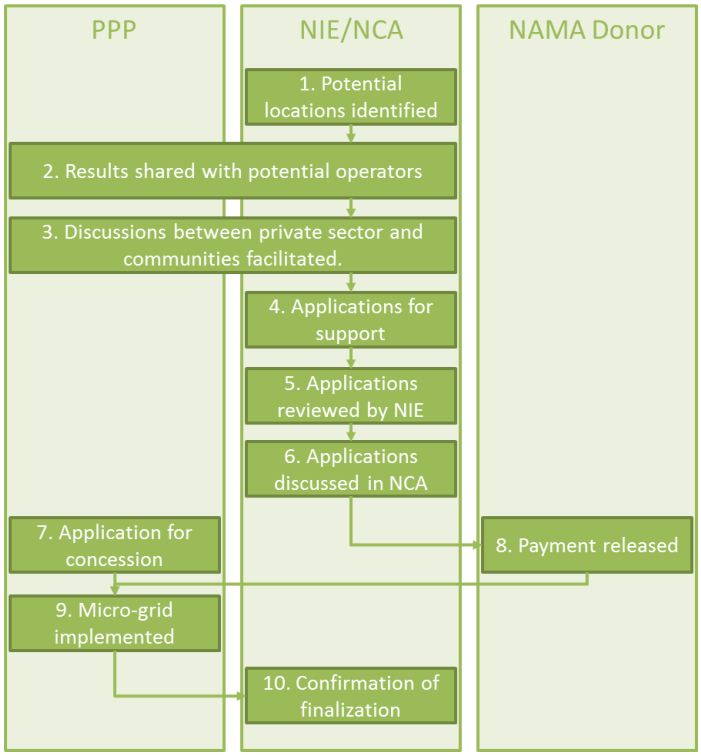

Figure 10: Process for Intervention 1

Intervention 2 – Grid extension

As there are existing electricity grids in Vanuatu, the procedures for applying for funding under the NAMA reflect to a large extent already common application procedures for grid extensions (as handled by UNELCO and VUI). Procedures are as follows:

1. Information about planned grid extensions is disseminated by grid operators to households near existing grids. This information includes a description of technical solutions, a rough first estimate of costs and the financial contribution required by the households.
2. Interested households apply for connection from the utility. Application documents might include copy of identification, plan of the premises to be connected, proof of ownership, etc.[67]
3. Technical assessment carried out by technicians of electricity supplier
4. Cost estimate is elaborated by electricity supplier/utility
5. Application for funding under the NAMA is handed in at NIE (application form is provided)
6. Application is verified against eligibility criteria (criteria see below)
7. If eligibility criteria are met, application is approved and written confirmation will be sent to applicant and electricity supplier
8. Funds will be released by NIE to electricity supplier
9. Implementation is taking place

[67] http://www.unelco.com.vu/en/customers/connections

10. Confirmation of finalization is sent by electricity supplier to NIE (confirmation form is provided)

The following graph visualizes the process for Intervention 2:

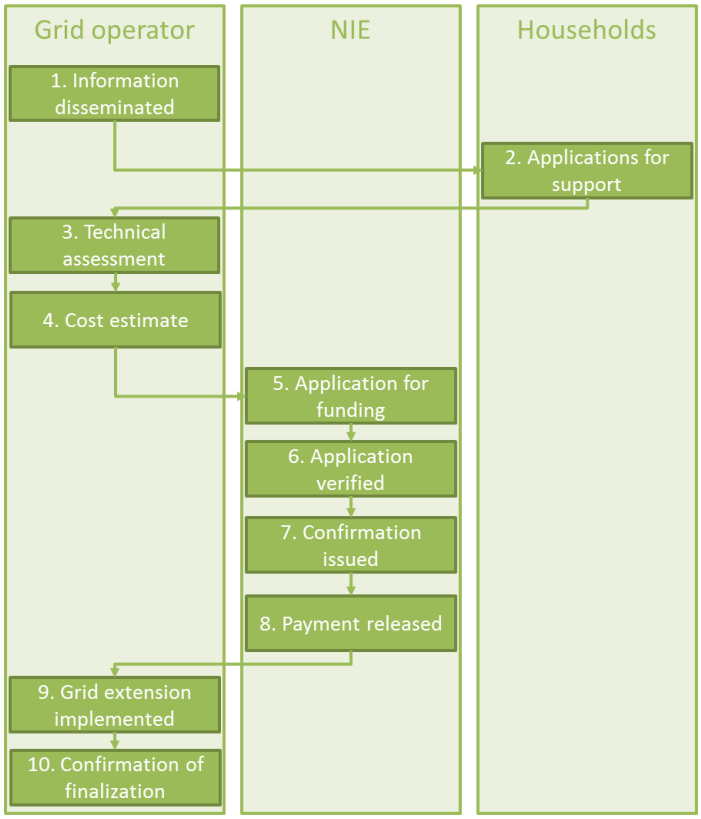

Figure 11: Process for Intervention 2

Intervention 3 – Individual household solutions

As there will be a large number of applications in Intervention 3, a different approach to Interventions 1 and 2 needs to be taken. In a first step, eligible technical solutions and suppliers for these solutions need to be selected and accredited. Then, the solutions can be disseminated to households. The procedure will be as follows:

1. NIE defines eligibility criteria for individual household solutions (criteria see below) and defines certain packages with various service levels (e.g. light/phone charging, light/radio/phone charging, etc.)
2. NIE invites the private sector to offer technical solutions to cover the various service levels
3. Private sector prepares offers to NIE for certain packages, meeting the eligibility requirements
4. NIE selects products to be supplied in each of the service levels and accredits suppliers. Attention will be paid at a fair balance of product durability and price of the products.
5. Information on available individual household solutions is distributed to potential households. This will be done through information material and awareness campaigns.

The information disseminated needs to include a technical description of the solutions provided and the costs of each solution.

6. Households commit to pay between 50% to 80% of cost to the supplier for the pre-approved package (selected in step 4).
7. Equipment supplier provides equipment to the supplier
8. Supplier submits claim to NIE for the balance of payment.
9. NIE checks the applications and approves if requirements are met
10. NIE releases funds to equipment supplier
11. Confirmation of finalization is sent by equipment supplier to NIE (confirmation form is provided)

The following graph visualizes the process for Intervention 3:

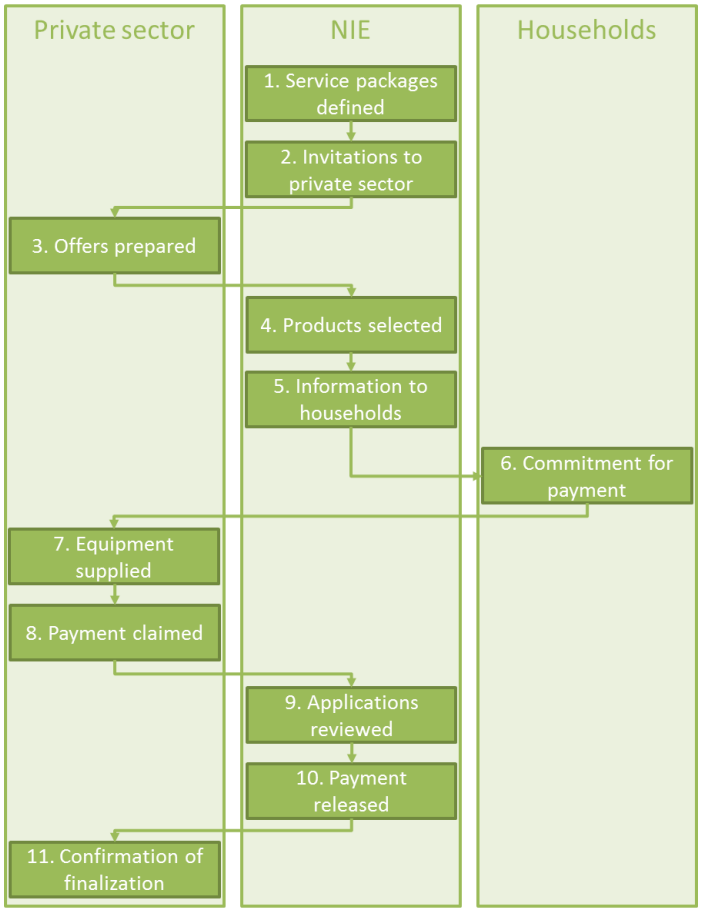

Figure 12: Process for Intervention 3

In order to be eligible for funding under the NAMA, minimum requirements need to be fulfilled in each of the three interventions. The eligibility criteria are defined as follows:

Eligibility criteria

For each of the interventions, eligibility criteria will be defined, which need to be complied with by the stakeholders involved. In the approval process of each intervention, stakeholders such as

PPPs or equipment suppliers need to prepare and present relevant documentation to allow the NIE to evaluate compliance with the eligibility criteria. This can be for example technical descriptions, certified test results, confirmations by other parties, etc.

Intervention 1 – Micro-grids

- The share of renewable energies in installed capacity and projected annual electricity generation needs to be at least 75%. Diesel units are allowed as backup.
- Local stakeholders need to be involved in the structure of the PPP with a share of at least 10%.
- The daily availability of electricity needs to be at least 4 hours.
- The minimum service level provided to consumers needs to include at least 4 sources of lighting, radio and phone charging.
- The electricity generation needs to operate with a minimum of 8 hours per day and 5 days per week.
- The price set for electricity consumers need to be in line with the requirements of the URA, as amended from time-to-time.
- However, there should be flexibility in determining tariff level (price) that that is affordable to electricity consumers.
- The operator of the micro-grid needs to connect private producers of electricity from renewable energy sources up to a maximum of at least 25% of the installed capacity in the micro-grid. The feed-in tariff granted to private producers needs to be in line with the requirement of the URA, as amended from time-to-time.
- The operator needs to run a monitoring system with yearly reporting in line with the reporting requirements under the NAMA.

Intervention 2 – Grid extension

- The daily availability of electricity needs to be at least 8 hours.
- The minimum service level provided to consumers needs to include at least lighting, radio and phone charging, thereby providing minimum service levels for lighting and Information and Communication Technologies (ICTs).[68]
- The price set for electricity consumers need to be in line with the requirements of the URA, as amended from time-to-time.
- The operator of the micro-grid needs to connect private producers of electricity from renewable energy sources. The feed-in tariff granted to private producers needs to be in line with the requirement of the URA, as amended from time-to-time.
- The operator needs to run a monitoring system with yearly reporting in line with the reporting requirements under the NAMA.

Intervention 3 – Individual household solutions

- The technical solution must be fully based on renewable energies

[68] Practical Action concludes in its Poor People's Energy Outlook that information and communication technologies are established as key tools for alleviating poverty. Information about the composition and delivery of services from public institutions, about political activities and their human rights, about the market value of their goods and produce and about education and livelihoods options make a difference for people's lives. Mobile phones are used for communication and increasingly for payment purposes.

- The daily availability of electricity needs to be at least 4 hours.
- The minimum service level provided to consumers needs to include at least lighting, radio and phone charging, thereby providing minimum service levels for lighting and Information and Communication Technologies (ICTs).
- Lighting must be available during 4 hours per night with a minimum level of light of 300 lumen.[69]
- Warranty period of equipment needs to be longer than 3 years
- Product must meet international standards

Evaluation criteria applied by the NIE

When applications are presented to the NIE, the evaluation is based on two parts:

- First, the NIE checks whether the eligibility criteria are met. If all criteria are met, the second part of the evaluation is carried out.
- The second part of the evaluation is a financial evaluation, comparing the financial support required with the service level achieved by the implementation of the measure. For each of the three interventions, financial criteria need to be discussed and agreed with the NAMA donor. These criteria can be changed from time-to-time.[70]

Details to be elaborated in full NAMA

6.3 Environmental and regulatory compliance

The implementation of projects in the three Interventions is embedded in the regulatory framework in Vanuatu, covering electricity and environmental issues. The following regulations are relevant for each of the Interventions:

Laws/regulations	Intervention 1 – Micro-grids	Intervention 2 – grid extension	Intervention 3 – individual solutions for households
Electricity Supply Act	✓	✓	
Guidelines for IPPs and PPAs	✓	✓	
Concessions for Electricity Supply	✓	✓	
Environment Management and	✓	✓	(✓)

[69] Practical Action concludes in its Poor People's Energy Outlook that 300 Lumen is sufficient for reading and other household tasks.

[70] For the different interventions, financial criteria need to be set. These can be for example maximum contributions (in absolute numbers) to a Solar Home System of a specific type or a maximum contribution per Watt capacity connected in the case of grid extension. If the interventions are successful, the support required in each intervention can decrease over time, e.g. through economies of scale or increased competition between private sector actors in disseminating Solar Home Systems. Therefore, criteria need to be adapted from time-to-time with an aim of maximising output (number of SHS, number of micro-grids,…) and minimizing financial input. In the long run, certain solutions can become financially viable without support from the NAMA.

Conservation Act			

Table 11: Laws/regulations relevant for the three interventions

Due to the small size of equipment disseminated in Intervention 3 (Solar Home Systems), there is hardly any impact from existing legislation and regulations. The only question mark is whether and how the Environment Management and Conservation Act is applicable for such equipment.

Solar Home Systems use batteries to be able to store the electricity generated during the day to be used in the evening (especially for lighting). The lifetime of batteries in these systems is usually shorter than the lifetime of the rest of the equipment (PV unit, converter). Currently, there is no regulation on disposal/recycling of batteries, which have come to an end of their technical lifetime. In the Vanuatu Rural Electrification Project (VREP), the elaboration of appropriate legislation, regulation or an Environmental Code of Practice (ECOP) is part of the project.

For Interventions 1 and 2, there are three main legal documents: the Electricity Supply Act, the Guidelines on IPPs and PPAs and the Environment Management and Conservation Act.

The Electricity Supply Act is especially important for Intervention 1, micro-grids. According to clause 1A, the Minister may grant a "person the sole concession for the manufacture and supply of electricity within such areas outside of Port Vila and Luganville".[71] It is key for a private investor to receive such a concession for a certain period of time, otherwise investments with a long-term perspective cannot be made.

The Environment Management and Conservation Act is a key document for Interventions 1 and 2, as it lays out the regulations for Environmental Impact Assessments. The following graph shows the procedures for the Environmental Impact Assessment.

The process has a first major step, where an application including supporting documents is made. Based on these documents, it is decided whether no EIA is required (either with recommendations or no comments) or an EIA is required. In case of an EIA being required, a defined process needs to be followed until the Director of Environment takes a decision, which can be a rejection, a reference back to previous steps or an acceptance.

[71] http://www.ura.gov.vu/attachments/article/52/ElectricitySupplyAct+March2011Amendments.pdf. The concessions for Port Vila and Luganville are covered by concession contracts with UNELCO/VUI.

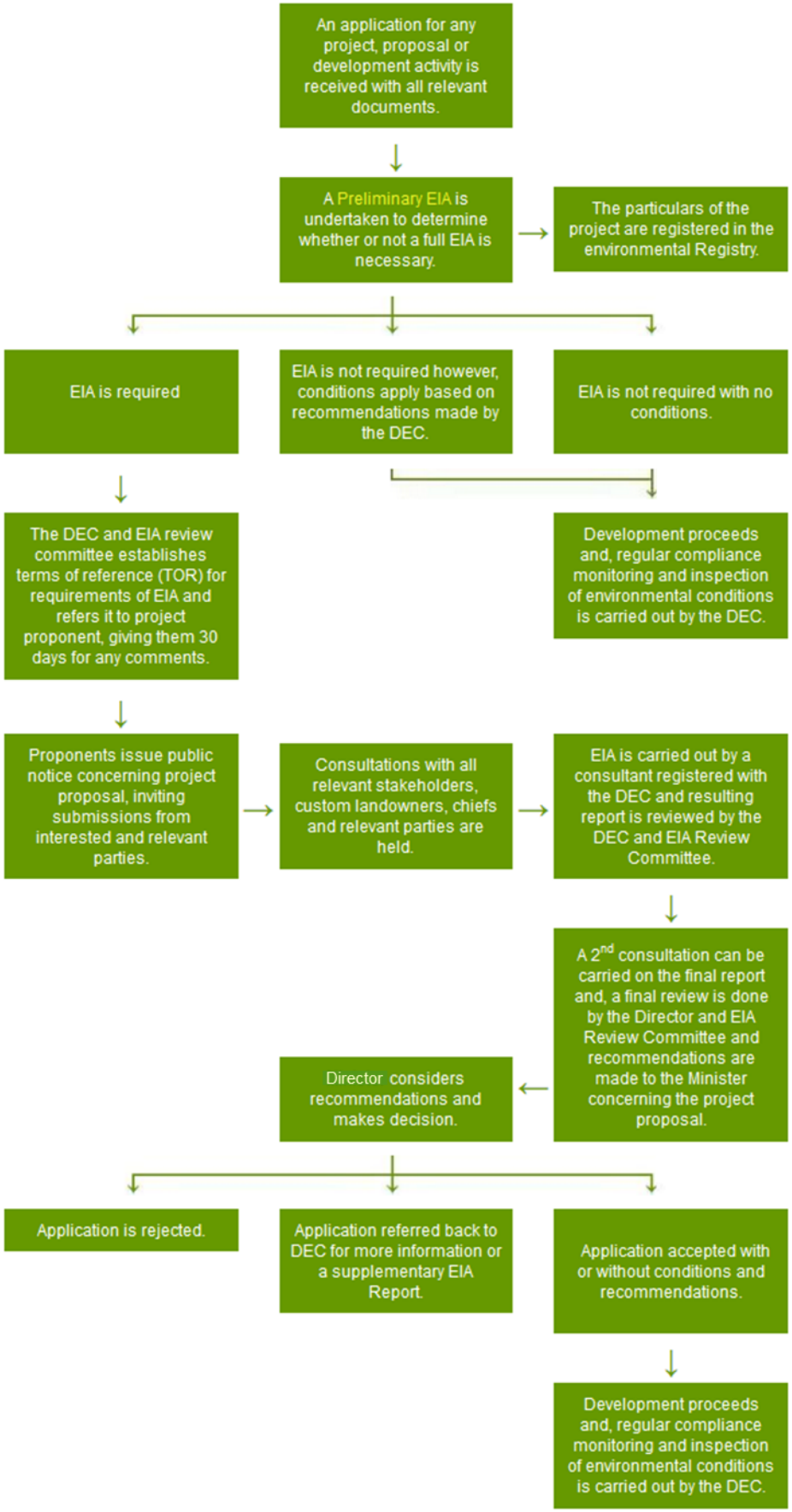
An application for any project, proposal or development activity is received with all relevant documents.
A Preliminary EIA is undertaken to determine whether or not a full EIA is necessary.
The particulars of the project are registered in the environmental Registry.
EIA is required
EIA is not required however, conditions apply based on recommendations made by the DEC.
EIA is not required with no conditions.
The DEC and EIA review committee establishes terms of reference (TOR) for requirements of EIA and refers it to project proponent, giving them 30 days for any comments.
Development proceeds and, regular compliance monitoring and inspection of environmental conditions is carried out by the DEC.
Proponents issue public notice concerning project proposal, inviting submissions from interested and relevant parties.
Consultations with all relevant stakeholders, custom landowners, chiefs and relevant parties are held.
EIA is carried out by a consultant registered with the DEC and resulting report is reviewed by the DEC and EIA Review Committee.
A 2nd consultation can be carried on the final report and, a final review is done by the Director and EIA Review Committee and recommendations are made to the Minister concerning the project proposal.
Director considers recommendations and makes decision.
Application is rejected.
Application referred back to DEC for more information or a supplementary EIA Report.
Application accepted with or without conditions and recommendations.
Development proceeds and, regular compliance monitoring and inspection of environmental conditions is carried out by the DEC.

Figure 13: Procedure of Environmental Impact Assessment

From the text of the Environment Management and Conservation Act it is not clear whether micro-grids have to carry out a full EIA or whether a Preliminary EIA is sufficient. The Act lists in clause 12 a number of environmental impacts (water resources, air quality, unsustainable use of renewable resources,…), which would require an EIA to be carried out. In many cases, micro-grids will not have any negative impact on the environment, therefore no EIA or only a Preliminary EIA should have to be carried out. It would be helpful for private sector to have a clear statement on the eligibility of the Act on micro-grids.

6.4 Quality assurance and adjustments

The NIE will prepare annual reports, which will be approved by the NCA and presented to the NAMA donor(s). These reports will summarize the activities in each intervention and present achievements in GHG mitigation, sustainable development and financial implications (see chapters 8.3 and **Error! Reference source not found.**).

The report will also allow the NIE to analyze the success in each intervention and identify issues and bottlenecks for an improved implementation of the NAMA.[72] If required, solutions will be presented to the NAMA donor for approval.

The involvement of stakeholders is a key step in achieving a good quality in NAMA preparation and implementation. The National Advisory Board (NAB) is acting as the National Coordinating Authority (NCA) in the NAMA and has therefore a key function in securing high quality of work. The NAB involves key stakeholders, including government agencies and NGOs (such as of Vanuatu Humanitarian Team (VHT) Network, Vanuatu Climate Adaptation Network and he Vanuatu Association of Non-Governmental Associations (VANGO)). Additionally, the NAB has the opportunity to invite observers and visitors to attend the meetings. This allows the NAB to involve the private sector (such as electricity and equipment suppliers) and communities. This wide involvement of stakeholders during the entire process of NAMA implementation is a key success factor for achieving a high quality in implementation.

The responsibility of the NCA is to oversee the work of the NAMA Implementing Entity (NIE) and to approve investments in Intervention 1 (micro-grids). The NIE is reporting on an annual basis to the NCA (see above) on the implementation of the NAMA. These reports also include proposals for necessary corrective action. The NCA will review and discuss these proposals in NAB meetings and involve relevant stakeholders to ensure a broad involvement of all relevant parties in adjustments.

[72] Due to the limited financial capacity of households in Vanuatu, a key success factor is the investment support provided in each intervention. The level of support provided should allow implementing the targeted number of projects/installations in each intervention, therefore a higher level of support will be appreciated by households. On the other hand, experience has shown that own contributions are an important factor in valuing a certain good ("goods for free have no value"). Also, the lower the financial support, the more projects/installations the NAMA donor can finance. Therefore a good balance needs to be found, which can be adjusted from time-to-time.

7 NAMA Finance

7.1 Methodology and Cost Analysis for implementation and operation of the NAMA

The following table gives an overview on the cost components in each of the three interventions:

	Intervention 1 – Micro-grids	Intervention 2 – grid extension	Intervention 3 – individual solutions for households
Investment support	• Support to co-finance investments into micro-grids	• Support to co-finance investments into grid extensions • Support to co-finance investments into household connections	• Support to co-finance investments into Solar Home Systems
Loan schemes	• Loan schemes to co-finance investment into micro-grids	-	• Loan schemes for households to purchase SHS
Capacity building	• Capacity building to identify suitable locations for micro-grids • Capacity building activities to train communities in operating micro-scale electricity grids		• Capacity building activities to train households on correct operation and maintenance of SHS
Adaptation of legislative environment	• Adaption of legislative environment to allow households/businesses to feed electricity into the grids		

Table 12: Cost components for the three Interventions

The following cost estimates are made for the preparation and implementation of the NAMA:

Investment Support

This is the biggest component and has to be analyzed by the three interventions:

Micro-grids

The costs for micro-grids very much depend on the size of the area to be supplied with electricity, the number/type of consumers and the capacity (in kW) required to serve the area. For each of the micro-grids, the implementer (most likely PPPs between private companies and communities) will have to investigate costs of implementation and operation.

In order to be able to estimate the financial funds required for this Intervention, certain assumptions can be made. In a study, UNDP[73] developed a model design which can supply electricity to 100 households (with a total of 400 inhabitants) as well as provide electricity for income generating activities. The model design comes in 2 versions, either a solar/battery system or a solar/biodiesel hybrid system. Due to the higher number of PV panels required and the costs of the batter, the solar/battery system is almost double as expensive as the solar/diesel hybrid system. Therefore, only the solar/diesel hybrid system is taken into consideration.

The system consists of the following components:

- 19 kWp PV panels
- Combined inverter/transformer
- Control system
- 15 kW diesel genset incl. controller
- Micro-grid with cables

Total investment cost for this system is USD 224,000. Assuming the implementation of 15 micro-grids and an investment support of 50%, required contribution from a NAMA donor would be USD 1,680,000.

Grid extension

For grid extension, cost estimates made under the GPOBA project can be used. The project has 4 components:[74]

- Subsidies for new electricity connections for low income households (USD2.2 million)
- Subsidies for household wiring for low-income households accessing electricity services under the project (USD 2.1 million)
- Implementation support for project management, communications and outreach, and training (USD0.35 million)
- Independent Verification (USD 0.2 million)

Total support provided under the GPOBA project is USD 4.85 million. The expected contribution from households is USD 0.556 million, which gives a support rate of around 90%.

Household solutions

For household solutions, cost estimates made under the VREP project can be used. The project has 2 components:

- Electrification of off-grid households, aid posts and community halls (US$ 3.1 million)
- Technical Assistance and Project Management (US$ 1.6 million)

[73] UNDP: Integrated Sustainable Rural Development: Renewable Energy Electrification and Rural Productivity Zones, 2014

[74] GPOBA: Project Commitment Paper, 2013

The project will contribute to 50% of the costs of SHS, therefore the contribution of the households will be USD 3.1 million.

Loan Schemes

As the investment costs for SHS is quite small (between USD 100 and 200), microfinance would be an ideal tool to facilitate the dissemination of these products. Part of the VREP is the development of microfinance products to encourage lending in rural areas, therefore no additional funding will be required.

Capacity Building

For grid connection, capacity building is already covered by the money committed through GPOBA. Also, VREP has money assigned for capacity building to the Department of Energy and other governmental departments.

Adaption of legislative environment

There are certain adaptations to the legislative environment required, especially in the direction of the implementation of micro-grids and possibilities to feed electricity into existing or future electricity grids. It is difficult to estimate costs, but USD 200,000 is taken as a first estimate. It is expected that the Vanuatu government is covering these costs.

Operation and Management

For the implementation of the NAMA, additional personnel will be required for the various tasks to be carried out. Part of the personnel will most likely be covered either by GPBOA or VREP. At least, 2 additional experts for micro-grids (1 for applications, 1 for technical issues) will be required. As a maximum, 6 additional experts will be hired under the NAMA. Based on total costs of USD 25,000 per person and year (incl. workplace, communication, etc.), overall cost is up to USD 150,000.

The financing of the additional personnel, operation and management costs will involve a success fee component. The start-up costs for additional personnel, operation and management will be covered by the NAMA donor. For the following years, performance indicators (such as projects operationalized or money disbursed to projects) will be defined. Payment by NAMA donors will be based on achievement of these performance indicators.
The following table summarizes the cost components by contributor:

	NAMA donor	Private sector/ households	Vanuatu government
Investments	USD 1,680,000 USD 4,300,000 USD 3,100,000	USD 1,680,000 USD 556,000 USD 3,100,000	
Loan schemes	included		

Capacity building	USD 550,000 USD 1,600,000		
Adaption of legislative environment			USD 200,000
Additional personnel			USD 150,000
Total	USD 11,230,000	USD 5,336,000	USD 350,000

Table 13: Cost components by contributor

Details to be elaborated in full NAMA

8 NAMA MRV

8.1 MRV management

As a NAMA is an instrument of output based aid, a reliable MRV system plays an important role in attracting donors and in the overall success of the NAMA. The methodology for monitoring the effects of the NAMA needs to follow the general principles of transparency, reliability and conservativeness. This is true for all components of monitoring, GHG emissions, SD effects and financial monitoring.

Responsibilities and Process workflow
The main responsibility for the MRV system lies with the Managing Institution, which reasonably delegates some of the tasks to the project implementers (PPPs, grid operators, equipment suppliers.

- The project implementers collect data according to the monitoring plan (as part of their approved application) and ensure they fulfill all related requirements such as record keeping and quality control.
- The project implementer reports 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, SD achievements and financial performance of the NAMA activities.
- The NCA checks and approves the annual monitoring report.
- 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.

The following graph visualizes the process:

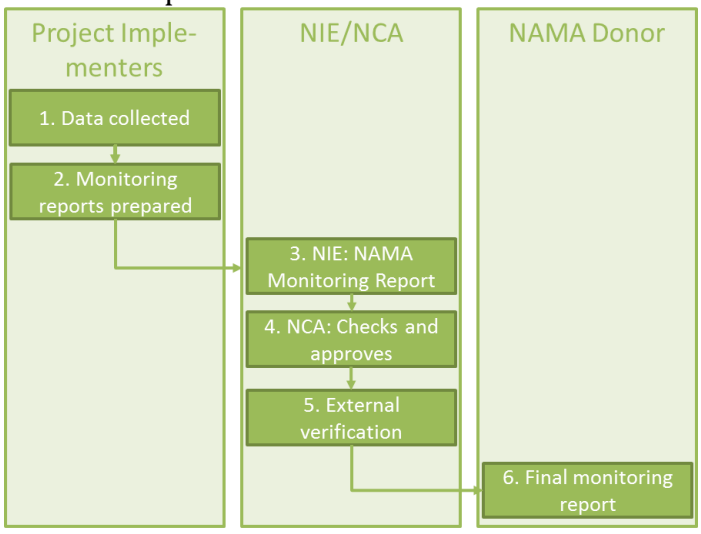

Figure 14: MRV process

8.2 Methodology for monitoring GHG mitigation and Sustainable Development

GHG emission reduction

The proposed methodology for the calculation and monitoring of GHG emission reductions follows to a large extent the Gold Standard Suppressed Demand Methodology "Micro-scale Electrification and Energization".

GHG emission reductions in a given year y (ER_y) are calculated by comparing actual (project) emissions (PE_y) with the emissions under a baseline scenario (BE_y).

$ER_y = BE_y - PE_y$

Baseline
As described in chapter **Error! Reference source not found.** the baseline approach is defined ex ante and the Minimum Service Levels for each consumer group (e.g. $MSL_{ec,hh,y}$) per unit as well as the baseline emission factor (EF) are fixed for the whole lifetime of NAMA intervention (the lifetime of the NAMA is agreed between the NAMA donor and the NAMA implementer).

Parameter	Description of parameter	MSL consumption value (kWh per day)
$MSL_{ec,hh,y}$	Energy consumption (ec) for a household (hh) in year (y)	3.0
$MSL_{ec,hc,y}$	Energy consumption (ec) for a health center (hc) in year (y)	8.6
$MSL_{ec,d,y}$	Energy consumption (ec) for a dispensary (d) in year (y)	4.1
$MSL_{ec,s,y}$	Energy consumption (ec) for a school (s) in year (y)	10.0
$MSL_{ec,k,y}$	Energy consumption (ec) for a kindergarten (k) in year (y)	4.4
$MSL_{ec,pa,y}$	Energy consumption (ec) for a public administration building (pa) in year (y)	4.4
$MSL_{ec,tp,y}$	Energy consumption (ec) for a trading place (tp) in year (y)	11.0

Table 14: MSL values for different consumer groups

In order to calculate the baseline emissions, the number of households and public institutions electrified through NAMA intervention need to be monitored.

Parameter monitored	Description
n_{hh}	number of households with new electricity access under the NAMA
n_{hc}	number of health centers with new electricity access under the NAMA
n_d	number of dispensaries with new electricity access under the NAMA
n_s	number of schools with new electricity access under the NAMA

n_k	number of kindergartens with new electricity access under the NAMA
n_{pa}	number of public administration buildings with new electricity access under the NAMA
n_{tp}	number of trading posts with new electricity access under the NAMA

Table 15: Monitored parameters for calculation of baseline emissions

The total MSL for all consumer groups is calculated as follows:

$$MSL_{ec,y} = (MSL_{ec,hh,y} \times n_{hh}) + (MSL_{ec,hc,y} \times n_{hc}) + (MSL_{ec,d,y} \times n_d) + (MSL_{ec,s,y} \times n_s) + (MSL_{ec,k,y} \times n_k) + (MSL_{ec,pa,y} \times n_{pa}) + (MSL_{ec,tp,y} \times n_{tp}) + (MSL_{ec,xx,y} \times n_{xx})$$

The total $MSL_{ec,y}$ represents the maximum energy consumption that can be accounted for when calculating the baseline emissions. In case the actual electricity consumption ($E_{d,y}$) as monitored is lower than $MSL_{ec,y}$ only the actual consumption can be accounted for.

The default emission factor (EF) for all consumer groups is based on the assumption of using a diesel generator and amounts to 1.3 kg CO_2/kWh.

Baseline emissions are therefore calculated as follows:

$$BE_y = MIN(E_{d,y} / MSL_{ec,y} ;1) * (MSL_{ec,y} * EF)$$

$MIN(E_{d,y} / MSL_{ec,y} ;1)$ is defined as the smaller value of either $E_{d,y}$ divided by $MSL_{ec,y}$ or 1.

Project emissions

Project emissions are monitored for each CEP, by actual measuring the fuel consumption arising from fossil fuel based electricity generation activities. Project emissions from renewable electricity generation are considered to be zero.

Fuel consumption needs to be monitored by each CEP for each fuel type (i) used, and reported to the MI.

The MI then aggregates the data and calculates the project emissions by multiplying the fuel consumption with an emission factor for each fuel type.

$$PE_y = \Sigma(FC_{CEP,I,y} * EF_i)$$

Sustainable Development indicators

As described in chapters 4.4 and 9.1, the following SD parameters will be monitored (depending on the Intervention):

- Air pollution/quality
- Others (Noise/visibility)
- Health
- Time savings/time availability due to project
- Access to clean and sustainable energy
- Income generation/expenditure reduction/Balance of payments

- Job Creation (number of men and women employed)

Details to be elaborated in full NAMA

8.3 Process for reporting GHG mitigation and Sustainable Development.

Reporting just as monitoring takes place on two levels. First on project level and then on national level, managed by the NIE. It is suggested to annually report the status of target achievement to the NAMA financing institution. The reporting process under the NAMA will also allow the Government of Vanuatu to use the results as in input for the Intended Nationally Determined Contributions (INDC).

Details to be elaborated in full NAMA

8.4 Process for verifying GHG mitigation and Sustainable Development.

Verification is a key element of quality control in a NAMA. The annual monitoring reports need to be verified by an external entity. It is suggested to contract a company accredited for the verification of emission reduction projects, such as DOEs accredited under the CDM regime, for this task. The final procedure for selecting a verification company have to be agreed with the NAMA donor.

Details to be elaborated in full NAMA

Cover Photo: Manfred Stockmayer, Energy Changes

Acknowledgements: Manfred Stockmayer & Oliver Percl, Energy Changes

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9 Annexes

9.1 Details on Sustainable Development Indicators for each Intervention

Intervention Name	Intervention 1 – Installation of micro-grids in areas with concentrated electricity demand (around health centers/schools)

Domain	Indicator	Selected (Yes/No)	Identified impacts	Explanation of chosen indicator	Effect on Indicator	Monitoring done (Yes/No)
Environment	Air pollution/quality	Yes	Better air quality, less emissions etc	Fuel-based lighting (such as petroleum lanterns) is associated with soot, indoor air pollution and burns. Burning kerosene causes severe indoor air pollution by emitting noxious fumes and PM, which are, according to the WHO, responsible for millions of cases of asthma and respiratory illnesses every year. Therefore reducing petroleum consumption will lead to reduction in the pollutants thereby having an positive impact.	Positive	Yes
	Water pollution/quality	No				
	Soil pollution/quality	No				
	Others (Noise/visibilty)	Yes	Noise problems through back-up diesel generators	Micro-grids will consist of renewable energy solutions in combination with diesel generators as back-up solution. These diesel generators can create additional noise in areas, which were not yet facing this problem. Micro-grid implementers will have to take measure to mitigate potential noise problems	Negative	Yes
	Biodiversity and Ecosystem balance	No				
Social	Health	Yes	Improvement of health situation	The NAMA will Improve healhcare conditions by avoiding burning petroleum (used for petroleum lamps in houses during evening and night), which causes severe indoor air pollution by emitting noxious fumes. Those are, according to the WHO, responsible for millions of cases of asthma and respiratory illnesses every year.	Positive	Yes
	Liveleihood of poor, poverty alleviation,peace	Yes	Improvement of livelihood of poor	The NAMA will improve light conditions allowing children to study at home, which has a significant impact on improving child education in rural families. Petroleum lighting is extremely hazardous and is responsible for many burns and deaths as well as loss of property through fires.	Positive	No
	Access to Sanitation and cean drinking water	No				
	Food security (Access to land and sustainable agriculture)	No				
	Time savings/time availability due to project	Yes	Ability to work in the evening	With a better light source, also adults may pursue their tasks in the house beyond nightfall and create additional income by selling handicrafts produced in the evening hours.	Positive	Yes
Growth and Development	Access to clean and sustainable energy	Yes	People less dependent on petroleum	Energy plays a critical role in economic development and poverty alleviation. In the absence of reliable grid electricity, households across the developing world depend on petroleum candles, biomass, and other non-electric sources for their lighting needs . There exists no convenient replacement for petroleum as light source in rural areas of Vanuatu because the public electricity system fails to reach rural customers on large scale and cannot provide them with uninterrupted power. The implementation of the NAMA will make people less dependent on expensive petroleum	Positive	Yes
	Education	Yes	Better learning conditions, access to radio and internet	Enhance education by allowing studying beyond daylight, introducing better learning conditions such as computer facilities, internet and distance learning if there is a lack of teachers. Access to radio and internet will also improve education and knowledge of grown-ups.	Positive	No
	Empowerment of women	No				
	Access to sustainable technology, Capacity development	No				
	Equality (quality of jobs given, job condition for men/women)	No				
Economic	Income generation/expenditure reduction/Balance of payments	Yes	Enhance productivity, efficiency, more business opportunities	Electricity allows to implement simple services such as providing cooling/freezing space or mobile phone charging to the establishment of Rural Productivity Zones (RPZ). Enhance efficiency by enabling people to perform better and more tasks at home and thus maximize their productive hours. Provide expanded business opportunities by allowing more time to work at night or by creating additional income by selling handicrafts produced in the evening hours.	Positive	Yes
	Asset accumulation and investments	No				
	Job Creation (number of men and women employed)	Yes	Job creation	There will be direct job creation through the implementation of micro-grid (workers for erecting the grids, operation and maintenance, fee collection, etc.). Indirectly, the micro-grid will generate jobs through new services provided by the availability of electricity.	Positive	Yes

Intervention Name	Intervention 2 – Extension of grids to neighboring communities

Domain	Indicator	Selected (Yes/No)	Identified impacts	Explanation of chosen indicator	Effect on Indicator	Monitoring done (Yes/No)
Environment	Air pollution/quality	Yes	Better air quality, less emissions etc	Fuel-based lighting (such as petroleum lanterns) is associated with soot, indoor air pollution and burns. Burning kerosene causes severe indoor air pollution by emitting noxious fumes and PM, which are, according to the WHO, responsible for millions of cases of asthma and respiratory illnesses every year. Therefore reducing petroleum consumption will lead to reduction in the pollutants thereby having an positive impact.	Positive	Yes
	Water pollution/quality	No				
	Soil pollution/quality	No				
	Others (Noise/visibilty)	No				
	Biodiversity and Ecosystem balance	No				
Social	Health	Yes	Improvement of health situation	The NAMA will Improve healhcare conditions by avoiding burning petroleum (used for petroleum lamps in houses during evening and night), which causes severe indoor air pollution by emitting noxious fumes. Those are, according to the WHO, responsible for millions of cases of asthma and respiratory illnesses every year.	Positive	Yes
	Liveleihood of poor, poverty alleviation,peace	Yes	Improvement of livelihood of poor	The NAMA will improve light conditions allowing children to study at home, which has a significant impact on improving child education in rural families. Petroleum lighting is extremely hazardous and is responsible for many burns and deaths as well as loss of property through fires.	Positive	No
	Access to Sanitation and cean drinking water	No				
	Food security (Access to land and sustainable agriculture)	No				
	Time savings/time availability due to project	Yes	Ability to work in the evening	With a better light source, also adults may pursue their tasks in the house beyond nightfall and create additional income by selling handicrafts produced in the evening hours.	Positive	Yes
Growth and Development	Access to clean and sustainable energy	Yes	People less dependent on petroleum	Energy plays a critical role in economic development and poverty alleviation. In the absence of reliable grid electricity, households across the developing world depend on petroleum candles, biomass, and other non-electric sources for their lighting needs . There exists no convenient replacement for petroleum as light source in rural areas of Vanuatu because the public electricity system fails to reach rural customers on large scale and cannot provide them with uninterrupted power. The implementation of the NAMA will make people less dependent on expensive petroleum	Positive	Yes
	Education	Yes	Better learning conditions, access to radio and internet	Enhance education by allowing studying beyond daylight, introducing better learning conditions such as computer facilities, internet and distance learning if there is a lack of teachers. Access to radio and internet will also improve education and knowledge of grown-ups.	Positive	No
	Empowerment of women	No				
	Access to sustainable technology, Capacity development	No				
	Equality (quality of jobs given, job condition for men/women)	No				
Economic	Income generation/expenditure reduction/Balance of payments	Yes	Enhance productivity, efficiency, more business opportunities	Provide expanded business opportunities by allowing more time to work at night or by creating additional income by selling handicrafts produced in the evening hours.	Positive	Yes
	Asset accumulation and investments	No				
	Job Creation (number of men and women employed)	Yes	Job creation	There will be direct job creation through the grid extension (workers for erecting the grids, operation and maintenance, fee collection, etc.).	Positive	Yes

Intervention Name	Intervention 3 – Individual solutions for households

Domain	Indicator	Selected (Yes/No)	Identified impacts	Explanation of chosen indicator	Effect on Indicator	Monitoring done (Yes/No)
Environment	Air pollution/quality	Yes	Better air quality, less emissions etc	Fuel-based lighting (such as petroleum lanterns) is associated with soot, indoor air pollution and burns. Burning kerosene causes severe indoor air pollution by emitting noxious fumes and PM, which are, according to the WHO, responsible for millions of cases of asthma and respiratory illnesses every year. Therefore reducing petroleum consumption will lead to reduction in the pollutants thereby having an positive impact.	Positive	Yes
	Water pollution/quality	No				
	Soil pollution/quality	No				
	Others (Noise/visibilty)	No				
	Biodiversity and Ecosystem balance	No				
Social	Health	Yes	Improvement of health situation	The NAMA will Improve healhcare conditions by avoiding burning petroleum (used for petroleum lamps in houses during evening and night), which causes severe indoor air pollution by emitting noxious fumes. Those are, according to the WHO, responsible for millions of cases of asthma and respiratory illnesses every year.	Positive	Yes
	Liveleihood of poor, poverty alleviation,peace	Yes	Improvement of livelihood of poor	The NAMA will improve light conditions allowing children to study at home, which has a significant impact on improving child education in rural families. Petroleum lighting is extremely hazardous and is responsible for many burns and deaths as well as loss of property through fires.	Positive	No
	Access to Sanitation and cean drinking water	No				
	Food security (Access to land and sustainable agriculture)	No				
	Time savings/time availability due to project	Yes	Ability to work in the evening	With a better light source, also adults may pursue their tasks in the house beyond nightfall and create additional income by selling handicrafts produced in the evening hours.	Positive	Yes
Growth and Development	Access to clean and sustainable energy	Yes	People less dependent on petroleum	Energy plays a critical role in economic development and poverty alleviation. In the absence of Solar Home Systems, households across the developing world depend on petroleum candles, biomass, and other non-electric sources for their lighting needs . There exists no convenient replacement for petroleum as light source in rural areas of Vanuatu because the public electricity system fails to reach rural customers on large scale and cannot provide them with uninterrupted power. The implementation of the NAMA will make people less dependent on expensive petroleum.	Positive	Yes
	Education	Yes	Better learning conditions, access to radio and internet	Enhance education by allowing studying beyond daylight, introducing better learning conditions such as computer facilities, internet and distance learning if there is a lack of teachers. Access to radio and internet will also improve education and knowledge of grown-ups.	Positive	No
	Empowerment of women	No				
	Access to sustainable technology, Capacity development	No				
	Equality (quality of jobs given, job condition for men/women)	No				
Economic	Income generation/expenditure reduction/Balance of payments	Yes	Enhance productivity, efficiency, more business opportunities	Provide expanded business opportunities by allowing more time to work at night or by creating additional income by selling handicrafts produced in the evening hours.	Positive	Yes
	Asset accumulation and investments	No				
	Job Creation (number of men and women employed)	Yes	Job creation	There will be direct job creation through the sale and maintenance of Solar Home Systems	Positive	Yes

10 References

Dornan Matthew: Access to Electricity in Small Island Developing States of the Pacific: Issues and Challenges, 2014

Ecofys: Intended Nationally Determined Contributions under the UNFCCC, 2014

GIZ: Nationally Appropriate Mitigation Actions – A Technical Assistance Source Book for Practicioners

GTZ and SenterNovem (2009) *Energising development: Report on Impacts*. GTZ, Eschborn, Germany. http://www.government.nl/files/documents-and-publications/reports/2009/06/01/energising-development-report-on-impacts/energising-development.pdf

GPOBA: Project Commitment Paper, 2013

IISD: Financing Nationally Appropriate Mitigation Actions (NAMAs): Leveraging private investment, 2014

IRENA: Handbook on Renewable Energy Nationally Appropriate Mitigation Actions (NAMAs) for Policy Makers and Project Developers

IRENA: Issues Report for Vanuatu, 2014

IRENA: Pacific Lighthouses – Renewable energy opportunities and challenges in the Pacific Islands region – Vanuatu, 2013

Melanesia's Million Miracle Programme (M3P): Promoting Universal Access to Modern Energy Services in Vanuatu, 2013

McCoy-West, et.al.: Geothermal Power Potential of Selected Pacific Nations, 2009

NAMA registry (UNFCCC): http://www4.unfccc.int/sites/nama/SitePages/Home.aspx

Practical Action (2014) *Poor people's energy outlook 2014: Key messages on energy for poverty alleviation*, Rugby, UK: Practical Action Publishing.

REN21 (2014) (Renewable Energy Policy Network for the 21st century): *Renewables 2014, Global Status Report*.

Republic of Vanuatu: The Environment Management and Conservation Act No. 12 of 2002

Republic of Vanuatu: Electricity Supply Act No. 21 of 2000

Republic of Vanuatu: Utilities Regulatory Authority Act No. 11 of 2007, 2007

Republic of Vanuatu: Chapter 197 – Geothermal Energy, 1987

Republic of Vanuatu: Vanuatu National Energy Road Map, 2013

SE4ALL: http://www.se4all.org

The World Bank: Project Paper for Small RETF Grant to the Government of Vanuatu for a Rural Electrification Project, 2013

UNDP: Integrating energy access and employment creation to accelerate progress on the Millennium Development Goals in Sub-Saharan Africa, 2012

UNDP: Integrated Sustainable Rural Development: Renewable Energy Electrification and Rural Productivity Zones, 2014

UNEP Risoe: Institutional aspects of NAMA development and implementation, 2014

UNFCCC (2007), http://unfccc.int/files/meetings/cop_13/application/pdf/cp_bali_act_p.pdf

UNFCCC (2009), http://unfccc.int/resource/docs/2009/cop15/eng/11a01.pdf

UNFCCC: Intended nationally determined contributions of Parties in the context of the 2015 agreement, 2014

UNFCCC/UNEP/UNDP, Guidance for NAMA Design – Building on Country Experience, 2013

UNDP: Sustainable Development Evaluation Tool, 2014

US Energy Information Administration: Electric Power Monthly, 2013

VaasaETT: Household Energy Price Index for Europe, 2013

Vanuatu National Statistics Office 2009, *2009 National Census of Populationand Housing, Summary release.* https://governmentofvanuatu.gov.vu/2009%20Census%20Summary%20release%20final5876.pdf?download=1%3Acensus