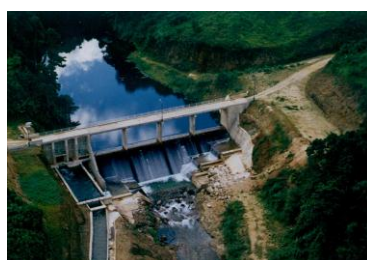




Vanuatu National Energy Road Map 2013-2020



March 2013

Acronyms and Abbreviations

ADB	Asian Development Bank
AusAID	Australian Agency for International Development
CIF	Climate Investment Funds
DOE	Department of Energy
FAESP	Framework for Action on Energy Security in the Pacific
GHG	Greenhouse Gas
GoV	Government of Vanuatu
GPOBA	Global Partnership for Output Based Aid
HDI	Human Development Index
LED	Light Emitting Diode
LPG	Liquefied Petroleum Gas
LV	Low Voltage
MEPS	Minimum Energy Performance Standards
MDGs	Millennium Development Goals
MIPU	Ministry of Infrastructure and Public Utilities
MV	Medium Voltage
OBA	Output Based Aid
PALS	Pacific Appliance Labeling and Standards
PIES	Public Institutions Electrification Scheme
PPAs	Power Purchase Agreements
PPC	Pacific Petroleum Company
PPPs	Public Private Partnerships
PV	Photovoltaic
RLSS	Rural Lighting Subsidy Scheme
SREP	Scaling Up Renewable Energy Program in Low Income Countries
SWAp	Sector Wide Approach
SWER	Single Wire Earth Return
UNELCO	Union Electrique du Vanuatu Limited
URA	Utilities Regulatory Authority
VERD	Vanuatu Energy for Rural Development
VISIP	Vanuatu Infrastructure Strategic Investment Plan
VUI	Vanuatu Utilities & Infrastructure Limited

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Foreword

Vanuatu places great importance on ensuring sustainable development in the energy sector. Energy is an important driver of economic growth, and will make a significant contribution to improving the living standards of the people of Vanuatu. A reliable and efficient energy sector will help local businesses to grow and will ensure that consumers can access the goods and services they demand. Modern energy sources provide a key platform for achieving the Government’s vision of “an educated, healthy and wealthy nation”

It brings me great pleasure to write this foreword for Vanuatu’s first National Energy Road Map, which has been endorsed of the Council of Ministers and the Government. This Road Map has been developed using a “whole-of-sector” approach, and provides a clear focus for all sector stakeholders to participate in energy sector progress. I wish to thank the Department of Energy, other government agencies, provincial council representatives, development partners, private sector participants, consumers, and the community for their contributions to this Road Map. I also would like to encourage continued involvement from all stakeholders in the energy sector to ensure that actions described in this Road Map are implemented.

The process of developing this Road Map has been challenging. The Government has not previously collected data on energy sector performance in a systematic way—limiting how far this Road Map can reasonably take recommendations in some areas. A Road Map such as this clearly needs to be a living document, and be open to incorporating further data and information as it becomes available.

These challenges make the delivery of this Road Map all the more remarkable. This Road Map reflects the Government’s firm belief that a fundamental break from the past is needed to achieve the outcomes demanded by the people of Vanuatu. The Government is not prepared to wait for further data and analysis before taking concrete steps forward with sector reform and investment.

I am confident that this Road Map will make a significant contribution to developing a pathway towards a brighter, energized future for Vanuatu. I strongly encourage donors and lenders to support the Government in developing the Vanuatu energy sector by contributing to the initiatives identified in this Road Map. With the continued support of our energy sector stakeholders, and the recommendations in this Road Map, we now have achievable targets to make a step change in the development of Vanuatu’s energy sector.

Hon. Moana Kalosil CARCASSES

Prime Minister of Vanuatu

March 2013

Vanuatu National Energy Road Map

Overall Vision: “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.”

The Roadmap has a focus on the five energy sector priorities:

1) **Access** - Access to secure, reliable and affordable electricity for all Citizens by 2030

Description:

- 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)

Targets:

- Within concession areas; 75% household connected by 2015, 90% by 2020 and 100% by 2030
- Close to concession areas; 33% household connected by 2015, 90% by 2020 and 100% by 2030
- Off-grid areas; 100% households having access to modern electricity via individual homes systems and basic power products by 2020
- Public Institutions; 90% having access by 2015 and 100% by 2020

2) **Petroleum Supply:** Reliable, Secure and Affordable Petroleum Supply throughout Vanuatu

Description:

- 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

Targets:

- Reduce the cost of distributing all petroleum products in Vanuatu by 5% in 2015 and 10% in 2020
- Improvements in Health, Safety and Environmental Standards. All Operators to meet new standards by 2020.

3) **Affordability** - A more affordable and low cost of energy services in Vanuatu

Description:

- 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

Targets:

- 65% renewable energy by 2020
- 20% improvement in diesel efficiency by 2020

4) Energy Security: An Energy Secure Vanuatu at all times**Description:**

- 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

Targets

- 40% of renewable energy generation by 2015 and 65% by 2020
- 10% improvement in diesel efficiency by 2015 and 20% by 2020

5) Climate Change- Mitigating climate change through renewable energy and energy efficiency.**Description:**

- Examine options for increasing renewable energy and improving energy efficiency and conservation

Targets:

- 40% of renewable energy generation by 2015 and 65% by 2020
- 20% improvement in Diesel efficiency by 2020
- Comprehensive data collection established to set realistic targets and begin energy efficiency initiatives

Executive Summary

Vanuatu National Energy Road Map: Towards a Brighter Future for All A Transformative Sector-Wide Programme

Energy is a fundamental enabler and catalyst for economic development and for enhancing the livelihoods and well-being of all Vanuatu citizens. This National Energy Road Map (“Road Map”) presents the Government of Vanuatu’s comprehensive action plan for developing the energy sector in a systematic, rational, and strategic and sustainable manner over the medium term, for the benefit of all its citizens nationwide.

The Road Map directly responds to the highest priority objectives in the energy sector from a national development perspective, and addresses the key constraints that have held back Vanuatu’s energy sector in the past from delivering affordable modern energy access, efficiently and sustainably to the vast majority of the population. It presents a systematically structured pathway and a balanced multi-prong action plan for implementation, including specific near and mid-term investments (on-grid and off-grid) for expanding access at least cost and renewable energy development, and for energy supply and demand-side efficiency improvements. Investment alone will not be sufficient, unless complemented by timely and effective enabling actions on several other fronts; especially enabling policy, institutional framework, and capacity strengthening.

The Road Map also projects financing requirements for the energy sector implementation program timeframe 2013-2018 (“Prospectus”); comprising specific investments identified to date – from existing studies – and that are part of an overall least-cost access scale-up plan for national development, as well as priority policy initiatives, and targeted capacity building for key sector institutions to enable effective implementation of the NERM

The vision of “an educated, healthy and wealthy nation”

The Vanuatu Government has established a national development vision of “an educated, healthy and wealthy nation”. This requires the provision of modern and clean energy services that are reliable, widely accessible and affordable, and crucially as well in a timely and sustainable manner. Broad access to electricity enables productive activities, provides lighting for reading, and improves communication. Modern cooking solutions improve health and safety outcomes in households and reduce mortality rates, particularly among women and children. Directly and otherwise, modern energy is central to achieving progress on almost all dimensions of human welfare and development, including: education, health care, access to water, essential communications and information as well as simple financial transactional services, income generation, and environmental sustainability.



Directly and otherwise, modern energy is central to achieving progress on almost all dimensions of human welfare and development, including: education, health care, access to water, essential communications and information as well as simple financial transactional services, income generation, and environmental sustainability.

The NERM’s driving vision and the action plan are consistent with and informed by the experience in many other countries that have successfully and effectively advanced along their national road maps

towards the goal of affordable universal access; and have demonstrably experienced the impacts that modern energy can have to achieve development goals.

The Three Pillars of Vanuatu's Energy Road Map

In light of the starting context and key challenges identified, the Road Map specifies achievable goals, interim outcome targets, and sets in motion specific actions towards effectively addressing the key priorities. In particular, the NERM has identified three strategic directions of action in the sector institutional framework that are necessary to enable achievement of the targets and outcomes sought in a timely manner:

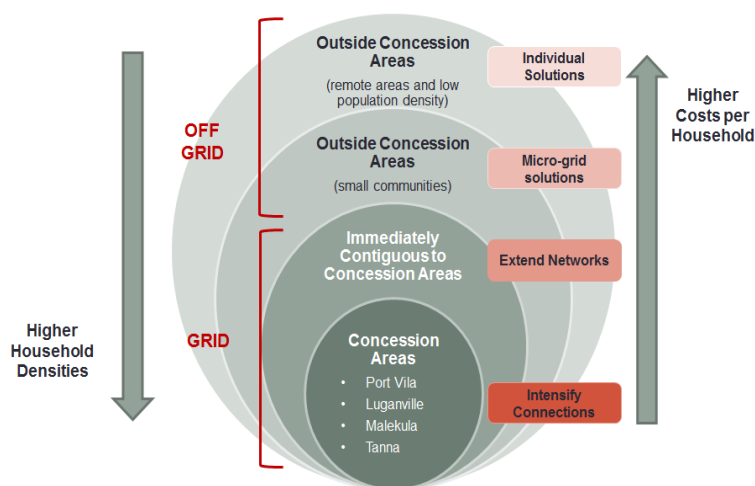
- **Government leadership and commitment- getting the policies right and staying the course.** The Government will establish a comprehensive and consistent set of enabling policies, a strengthened legislative and regulatory framework, and targeted financing mechanisms to be transparently applied for all sector stakeholders, in a sustained and predictable way in accordance with laws and regulations; to ensure that going forward Vanuatu's energy sector institutions and private sector work together in achieving the sector outcome targets and expectations within the time frames specified in this Road Map.
- **Empowering and holding accountable key energy institutions.** Effective and fast-paced implementation requires strong sector institutions (DoE, URA, and MLNR), with the requisite legislative mandate, autonomy and independence, while being held accountable for delivering results. Specific initiatives are outlined in the main report.
- **Implementing a sector-wide approach under the principle of "Many Partners, One Team, One Plan".** The Road Map initiatives aim together to transform the sector by moving away from a fragmented and a piece-meal project-based approach - within concession areas and off-grid programs - towards a programmatic framework for coordinated implementation and sector development; and anchored by a sound overall least cost sector-wide investment program, directly linked to the Government's sector outcome targets that are aligned with the national development vision priorities. 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; especially in existing concession areas and to the extent capacity exists, outside these areas as well. At the same time, the Government appreciates that public funds will have to be raised as well, in a sustained and programmatic manner, to co-finance the public good elements of the access scale up program; including well designed and targeted subsidies to address affordability of energy access especially for the poorer segments.

Strategic Investment Planning Framework for Scaling up Electricity Access Nationwide by 2030.

Facilitating timely delivery of modern and affordable energy services to households, communities and institutions - irrespective of where they live in Vanuatu - represents a particularly challenging aspect of the implementation strategy and investment and financing requirements analysis underlying the Road Map; requiring the balancing of technical, economic, regional balance and equity, as well as financial considerations in identifying the least cost energy services delivery options and mechanisms. In particular, the economic and physical geography and spatial demographic spread and dispersed settlement patterns of the population across Vanuatu together contribute to high average investment cost for scale up. The Government also recognizes that real

progress to extend affordable access nationwide will require well designed and targeted subsidies, especially for the poorer segments of the population. The Road Map has made a beginning in this direction and identifies targeted subsidy programs in concession (grid) areas and in off-grid areas for implementation in the near-to-medium term.

Specifically, the least cost sector-wide electrification strategy underlying the identified investments in the Road Map, as well as those to guide its future development and expansion, is tailored broadly to each of four categories of access scale up delivery mechanisms, best suited depending on where the households are geographically situated and the settlement patterns within those communities. This is depicted schematically in the Figure on the



right; with energy service standards and delivery mechanisms that are least cost for their respective contexts. The strategy comprises a multi-prong complementary set of interventions of least cost grid-based electrification rollout, well-designed and comprehensive off-grid access scale-up programs, and cost effective renewable energy development and energy efficiency improvement investments. Consistent with the strategic framework outlined above, for scaling up electricity access, the Table below presents the Government’s targets for the electricity sector differentiated by customer segments.

Electricity Access – Baseline and Road Map Targets *

	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.

National Energy Road Map Action Plan (2013-2020) - Estimated Cost by Component Category

The initiatives unveiled in this Road Map, encompass a program estimated to cost about US\$200 million over the medium term 2013-2020; to implement a coordinated set of actions along three fronts:

- **Policies** and legislative mandate changes to enable future development of the sector, including a framework for public private partnerships, subsidy policy, resource development policy (about US\$5 m)
- **Investments** required to deliver the priority outcomes within a public-private partnership framework (about VUV 20 billion or US\$ 230 million). Such priority outcomes include: the Energy for Rural Development Programme for off-grid access, increasing access within existing concession areas through a targeted capital subsidy support program for the poor, and the Efate geothermal power and island ring network development (subject to resource confirmation and further feasibility studies).
- **Institutions** accountable for management of the Road Map implementation; including technical assistance for building skills in energy planning and policy analysis; project management for off-grid program delivery; program results and monitoring framework and information management, and for critical investment gap studies (about US\$ 13million)



The Table below shows a breakdown of cost by major component categories, in the petroleum and electricity sub-sectors.

Summary of Road Map Components

		Total Estimated Cost (US\$)
PETROLEUM SECTOR		
Technical Assistance		US\$1.1 m
Investments		US\$19.3 m
Subtotal Petroleum Sector		US\$20.4 m
ELECTRICITY SECTOR		
Technical Assistance, priority studies, capacity building, Implementation support		US\$24.3 m
Investments		
Access Investments	Households – Grid Connections	US\$7.5 m

	Total Estimated Cost (US\$)
Households – Grid Extensions	US\$18.0 m
Households – Off-grid	US\$5.2 m
Public Institutions – Off-grid	US\$6.5 m
Administration and services	US\$8.0 m
Efate ring road transmission/distribution extension	US\$23.5 m
Other access investments	US\$6.9 m
Renewable Energy Investments	US\$110.6 m
Subtotal Electricity Sector	US\$210.5 m
TOTAL	US\$230.9 m

Vanuatu is fortunate in having an actively engaged private sector and that is keen to participate in the sector’s growth and expansion. Success of the Road Map in achieving the outcomes and results sought will depend in large measure on their continued and constructive engagement, including significant investment, under an enabling framework to be established the Government. Another key to the success of this transformative sector-wide programme will be continued and significant support from development partners that is harmonized and aligned within a programmatic framework.



Devil's Point Wind Farm, Efate (3 MW)

1. Introduction

The Government of Vanuatu has developed a National Energy Road Map to put the sector on the path to achieving objectives shared by the Government, members of the public, development partners, and private energy sector operators. This Road Map provides a consistent basis for tackling energy sector challenges, recognizing that streamlining government policy, legislation, and investment is needed to enable Vanuatu to achieve its development objectives.

This section describes what this Road Map aims to achieve, and how the Road Map has been developed—the guiding principles that have been used to inform key decisions and the process followed to obtain stakeholder input.

1.1. Purpose of the Road Map

Vanuatu's energy needs are met through a partnership between the Government and the private sector. The petroleum supply in Vanuatu is managed by private companies Pacific Petroleum (diesel and petrol) and Origin Energy (Liquefied Petroleum Gas -LPG). In the electricity sector, private companies UNELCO Limited and Vanuatu Utilities Infrastructure (VUI) generate and supply electricity to consumers in the concession areas serviced by them. The Government, through the enabling legislation, regulations, concession contracts, and sector institutions, provides the enabling framework for the private sector participants to operate in the sector profitably and provides the oversight of the sector. In 2007, the Government passed the Utilities Regulatory Authority Act to establish an independent regulator to provide prices and regulatory oversight of the electricity and water sectors. The Department of Energy is charged with the responsibility for rural electrification.

These arrangements have served the nation well, however much more needs to be done to build on these achievements in order to achieve of the Government's vision for the sector.

Like most other Pacific Island nations, Vanuatu has no known indigenous fossil fuels, and has not yet fully developed the renewable energy resources that are available within the country. As a result, the economy relies heavily on imported petroleum products, and has felt the impact of recent volatile and high world prices for petroleum. Electricity prices are also high for many consumers, in part due to on the cost of diesel-fuelled generation. Electricity access rates across Vanuatu are low, and most households (spread over more than 65 inhabited islands) are unable to afford electricity tariffs, connection costs, or individual generation costs.

The issues in the energy sector create significant challenges for Vanuatu's economy, and restrict the progress than can be made in areas of economic and social development (for example, in the education and health sectors). Vanuatu does not have a comprehensive energy policy,¹ and a lack of institutional capacity within the Government constrains much-needed investment in the energy sector.

The Government requires a step-change in energy sector strategy

Continuing with past policies and investment strategies will not achieve what the Government and people of Vanuatu expect from the energy sector. Historically, the Government has pursued fragmented policies to develop the energy sector and has largely been content to respond to individual project proposals from development partners and private investors. This approach has

¹ The most recent energy policy in Vanuatu was published in 2007, and included a work plan only for 2007 and 2009

failed to realize efficiencies across the sector, and is unlikely to unlock all sources of available financing to achieve sector goals.

This means that a break from the past is needed to build the type of energy sector that Vanuatu aims to achieve. The preparation of this Road Map has provided the Government, development partners, private sector participants, and consumers with an opportunity to work together to define their shared objectives for the sector, and to plan out the actions that are needed to achieve those objectives.

A high level vision and strategic priorities will guide the Vanuatu energy sector

The Government has developed a high level vision for Vanuatu’s energy sector, which was announced at the launch of the Road Map development process in October 2011. The vision is:

“To energise Vanuatu’s growth and development through the provision of secure, affordable, widely accessible, high quality, clean energy services for an Educated, Healthy, and Wealthy nation.”

This vision provides strategic guidance to the Government in developing new policies and plans for the energy sector. To achieve the high-level strategic vision, the Government identified priorities, which will focus the future performance of the sector. These priorities are summarized in Table 1.1.

Table 1.1: Overview of Energy Sector Priorities

Priority	Description
Petroleum Supply	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ 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	<ul style="list-style-type: none"> ▪ Examine options for increasing renewable energy and improving energy efficiency and conservation

This Road Map provides recommended actions to rapidly improve energy sector performance

To address the Government's priorities and achieve the strategic vision for Vanuatu, this Road Map presents the Government's blueprint for:

- The **actions** required to achieve the priorities set for the energy sector. These actions include the physical investments in new facilities, and the institutional, legislative and regulatory changes that are needed to support energy sector development. The Road Map also outlines the roles that different entities (the Government, regulator, private sector, development partners) will play in addressing sector priorities.
- The **enabling initiatives** needed to ensure that the actions can be implemented. This recognizes that simply listing investments and policy changes will not lead to the changes that we need to see—other critical inputs include:
 - **Funding and financing**² to transform investment plans into reality. The Road Map highlights financing gaps to enable donors, private sector players, and lenders to understand the range of opportunities in Vanuatu's energy sector.
 - Effective **implementation** plans for delivering the actions. Institutions need to be strengthened and capacity needs to be built, particularly in the areas of energy sector planning, policy making, legislative and regulatory frameworks, and project management.
 - Ongoing **monitoring and evaluation** of the actions taken under this Road Map to ensure that results are being delivered and to identify changes that are necessary to achieve the greatest positive impact.

The Road Map has addressed each of the above five priorities in urban and rural areas, by grouping the priorities into two main sections: petroleum (Section 3) and electricity (Section 4). The Road Map covers the time period to 2020, while including near term targets and actions to 2015.

1.2. How the Road Map has been developed

Difficult decisions have been made throughout the process of developing Vanuatu's first energy sector Road Map. These decisions lay the platform for future investment and growth in the energy sector, and stakeholders are understandably keen to know how decisions have been made.

Guiding Principles Adopted in the Road Map

To ensure consistent and predictable decisions, the following principles have guided this Road Map:

- **Least-cost approaches.** The Government wants to achieve the objectives and priorities set out in this Road Map at the lowest total lifecycle cost from amongst the technically feasible options. This will ensure that the financial resources available to the energy sector will have the greatest possible impact. Implicit in the least-cost approach, the Road Map recognizes that differing qualities of energy services will be provided in different locations (i.e. urban, rural, and remote), reflecting economic and financial feasibility issues, and that different technologies might be used to provide energy services. The differences in service quality are linked to a range of factors, including: a) value and criticality of reliable supply (e.g. hospitals and national communications networks require very high reliability); b) affordability of services and willingness to pay;

² Financing refers the initial payments or upfront capital provided to initiate an investment or development (e.g. bank financing, equity). Funding provides the money to repay an investment over time (e.g. through consumer charges, government subsidies)

c) level of demand; d) the need for and/or the costs of financing and sustainability of any subsidies for different customers (e.g. remote area customers). Over time, the energy supply and demand situation across Vanuatu will change as economic growth and population patterns change and the energy infrastructure and quality and reliability of energy services in different locations will need to be improved to higher quality of service, when economically and financially justified.

- **Pro-active risk management.** The Road Map identifies some important risks to achieving sector objectives and priorities, and suggests approaches to mitigating these risks. For example, the volatility of future petroleum prices is a key risk that directly affects the people of Vanuatu through the price of transport fuels, electricity, and other fuels. The Road Map presents strategies to manage this risk, primarily through diversifying Vanuatu's energy resource mix.
- **Financial sustainability.** The Road Map presents solutions that are able to be maintained over time through tariffs that recover cost of operating the energy sector, including regulatory, operations, maintenance, fuel and financing costs - plus transparent subsidies where needed. Financial sustainability is important for the viability of businesses involved in the production and/or supply of energy. In addition, a transparent and predictable framework for tariff setting and cost recovery is essential to attract the much needed investment necessary to help achieve the Government's priorities for the sector.
- **Environmental and social sustainability.** The investments presented in this Road Map are expected to provide net environmental and social benefits. For example, investing in renewable energy sources will reduce local noise and air pollution near existing diesel generation plants, and will reduce Vanuatu's emissions of greenhouse gases. Similarly, improving the petroleum supply chain between islands will reduce the incidences of small oil spills. The Road Map has considered the impact on the environment when evaluating different investments, and identifies ways to ensure that environmental impacts are mitigated. Special consideration has also been given to groups with specific vulnerabilities, women and the poor, and to incorporate an element of equity. The 'whole of sector' approach in the Road Map includes the provision of sustainable, affordable electricity supply that meets the needs of the poor and those living in remote areas.
- **Clarity of roles.** To achieve real change in Vanuatu's energy sector, different sector players need to be held accountable for results. The Road Map describes clear, appropriate and effective roles for the Government (policy and legal framework – the enabling environment), the regulator (sector oversight), and the private sector (investment) to ensure that parties fulfill their responsibilities for taking each initiative forward. The clarity of roles will ensure efficient and effective management and operation of the sector.

These principles enable the Government to select between different options for sector reform and investment. The initiatives that are presented in this Road Map are considered to evaluate well across each of these principles—they are least-cost, low risk, financially sustainable, environmentally and socially responsible, and clearly allocate roles to different entities.

Process for Developing this Road Map

The process for developing the Road Map was launched by the Hon. Prime Minister of Vanuatu in October 2011, when the Government set out its vision and key priorities for the energy sector.

The Department of Energy is responsible for the development, implementation and review of this Road Map. The Energy Taskforce (which has broad Government representation) has directed the Department of Energy, and has received input from a Technical Committee comprised of the private sector utilities, petroleum suppliers, Government departments, a representative from the business community and the Utilities Regulatory Authority (URA)³. The preparation of the Road Map has been supported by the World Bank as the lead development partner, and has incorporated input from other development partners who are active in Vanuatu.

The Road Map complements a number of other activities in the energy sector and Vanuatu more broadly. Most importantly, the Road Map has worked in tandem with the **Vanuatu Infrastructure Strategic Investment Plan (VISIP)**, which identifies priority projects for infrastructure development in Vanuatu. Key energy sector investments have been coordinated between the VISIP and this Road Map. The Road Map has also drawn on a number of studies of Vanuatu's energy sector and potential energy projects, and incorporates the analysis and findings of the following recent studies:

- AusAID Vanuatu Electricity for Rural Development (VERD) Program, (Program Design Document) November 2012
- ADB, Promoting Energy Efficiency in the Pacific, May 2011
- Castlerock, Vanuatu: Efate Geothermal Power and Island-Ring Grid Development Framework, January 2012
- SMEC, Promoting Access to Renewable Energy in the Pacific (Vanuatu Component), June 2012
- Castalia, Global Partnership on Output-Based Aid: Improved Electricity Access in Vanuatu, Draft Report, September 2012
- Hale & Twomey and David Butcher and Associates, Draft Final Report: Options for Increasing the Efficiency of Vanuatu's Oil and Gas Supply Chain, November 2012
- Annual Reports from the Utilities, URA, and Government Departments

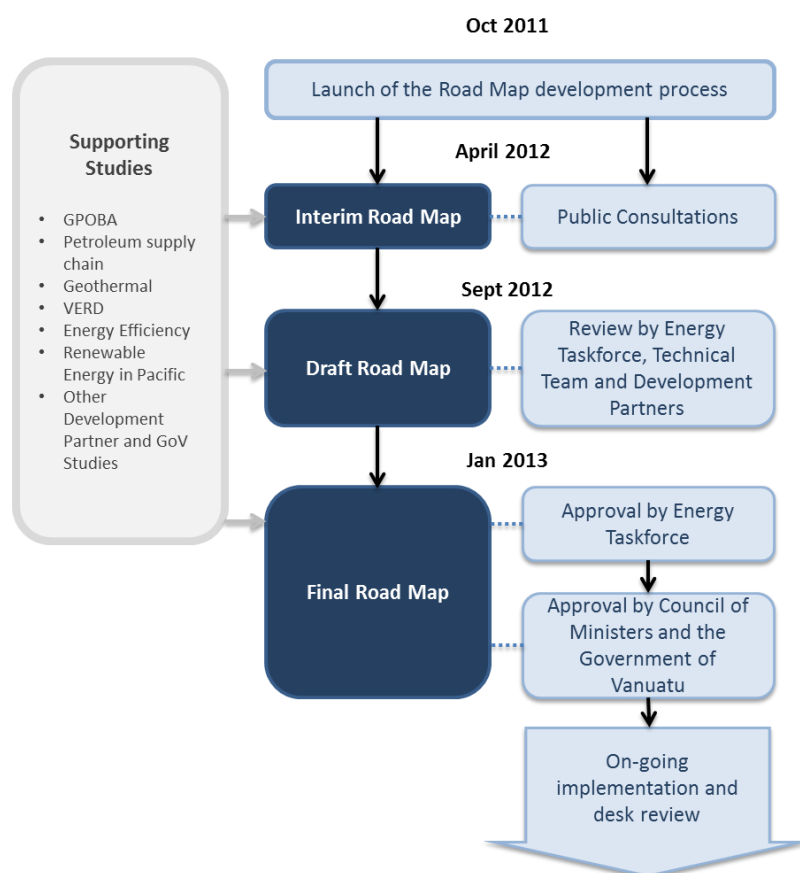
The Road Map extends the work completed in these studies in two ways. First, the Road Map identifies the linkages between different initiatives, and presents them as part of a coherent sector plan. This will help to ensure that separate activities in the energy sector are complementing one another to avoid duplicating effort. Second, the Road Map provides specific detail on implementation, including the timing of specific investments, the next steps to move initiatives forward, and clearly identifies those responsible for the next steps.

Consultations on the Road Map were held in Port Vila and Luganville in March 2012 to gain wider input into the content and direction of the Road Map. Key private and public sector stakeholders, including representatives of provincial councils and community representatives attended these consultations and provided valuable feedback on the priorities and actions identified in the Road Map. Further consultation on the Draft Road Map was then held with the Energy Taskforce, the Energy Technical Team and development partners in September 2012. Written comments were received from these stakeholders which have been incorporated in the final document.

³ Appendix G provides the list of members of the Energy Taskforce and the Energy Technical Team.

The Final Vanuatu National Energy Road Map was considered by the Council of Ministers and endorsed for implementation in January 2013.

Figure 1.1: Overview of the Road Map Development Process



1.3. Contents of the Road Map

The remaining contents of the Road Map are as follows:

- **Section 2 starts by placing the challenges faced in Vanuatu within the context of global energy sector experience.** This section explores the relationship between energy and poverty and development, highlighting the important role that energy plays in bringing populations out of poverty, and driving economic and social development. This section also presents relevant background on Vanuatu’s energy sector, and summarizes the key current challenges facing the sector. Finally, this section presents three key strategic directions for action that are addressed in this Road Map. These strategic directions are designed to steer a break from the past and achieve the vision summarized above.
- **Section 3 presents targets and actions for the petroleum sector.** This section describes what needs to be done in the petroleum sector to achieve the strategic directions and Government priorities, recognizing that petroleum will play an important role in Vanuatu’s transition to modern forms of energy.
- **Section 4 presents targets and actions for the electricity sector.** This section focuses on initiatives that will increase access to electricity, while also ensuring that electricity is affordable to Vanuatu households and businesses. Specific opportunities to develop

Vanuatu's renewable energy resources are presented, together with the implementation steps that will turn these opportunities into reality.

- **Section 5 summarizes the next steps** to achieve a step change in sector performance, and describes the next steps for implementing the recommended actions.

The Government notes that the Road Map is a “living document” and will need to be revised with changing circumstances or with new information. The Government therefore encourages stakeholders to provide feedback on any of the material presented in the Road Map or on other matters for consideration as part of the Road Map. Please provide any comments to Leo Moli, Acting Director of Energy, Department of Energy, lmoli@vanuatu.com.vu.

2. Vanuatu’s Road Map—Builds on Global Experience

Vanuatu’s vision and expectations of its energy sector are consistent with those of many other nations that have successfully advanced along their respective energy sector road maps effectively, efficiently and in a timely manner. This chapter highlights the relevant lessons from international experience to inform the strategic directions and framework principles for addressing the key priorities and actions underlying Vanuatu’s first Energy Road Map. Each of the nations described in this section has charted a unique path towards achieving the widely cherished national vision of achieving near-universal access to modern energy. Each approach needs to be appropriate for the country context; and no single “model” can be attributed to all of them. Nevertheless, the successful national programs have consistently demonstrated a common set of guiding underlying framework principles, which are used to guide this Road Map.

This chapter is organized as follows.

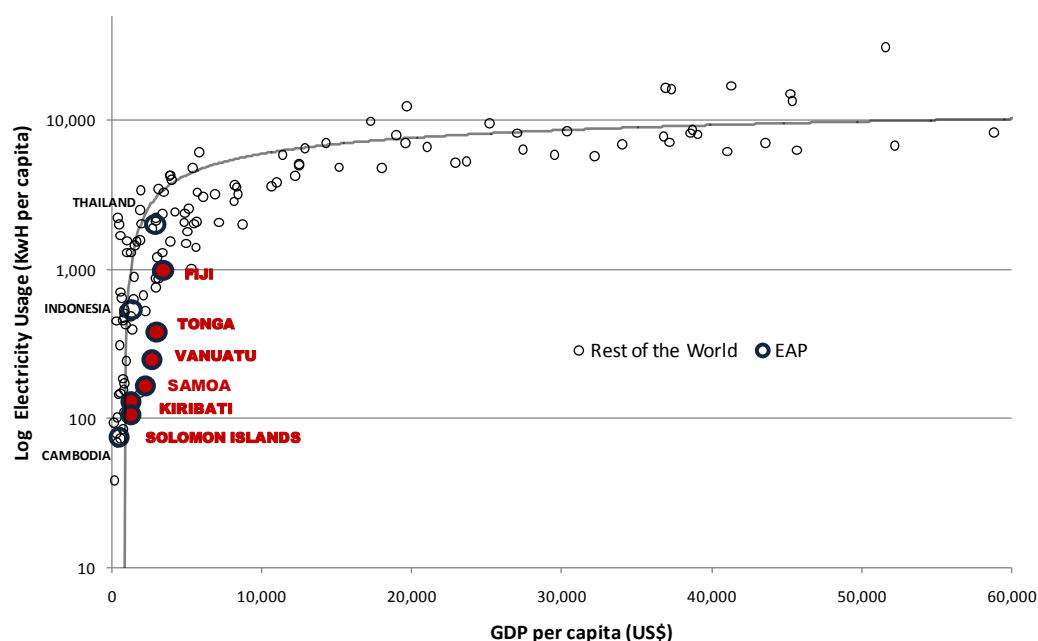
- Section 2.1 highlights the well-established, universally accepted basis and cumulated empirical evidence, that widely accessible and affordable modern energy is a fundamental enabler of economic and human development of a nation. This section highlights the key linkages and essential pathways linking modern energy with the pursuit of broad-based economic growth and prosperity, eliminating poverty, and improving human and social development nationwide; while addressing climate change concerns at the same time. This discussion also puts in focus the central role of “the two faces of energy poverty” – electricity and modern cooking fuels - that a well-designed energy road map needs to effectively address to achieve the development outcomes sought.⁴
- Section 2.2 presents a strategic-level overview of the energy sector in Vanuatu—where the sector is positioned today in relation to the national priority of secure and affordable modern energy access for all. These “starting point coordinates” for the road map ahead also serve to benchmark Vanuatu’s position in terms of modern energy access levels (electricity and modern cooking fuels) attained by a sample of countries (including some Pacific island nations). Vanuatu’s relative position on measures such as the affordability of modern energy and regional balance in coverage is also considered. The discussion in this section illuminates at a strategic level the key challenges that need to be addressed as priorities in this Road Map to expand coverage, achieve regional balance across the provinces, and improve the affordability of modern energy sources.
- Section 2.3 summarizes the strategic directions and framework core principles driving this Road Map, informed by lessons from relevant country-level programs—worldwide and in the region—that are well advanced in implementing their respective national energy road maps; and –that have successfully and effectively addressed, in a timely and efficient manner, the interlocking set of challenges on the path towards the provision of secure, affordable access to modern energy services for all citizens.

⁴ (i) Sustainable Energy Access for ALL (“SE4 ALL) 2025/2030”, UN Rio+20 summit, June 2012; (ii) “Achieving Universal Energy Access To Modern Energy in East Asia and the Pacific Islands – One Goal, Two Paths”, (“1G2P”) Flagship Report, 2011, World Bank, AusAID.

2.1. The Road Map Address the Essential Linkages between Energy, Poverty, and Development

The Road Map builds on a solid and established foundation that access to modern energy is a fundamental enabler and catalyst for economic development, and enhancing the livelihoods and well-being of all Vanuatu citizens. It affects all businesses and every household. This relationship between the use of modern energy and economic growth and development is by now fairly well established. It is widely accepted from worldwide experience that electricity use and GDP per capita are highly correlated (see Figure 2.1). Energy and development are mutually reinforcing factors, in that energy not only results from, but also actively contributes to, economic growth and development in national aggregate average terms (IEA 2010).

Figure 2.1: GDP per Capita v Electricity Use



Note: EAP is East Asia and Pacific Region

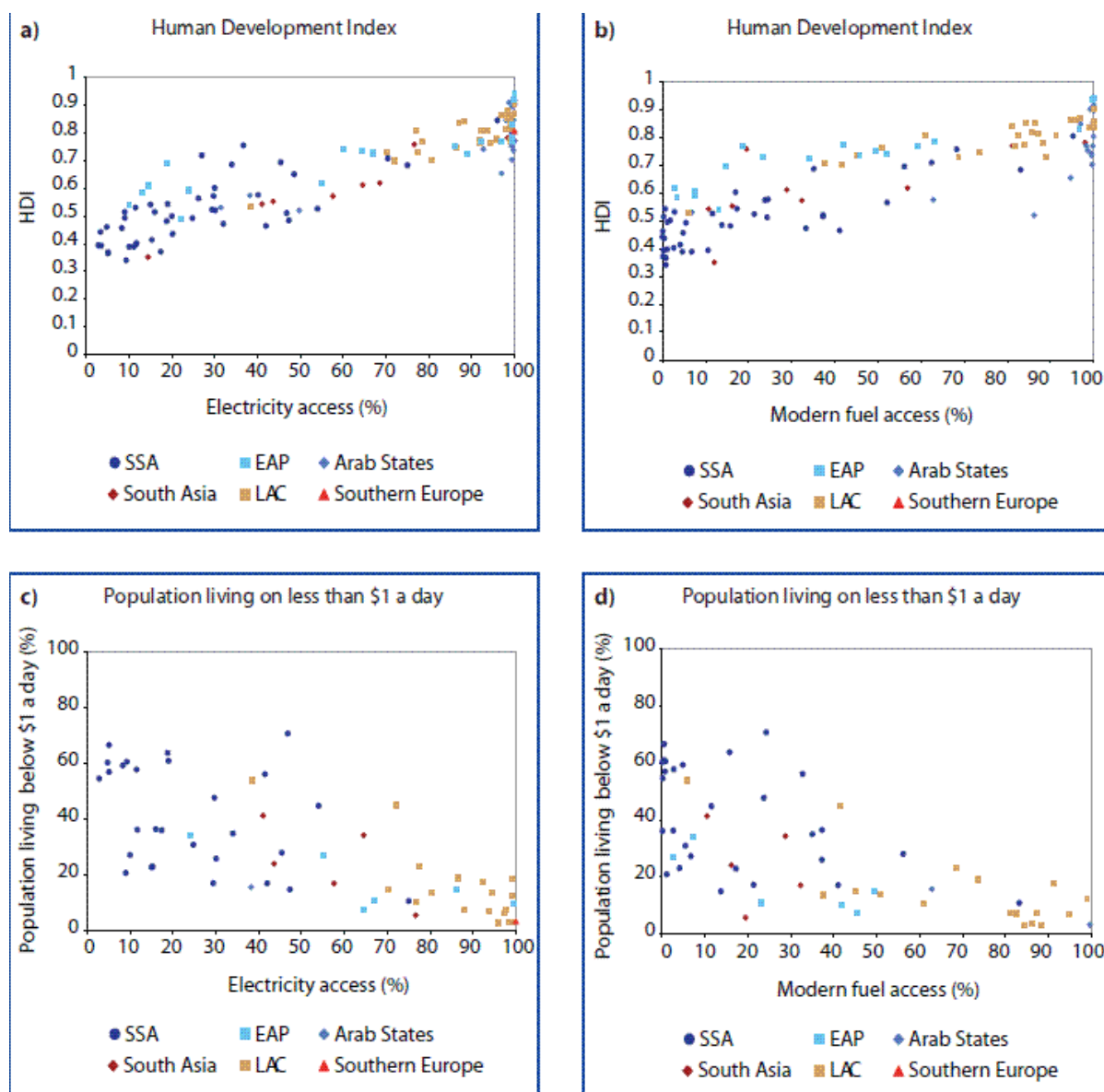
Source: World Bank, Achieving Universal Access to Modern Energy in East Asia and the Pacific, One Goal Two Paths, Flagship Report, 2011, and estimates.

The priority accorded under the Road Map to scaling up affordable and *widespread* access to modern energy in a timely manner stems from the recognition that at the grass roots level, energy fundamentally influences most aspects of peoples' daily lives and well-being. Directly and otherwise, modern energy is central to achieving progress on almost all dimensions of human welfare and development, including: education, health care, access to water, essential communications and information as well as simple financial transactional services, income generation, and environmental sustainability. The lack of access to modern energy services that are affordable, safe, and clean, forces the poor – urban and otherwise - and remotely located population – rural and “off-grid” - to make do with using higher priced inferior alternatives. Left unchecked, such a situation of “energy poverty” entrenches the income poverty trap, exacerbated by the inferior quality of health care, education and other local services needed, while also limiting income generation opportunities.

This is supported by considerable empirical evidence of a significant relationship between access to modern energy and human development. The four graphs in Figure 2.2 highlight the link between

modern energy access and the Human Development Index (HDI) measure of progress on the *basic dimensions of human development* – a long healthy life, access to education and knowledge, and a decent standard of living.⁵ Access to electricity and modern cooking fuels is positively correlated to human development and negatively correlated to measures of poverty and degradation.

Figure 2.2: Human Development and Modern Energy Access



Sources: UNDP (2007), for information on population living on less than \$1 and mortality rates and UNDP (2009) for data on HDI and combined gross education enrolment ratios.

Note: EAP (East Asia and the Pacific), LAC (Latin American and the Caribbean), and SSA (Sub-Saharan Africa)

Source: WHO, UNDP “The Energy Access Situation in Developing Countries”, November 2009

The Human Development Report of United Nations tracks progress in human development across the world. The 197 nations covered in the latest report (HDR 2011), are classified in four country groupings: labeled “very high”, “high”, medium “low” human development.⁶ What is revealing – with far reaching implications for national and energy sector policies, plans and road maps – is *a*

⁵ “The Energy Access Situation in Developing Countries”, WHO, UNDP, November 2009.

⁶ Human Development Report (HDR), 2011 – Sustainability and Equity, a Better Future for All”, United Nations Development Programme (UNDP). The HDI and MPI indices of the UN intend to capture a broader range of human development dimensions than those under the UN’s Millennium Development Goals (MDGs).

country does not have to wait to “get rich” in terms of national income per capita, to afford or achieve a better life for an all its citizens (higher HDI/MPI). Many countries have achieved comparable or even higher indices with lower national incomes. Well-orchestrated and targeted actions and investments for scaling up modern energy access to all can make a big difference in improving the lives of the otherwise excluded rural and poor population segments.

More specifically, *access to modern forms of energy—electricity and “modern cooking solutions”⁷—are both essential for achieving rising and enduring improvements in human development outcomes at the grassroots level, in individual communities, and homes, spread nationwide*, be they situated in urban and proximate areas, rural and “off-grid” areas, or remote settings. First, modern energy is used for the provision of clean water, sanitation, and for effective delivery of health care as well as educational and knowledge services. Second, widespread affordable access enables sustainable development benefits by providing reliable and efficient lighting, heating, cooking, mechanical power, and transport and telecommunication services. In short, national and sector policies require effectively addressing the two faces of “energy poverty”; lack of access to electricity, and lack of access to modern cooking options.

Beyond Energy Access: addressing affordability

If the expected social and economic benefits from modern energy services are to materialize, besides widespread access, well designed and targeted policies aimed at bridging the “affordability gap”, especially for the poor segments of the population, are crucial for ensuring broad-based and sustainable benefits. In the case of electricity, for example, throughout the developing world, electricity usage typically claims a higher share of rural incomes than urban incomes. When electricity connection charges and usage charges (unit prices and monthly bills) are perceived to be unaffordable, many households choose or otherwise cannot afford to connect despite being in an area that already has access to electricity; while many of those with grid connection overly limit their usage.

In respect of the first cost barrier – affordability of the upfront connection charge – good practice experience is instructive. In particular, effectively targeted subsidy policies and financing mechanisms for getting the power to the poor.⁸ Indeed, *the benefits of increased access to electricity are demonstrably high even for poor people*. International studies indicate that the welfare benefits of rural electrification for a household using electricity typically range from US\$10–US\$20 a month, or up to US\$1 per kilowatt hour (kWh). For example, for household lighting alone, the benefits are estimated to be close to US\$0.80 per kWh in Lao PDR and US\$0.50 per kWh in the Philippines. These benefits are much higher than the cost of supplying electricity to rural areas, which ranges between US\$0.15–\$0.65/kWh.⁹

⁷ The term “modern cooking solutions” collectively refers cooking fuels to: modern (electricity, natural gas, liquefied petroleum gas (LPG), and biogas); and advanced clean and efficient cook stoves for wood-based fuels (biomass), coal and charcoal. In contrast the commonly used terms, “traditional cooking fuels” and “solid fuels” refer to wood-based biomass fuels, agricultural residues, and dung. For cooking, “modern energy” and “traditional energy” are used to distinguish between ways of using energy rather than a type of fuel. Thus, the use of natural gas, LPG, biogas as well as solid fuels in efficient or less polluting stoves, is considered together as modern cooking solutions. The use of solid fuels in inefficient or open stoves is considered a traditional cooking method. Coal, charcoal, and kerosene are seen as “transition fuels”, which are best used with efficient or less polluting stoves. Recently ‘advanced cooking stoves’ is a term used to represent a newer generation of stoves that have higher combustion efficiency and are manufactured in either workshops or factories. These can represent major progress over the earlier generation of “improved cooking stoves”.

⁸ A noteworthy case in point is the implementation experience in the national electrification access scale up program of the Lao People’s Republic. The *Power to the Poor Program of Lao PDR* has delivered impressive results, utilizing a well-designed and targeted financing and subsidy mechanisms aimed at increasing the connection penetration rates in rural areas where grid service is available and yet the qualifying poor households cannot afford to connect for several years. Program experience shows that in the areas where it has been introduced the connections have typically risen from 65 percent to the mid-90 percent levels in most locations. ASTAE report; World Bank, *Achieving Universal Access to Modern Energy in East Asia and the Pacific, One Goal Two Paths, Flagship Report, 2011* ; see also Vietnam Lessons of Experience, ASTAE report

⁹ World Bank, *Achieving Universal Access to Modern Energy in East Asia and the Pacific, One Goal Two Paths, Flagship Report, 2011*

Role for well-designed and delivered subsidies

While the potential economic benefits of modern energy access are high in relation to the cost of supply, international experience also points to the essential role of judiciously designed, targeted, and delivered subsidies for grid extensions—Medium Voltage (MV), Low Voltage (LV), customer connections—beyond high density urban areas, as well as subsidies aimed at customer “intensification” in areas where the grid may be nearby but the poor are unable to afford the connection charges. Almost without exception, international experience in countries¹⁰ that have achieved near-universal access unambiguously indicates that their program implementation and results achieved involved capital subsidies for grid extensions into new areas and connections for the poor within reach of an existing grid. These programs also provided subsidies for complementary off-grid initiatives where grid extensions or reach was not a least cost strategy.

The inescapable conclusion is that a soundly designed, national subsidy policy and financing mechanism is an essential component of the overall financing policy platform underpinning national access scale up programs. This is an important component of program design to ensure that participating service providers—public and private—maintain financial viability.¹¹

2.2. Vanuatu’s Energy Sector: Context and Challenges

This section presents a strategic level overview of the energy sector context and related challenges in light of where Vanuatu is positioned today against its national priority of secure and affordable modern energy access for all. The discussion serves to illuminate at a strategic level, key challenges to be addressed on a priority basis in the Road Map to expand coverage, achieve regional balance, and improve the affordability of modern energy.

Petroleum - High dependency on imports and exposure to price volatility

Consumers of petroleum in Vanuatu are currently served predominantly by two private suppliers—Pacific Petroleum Company (diesel, petrol, kerosene and lubricants) and Origin Energy (LPG). Both are supported by a few private retailers and distributors throughout the country. The sector is largely self-governing, and although both private companies adhere to many international standards, the regulatory framework needs substantial strengthening. The Price Control Act 1974 provides the enabling framework to monitor petroleum product prices but this has not been undertaken since the early 1990s. Additionally, the security of supply (in terms of prices and physical supply) of petroleum products is a large concern for the many businesses and households reliant on petroleum products.

The Vanuatu market for petroleum and LPG is small by regional standards, with annual domestic demand in 2010 of around 56 million litres (including 3 million litres of LPG) or about 10 percent of the size of Fiji's market. Assuming sufficient storage was available in Vanuatu, its annual petroleum demand could be met by slightly more than one delivery from the 40,000 tonne Medium Range ocean tanker currently used to deliver fuel to Vanuatu.

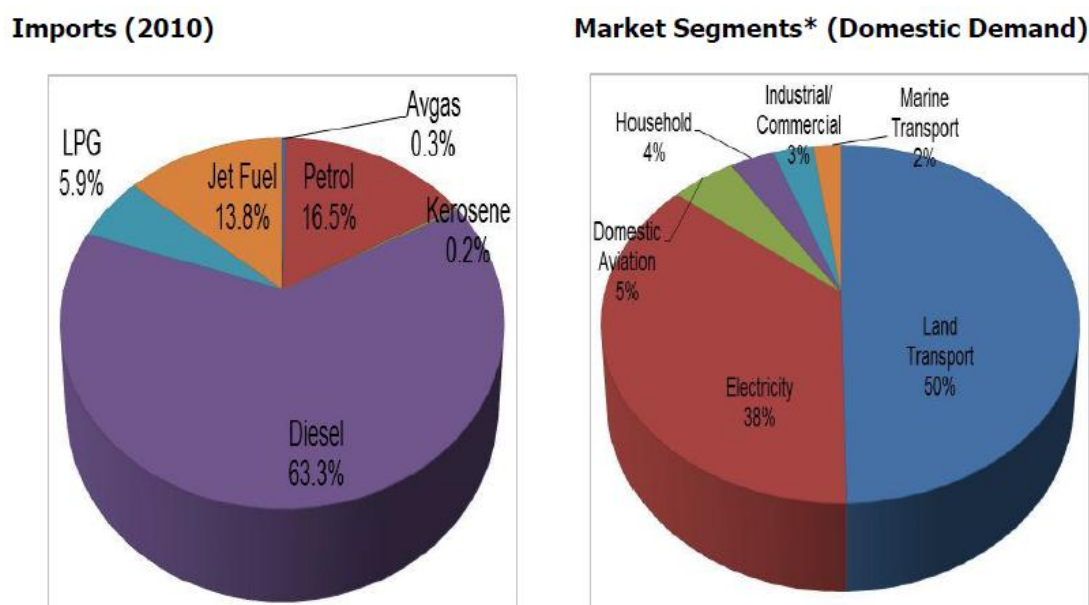
Diesel is the largest volume imported (63% or 33 million litres) as it is also used in electricity generation (18 million litres including use for outer islands generation). Land transport is the largest consumption sector representing 50 percent share of demand. Whilst there is evidence that the transport sector demand is correlated to the number of vehicle registrations, the analysis of the

¹⁰ World Bank, *Achieving Universal Access to Modern Energy in East Asia and the Pacific, One Goal Two Paths, Flagship Report, 2011*

¹¹ World Bank, *Achieving Universal Access to Modern Energy in East Asia and the Pacific, One Goal Two Paths, Flagship Report, 2011*

transport sector is not sufficient to fully inform recommendations for efficiency improvements at this stage. Electricity generation accounts for 38 percent of the demand. Over 80 percent of all electricity generated in Vanuatu is from diesel fuel. About 4 percent of petroleum imports is used in households and 3 percent of demand comes from commercial and industrial establishments. LPG is used for cooking by 13 percent of households, mostly in Port Vila and vicinity.¹²

Figure 2.3: Petroleum Imports and Use



*Market Segments excludes bunkering (1.3 million litres) and international aviation (3.6 million litres)

Source: Hale and Twomey, and David Butcher and Associates "Draft Final Report: Options for increasing the efficiency of Vanuatu's oil and gas supply chain" November 2012"

The cost of petroleum is impacted by lack of scale - the same supply infrastructure is required (albeit less than for higher volume countries) but market demand volumes are of a lower order of magnitude, leading to higher per litre costs.

The market is a monopoly with only one bulk supplier each for petroleum fuels for transport and aviation and LPG. Pacific Petroleum Company is the only petroleum marketer (selling petrol, kerosene, aviation fuels, diesel and lubricants) having acquired the marketing assets of oil majors as they withdrew from the region. Origin is the sole importer and marketer of LPG. There is small competition at the margin where some parties are distributing diesel from isotainers.¹³ This raises serious health, safety and environment issues.

A specific regulatory framework for the sector is non-existent and the sector appears to be largely self-regulating in terms of environment, health and safety standards including for fuels quality, infrastructure and facilities. Matters such as pricing, risk management, and energy security are left to the industry.

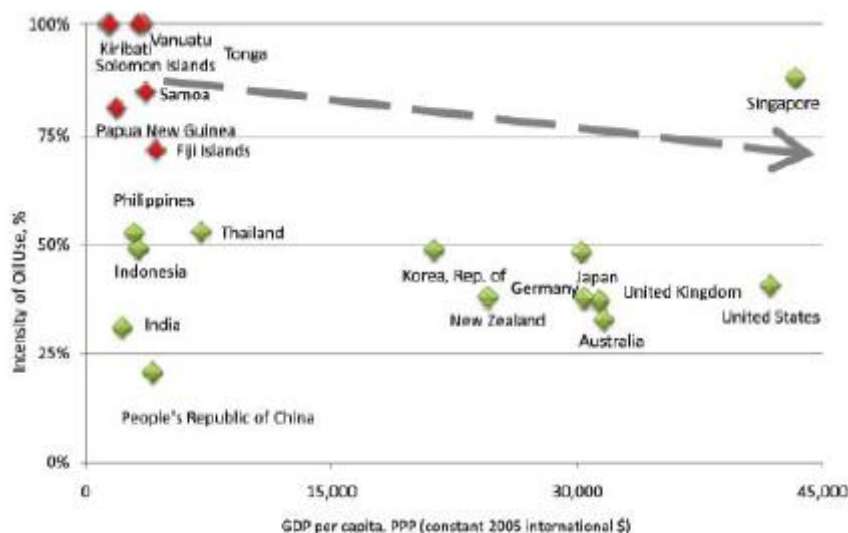
¹² Vanuatu National Statistics Office, "National Population and Housing Census", 2009

¹³ An isotainer is a transportation vessel contained in a 20 foot shipping container. Each isotainer can hold about 20,000 litres of fuel.

The GoV recovers a significant proportion of revenue from excise, duties and value added tax - in 2010 fuel taxes accounted for 11 percent of GoV revenue.

Like many small island nations, Vanuatu became heavily dependent on oil for its commercial energy needs through the course of the 20th century. Vanuatu ranks among the nations with the very highest petroleum energy intensity, anywhere in the world (Figure 2.4).

Figure 2.4: Dependence on Oil

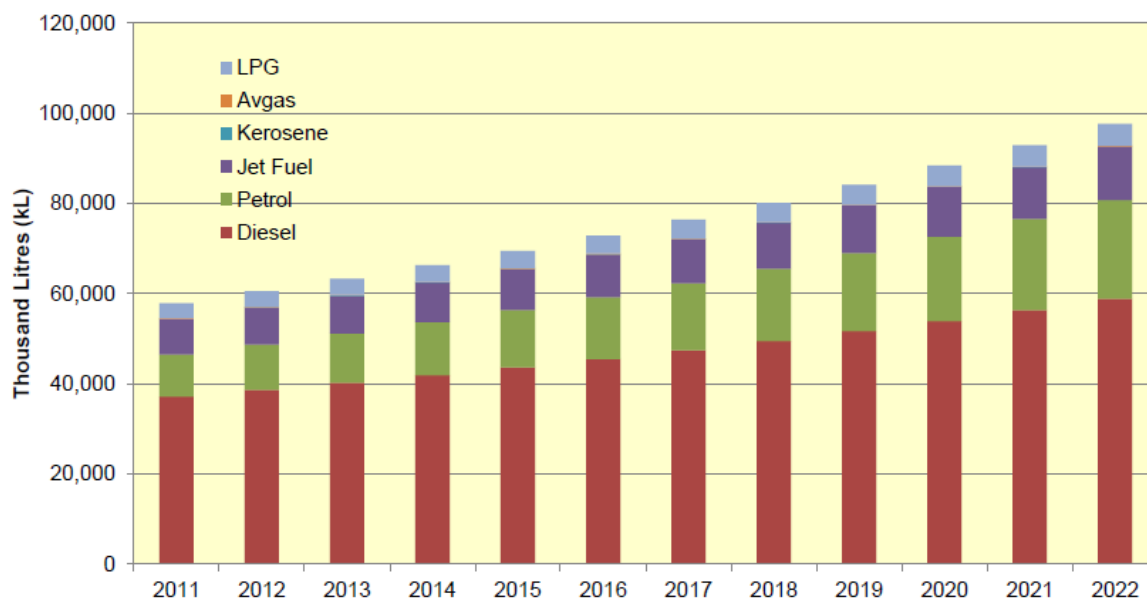


Source: ADB (quoted in Hale and Twomey, and David Butcher and Associates “Draft Final Report: Options for increasing the efficiency of Vanuatu’s oil and gas supply chain” November 2012”

For Vanuatu petroleum products are important inputs into major sectors of the economy - tourism, transportation, fishing and agriculture. Petroleum consumption has increased rapidly over the last 10 years, at an annual average rate of 5.7 percent. Once diesel use for electricity is excluded, consumption of petrol, LPG and diesel has doubled, with the transport sector generating most of the increase. Diesel used in electricity generation has grown more slowly (dropping a little in the last couple of years) with the introduction of more renewables into the generation mix.

Based on current trends and projected growth rates (GDP growth estimated at 4 percent), petroleum demand is expected to nearly double by 2022 (to approximately 100 million litres) — see Figure 2.5. Increases are expected to be highest for land transport fuels (petrol and diesel) based on correlation with historical growth rates. Kerosene (for aviation use) will be influenced by operating efficiencies achieved by airlines and may not see substantial increases in demand, despite increases in tourist numbers.

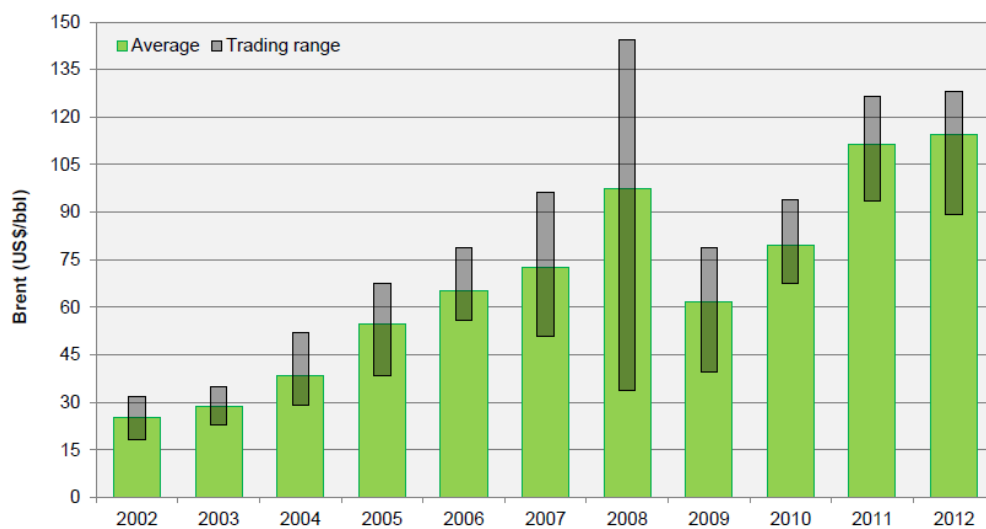
Figure 2.5: Petroleum product demand forecast, by fuel type, 2012 to 2022 ('000 litres)



Source: Hale & Twomey

Vanuatu’s extreme dependency on imported petroleum to meet its commercial energy needs exposes it to two types of risks: oil price variability and price shocks; and interruptions in the delivery of fuel caused by either natural phenomena or by international or domestic political turmoil. Since the beginning of the 21st century, the price of oil has risen dramatically and the volatility of the world oil price has also increased as can be seen in Figure 2.6.

Figure 2.6: World Oil Prices – average and trading range (2002-2012)

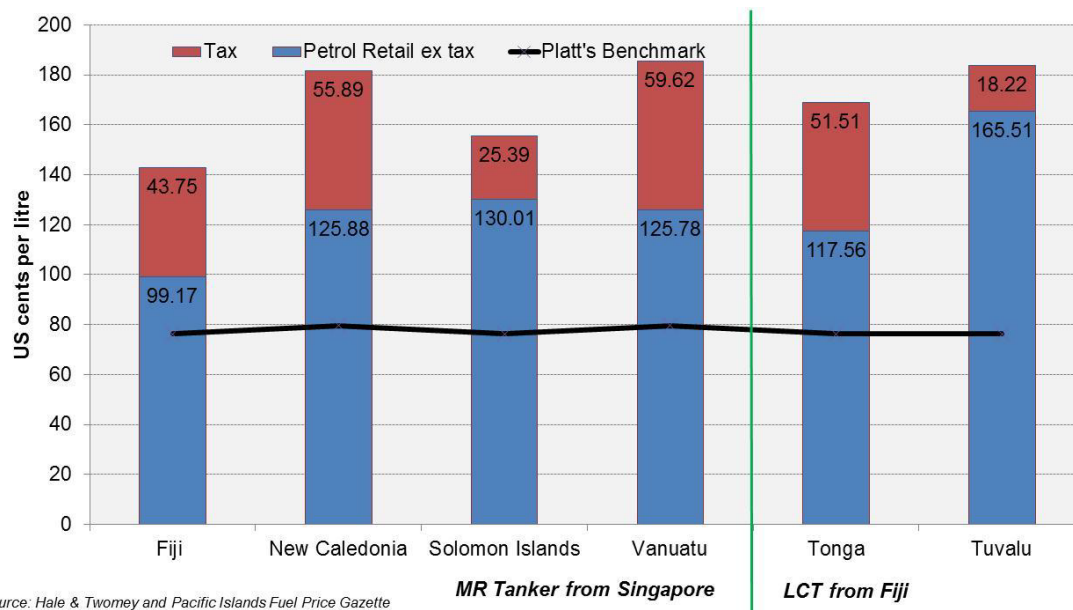


Source: Hale and Twomey, and David Butcher and Associates “Draft Final Report: Options for Increasing the efficiency of Vanuatu’s oil and gas supply chain” November 2012

While domestic prices in Vanuatu have followed the same trend, a cross-comparison of diesel retail prices across selected Pacific Island countries (Figure 2.7) shows that Vanuatu prices are higher than for some comparable countries (notably Tonga, Fiji). Petrol price cross-country comparisons also show a similar relationship as well. The price of diesel fuel has a direct impact on the cost of transport and electricity generation as the retail cost of service structure of both these sectors are to

a large extent determined by the costs of diesel fuel. The Utilities Regulatory Authority (URA) of Vanuatu, in its position paper on the Electricity Tariff Review, dated March 2010, estimated that diesel costs account for about 40 percent of the revenue generated from Port Vila Electricity tariff.

Figure 2.7: Retail Diesel fuel price in Pacific



Source: Hale & Twomey and Pacific Islands Fuel Price Gazette

Average April - September 2011, excluding duties and taxes; Source: Hale and Twomey, and David Butcher and Associates "Draft Final Report: Options for Increasing the efficiency of Vanuatu's oil and gas supply chain" November 2012

The implications from this analysis are that Vanuatu, which has a far higher level of petroleum usage intensity in its economy and which also is marked by higher retail prices than some of its regional comparators, has much higher degree of exposure and vulnerability to petroleum supply shocks and price volatility.

The costs of fuel in Vanuatu reflect the various elements of the fuel supply chain: 1) purchase of refined products in Singapore or Australia; 2) ocean transport in bulk to Vanuatu; 3) landing charges in Vanuatu (wharfage and port charges); 4) receipt, storage, handling costs; 5) distribution costs within Vanuatu to different market segments; 6) wholesale and retail margins. Added to these supply chain costs are fuel taxes. The prices of fuels in Vanuatu are regularly adjusted to reflect changes to international benchmark prices for refined petroleum products.

The price volatility and supply shocks (influenced by the international supply chain) are exacerbated by the inefficiencies in the domestic supply chain. The natural geography of Vanuatu does not lend itself well to a low cost supply chain. However, there remains significant room to improve the certainty, frequency, and efficiency of scheduling and delivery in the domestic supply chain. Although the storage levels are determined on a commercial basis by the two importers of petroleum products, the low storage levels on the outer islands have caused considerable differences in costs for consumers across the country.

Both Pacific Petroleum Company (PPC) and Origin Energy have generally operated to international standards for health, safety and the environment. However, the regulatory framework for the petroleum sector in Vanuatu is poor. There are no specific regulations or pieces of legislation that directly govern the petroleum sector. However, some aspects of the management of petroleum waste products are incorporated into legislation governing the ports, for example.

Electricity sub-sector institutional framework

Vanuatu has had a long history of private sector involvement in the electricity sector. Currently two private utilities service the four concession areas. UNELCO has been operating in Vanuatu since 1939 and currently supplies the Port Vila, Malekula and Tanna concession areas. Vanuatu Utilities and Infrastructure Ltd (VUI) began operating in the Luganville concession area in January 2011. The Utilities Regulatory Authority provides regulatory oversight for these concessions, and the Department of Energy (DoE) is responsible for access to energy in rural areas. The Government provides the enabling framework (through legislation, regulations and concession contracts) for the sector participants to operate in the sector to service the people of Vanuatu, but acknowledges that much improvement is needed to ensure that the vision for affordable, reliable, and secure energy is provided to all citizens.

Enhanced sector policy and law, and increased government capacity

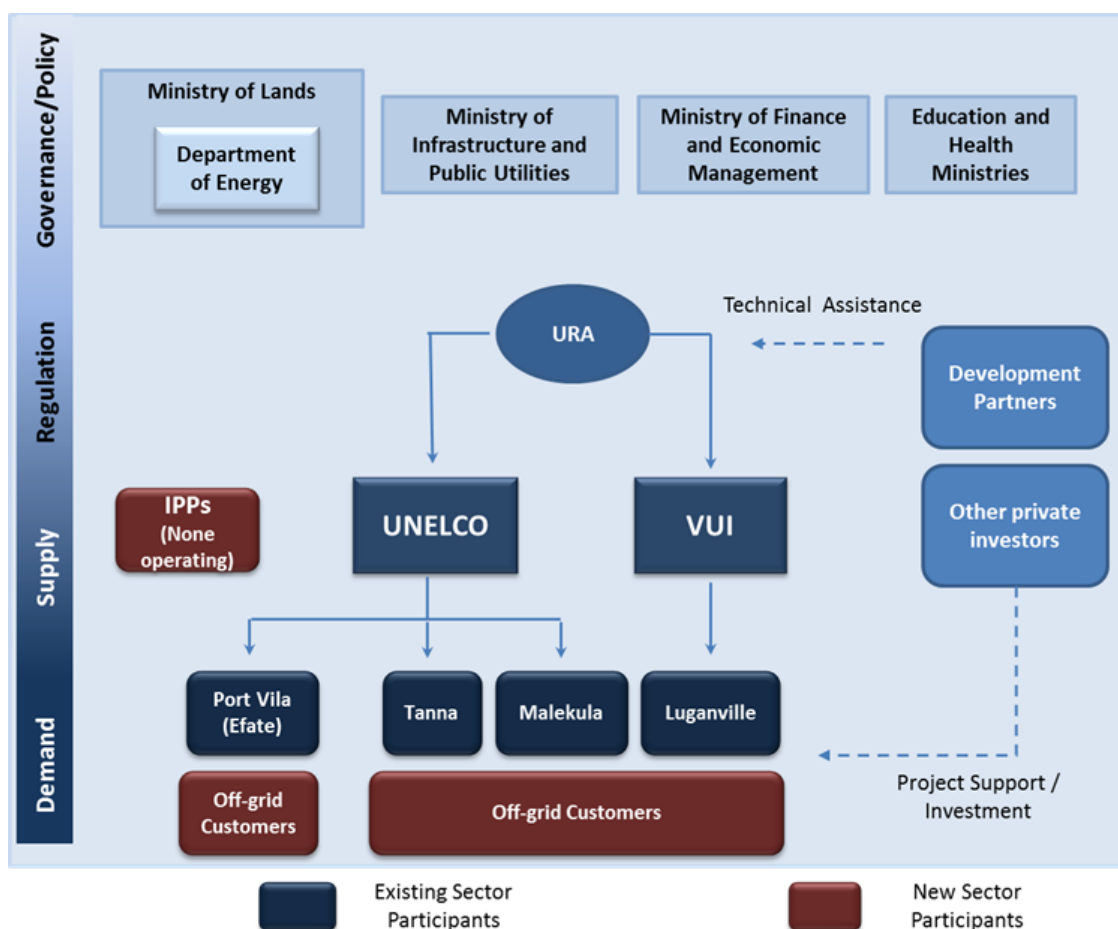
Figure 2.8 provides an overview of the stakeholders that are most active in Vanuatu's electricity sector; the relevant and key Ministries responsible for governance and policy – as well - the regulator (the URA) responsible for monitoring pricing and quality, and the two private sector operators – UNELCO, VUI - that supply customers in four concession areas. To effectively move the sector forward and deliver on expectations for sustainable modern access to all citizens in timely manner, the Government intends to ensure a clear separation of roles between policy, regulation, and service delivery as well as address key gaps in enabling policy and legislation.

The Department of Energy (DoE), within the Ministry of Lands and Natural Resources (MLNR), plays a central role in coordinating energy sector development and policy in Vanuatu, including identifying and managing rural energy projects. Other Government Ministries involved in the electricity sector include the Ministry of Infrastructure and Public Utilities (MIPU), responsible for all the public infrastructure of the government, and the Ministries of Education and Health, which are involved in a program of solar energy packages for social institutions. Given the other responsibilities of these Ministries, energy issues have not had the attention they need to make real progress.

There are various legislation and regulations governing the oversight of the electricity sector, however there are gaps or inconsistencies that need to be addressed to provide the regulatory certainty for much needed investment in the sector. For example, the Electricity Supply Act permits independent power producers to generate electricity and supply it outside the concessions, or to the concessionaires.¹⁴ However, concessionaires are not obliged to purchase power. There is also no framework for Independent Power Producers (IPPs) to access existing networks and for the concessionaires to pass through costs incurred under Power Purchase Agreements (PPAs) with the IPPs.

¹⁴ See Article 1B of the Electricity Supply Act 21 of 2000

Figure 2.8: Overview of Energy Sector Stakeholders



Note: IPPs = independent power producers

The MLNR is responsible for administering the Geothermal Energy Act [Cap 197], under which the Government grants licenses for geothermal prospecting and production. Whilst consultants have described this Act as reasonably well structured and comprehensive, they have identified areas where further detail needs to be provided, such as regulation of geothermal drilling activities.¹⁵ Draft regulations have been prepared that cover the application and granting of drilling licenses and consents, and the regulation of drilling safety.

There is a need for a review of the legislative and regulatory framework to provide an enhanced enabling framework for investment and operations and to improve the productive and allocative efficiency in the electricity sector.

Concessions are governed under a hybrid contract/institutional regulatory model

The Electricity Supply Act [Cap 65] governs the granting of concessions; and under this Act, the Minister of Infrastructure and Public Utilities has the responsibility for monitoring concessionaire performance and addressing various matters such as access to private land.¹⁶ Until 2007 Vanuatu followed an approach of regulation by contract—that is, service standards and rules for tariff setting were defined in the concession agreements between the Government and each utility. In 2007, the

¹⁵ Castlerock, “Vanuatu: Efate Geothermal Power and Island-Ring Grid Development Framework” January 2012, Appendix G

¹⁶ The Electricity Supply Act covers the granting of concessions and governs the powers of the concessionaires, damages, and penalties for other parties generating electricity, and compensation in respect of failure to supply. Other wrongful acts are also provided for include obstruction of an authorized officer, and power to enter to ascertain quantity of electricity consumed

Government passed the Utilities Regulatory Authority Act (URA Act) to establish an independent regulator, the Utilities Regulatory Authority (URA), which has the primary objective of regulating utilities to ensure the provision of safe, reliable and affordable electricity (and water) services throughout Vanuatu. The URA also manages consumer complaints and advises the government on matters related to electricity.

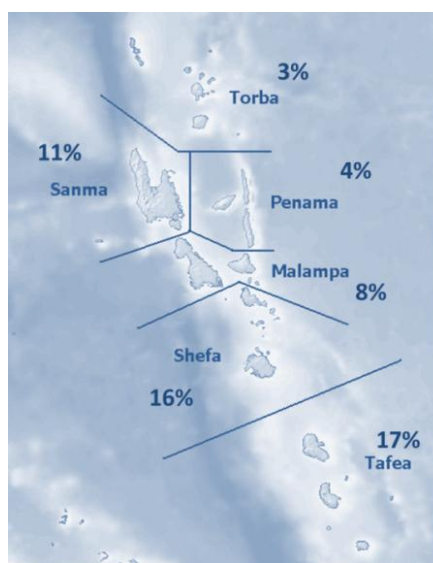
The URA is empowered to review and in light thereof set the maximum level of retail tariff for each concession. If the concessionaire does not agree with the URA’s decision, the matter goes to arbitration for final decision that is binding on both parties. However, there are ambiguities and gaps between the Electricity Supply Act and the URA Act. There is scope for enhancing the retail tariff review process and methodology; for example, include for IPP/PPA pricing arrangements and to ensure that the approved tariff is transparently and verifiably linked to an acceptable overall least cost investment plan from a national development perspective – generation, network, connections - as well as efficient operating performance of existing equipment and assets. Licensing of service providers, including licensing of electricians and standards is also noted as a gap on the current arrangements.

Electricity access

Overall low coverage, huge urban rural divide, near stagnant pace of access expansion

On a national level, following more than three decades of independence, about 73 percent of the population of Vanuatu¹⁷ still does not have access to electricity. Overwhelmingly, those without access, live in rural areas, and outside of Efate Island. The fortunate minority with access mostly resides in the urban areas of the four electricity service concession areas on the four largest islands of Vanuatu: islands of Efate, Tanna, Malekula (UNELCO), and Santo (VUI). Even on these largest four islands (of the 80+ islands of Vanuatu), the share of those without access remains high: Efate (24 percent), Santo (65 percent Tanna (86 percent), Malekula (84 percent). From a provincial and regional development and equity perspective, there is a severe imbalance in access, as can be seen from Figure 2.9; the population without access ranges from 86 percent up to 97 percent, depending upon province.

Figure 2.9: Electrification Rates by Province (excluding Efate, Tanna, Malekula, Santo islands)



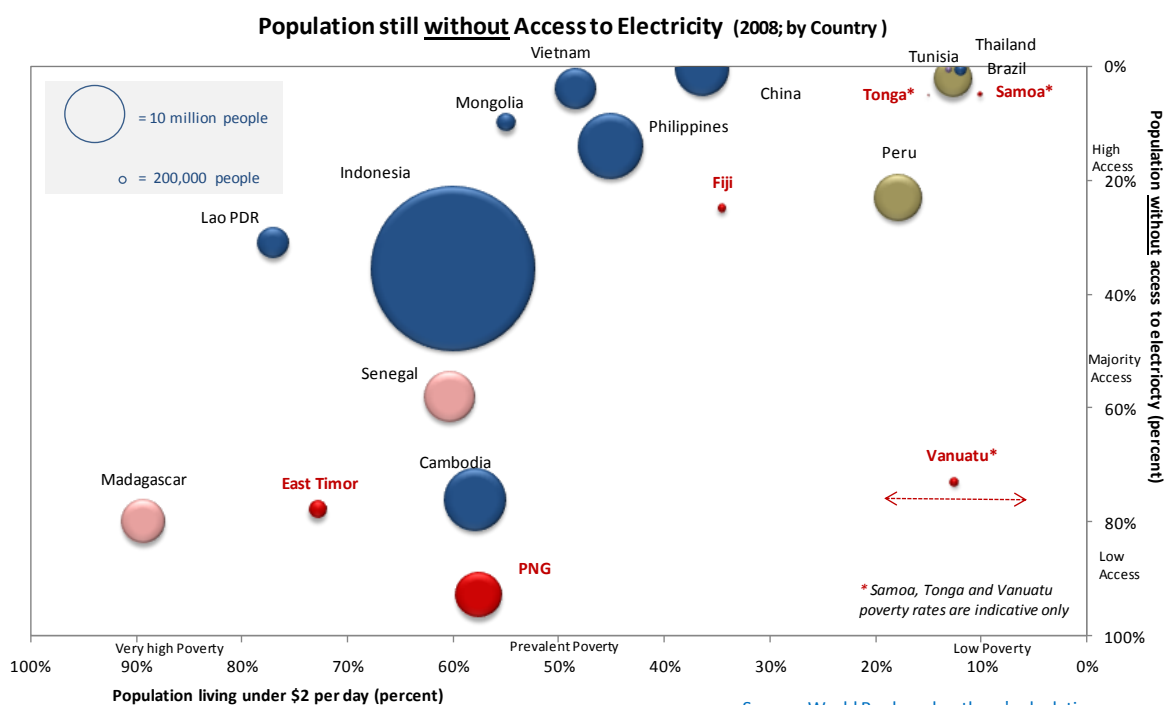
Source: AusAID, “Vanuatu Electricity for Rural Development Program” (—Draft Program Design Document)” November 2012 and Vanuatu National Statistics Office, “National Population and Housing Census”, 2009

¹⁷ 233,000 reported in the 2009 Census update.

Government policies and leadership can make the big difference in achieving access for all in a timely manner – international experience

The Road Map takes note that by comparison to international good practice experience, electricity access levels in Vanuatu are unusually low, and stand out in relation to its national income level or equivalently the poverty prevalence level (Figure 2.10). Countries with poverty prevalence comparable to that of Vanuatu—including the island nations of Tonga and Samoa—have achieved through their policies far higher national access rates for electricity, and that are consistent with the empirical evidence highlighted in section 2.1, of strong positive correlation observed globally between relatively high poverty prevalence and low access to electricity and vice versa.

Figure 2.10: Population without electricity access and poverty prevalence



Source: World Bank and authors' calculations.

Source: World Bank, Achieving Universal Access to Modern Energy in East Asia and the Pacific, One Goal Two Paths, Flagship Report, 2011 report database and calculations

It is also noteworthy that the national electrification programs of the Lao People’s Republic and Vietnam led to increase access rates from relatively low levels to 70 percent and 95+ percent respectively, within a span of about two decades.¹⁸

Social institutions—while electricity access rates achieved to date in schools and hospitals are considerably higher than for households, they remain well short of providing universal access, as the table below shows.

¹⁸ Both nations have achieved extremely very high levels of electricity access (70 percent nationally in Laos, 95+ percent in Vietnam), and at a fast pace; the bulk of the scale up was achieved within about two decades. This achievement is outstanding even more so in light of their relatively low national income levels: in 2005 PPP US\$: Vietnam (US\$ 2,805/capita, Lao PDR (US\$ 2,242/capita), Vanuatu (US\$ 3,950/capita). World Bank, “Lao PDR – Power to the People, Twenty Years of National Electrification, A Success Story”, Asia Sustainable alternative Energy program (ASTAE), 2011. World Bank, “Vietnam – State and People, Central and Local Working Together, The Rural Electrification Experience”, Asia Sustainable alternative Energy program (ASTAE), 2011.

Table 2.1 Social Facilities with No Electricity Access

% social facilities with no electricity access	
Primary schools	63%
Secondary schools	27%
Health centres	30%
Dispensaries	29%
Source: AusAid. Vanuatu Electricity for Rural Development Program Draft Program Design Document—June 2011 (p.58)	

Furthermore, in the case of the institutional facilities that already have some form of access, signs point to some concern about the sustainability and maintainability of solar PV and other energy related equipment installed to date, including; performance, adequacy in relation to the energy needs at each location; post-installation servicing and maintenance problems arising from factors such as capacity of local dealers and service technicians, extent of standardization (or lack thereof) across locations, timely availability of spare parts. Much of this equipment has been supplied under different donor projects.¹⁹

The lack of significant progress achieved to date in the energy sector and highlighted in the preceding - extremely low access, coupled with a huge urban-rural divide and a severe geographical imbalance across the five provinces, and extremely slow pace of scale up – undermines Vanuatu’s economic competitiveness as well impedes progress on human development across the entire nation. Table 2.2 highlights this by comparing the HDI, and lack of access to electricity across seven Pacific island nations. The table shows that HDI improves with increasing access to electricity. The Vanuatu Road Map action plan outlined in the following sections builds on the good practice international experience with scaling up modern energy access and commits the Government to addressing this priority gap in a targeted and timely manner.

Table 2.2: Lack of Electricity Access and Human Development (Selected Island Nations)

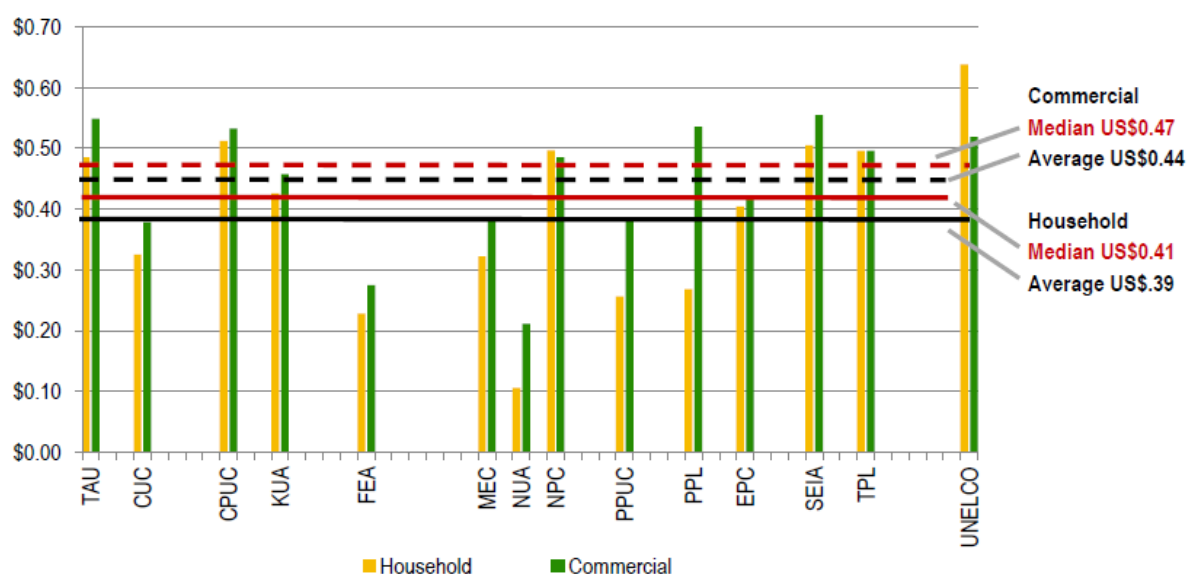
Country	GNI/capita (US\$, constant 2005 PPP)	HDI Score/rank (Out of 187 countries)	Population without electricity access (%)
Tonga	4,186	90 (.704)	< 5
Samoa	3,931	99 (.688)	< 5
Fiji	4,145	100 (.688)	< 25
Kiribati	3,140	122 (.624)	~ 55
Vanuatu	3,950	125 (.617)	~ 75
Solomon Islands	1,782	142 (.510)	> 80
PNG	2,271	153 (.466)	~ 90

¹⁹ Experience reported from other countries in case of the institutions located in off-grid areas indicates high incidence of under sizing, under performance, difficulty in obtaining replacement parts on account of lack of standardization of equipment standards and specifications across various donor programs, weak or non-existent post installation maintenance technicians/service agents within proximity, and a high failure rate of the overall system.

Existing concession areas - large gap between retail tariffs and consumer affordability

High retail electricity prices impact on consumption and business competitiveness - Electricity consumers in Vanuatu pay among the highest retail electricity prices in the world. Figure 2.11 shows that average electricity tariff in Vanuatu – in the four concession areas—compared to the amount that consumers pay in other island nations. It is important to note that while average tariffs are high, there is a range of prices paid in Vanuatu, with consumers with low demand (less than 60kWh per month) paying low tariffs (currently 34 percent of the base tariff of 53.29 Vatu per kWh).²⁰

Figure 2.11: Electricity Prices in the Pacific (US\$/kWh)—Household 200 kWh/month and Commercial 500 kWh/month



Key: TAU (Cook Islands); CUC (Saipan); CPUC (Chuuk, Micronesia Fed. St), KUA (Kosrae, Micronesia, Fed St.); FEA (Fiji); MEC (Majuro, Marshall Islands); NUA (Nauru); NPC (Niue); PPUC (Palau); PPL (Papua New Guinea); EPC (Samoa); SEIA (Solomon Islands) TPL (Tonga); UNELCO (Vanuatu)

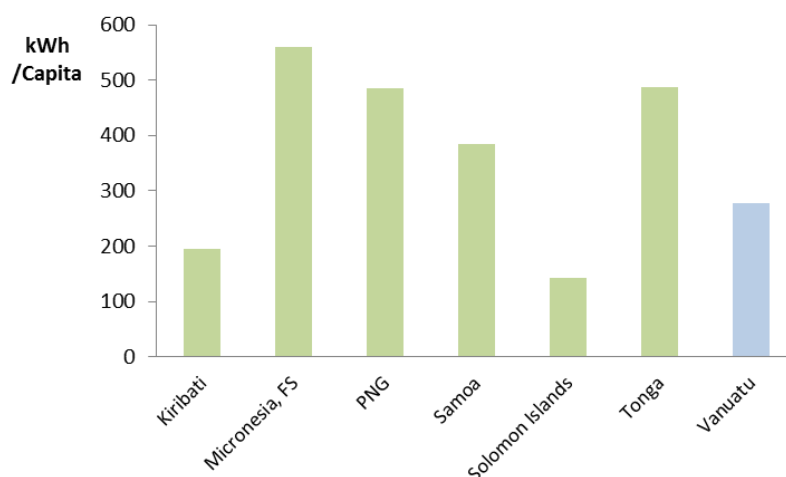
Source: Pacific Power Association, Performance Benchmarking for Pacific Power Utilities, December 2011

High electricity tariffs in concession areas make electricity expensive for most connected households (See Appendix A for the full tariff structure for concession areas). As a result they limit their usage and receive fewer of the associated benefits. Additionally, high tariffs add to the high cost of doing business in Vanuatu and undermine economic competitiveness.

Figure 2.12 highlights the very low average annual consumption per household in Vanuatu, compared to some other Pacific island nations. For example, a typical low-income household in Vanuatu would use approximately 30 kWh per month to run several lights, listen to radio, and charge cell phones.

²⁰ This rate only applies to the first 60kWh consumed. Consumption between 61-120kWh is charged at 1.21 x base tariff, and any consumption above 120kWh is charged at three times the base tariff. See http://ura.gov.vu/index.php?option=com_content&view=article&id=47&Itemid=76&lang=en

Figure 2.12: Electricity Consumption in Vanuatu, and the Pacific (2009)

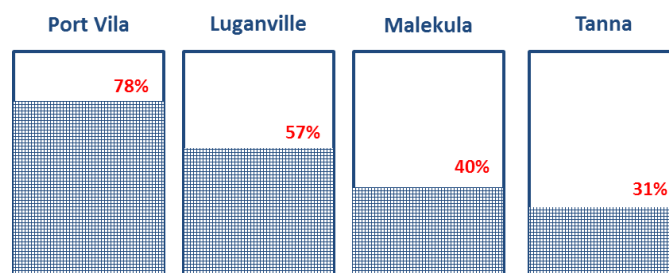


Source: International Renewable Energy Agency, "Renewable Energy Country Profiles", 2009

Low connection rates within existing concession areas

In the existing concession areas, there remain a large number of households and some businesses without a grid connection (Figure 2.13). Moreover, many of those with electricity service are households sharing connections with neighbors and do not have their own account. For example, in Port Vila about 9,000 households are connected to the grid using only 5,000 UNELCO electricity accounts.²¹

Figure 2.13: Connection Rates in Concession Areas*



Source: Vanuatu National Statistics Office, "National Population and Housing Census", 2009; *Includes households using electricity from the main grid by shared connections

Bridging the affordability gap in existing concession areas

Reducing the share of high cost diesel use for base load electricity generation, while also enhancing energy security – creates a role for cost-competitive renewable energy. The cost of electricity generation in the concession areas in Vanuatu is very high even in comparison to other Pacific Island nations.²² One contributory factor is high reliance on imported petroleum to fuel diesel generation. For example, in February 2012, more than 55 percent of delivered electricity costs

²¹ Households that share their power use a variety of methods to split payments, often determined by the account holder. These methods include fixed monthly payments for an agreed number of hours of electricity use, an even split of the bill each month, and a payment of an agreed amount upon each use.

²² In May 2012 the base tariff for electricity, was 55.18Vatu/kWh or 0.58USD/kWh, compared to 0.34USD in Palau, between 0.36-0.44USD in Samoa, 0.35USD in Fiji. (Source: URA, "For Consumers - Pricing" www.ura.gov.vu, Oceania TV, "Chais Era Belau" <http://www.oceaniatv.net/?p=1217>; Electric Power Corporation, "Understand Your Bills" www.epc.ws; and Fiji Energy Association, "New Tariff" www.fea.com.fj, accessed 11 June 2012).

were made up of the cost of imported diesel.²³ Increasing the share of renewable energy, particularly to substitute diesel fuel for base load generation, offers the opportunity to significantly lower costs of generation. However, without a sound sector wide least cost plan for renewable energy development from the national perspective—both for grid and off-grid—the little development that has happened outside of the Sarakata hydro plant²⁴ is mostly small and fragmented providing relatively small amounts of intermittent non-firm energy. Currently only around 19 percent of electricity is produced using renewable energy (10 percent from the Sarakata hydro plant, which serves Luganville, Santo; and approximately 9 percent of intermittent wind energy generation on the UNELCO’s system on Efate).²⁵ Recent indications are that UNELCO has scaled up the use of biodiesel in its power plants including investment in copra plantations to increase security of supply of biodiesel. As a point of comparison, some of other Pacific Islands (such as Samoa and Fiji) have systematically planned for and continue development of their renewable energy resources—to reduce the share of high cost diesel base load generation—in a cost effective and sustainable manner.²⁶

International experience indicates that if the development of renewable energy potential—especially for base load generation—is accomplished in a transparent and cost-effective manner to ensure a least cost outcome for the nation, it can go a long way towards substituting expensive diesel fuel and at substantially lower generation costs; and increasing the share of renewable energy base load generation also enhances energy security from reduced imports of petroleum products. Government leadership is called for orchestrating development and oversight of an effectively and transparently structured public-private-partnership (PPP) transactional framework, coupled with action on enabling policies and supporting legislation, in order to enable private sector participation in renewable energy development. The development of renewable energy, especially as base load generation under a least cost plan will contribute to improving energy security and can help lower and stabilize retail electricity prices to consumers in the four existing concession areas.²⁷

Targeting the connection cost barrier for the poor households—International good practice experience highlighted in the previous section of this chapter supports the deployment of effectively designed and targeted subsidy policies and supporting financing mechanisms—such as Output-Based Aid (OBA)—for increasing the share of the poor households who otherwise would not be able to connect to the grid within the concession area. The Road Map aims to support the piloting and design of a national subsidy policy framework and mechanisms tailored along these lines for deployment in a programmatic approach in support of its goal of achieving access for all.

Extending the grid in the concession areas and beyond—strategic challenges

The energy service providers have investment plans in place to extend the electricity grids within the concession areas. These investment plans are subject to regulatory approval, however the process

²³ URA, “Monthly Energy Market Report for February 2012” www.ura.gov.vu accessed 12 June 2012

²⁴ When the Sarakata Hydro Plant was built on Santo, the Government established the Sarakata Hydro Fund, which collected the implied savings generated from displaced diesel generation. The Sarakata Hydro fund was designed to support electricity grid extension investments. Similarly, the utilities are required to establish a fund to support grid extension investments, agreed upon by the Government, under Section 6 of their concession contracts.

²⁵ Biodiesel (Coconut Oil - CNO) has been blended with diesel in UNELCO diesel generators. However, concern has been raised over the high cost of copra relative to diesel (due to higher prices from exports). See URA, “Electricity Tariff Review Final Decision” May 2010, URA, “Monthly Energy Market Report for February 2012” www.ura.gov.vu accessed 12 June 2012 and URA, “Industry Structure”, accessed from http://ura.gov.vu/index.php?option=com_content&view=article&id=38&Itemid=73&lang=en

²⁶ 55 percent of generation in Fiji, 48 percent in Samoa, and 86 percent in PNG was from renewable sources on 2019, Performance Benchmarking for Pacific Utilities, Benchmarking Report, Pacific Power Association with support from Pacific Infrastructure Advisory Centre and the Secretariat of the Pacific Community, December 2011

²⁷ Castlerock (2011) - Efate geothermal least cost development plan and framework, pre-feasibility study; SMEC for ADB, “Promoting Access to Renewable Energy in the Pacific” Ongoing Technical Assistance (TA 7329) to Government of Vanuatu, October 2011

for consultations and approval lack transparency. Funds to support investment in grid extensions (such as the Sarakata Fund and the Section 6 Investment Fund) have also been put in place. The process for the collection and utilization and approval of projects under such funds lack transparency and need to be reviewed and clarified. Such funds, if transparently managed, can also be complemented by development partner funds to support grid extensions or investment in micro grids where such are assessed to be economic. A review of the processes and the adequacy of such mechanisms is a necessary step to ensure that the service providers have the regulatory certainty and incentives to undertake investment in grid extensions.

The award of new concessions or renewal of existing concessions is subject to the Government Tenders and Contracts Act. The Act needs to be reviewed to ensure it is efficient and that it provides the regulatory certainty to promote grid extensions (and access) as part of the broader review of the legislative and regulatory framework for electricity.

Off-grid electricity access—strategic challenges

Outside of Efate Island and the other existing concession areas, the Government of Vanuatu is responsible for electrification. As noted previously, the share of population without electricity access in these “off-grid” areas typically ranges between 85-97 percent, depending upon the province and location within each. To date off-grid electrification has mostly been funded by donor grants; and primarily for purchase and installation of solar PV battery systems for selected institutions—health and education facilities—and attempts to build private sector capacity for dealer supply and delivery chains for the institutional and individual solar home system market segments. In addition these grants have supported limited interventions to promote the Pico-solar portable battery charging products in the private retail market that are handy for cell phone charging and powering a modern light. The off-grid program experience to date has drawn attention to the several key challenges that need to be squarely and effectively addressed in a systematic and programmatic manner under the Road Map.

Fragmentation and small-scale donor funded projects activities in off-grid areas don't add up.

While the development partners have supported numerous small projects—comprising mostly equipment installations, accompanied by limited capacity building efforts—given the lack of coherence and limited scale, there are few results to show on a nationwide impact basis, except in a few specific instances. Moreover, these small project activities have not been well coordinated with other sector programmes.

Sustainability of energy services for institutions. Timely and competent maintenance of solar PV systems installed in social institutions is vital to enable the health and educational facilities in delivering quality services. However, in addition to the fragmentation and lack of scale in off-grid projects, to date, they have been marked by lack of standardization across projects. These factors, coupled with weak capacity of the after-sales service maintenance chains, have undermined sustainability of equipment performance following installation. Noteworthy and of relevance to Vanuatu’s Road Map in this context is the recent international experience with good practices in institutional market solar PV systems design—including sizing, specifications, standardization, and aggregation to establish program scale—and structuring of competitive bids that integrate post-installation maintenance service requirement on on-going basis, with performance based incentive payments built-in the contracts.²⁸

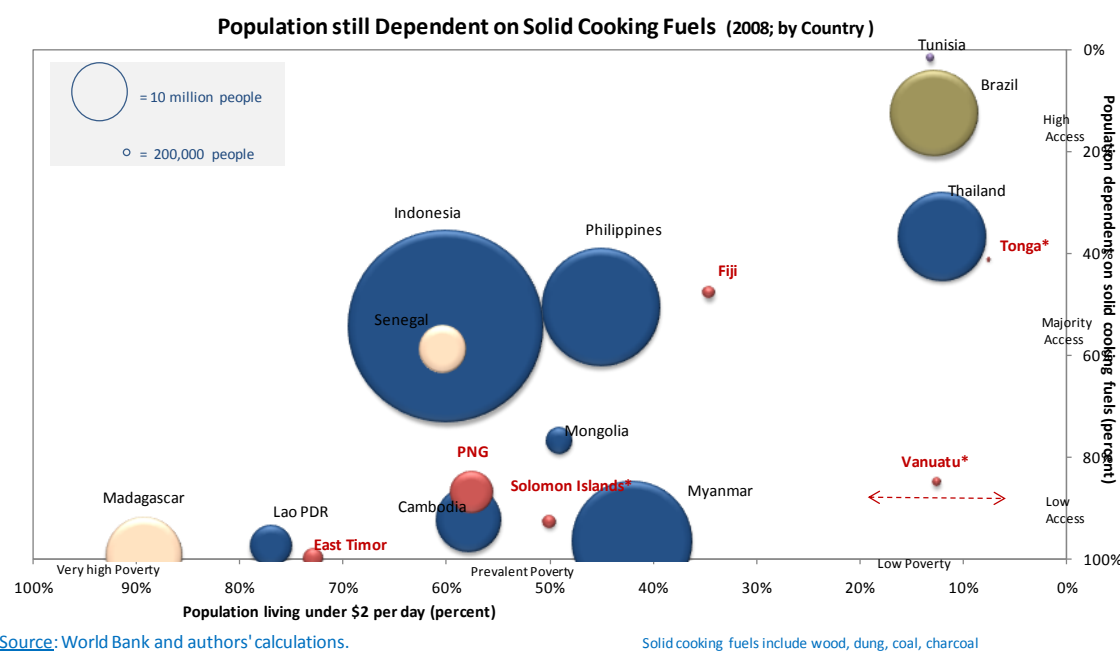
²⁸ Reference here Bank ESMAP report on “ Best Practices Toolkit for solar PV energy systems for institutions”, 2010; and Consultant

Lack of a comprehensive off-grid access expansion and renewable energy development strategy and implementation plan is a roadblock for achieving universal access. Technical assistance studies, some still on going, have identified several prospects for renewable energy generation – hydro, solar PV- for grid as well as green site standalone mini/micro grid hybrid networks. However there is no comprehensive scale up strategy for developing them systematically; that is integrated into a credible least cost investment plan nationwide, to address the access challenge in the “off-grid space” – institutions, and all households outside of concession areas - within a reasonable time frame.²⁹

Modern cooking fuels—limited access, big rural-urban divide

The use of dirty solid cooking fuels such as wood-based biomass or charcoal, using traditional methods, still dominates in much of the Asia and the Pacific Islands region, and Vanuatu is no exception. Specifically, the share of Vanuatu’s population with access to modern cooking fuels – electricity, LPG, kerosene including propane – is under 20 percent. Those with access to modern fuels are predominantly in urban areas in and around Port Vila. Little has changed in these regards for most of the rest of country when it comes to access to modern cooking fuels. Similar to the situation with electricity access: access to modern fuels for cooking is low in relation to national income and poverty prevalence (Figure 2.14), and the widespread use of solid fuels (mostly biomass), and low access to modern cooking fuels is predominantly in rural areas and outside of Efate (Figure 2.14). Improved access to modern cooking solutions can help in improving health and reducing premature mortality, especially among women and children, and reduce the urban-rural divide.

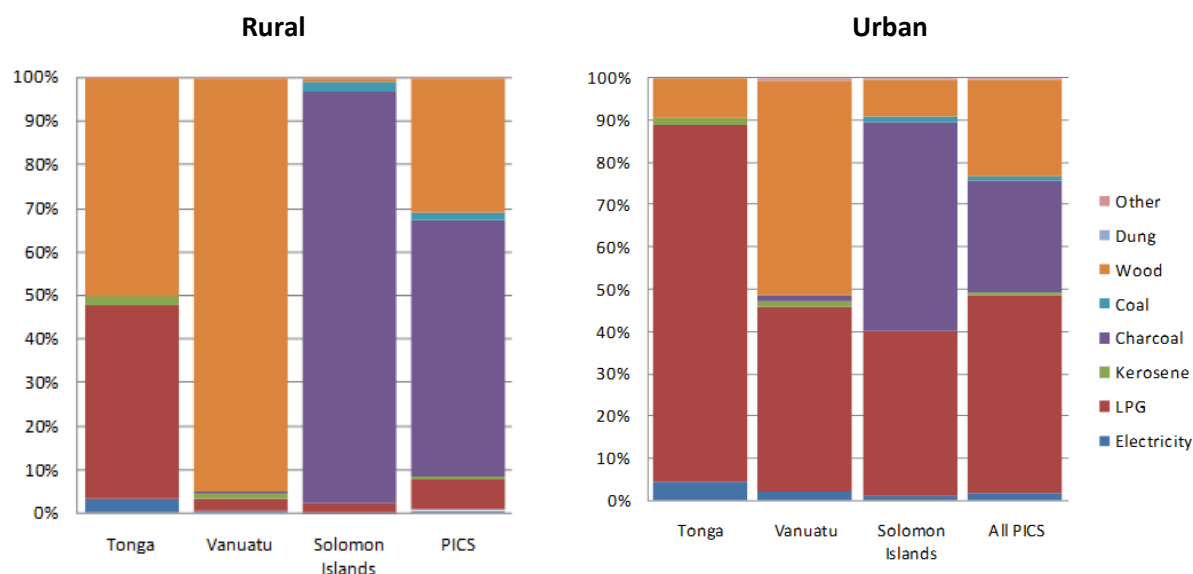
Figure 2.14: Access to modern cooking fuels – selected cross-country comparison



Source: World Bank, Achieving Universal Access to Modern Energy in East Asia and the Pacific, One Goal Two Paths, Flagship Report, 2011 report database and calculations

Report to the World Bank and Government of Tanzania “Solar PV Market packages for institutional market 2008
²⁹ AusAID, Vanuatu Electricity for Rural Development (VERD) Program, (Program Design Document) November 2012

Figure 2.15: Modern cooking fuels – a big urban-rural divide



Source: World Bank, Achieving Universal Access to Modern Energy in East Asia and the Pacific, One Goal Two Paths, Flagship Report, 2011 report database and calculations

Addressing climate change while putting people first

The global nature of greenhouse gas (GHG) emissions puts pressures on all nations to reduce their carbon footprints and at times introduces conditions for access to external funding sources that have more to do with global trends and agendas than national priorities. In the case of Vanuatu, it is projected that achieving universal access to modern energy would make a negligible difference to global GHG emissions.

Under a least-cost planning process and a sector-wide coordinated investment program, petroleum will continue to play a key role in meeting Vanuatu’s energy needs in the near to medium term. Renewable energy generation options have emerged as economically attractive options for diesel fuel substitution; notably grid connected solar PV, and where appropriate hydro and geothermal. Renewable energy will also contribute to improving energy security. In the off grid and remote areas of Vanuatu, on-going studies indicate that renewable energy can make a significant contribution. The predominant source for these systems is expected to be solar PV-hybrids, and where feasible small hydro plants. Furthermore, promoting the use of highly energy efficient LEDs for lighting, and other higher energy efficiency end use products, will also contribute to reducing GHG emissions. Finally, switching to modern cooking fuels and using efficient cook stoves will also make some contribution to reducing the GHG emissions and help reduce deforestation from the use of traditional fuels.³⁰

In summary, 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. This is consistent with a “whole of sector” approach, where renewable energy is pursued for its economic,

³⁰ The World Bank has noted in its Flagship report on Energy Access for all, that even in the hypothetical scenario if the incremental demand electricity access scale up in developing countries were supplied entirely from fossil energy sources, the incremental GHG emissions would make a negligible difference to the overall global situation. Besides, the welfare benefits of electricity access have been reported to be of the order of US\$0.50–US\$1 per kilowatt hour (kWh). In contrast, a stringent valuation of the corresponding carbon damages in a worst-case scenario is far less at only a few cents per kWh; World Bank, Achieving Universal Access to Modern Energy in East Asia and the Pacific, One Goal Two Paths, Flagship Report, 2011 ; Gilbert 2009).

energy security, and access-enhancing and environmental benefits.³¹ The Government will continue to address climate change issues through the National Climate Change and Disaster Risk Reduction Policy, which includes both mitigation and adaptation activities. This policy is currently being developed under the lead of the National Advisory Board on Climate Change and Disaster Risk Reduction, and is due to be endorsed by Parliament in 2013. The Board will also develop a new Climate and Disaster portal www.nab.vu, which will describe activities undertaken in the energy sector.³²

2.3. Strategic Directions for Action—Steering a Break from the Past, Towards a Brighter Future for all Within a Generation

This section outlines the strategic framework and directions for action put forth under the Road Map. The underlying framework and core organizing principles have been informed by the experience of successful country programs that are well advanced in the implementation of their respective national energy road maps³³; and are relevant to effectively address the key priorities identified for the energy sector context in Vanuatu.

Business-as-usual in the Vanuatu energy sector will not deliver the transformative results sought

The discussion in sections 2.1 and 2.2 underscores that the energy sector as presently structured and functioning will not be able to step up and play its essential role in transforming the national vision of a healthy, wealthy and educated nation for all, with timely results. In particular, Vanuatu is faced with:

- **Low access, large urban-rural divide and stagnation**—Nearly 32 years following independence, the vast majority of the citizens of Vanuatu have to put up with low access to secure, reliable, and affordable modern energy. Of the nearly 233,000 citizens of Vanuatu, an estimated 75% do not have access to electricity and over 80 percent do not have access to modern cooking fuels. As a consequence, life for the 75-80 percent without access—who live predominantly in rural areas and spread across all the other islands outside Efate – has not been “touched” by modern energy in a measurably beneficial way all these years. Within the existing concession areas, large numbers of households have not yet been connected
- **Priority institutional sector facilities — health and education — have a way to go to achieve universal access.** Even in the case of the facilities with access today, issues of sustainability and maintainability of quality energy services to enable effective service delivery of health and education services, remain to be addressed head on.
- **Vanuatu residents pay among the very highest retail prices for electricity and petroleum products in the world,** even compared to most of its island neighbor nations. High electricity tariffs in concession areas pose an affordability barrier for most connected households; limiting their usage to among the lowest average consumption, even compared to some other Pacific Island nations. Others cannot afford to connect to the

³¹ See World Bank “A Whole-of-Sector Approach to Energy Development in the Pacific Islands”, Forum Energy Ministers Meeting, Brisbane, June 2010 <http://www.theprif.org/sites/theprif.org/files/Whole%20of%20Sector%20Approach%20to%20Energy.pdf>

³² See Daily Post, “Vanuatu Climate Change & Disaster Risk Lessons, Mainstreaming and National Policy” 31 October 2012 at <http://www.dailypost.vu/content/vanuatu-climate-change-disaster-risk-lessons-mainstreaming-and-national-policy>

³³ “Electricity Access: Delivering results on the Ground”, Chapter 3, World Bank, Achieving Universal Access to Modern Energy in East Asia and the Pacific, One Goal Two Paths, Flagship Report, 2011

grid on account of the high connection charges. High tariffs also add to the high cost of doing business in Vanuatu and undermine economic competitiveness.

- **Fragmentation of donor activities** outside the present concession boundaries, with numerous small projects comprising mostly equipment installations, accompanied by limited capacity building efforts, and marked by little coherence, have not added up to make a big impact on energy access and services for households and communities situated in the off-grid access. The vast majority of the population and communities—mostly outside Efate Island and rural areas—aspire to have modern energy within their lifetimes.
- **Dim prospects for the future without a geospatially comprehensive and credible strategic plan for least cost access expansion and renewable energy development** from a national development perspective. Such a plan is urgently needed to guide, coordinate, and align all investment and implementation in the energy sector, be it in the public sector or private sector—within concession areas or outside across the rest of the country—towards systematically and purposefully scaling up access per the overall and interim targets driving the national plan.

Strategic Directions - Way Forward

In light of the context and challenges highlighted in the preceding sections, this Road Map specifies achievable goals and interim outcome targets, and sets specific actions towards effectively addressing the key priorities in the energy sector (elaborated in Sections 3 and 4). In addition, this Road Map also outlines below, the underlying framework and core principles for detailing the essential building blocks of the policy, legislative and regulatory, and institutional frameworks that will facilitate the required change from stagnation towards achieving modern energy access for all in a sustainable and timely manner. The strategic directions adopted in this Road Map are:

- **Government leadership and commitment— getting the policies right and staying the course** The Government will establish clear targets for the energy sector, linked to national vision; and put in place a comprehensive and consistent set of enabling policies and a strengthened legislative and regulatory framework to ensure that going forward Vanuatu’s energy sector institutions can effectively play their respective roles in ensuring timely progress in achieving the sector outcome targets and expectations identified in this Road Map. Specific elements of this agenda include: the Government addressing key gaps and ambiguities present in the Electricity Supply Act, the URA Act, and Geothermal Act, resources development policy; and development and implementation of an overall subsidy policy and supporting financing mechanisms, as well as risk-sharing framework under public-private partnership arrangements considered to be in the national interest. The Government will ensure that these provisions are transparently applied for all sector stakeholders, in a consistent and predictable way, in accordance with laws and regulations of the Republic of Vanuatu.
- **Empowering and holding key energy sector institutions accountable**—The Road Map recognizes that effective and fast-paced implementation requires, besides tapping Vanuatu’s private sector energy service providers, strong sector institutions (DoE, URA, and MLNR), with the requisite legislative mandate, autonomy and independence, while being held accountable for delivering results. Under the Road Map, the Government is committed to empowering key energy sector institutions, including the DoE, the URA, and the MLNR, to ensure that the required changes in the energy sector are well-designed and implemented quickly and effectively. In particular, the DOE needs to be provided with the

mandate and accountability to oversee the Road Map implementation, monitor progress and results, and report regularly to the Government of Vanuatu. The Government is also committed to providing sufficient funding to engage additional staff necessary for the effective functioning of the DOE and the MLNR. Similarly the Government will take the necessary steps to empower the URA via a strengthened legislative mandate and broadened scope of oversight, as well as ensuring its independence and funding.

- **Bringing it All Together - Implementing a Sector-wide approach (Swap) under the principle of ‘Many Partners, One Team, One Plan’** — The Government is committed to leading the quantum shift in energy sector moving away from fragmented project-based approach (within concession areas and off-grid program activities and initiatives outside of these areas); to a programmatic approach for implementation, anchored by a sound, overall least cost sector-wide investment programme, directly linked to sector outcome targets consistent with the national vision. This will help to ensure that all stakeholders – sector institutions, private sector, and donors - are working towards a common national vision and under a common results framework; and enhance coordination and aid effectiveness across donor funded projects to achieve the Road Map targets overall.³⁴ The Government is also mindful of striking the right balance between the public and private sector roles and their comparative advantages in participation modalities and scope. Specifically, 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; especially in existing concession areas and to the extent capacity exists, outside these areas as well. At the same time, the Government appreciates that public funds will have to be raised as well, in a sustained and programmatic manner, to co-finance the public good elements of the access scale up program; including well designed and targeted subsidies to address affordability of energy access especially the poorer segments. —***The financing requirements required for the energy sector Road Map implementation program timeframe 2013-2018, are identified in the Prospectus presented in sections 4 and 5.*** These encompass specific investments identified to date as part of an overall least-cost access scale-up plan, enabling policy initiatives, and targeted capacity building for key sector institutions, and identify the major role and contribution expected of the private sector.

The Vanuatu Energy Road Map and Financing Prospectus – anchored by a strategic investment planning framework for expanding energy access to all

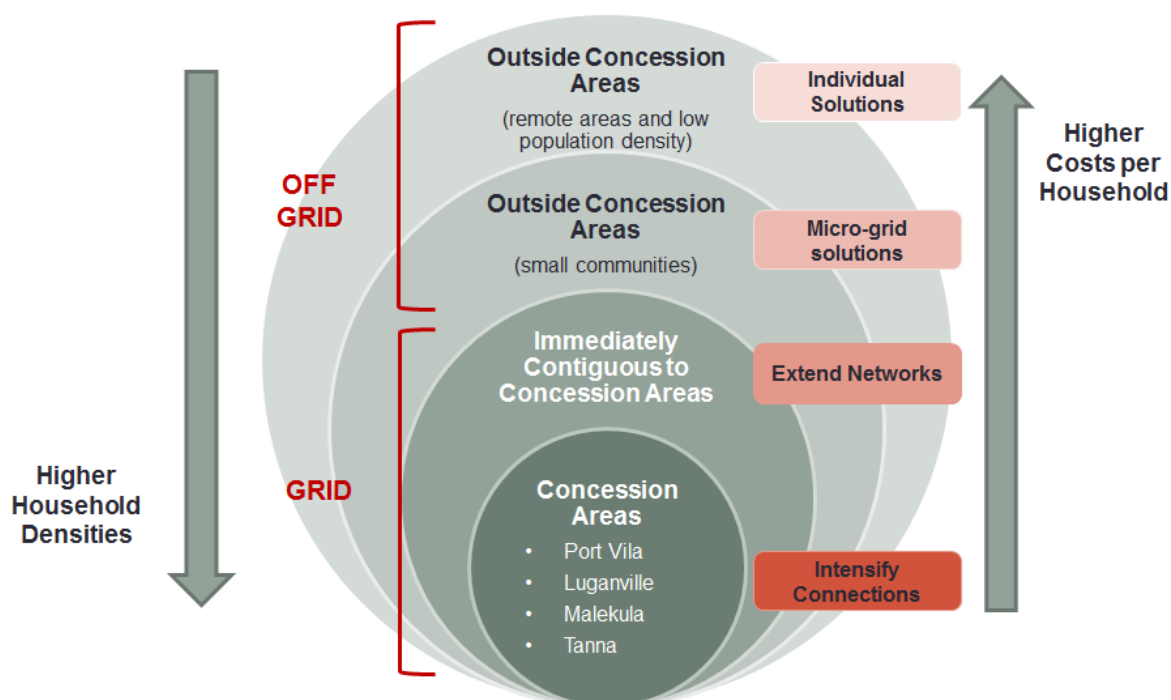
Least cost energy services delivery modality options - The Government is committed to deliver vital social services and basic infrastructure, including electricity, to enable the well-being of all citizens – households, communities and institutions - and in a timely manner, irrespective of where they live. A particularly challenging aspect of this task arises from the economic and physical geography and geospatial demographic spread and settlement patterns of the population across Vanuatu; with approximately 243,000 inhabitants (about 50,000 households), spread over 80 mostly volcanic islands in an 800-km north-south aligned chain, with varied topography and varying degree of

³⁴ The sector-wide approach (SWAP) has the endorsement of all the major bi-lateral and multilateral finance and donor agencies, as signatories to the Paris Declaration of March 2005 which set international guidelines and targets for raising the quality of aid, to enhance aid effectiveness, by harmonizing efforts with other donors, and by aligning aid with partner country strategies and systems, and moving away from project based approaches (PBA). For example see: (i) EC Policy Guidelines “Support to sector programs” July 2007, http://ec.europa.eu/europeaid/multimedia/publications/publications/manuals-tools/t105_en.htm and (ii) World Bank, Achieving Universal Access to Modern Energy in East Asia and the Pacific, One Goal Two Paths, Flagship Report, 2011

nucleation of the individual communities and households. These structural factors, among others, in turn directly influence the technical, economic and financial considerations in the calculus undertaken to identify the least cost access scale-up strategy suited for Vanuatu.

Moreover, Vanuatu can also benefit from relevant good practice lessons of international experience with least cost approaches to achieve electricity access scale-up efficiency and speedily; comprising a multi-prong complementary set of interventions of grid-based electrification rollout where least cost, and otherwise a well-designed comprehensive off-grid access scale-up and renewable energy development program.³⁵ Taken together all these considerations underlie the least cost electrification strategic approach in the Road Map, and that is tailored to each of the four population segments depicted schematically in Figure 2.16.

Figure 2.16: Strategic Framework for Scaling up Electricity Access Nationwide by 2030 – Least Cost Energy service delivery modalities by Four Population Segments



Broadly, the strategic approach for electricity access scale up under the Road Map distinguishes broadly four target segments of the population for access scale up, with least cost delivery options and service standards matched for each segment, as outlined below:

- **Existing concession areas**—these comprise the four existing service concession areas—Port Vila, Tanna, and Malekula (UNELCO), and Luganville, Santo (VUI)—depicted as the inner most circles in Figure 2.16. The Road Map identifies mechanisms and specific action plan for scaling up access to the remaining unconnected households; and actions aimed towards the aggressive development and in a transparent manner, of cost effective grid connected renewable energy for base load supply and diesel fuel substitution to significantly lower the cost of power generation.

³⁵ World Bank, Achieving Universal Access to Modern Energy in East Asia and the Pacific, One Goal Two Paths, Flagship Report, 2011 especially see: (i) "Electricity Access: Delivering results on the Ground" chapter 4; (ii) "Designing a National Electrification program for Universal Access" Chapter 2.

- **Immediately contiguous extensions**—the second circle in Figure 2.16 conceptually represents areas (across Vanuatu) that are immediately and proximately contiguous to the four concession areas, and where there is potential to extend the grid networks to expand access under a least cost strategy. Pre-feasibility studies are to be undertaken to identify the least cost development framework to extend grid service into the areas contiguous to the four existing concessions, with additional generation from cost effective renewable energy sources (a study for Efate geothermal and ring network development has been completed).
- **Off-grid access for all program delivery mechanisms**—Off-grid areas represent geospatially the population segments that fall outside the existing concession areas, even following least cost grid extensions outlined above. Schematically these are represented in Figure 2.16 by the third and the fourth largest circles, to differentiate between three distinct delivery mechanisms for least cost electricity access provision. Specifically, the Government will develop a sound energy sector wide plan for off-grid areas—including renewable energy development, investments, supporting capacity building and enabling subsidy policy framework and financing mechanisms.³⁶ This will underpin the design, financing, and effective implementation of a scaled up off-grid electrification *program*, which will be coordinated across donors to align with the plan. The three key sub-program components of the “off-grid access” program can be broadly labeled as follows:
 - **Institutions universal access program**—ensuring that **all** social institutions are equipped with reliable electricity supply facilities
 - **Hybrid micro grids**—for small and compactly clustered settlements/communities with sufficient load and powered by solar PV-battery-diesel, and as appropriate small hydro and other cost effective renewable energy source.
 - **“Basic electricity access for all” program** to enable the powering the most essential energy needs for cell phone-charging and modern lighting (at a minimum). For the majority of the households in off-grid areas, in dispersed settlements well outside of four grid system footprint these relatively low-cost, user-friendly gadgets provide high-quality modern light-emitting diode (LED) lighting, and sufficient power for cell phone and small radio battery charging. Taken together, this ‘basic electricity’ service potential represents an immediate life-changing prospect.

³⁶ The World Bank has noted in its Flagship report on Energy Access for all, that even in the hypothetical scenario if the incremental demand electricity access scale up in developing countries were supplied entirely from fossil energy sources, the incremental GHG emissions would make a negligible difference to the overall global situation. Besides, the welfare benefits of electricity access have been reported to be of the order of US\$0.50–US\$1 per kilowatt hour (kWh). In contrast, a stringent valuation of the corresponding carbon damages in a worst-case scenario is far less at only a few cents per kWh; World Bank, *Achieving Universal Access to Modern Energy in East Asia and the Pacific, One Goal Two Paths*, Flagship Report, 2011 ; Gilbert 2009).

3. Petroleum Sector Targets and Actions

Petroleum is fundamental to Vanuatu’s energy sector, and will play an important role in Vanuatu’s transition to modern forms of energy. Petroleum is the dominant fuel used in electricity generation and will remain so in the medium term, and is the base for modern cooking fuels, such as kerosene and LPG. As described in Section 2, achieving a more efficient petroleum sector will help to drive economic and social development in Vanuatu.

This section explains what needs to be done in the petroleum sector to achieve the Government’s priorities set out above. This section begins by establishing targets for the petroleum sector in Vanuatu over the medium and long term. This section then describes the actions that will help take the petroleum sector forward and contribute to the outcomes that the Government aims to achieve. The recommended actions begin in Section 3.2 by describing the areas where the Government will take the lead by putting in place a framework that enables affordable and secure supply of petroleum. Section 3.3 describes the institutions in the energy sector that need to be empowered to ensure accountability for improved results. Finally, Section 3.4 describes the specific investments that will be undertaken to improve efficiency and security of supply in a coordinated way.

3.1. Petroleum Sector Targets

The discussion in Section 2.2 of this Road Map highlights that security of petroleum supply is essential for continued economic growth and social development in Vanuatu. Improving the affordability of petroleum products can also have a significant impact on living standards for the large proportion of rural households that currently use solid cooking fuels (such as charcoal). Similarly, improved fuel security through lower price levels and lower volatility will reduce costs and risks for businesses, particularly in the transport sector. This is consistent with the findings of the Framework for Action on Energy Security in the Pacific (FAESP) completed in 2010, which highlights the need for countries within the Pacific to work towards achieving high-quality, affordable and accessible petroleum supply and ensuring its efficient use.³⁷

The Government of Vanuatu has identified targets for the petroleum sector to achieve the vision of more reliable, secure, and affordable petroleum supply. These targets are ambitious, but can be achieved with appropriate actions to overcome the challenges identified in Section 2.2 of this Road Map. These appropriate actions include investments in domestic transportation for petroleum products that will help to reduce distribution costs, and regulatory changes that will provide strong incentives to focus on meeting high health, environmental and safety standards. Table 3.1 presents the targets for the petroleum sector to be achieved by 2015 and 2020.

Table 3.1: Targets for the Petroleum Sector

	2015	2020
Reduce the cost of distributing all petroleum products in Vanuatu by:	5%	10%
Improvements in Health, Safety & Environmental Standards	Local legislation and policies in place that comply with	All operators meeting the new standards

³⁷ See Secretariat of the Pacific Community, “Towards an Energy Secure Pacific: A Framework for Action on Energy Security in the Pacific”, 17 June 2010. Available online at http://www.sprep.org/att/irc/ecopies/pacific_region/686.pdf http://www.reeep.org/file_upload/6119_tmpphplpyyb.pdf.

The Government understands the need to balance the capital investment requirements that will increase the security of supply, with potential consequential increase in prices to fund the capital expenditure required. Investments need to be targeted to having the largest impact on improving security of supply, without placing upward pressure on prices. Other complementary initiatives can also help to create downward pressure on prices. For example, more efficient domestic distribution channels are likely to result in lower prices, helping to offset the cost of further investments to improve the international supply chain into Vanuatu. Furthermore, increased storage on the outer islands could improve efficiency of the domestic supply chain by requiring fewer, but larger petroleum shipments.

3.2. Achieving Government Leadership and Commitment

This section describes the ways that the Government will help to ensure that the challenges described in section 2.2 are overcome through policy, law, and regulation. The measures described in this section will contribute to achieving the national vision of more affordable and reliable petroleum products to fuel the growing economy and raise standards of living. The petroleum sector in Vanuatu currently has few legal and policy instruments to ensure the safe delivery of reliable and affordable petroleum products to the citizens of Vanuatu, and the following actions will help the Government to address key stakeholder concerns.

Key actions include:

1. Developing and passing new laws and regulations governing the downstream petroleum sector. These will include: i) specific licensing requirements for petroleum suppliers, distributors and retailers; ii) handling of dangerous goods; iii) health, safety and environmental risk assessment, monitoring and compliance requirements.
2. Empowering and holding accountable key energy sector institutions with oversight of the downstream petroleum sector.
3. Undertaking a study of the transport sector, incorporating considerations of a) vehicle registration and revenue; b) engine efficiency and vehicle standards; c) implementation of appropriate fuel quality standards for Vanuatu; d) fuel demand forecasts; and e) vehicle inspection and compliance arrangements.
4. Energy security. Establishing, in consultation with industry, fuel storage capacity and reserve stock levels that provide Vanuatu with energy security levels that are prudent and economically efficient.
5. Establishing quality standards for the construction, maintenance and operation of petroleum storage and transportation assets. Validation, verification and independent auditing of such assets will be part of the regulatory regime.
6. Improving the collection and analysis of petroleum data and the impacts petroleum product supply can have on the economy of Vanuatu.
7. Re-establishing price monitoring of petrol, diesel and kerosene.
8. Introducing Price Regulation for LPG

Re-establishing Price Monitoring to Increase Transparency for Petroleum

The Government will re-establish regular monitoring of the prices of petroleum products (excluding LPG), and will benchmark prices with those in other Pacific countries. This monitoring and benchmarking function will help to ensure that prices reflect the efficient cost of supply. At present, the evidence suggests that suppliers of petroleum products other than LPG are not currently earning excessive profits, given their current investment plans, and have passed through efficiency gains to consumers. Supplier returns for petrol, kerosene and diesel in Vanuatu are estimated at around 16-17 percent, which is only marginally higher than the regulated returns for suppliers in other Pacific countries (15 percent).³⁸ However, the Government believes that monitoring of petrol, kerosene and diesel will help to protect consumers in Vanuatu in the long run by ensuring that price remain at reasonable and at cost-reflective levels.

Price monitoring of petrol, kerosene and diesel will also build public confidence in the petroleum sector, increasing transparency by providing a regular assessment of the average margins of the petroleum importers, distributors and retailers. This will help to limit any unnecessary upward pressure on petrol, kerosene and diesel prices, and will improve suppliers' incentives to pass efficiency gains on to consumers and improve affordability.

The *Price Control Act 1974* provides the required legal authority to enable price monitoring to be implemented. The Government will assign the price monitoring responsibility to the Utilities Regulatory Authority, as the URA already has knowledge and experience with good practice methods of regulation and price monitoring. Appropriate amendments will be made to the *URA Act*.

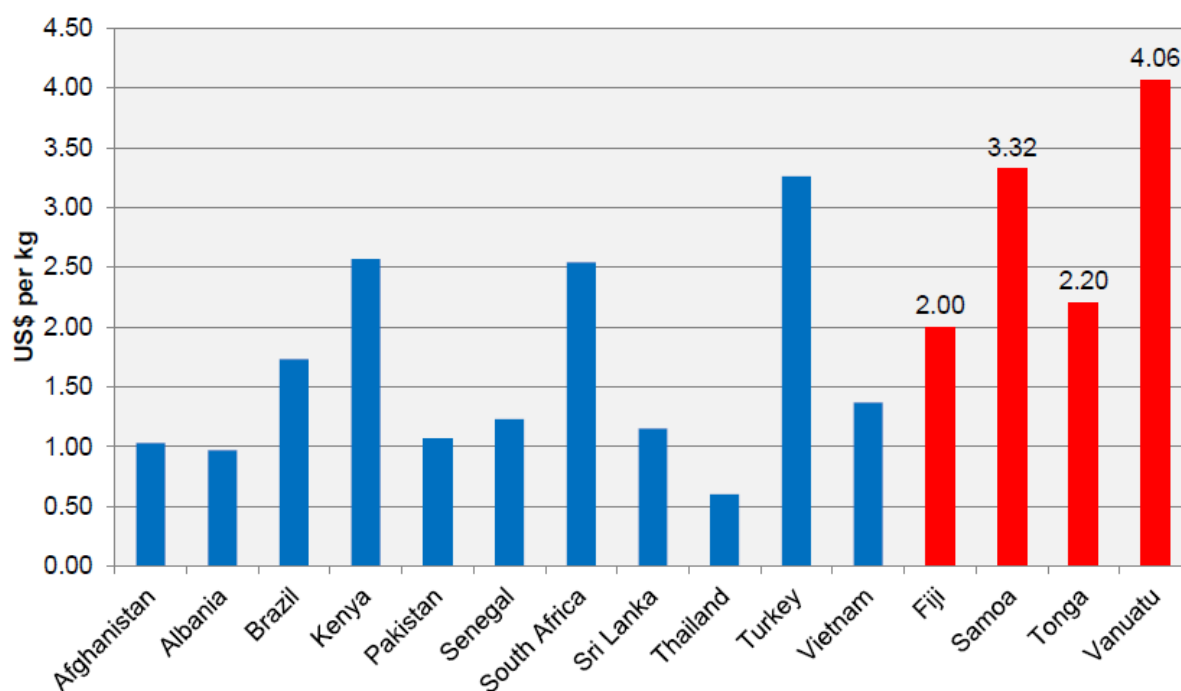
However, supplier returns for LPG do appear to be high, after independently assessing LPG supply chain costs and margins. Pre-tax supplier returns on capital for LPG in Vanuatu are estimated at around 22 percent per year, based on independent and conservative estimates of the depreciated replacement cost of Origin Energy's capital stock and a review of LPG supply chain costs. This 22 per cent return on capital for the LPG supplier in Vanuatu contrasts with the healthy pre-tax supplier returns of 15 per cent per year in Pacific Island markets with regulated prices.

Prices of LPG in Vanuatu in 2011 were significantly higher than other similar sized markets in the region and in comparison to countries outside the Pacific (Figure 3.1), and this is consistent with other independent analysis over the last 10 years by the Pacific Islands Forum Secretariat.³⁹

³⁸ Hale and Twomey, and David Butcher and Associates "Draft Final Report: Options for Increasing the efficiency of Vanuatu's oil and gas supply chain" November 2012

³⁹ See Hale & Twomey (2011), p.79

Figure 3.1: LPG Retail Prices (including taxes), Vanuatu versus selected countries, December 2011



Sources: World Bank December 2011 LPG Report , Samoa Ministry of Commerce, Tonga Ministry of Commerce and Hale & Twomey.

Introducing Price Regulation for LPG

The Government will introduce price regulation for LPG products. The move towards regulation, rather than monitoring, reflects the high price and margins of LPG in Vanuatu and the existence of a single supplier, Origin Energy. The price margins on LPG are estimated to be much higher than required to attract investment to the market. The pre-tax returns are estimated at 22 percent, although Origin Energy claims they are much lower at 14-15 percent.⁴⁰ Origin Energy faces little threat from competition given the small size of the LPG market in Vanuatu and the high up-front capital costs of establishing a competitive alternative LPG supplier. In the absence of such a competitive threat, and with strong evidence of a history of high prices and returns on LPG in Vanuatu, the Government will introduce regulation of LPG prices.

Price regulation for LPG is expected to be relatively straightforward. Regulation can be introduced with the *Price Control Act 1974* by adding LPG to the list of goods to be regulated. To ensure consistency with price monitoring of other petroleum products, the Government will assign the price regulation responsibilities for LPG to the URA through appropriate amendments to the *URA Act*. In light of the small LPG market in Vanuatu, the Government expects that the regulator will adopt a light-handed and low cost approach for regulation of LPG prices.

Managing Health, Safety and Environmental Risk

Current operators in Vanuatu generally conform to international norms in managing health, safety and environmental risks. However, the entry of low-cost operators to the sector (and the prospect of further entry) creates the risk of attracting suppliers that do not have appropriate operating standards or a commitment to responsible operations. Simple operational licenses will help to safeguard performance by setting out expectations in terms of environmental performance and safety, while encouraging market entry and competition.

⁴⁰ Hale and Twomey, and David Butcher and Associates "Draft Final Report: Options for Increasing the efficiency of Vanuatu's oil and gas supply chain" November 2012

The Government is committed to ensuring that health and safety are priorities in the management and distribution of petroleum products. A thorough review of the existing health, safety and environmental framework is required. The review will help to place a particular focus on the shortcomings of the existing framework, and identify shortcomings that need to be addressed through new regulations. Although general environmental protection regulation exists, the new regulations will fill in gaps in the petroleum sector, and are expected to cover fuel quality standards, a petroleum emergency response strategy. This strategy would include addressing the prevention of pollution, the response, and responsibility of pollution when it occurs (in particular responding to any oil spills). The regulations will also increase the responsibilities of operators in relation to the health and safety of their employees, customers and the general public.

3.3. Empowering and Holding Accountable Key Energy Sector Institutions

Strong and effective institutions are essential to successfully achieving the Government's petroleum sector targets, and moving towards the Government's vision for the energy sector. Sector institutions need to be empowered to effectively implement the initiatives described in this Road Map.

Re-establishing price monitoring of petroleum products and introducing price regulation for LPG will require capacity to be built. Price monitoring requires the regulator to regularly review and analyze the prices of petroleum products in several countries (including Vanuatu), and to benchmark Vanuatu's prices with other comparable Pacific nations.⁴¹ The Pacific Islands Forum Secretariat previously carried out petroleum price monitoring in the Pacific region, however this monitoring was discontinued in 2006.⁴² The Government therefore needs to ensure that the institution responsible for price monitoring and regulation is adequately trained in best practice monitoring and regulation of commodities. The URA is best placed to undertake these functions because it has experience with price regulation and its mandate is to be extended to include price monitoring of petroleum and regulation of LPG.

The Government is committed to ensuring that the URA has the capability to monitor prices at regular intervals, and evaluate if efficiency gains are being passed through to consumers. The additional funding required to support the authority has not been sourced yet and initial estimates for the additional funding required for the URA to complete regular price monitoring and benchmarking suggest an approximate funding requirement of VUV44.5 million (US\$0.5 million) over 6 years. The funding component required to support regulation of LPG prices needs to be estimated.

3.4. Implementing a Sector Wide Approach (SWAp) to Investment

This section describes the investments in the petroleum sector that the Government will support to improve the security of supply and affordability and safety of petroleum products throughout Vanuatu. Having all petroleum sector investments in this Road Map helps to ensure that plans are coordinated with other developments in energy sector (including electricity), to ensure that progress is made efficiently and effectively to move towards the Government's vision of widely accessible, secure and affordable energy for all Ni-Vanuatu.

⁴¹ An example of petrol price monitoring from New Zealand that focuses on importer margins is available on the following website: <http://www.med.govt.nz/sectors-industries/energy/pdf-docs-library/liquid-fuel-market/weekly-oil-price-monitoring/Graphs.pdf>

⁴² See <http://www.forumsec.org/pages.cfm/documents/energy-2/> for copies of the Pacific Fuel Price Monitor from 2002-2006

With the exception of infrastructure safety upgrades, the estimated costs of the investments presented in this section are not available at this time. The Government is working closely with private sector operators to better understand the investment requirements, and how these can be financed.

Improving the Efficiency of Local Fuel Distribution with Barge Transportation

Fuel transport between islands currently makes up a large proportion of the total cost of petroleum products in Vanuatu. Improving the efficiency of the distribution of petroleum products to outer islands will place downward pressure on retail fuel prices in those locations. Efficient distribution will also significantly improve security of petroleum supply.

Pacific Petroleum has signed a Memorandum of Understanding with the Government to invest in a new double-hulled fuel barge to distribute petroleum products to the outer islands more efficiently, resulting in a reduction in the freight costs of fuel to outer islands, and an improvement in energy security on those islands through the reduction in the frequency of short-term fuel shortages. The barge will store bulk petroleum products under the deck, with packaged products on deck (including LPG bottles, drums and lubricants). The diesel and/or petrol will be off-loaded from the barge into small bulk storage tanks (20,000 to 50,000 litres each) located on islands away from Santo and Efate. These storage tanks have to be built and are to be appropriately sized to provide sufficient capacity to meet demand and reserve buffer stocks, while taking into account an efficient schedule of fuel deliveries by the barge. The capital and operating costs of the barge and the local storage tanks are to be recovered through the price of fuels. Pacific Petroleum expects to start delivery using the barge between late 2012 to early 2013.

The barge will help to increase the efficiency of the domestic supply chain, while also improving the operating and safety standards of domestic distribution. The Government plans to contribute 30 percent towards the cost of the barge, with Pacific Petroleum investing the remaining 70 percent. This capital funding structure will reduce the cost of the return on investment that Pacific Petroleum requires (compared to fully funding the barge), thereby reducing the cost of delivery for consumers. Although the precise impact on retail fuel prices has not been estimated, the investment is expected to help lower consumer petrol prices and encourage more consumers to move from solid cooking fuels to the modern cooking solutions.

The Government will initiate a study with PPC to optimize the scheduling of domestic distribution. Developing an efficient distribution schedule will ensure that the barge investment and associated investments in fuel storage tanks provides maximum benefits to the outer islands, without increasing costs unnecessarily. This optimization of scheduling will be coordinated and balanced with investment in storage on the outer islands (discussed further below) to achieve a low cost barge operation.

Balancing Financial and Physical Hedging to Provide Greater Fuel Security and Price Stability

Financial and physical hedging can be effective at managing the risk of volatile and increasing petroleum and LPG prices. In Vanuatu, financial hedging is considered to be more effective at managing exposure to high and volatile prices, because the current level of storage is considered to provide an adequate level of security.

Financial hedging can be an effective way to reduce the risk of price volatility, thus increasing the level of certainty. There are a variety of hedge products that could be used to reduce risk, including swaps, call options, and zero cost collars. Ideally, the hedge products should provide equal and opposite risk to the risk currently facing Pacific Petroleum and Origin Energy. Changing the pricing structure to monthly averages (from the current 5 day delivery pricing) will help to match the risk to

the hedge products offered in the Singapore market. Monthly pricing alone will also reduce the volatility in the price of petroleum products.

Additional storage in the existing terminals and new storage facilities in outer islands is likely to be required around 2015/2016 to maintain security of supply of petroleum products. Improving storage facilities requires high cost, lumpy investments that can have a large impact on prices. Additional reserves will enable Vanuatu to physically hedge against high and volatile international petroleum prices, and facilitate better distribution of petroleum products to the populations living in the outer islands. The investments in outer islands will be coordinated with the optimization of the domestic barge schedules.

The Government is focused on achieving a balance between improving security of supply (by increasing storage or financial hedging) and keeping prices down, with the need to increase prices to pay for the large investments in storage. Therefore, the Government recommends that Pacific Petroleum and Origin Energy initially focus on improving security of the supply chain with the use of hedge products. The Government will also discuss the risks associated with increasing storage with the suppliers of petroleum and LPG, to understand how required investments can be incorporated into each supplier's capital investment plans. The Government will explore, with PPC and UNELCO, the scope for deferring storage investments in the existing storage fields on the main islands to keep unnecessary capital investment costs down.

To support the commitment to financial hedging the Government will undertake a review on the options for developing a financial risk management policy and framework. A financial risk management framework will enable sector stakeholders to manage risk more effectively. The framework is expected to include financial hedging, clear allocation of responsibilities, and powers to levy.

Upgrade Safety of Infrastructure

A variety of investments are needed to address the safety and environmental risks in the Santo, Port Vila and Bauerfield Airport terminals. Minimizing the risks of fire and spills will improve the reliability of the supply chain for both petroleum and LPG.

A recent petroleum sector study found that to improve the safety of the terminals, Pacific Petroleum needs to include in its capital investments:

- Fire protection systems
- High level alarms to avoid risk of tank overflow
- Change to top loading of trucks
- Upgrade Santo tank compound with high density polyethylene (HDPE) Liner
- Reduce the proximity of petrol storage to nearby residential areas, and
- Undertake an initial survey for the seismic ratings of tanks.

Origin Energy also has safety issues that can be addressed by:

- Installing a fire protection system
- Reducing proximity of storage to residential areas in Port Vila, and
- Installing a gas leak detection system.

Although some of these investments are minor, they will generate significant improvements for the safety of staff at the terminals, the public and improve the security of supply. The investment requirements for Pacific Petroleum are estimated to cost a total of VUV560 million

(US\$6.2 million),⁴³ and about VUV90 million (US\$1 million) for Origin Energy. The Government is of the view that the private sector should address the investments with the largest risks first, and the remaining investments should be spread out over a suitable timeframe to avoid upward pressure on retail prices of petroleum products and LPG.

3.5. Summary of Petroleum Sector Actions

Table 3.2 summarizes the cost of the actions presented in this Road Map for the petroleum sector.

Table 3.2: Actions for the Petroleum Sector 2012-2022

	Total Estimated Cost (US\$)
Achieving Government Leadership and Commitment	
Re-establishing Price Monitoring (Petroleum) and Regulation (LPG) to Increase Transparency (<i>Include information gathering</i>). Develop and implement Financial Risk Management Framework.	US\$0.5 m
Managing Health, Safety and Environmental Risk (<i>Including review of health, safety and environmental frameworks and a petroleum emergency response strategy</i>)	US\$0.4 m
Transport sector study, including considerations on fuel quality standards	US\$0.2 m
Implementing a Sector Wide Approach (SWAp) to Investment	
Improving the Efficiency of Local Fuel Distribution to six islands of Tanna, Shepherd, Malekula, Pentecost, Ambrym, and Banks with Fuel Barge Transportation (US\$1.6 m <i>estimate based on cost of similar barges</i>) and installation of twelve 20,000 litre fuel storage tanks (estimate of installed cost of 12 tanks, NZ\$600,000)	US\$2.1 m
Energy Security through Balancing Financial and Physical Hedging(<i> capital expenditure on two new 5 million litre fuel storage tanks on at Port Vila in 2015/16, one for jet fuel (DPK) and one for ground fuels (diesel and petrol))</i>)	US\$10 m
Upgrade Safety of Infrastructure (<i>Origin and PPC storage fields, and review risk of encroachment in residential areas</i>)	US\$7.2 m
Total	US\$20.4 m

Source: Compiled from Hale and Twomey, and David Butcher and Associates "Draft Final Report: Options for Increasing the efficiency of Vanuatu's oil and gas supply chain" November 2012

⁴³ Hale & Twomey use a different exchange rate, providing investment estimates of VUV611 million or US\$6.2 million for Pacific Petroleum, and VUV96.2 million or US\$976,000 for Origin Energy.

4. Electricity Sector Targets and Actions

Electricity is essential to contribute towards better living standards and economic prospects for the people of Vanuatu. Section 2 of this Road Map highlights the key linkages and pathways linking modern energy access with the pursuit of broad-based economic growth and prosperity, eliminating poverty, and improving human and social development nationwide; and identifies at a strategic level, challenges in the energy sector to be addressed as priorities in this Road Map to expand coverage, achieve regional balance in access across the provinces, and improve the affordability of modern energy sources.

This section presents the actions needed to deliver electricity more efficiently and cost effectively in Vanuatu, and achieving secure, affordable, and widely accessible electricity for all Ni-Vanuatu within a generation. Specifically, it is organized along the following lines. Section 4.1 presents the Road Map targets for access, renewable energy, and for energy efficiency; and as benchmarks to monitor implementation progress over time. The enabling policy and framework actions required to ensure that the Road Map targets are achieved, are presented thereafter, broadly grouped along the three pillars of the Road Map (identified in section 2.3 on Strategic Directions – Way Forward): Government leadership and commitment (Section 4.2), empowering energy sector institutions and holding them accountable (Section 4.3), and implementing a sector-wide approach anchored by an overall least-cost energy sector investment program to meet the targets (Section 0).

4.1. Electricity Sector Targets

Most citizens and many social institutions in Vanuatu lack access to secure, reliable and affordable electricity, as described in Section 2. The Government understands that the pace of modern energy access expansion needs to rapidly accelerate. The considered targets for the electricity sector Road Map presented in this section are ambitious, but the Government is confident that they are achievable. The investments and enabling initiatives described in the remainder of this section of the Road Map will ensure that Vanuatu delivers a transformative change from past trends.

Targets for expanding electricity access

Table 4.1 presents the Government's targets to ensure Vanuatu achieves universal electricity access by 2030 to households (estimated 53,000 HH), social service institutions (health and education), as well as commercial establishments. Consistent with the strategic investment planning framework for expanding electricity access nationwide, presented in section 2.3, the targets specified in Table 4.1, broadly distinguish household(HH) segments by the least cost supply option modality: those residing in one of the existing concession areas with grid service (about 18,500 HH); those who live outside these concessions but sufficiently close, and where grid extensions are confirmed as the least cost option (approximately 3,000 HH); and the remaining population in the "off-grid" areas (about 31,500hHH).⁴⁴

⁴⁴ Figures derived from Vanuatu National Statistics Office, "National Population and Housing Census", 2009

Table 4.1: Access Targets for the Electricity Sector*

	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.;

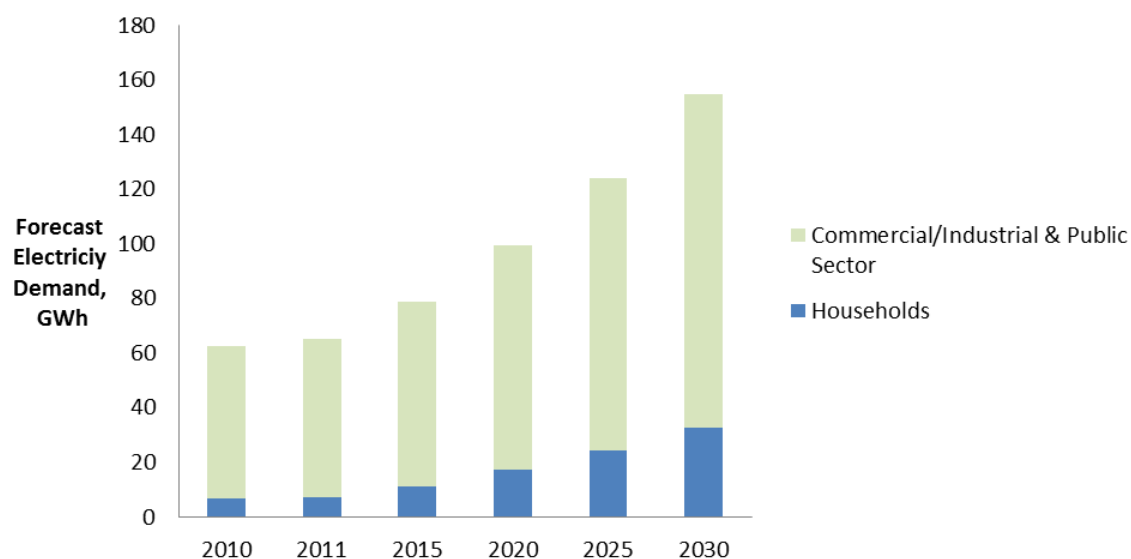
*** Basic power products refer to the cash-and-carry Pico lighting and charging products sold through retail shops and other establishments.

The Road Map’s 2015 access target of 75 percent in concession areas is projected to come from new connections to be made in Port Vila, Luganville and Malekula, where most of the unserved households reside within the reach of existing networks.⁴⁵ Table 4.1 also indicates that by 2015, 1,000 additional households that are currently outside the existing concession areas would be most efficiently served by a grid extension.⁴⁶ Figure 4.1 shows the projected growth in aggregate electricity demand across the four concession areas as the number of households and commercial and public customers grow in line with implementation of the Road Map’s access targets and with the growth in electricity demand per household with rising income levels. In particular, the doubling of demand over the next 10 years will drive the need for significant investment in additional generation capacity as well (discussed further below).

⁴⁵ In Tanna, 91 percent of unserved households within the concession area are beyond the reach of the existing grid, which means that new connections can only be made after major extensions have been completed to the existing grid.

⁴⁶ The Efate Geothermal Power and Ring Network Development feasibility study has identified that about 1,000 hh connections of the 3,000 total shown in Table 4.1 are on Efate Island, outside the existing concession area and in proximity to the road around the island. A comparable feasibility study for the Luganville area is planned.

Figure 4.1: Forecast Demand for Electricity in Vanuatu, 2011-2030



Note: NERM forecast (2011-2030); see Appendix B for details and by concession area

In the “off-grid areas” where the majority of the national population lives (about 31,500 HH), it is estimated at under 10 percent of these households currently have some form of access to electricity; such as solar home systems, and portable generators.⁴⁷ The Road Map targets in Table 4.1 call for 100 percent access by 2020; guided by the strategic investment planning framework underlying the Road Map for least cost access scale up nationwide, highlighted earlier in Figure 2.16 Specifically, where grid-based supply is not the least-cost supply option, the Government will promote cost effective alternative options for energy access taking into consideration the affordability of the option to users. The service delivery modalities as well as service standards for off-grid households will be different from grid service standards and will further depend upon the energy supply option appropriate in each context. Potentially, off-grid energy supply options will include one or more of the following modalities: green-site small community networks where feasible (typically solar-PV diesel hybrid powered or small hydro or biomass fuelled and in situations where a sufficiently compact geographic cluster of demand exists); individual solar home system solutions, and basic power charging products. The latter include cash-and-carry charging products that can power one or more lights, cell phone battery, and small radios for essential communications in households and public institutions, and charging for computers in public institutions. The Road Map targets 100 percent access by 2020 for off-grid households; provided by at least one of the three modalities identified above. Finally, the Road Map calls for all public institutions to have electricity access by 2020; served by a grid connection or otherwise an off-grid energy solution appropriate for the specific location.

Renewable Energy and Demand-side Efficiency Targets

The relatively high retail tariffs for electricity in concession areas (Figure 2.11), increases the cost of doing business, and in many cases also undermines the competitiveness of Vanuatu businesses. Furthermore, households are marked by among the lowest average electricity consumption levels, compared to some other Pacific island nations (Figure 2.12). The Road Map has identified two

⁴⁷ Estimates based on GIS analysis of the enumeration areas outside the concession, and figures from the 2009 census for households that were without access to electricity from the grid. Efate Geothermal Power and Ring Network Development study, Castlerock,

mechanisms to help bring down the price of electricity over time, while also improving the efficiency of electricity generation. *First*, investing in renewable energy technologies when they are least-cost is an effective way to meet new demand and improve electricity affordability; as long as these efficiency gains and reduced generation costs are transparently passed through under the retail electricity tariffs charged to consumers. *Second*, improving the efficiency of electricity generation, distribution and supply, and electricity use will ensure that electricity is relatively more affordable, and that households can extract more value from their energy budgets.

While expanding access to electricity, the Government will ensure that new connections are supplied in a least cost manner using competitive renewable energy supply in the concession and off-grid areas. This strategy, together with regulatory and subsidy policies to be introduced, will aim to reduce the cost of supply, and lower electricity tariffs to maximum extent feasible, while maintaining the financial viability of the service providers. The Government also recognizes that clear rules and regulations for the pricing of electricity are important to ensure that the activities supported through this Road Map benefit consumers to the maximum extent.

Table 4.2 summarizes the Road Map targets for renewable energy supply and energy efficiency. The targeted level of growth in the penetration of renewables to 2020 builds on recent developments, such as the commissioning of the 3 MW Devil’s Point wind farm in 2007.

Table 4.2: Renewable Energy and Efficiency Targets for the Electricity Sector

	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.

In addition to pursuing least cost renewable generation, affordability can also be improved by increasing the efficiency of electricity that continues to be generated from diesel engines. The Road Map has set a target for improving diesel generation efficiency in concession areas, to match the Pacific benchmark of good performance (between 168 and 210g/kWh).⁴⁸ Analysis completed for this Road Map shows that UNELCO has performed well compared to most other Pacific utilities, ranking 6th out of 19 utilities, with existing fuel efficiency currently varying between 213.32g/kWh in Port Vila to 288.28g/kWh in Malekula.⁴⁹ However, all concession areas except Tanna have shown trends of deteriorating performance (increasing fuel consumption per unit of electricity) over the last five years or longer, with a few small improvements observed in 2010. This trend of deteriorating efficiency needs to be reversed, and the Government is confident that a 20 percent improvement in

⁴⁸ PPA, “Performance Benchmarking for Pacific Power Utilities”, December 2011

⁴⁹ UNELCO Annual Technical Reports 2006-2010

fuel efficiency can be achieved by 2020. A 17 percent improvement in the average fuel efficiency will ensure that Vanuatu meets the benchmark lower band of 210g/kWh. Any benefits from the improvements in efficiency of fuel use in thermal generation are transparently passed through the regulated retail electricity tariffs to benefit consumers.

Demand-side energy efficiency—The Government acknowledges that least cost approaches requires supporting demand-side, as well as the supply-side, energy efficiency initiatives. A major constraint to this is that there is currently insufficient energy efficiency data collection to establish meaningful targets for end-use efficiency. To ensure that energy efficiency improvements can be achieved in the future, this Road Map sets a target for having comprehensive data collection established and in effect by 2015. Specific actions for improvement will then be identified and defined by 2020, and implementation plans will be included in Vanuatu’s revised Energy Road Map. The Government understands the importance of energy efficiency initiatives, and their centrality to meeting the Government’s vision for the energy sector. Therefore, where possible the Government will encourage implementation of energy efficiency initiative as soon as possible once sufficient data is available to design cost-effective and sustainable initiatives. The Government expects these initiatives to, amongst others, include appliance labeling, minimum energy performance standards, and improvements to building standards. These possible energy efficiency initiatives are summarized below and will continue to be progressed by the Government. The Government also requires that all priority studies in this Road Map (focusing on supply or demand) include an evaluation of, and recommendations for, related practical measures to improve the efficiency of using energy services.

4.2. Government Leadership and Commitment – Getting the Policies Right and Staying the Course

The existing institutional framework for supplying electricity in Vanuatu presents a number of constraints and barriers to achieving the national vision of reliable, affordable and widely accessible energy for all citizens in Vanuatu by 2030. The Government is committed to establish and put in place a comprehensive and consistent set of enabling policies and a strengthened legislative and regulatory framework and institutions, to ensure that going forward Vanuatu’s energy sector institutions, private sector, and other stakeholders play their respective roles in an effective and efficient manner to ensure timely progress towards achieving the Road Map objectives. Further, the Government will ensure that all such provisions are developed following stakeholder consultations and are transparently and uniformly applied for all sector participants, in a consistent and predictable way, and in accordance with laws and regulations of the Republic of Vanuatu. Priority elements of this agenda for the first year of implementation under the Road Map include:

1. Development and implementation of an overall subsidy policy framework and supporting financing policy platform for enabling affordable modern energy access to all by 2030;
2. Addressing key gaps and ambiguities present in the Electricity Supply Act, the URA Act, and the Geothermal Act and regulations, Government Tenders and Contracts Act, and other relevant legislation and regulations to enable timely and effective response from the energy sector institutions and participants in advancing the Road Map implementation;
3. Design and structuring of an effective risk-sharing framework under public-private partnership arrangements that is in the national interest while also providing adequate return on investment for the private sector, with particular focus on accelerating the potential transactions such as for the Efate geothermal power and ring road network development

(subject to resource confirmation). Considerations include legislative and regulatory reviews to facilitate independent power producers (IPPs), the process, methodology and approval for IPP “buyback” tariffs (within a least cost investment framework), Power Purchase Agreements (PPAs) and pass through of such costs to consumers. Other considerations include matters in relation to access to land and transmission easements in the context of community ownership, and an environmental and social framework for creating an enabling environment for the necessary future investments in generation and the network.

Subsidy policy framework and financing mechanisms

International experience highlighted in Section 2, indicates that no program of universal electricity access has succeeded without some form of a subsidy, coupled with a sustainable financing framework and financing mechanism. Specifically, such programs inevitably involved capital subsidies, particularly for enabling affordable connections targeted for the poor, be they located within reach of an existing grid or otherwise via grid extensions. These programs also provided subsidies for complementary off-grid initiatives where grid extension is not a least cost strategy for access. A crucial and shared policy element across the good practice countries that were successful, has been their ability to strike the right balance between achieving widely affordable access, maintaining financial viability of participating service providers—public and private providers ability to recover operating costs and their share of investment costs — and taking into account the draw on public funds (including donor funds) called for financing the public share of the least cost sector wide investment program to address affordability.

Section 6 of the existing concession contracts⁵⁰ provides the opportunity to effectively use an investment support fund to support additional developments of the electricity network and/or subsidize additional connections. The Government will ensure that this investment fund is used effectively and in a transparent manner; and consistent with good regulatory practices, there is adequate oversight for the approval and the use of the funds in terms of the agreed number and location of connections.

The Government will consider and endorse a sustainable subsidy policy and financing policy platform to effectively support all the Road Map actions and investments within 12 months of the publication of the Road Map. Once approved, this policy will become an integral component of the Road Map as the implementation moves forward. Under this policy, utilities and service providers will also have obligations when receiving subsidies or financing to achieve specified targets.⁵¹

Enhanced Legislative and Regulatory Framework – ensuring least cost national development that provides real benefits for consumers

Ensuring reliable, affordable, widely available electricity access outcome targets rests on implementing the best ways to expand and operate the electricity systems and the sector. These outcomes call for a review of the policy and legislative frameworks and processes to ensure that the right investment choices are pursued, implemented in a timely manner, and critically that the derived benefits of the investments made flow-through to consumers. The Government is committed to ensuring that the enabling policy, legislative, and regulatory framework is in place to govern planning, investment, and regulation in the electricity sector accordingly.

⁵⁰ Government of Vanuatu and UNELCO SUEZ, “Convention relating to the concession for the generation and public supply of electric power in Port Vila”,

⁵¹ The subsidy design developed as part of the Global Partnership for Output-Based Aid Project and lessons from its implementation will be used to guide the Government’s subsidy policy. The study has been completed and the program is expected to be implemented from 2013. Global Partnership for Output-Based Aid: Improved Electricity Access in Vanuatu, Castalia Strategic Advisors, September 2012

The Government is committed to undertake a review of legislation currently in place (the Electricity Act, URA Act, and Geothermal Act and others) and in light thereof, draft appropriate structured revisions to address gaps and otherwise strengthen the current provisions of these Acts, to support the objectives and actions described in this Road Map. In particular, the review will focus on two key issues:

- **Ensuring that least-cost investments are selected for implementation.** The Government will need to develop processes to ensure that the range of options for developing the sector is evaluated, and that the least-cost options are selected for implementation. This Road Map has drawn on studies that assess the cost of specific projects (such as the Efate geothermal project), but a more systematic way to review potential developments is needed.
- **Passing through the benefits of least-cost investment into electricity tariffs.** Selecting least-cost projects is only valuable for consumers if the benefits of reducing cost are reflected in tariffs. The Government will consider how arrangements for regulating electricity tariffs could be improved to ensure that the benefits of least-cost developed are passed through into tariffs.

Policy and risk-sharing framework for developing Public Private Partnership (PPP) transactions

Vanuatu does not yet have a policy to guide under what situations, and how public private partnerships (PPPs) will be developed and structured in the energy sector, as potentially they have a role to play in sector development and expansion envisaged under the Road Map. It is common for governments to enter into PPPs to share some of the risk associated with particular projects. The Government of Vanuatu is interested in exploring this option for electricity projects that provide particular benefits, but have risks that private investors may not be well placed to manage. A priority first case in point is the potentially transformative Efate geothermal power and ring road network development project transaction that has been assessed in a Government sponsored pre-feasibility study as the overall least cost option for scaling up access on Efate (subject to resource confirmation) and if efficiently structured, can substantially lower the cost of electricity production by substituting high cost base load diesel generation with significantly lower cost base load geothermal power.

A well-defined policy for structuring PPPs will ensure that the Government and the private partner(s) take on efficient levels of risk, and have a clear understanding of what each partner will contribute towards project success. Such a policy will enable the government and the private sector to allocate project responsibilities and risks to the party that is best placed to manage particular project functions and at least overall cost of development; by appropriately leveraging private sector investment and management, while injecting public financing for the public good elements – including for example upstream risks of resource confirmation - of the project scope.

Within the near-term time frame covered by this Road Map, a PPP policy is urgently needed to support the geothermal power and network development transaction on Efate; a large investment that requires explicit Government support to ensure that the asset base and return-to-shareholders are kept to a reasonable level. The Government will commission on a priority basis the preparation of a PPP policy framework for approval by Council of Ministers; with particular emphasis on advancing the Efate geothermal power and ring road network development project transaction as soon as possible. The PPP framework will also include provisions for independent power producer licensing and compliance, PPAs, and PPA pricing policy. The Government will explore how these provisions could be included in an efficient, consistent and transparent way within the established institutional, regulatory and concession contracts framework to provide certainty for potential

investors in generation facilities, and to ensure that they have a positive relationship with the existing concession contracts.

This experience could then provide a model for future transactions in the electricity sector, or other sectors in Vanuatu, while maximizing benefits of the development to consumers, passed through transparently via retail electricity tariffs. A related issue to be addressed is to clearly define the Government's role in investments, where support is needed in respect of project investments identified later in this section, such as hydropower projects.

Continuing Commitment to the Utilities Regulatory Authority

Since its establishment in 2007, the Utilities Regulatory Authority (URA) has been mandated under the URA Act, the function of utilities regulation, with the aim of ensuring the provision of safe, reliable and affordable electricity (and water) services.⁵² The URA is empowered to set the maximum level of tariffs for each concession, and also manages consumer complaints and advises the Government on matters related to electricity and water. The Government is committed to maintaining a strong (expertise, capacity, sustainable funding arrangements) and independent regulator of monopoly sectors in Vanuatu, and believes that the URA has a vital and constructive role to play in providing oversight of private and public sector companies operating in the electricity sector and accomplishing the Road Map target of achieving affordable universal electricity access in Vanuatu in the most efficient manner.

The Electricity Supply Act [Cap 65] governs the granting of concessions; and under this Act, the Minister of Infrastructure and Public Utilities has the responsibility for monitoring concessionaire performance and addressing various matters such as access to private land.⁵³ Until 2007 Vanuatu followed an approach of regulation by contract—that is, service standards and rules for tariff setting were defined in the concession agreements between the Government and each utility. In 2007, the Government passed the Utilities Regulatory Authority Act (URA Act) to establish the Utilities Regulatory Authority (URA), which has the primary objective of regulating utilities to ensure the provision of safe, reliable and affordable electricity services throughout Vanuatu. The URA also manages consumer complaints and advises the government on matters related to electricity.

The URA is empowered to review and in light thereof set the maximum level of retail tariff for each concession. If the concessionaire does not agree with the URA's decision, the matter goes to arbitration for final decision that is binding on both parties. However, as mentioned in Section 2 the Electricity Supply Act and the URA Act need to be enhanced. The Government will commission a review to explore options for enhancing the tariff review process, and the effective regulation of electricity sector operators and their activities. This review will consider how the current mandate given to the URA could be expanded and strengthened in scope and modality. This will ensure that investments in concession areas – existing and new concessions in future – that are to be recovered through the tariff setting mechanism under the tariff review and approval process, are in accordance with the overall least cost investment program of the Road Map; and to ensure that consumers continue to benefit to the maximum extent feasible from development of the sector.

⁵² Utilities Regulatory Authority Act No. 11 of 2007

⁵³ The Electricity Supply Act covers the granting of concessions and governs the powers of the concessionaires, damages, and penalties for other parties generating electricity, and compensation in respect of failure to supply. Other wrongful acts are also provided for include obstruction of an authorized officer, and power to enter to ascertain quantity of electricity consumed

Improving energy efficiency

Currently, anecdotal evidence suggests that the end use of electricity in Vanuatu may not always be efficient, resulting in higher bills for consumers than necessary. For example, efficiency can be improved substantially by using more efficient appliances.⁵⁴ Improving energy efficiency—in end use by consumers and in production and delivery by producers—has the potential to significantly lower investment requirements for new generation capacity. In short improving energy efficiency is win-win proposition. And in addition it also contributes positively towards a lower carbon emission growth.

The collection and analysis of energy efficiency data, as initiated by the Asian Development Bank (ADB)⁵⁵, will allow a Vanuatu Energy Efficiency Action Plan to be designed for households, businesses and the public sector to receive maximum benefits from their energy consumption. Depending on the findings of the data analysis, proposed initiatives may include one or more of the following:

- **Appliance Labeling**—Energy rating labels to be provided with any electric appliance for sale, informing the consumer how much electricity the appliance will use. The increased information available will allow consumers to compare products in terms of energy efficiency, and will provide the opportunity to guarantee years of energy savings by purchasing the more efficient product. This light-handed approach to regulation, which reduces information asymmetry, has been highly successful overseas.⁵⁶
- **Minimum Energy Performance Standards (MEPS)**—Products subject to MEPS are required to meet a minimum level of efficiency to be sold to consumers. This will ensure that the most inefficient energy using products sold to consumers are no longer available on the local market. The level of the standards will need to be calibrated appropriately to take into account Vanuatu incomes to ensure some lower-priced product options remain in the market. Vanuatu is also interested in participating in the Pacific Appliance Labeling and Standards (PALS) programme, which supports the introduction of energy labeling and standards for electrical appliances throughout the Pacific region.⁵⁷
- **Amendments to the Building Code**—Incorporate minimum energy performance standards into the building code, to be enforced for all new construction, especially commercial buildings. Improved standards could result in the energy use for new buildings dropping by more than 25 percent.⁵⁸

The DoE will develop an Energy Efficiency Implementation Plan for Government endorsement, outlining in appropriate detail, recommendations for initiatives – specific measures and modalities – for energy efficiency improvement – supply side and demand side –and backed by quantitative estimates of the expected costs and benefits there from following the collection and analysis of data. The Government may be able to source up to US\$0.1 million to support this from the ADB, which offers grant funding for energy efficiency projects in the Pacific.⁵⁹

⁵⁴ In New Zealand, energy labeling has encouraged consumers to purchase more efficient appliances. This resulted in a 33 percent improvement in 'sales weighted comparative energy consumption' (kWh/year) for refrigerators since 2000. <http://www.eeca.govt.nz/energy-savings-to-date>

⁵⁵ ADB, "Promoting Energy Efficiency in the Pacific" Final Report May 2011

⁵⁶ See New Zealand's Energy Rating and Energy Star Labels, <http://www.eeca.govt.nz/energy-savings-to-date>

⁵⁷ See <http://www.spc.int/edd/fr/section-01/energy-overview/energy/166-spc-press-release>

⁵⁸ Peter Johnston & Katerina Syngelakis, "Energy Efficiency in Vanuatu: Issues, Opportunities & Constraints", March 2012

⁵⁹ Peter Johnson, "Renewable energy and energy efficiency trade and investment forum for Papua New Guinea, the Solomon Islands, and Vanuatu" *Promoting Energy Efficiency in the Pacific – Phase 2 (PEEP2)*, 8-9 August 2012

Comprehensive framework for Environment and Social Safeguards

A consistent and harmonized sector-wide framework is essential to identify and effectively address the environmental and social impacts of the energy sector projects to be implemented under this Road Map. Currently, energy sector projects are guided by a number of different laws and regulations, and depending as well on the source of funds, different development partner policies and guidelines for dealing with environmental issues, indigenous peoples' rights, land issues, ownership negotiations, resource rights, and compensation and resettlement requirements. The Government will initiate the development of a social and environmental framework taking into account existing national laws and regulations and key development partner policies and guidelines. Such a framework would provide sufficient minimum standards and economize on the number of impact assessments required prior to implementation to provide a more supportive basis for developing new projects, especially where development partner funding is involved. The framework will also be consistent with developments in responding to the issues surrounding land rights and compensation. Equitable land governance is a complex, but vitally important issue in Vanuatu, and can impact on important investments in the energy sector. However, considering that only about 4 percent of land leased is used for public infrastructure projects⁶⁰ (including energy infrastructure), the Government considers that the issues is best dealt in a specialized review, independent of the Energy Road Map.

4.3. Empowering Key Energy Sector Institutions and Holding Them Accountable

An essential ingredient to successfully implementing this energy Road Map is the presence of strong and effective sector institutions. As described in Section 2.2, each of the energy sector institutions needs to be empowered to lead and facilitate the Road Map actions. The Government is committed to ensuring that the DoE, MLNR, the MIPU, and the URA are accorded the appropriate and requisite mandate by the Government as well as, accountability, and capability for policy setting, monitoring and enforcement oversight for sector initiatives that underpin Road Map implementation aimed at meeting the targets and expectations set. This section describes how the Government plans to ensure that these institutions are sufficiently empowered, resourced and are held accountable for implementing the Road Map

Building Capacity at the Department of Energy

Without a strong DoE, the Road Map will not be able to achieve its objectives. The Government established the DoE⁶¹ as part of its launch of the energy Road Map to recognize that a dedicated, well-resourced team is needed to drive future actions in the energy sector. The DoE has led the development of this Road Map. However, it is clear that the DoE will require further technical assistance and additional capacity to successfully lead and support the implementation of the actions set out in this Road Map.

An implementation unit within the DoE will be established with the specific responsibility of overseeing implementation of activities described in this Road Map. The Government will ensure that this implementation unit has the available resources and capacity going forward to carry out its essential work. Several independent studies⁶² have identified that significant capacity building in the

⁶⁰ Acknowledging that land for some infrastructure projects are purchased rather than leased. World Bank "Towards More Equitable Land Governance in Vanuatu: Ensuring Fair Land Dealings for Customary Groups" Draft Discussion Note, April 2012

⁶¹ Prior to the Road Map launch, the Energy Unit was responsible for energy related issues

⁶² Castlerock, "Vanuatu: Efate Geothermal Power and Island-Ring Grid Development Framework" January 2012; Castalia, "Global

DoE is required for successful implementation of the Road Map. Strengthening the capacity of the DoE will ensure that Road Map policy initiatives and investments are well supported, and have sufficient momentum in moving from planning to implementation.

There are three specific initiatives described in this Road Map that involve a specific role for the implementation unit in the DoE (in addition to its broader monitoring and stakeholder liaison roles). The Vanuatu Electricity for Rural Development (VERD) program includes funding to create a 'Rural Energy Unit' within the DoE to support the rollout of the rural electrification projects (RLSS and PIES, described in Section 4.4.1). The initial proposal under the VERD was for the DoE to implement the rural program, however following concerns over lack of progress due to lack of capacity, the program is now expected to be implemented through the support of a Management Contractor. The Output Based Aid subsidy design for grid-based electricity connections, described in Section 4.4.1, also contemplates that the DoE manage the subsidy program policy, and monitor and evaluate results. The initial feasibility study for geothermal energy development has identified that the Government requires least two additional personnel to provide advice on the legal, technical, financial and commercial aspects of the geothermal investment—housed within the DoE (detailed in Section 4.4.2). In addition to the above specific programs, there is a critical need for data collection, analysis and availability to support Government decisions, inform development partner programs and ensure public and consumer confidence in decisions and programs in the energy sector. The process commenced as part of the development of the Road Map needs to be consolidated and maintained within the DoE.

The Government will also initiate a priority assessment of the resources and institutional structure of the DoE. The assessment will ensure that the allocation of resources with the DoE enable effective and efficient implementation of the Road Map. The assessment will also identify the most appropriate structure for the DoE, and a strategy for ensuring that the DoE has the ability to adapt to meet the needs of energy sector as the implementation program evolves through to 2020 and beyond. This priority assessment is expected to be conducted during the first year of the Road Map implementation, and will cost approximately US\$500,000.

These actions are critical to the success of this Road Map, and highlight the importance of the DoE in Vanuatu's energy sector. The Government is committed to empowering the DoE, by building the capacity as suggested by the studies mentioned above. The technical capabilities of the staff within the DoE will also be strengthened to lead implementation activities, and to accurately monitor and evaluate changes in the energy sector over at least the next 15 years. This will allow the Government to assess whether the actions set out in this Road Map (and enhanced over time) are achieving their intended outcomes, or whether further measures are needed to develop the energy sector.

4.4. Implementing a Sector Wide Approach (SWAp) to Investment – many players, one team, one plan

The Government is moving away from fragmented project-based approach (within concession areas and off-grid program activities and initiatives outside of these areas) to a programmatic approach for implementation, anchored by a sound, overall least cost sector-wide investment programme, directly linked to sector outcome targets consistent with the national vision. This will help to ensure that all stakeholders – sector institutions, private sector, and donors - are working towards a

common national vision and under a common results framework and to enhance coordination and aid effectiveness across donor funded projects overall.

An important tool for raising the funds required for a sector wide programmatic approach to energy development is a credible and bankable investment prospectus. As described in Section 2.3 above, an investment prospectus is anchored by a comprehensive and least cost funding and financing plan, which is linked to specific targets for sector development over the short, medium and long term.

Identified Investments

The Road Map has identified, to date, the following investments as part of an overall least cost strategy to scale up access nationwide and in a timely manner:

- **Investments with committed funding for scaling up access nationwide**—comprising the three programs described in this section that will significantly improve access in urban and rural areas. All three programs have funding that has been allocated or committed by development partners, although further support is welcomed to accelerate progress and extend the reach of the programs.

Other identified least cost investments—required for extensions of the electricity network and expanding power generation, to support increased access and economic growth. These require additional funding to be committed prior to implementation.

4.4.1. Investments with Committed Funding

The legal, policy and regulatory changes described in Section 4.2 will enable the energy sector in Vanuatu to implement the investments required to achieve the Government’s vision of secure, affordable and widely accessible electricity. However, policy changes clearly need to be coupled with physical investments in electricity infrastructure to supply Vanuatu households and businesses. This section presents the investments that have funding allocated or committed from various development partners, and addresses some of the constraints to increasing access to electricity services. The Government supports these investments, together with the investments in Section 4.4.2 that require additional funding to be committed, to ensure that Vanuatu will achieve its targets by 2015 and 2020, and the vision of universal access by 2030.

Subsidized Household Connections in (and close to) Concession Areas

On average, 560 new customers are connected each year in the four electricity concession areas of Vanuatu, however the rate of new connections that has been steadily decreasing over the last four years (and possibly longer).⁶³ The Government recognizes that maintaining this level of investment will not achieve the objective of providing universal electricity access by 2030. Instead, Vanuatu needs to make a step change in access rates and improve the efficiency of the supply-side of electricity services.

Within the existing concession areas, the connection targets of 75percent (2015), 90percent (2020) and 100percent (2030), will not be achieved without a well-designed programme of subsidies.⁶⁴ The Government is committed to supporting a program of grant funded Output-Based Aid (OBA) subsidies that will provide a contribution to the costs of each household connection. The Global Partnership for Output Based Aid (GPOBA) has proposed initial funding of VUV360 million

⁶³ UNELCO Annual Technical Reports 2006-2010; UNELCO has also prepared rural electrification plans. “Electrification Rurale De Vanuatu” 2006.

⁶⁴ The data presented on electricity access rates in other Pacific countries that have higher household densities, such as Samoa and Tonga, suggests that access rates of greater than 95 percent are achievable in similar communities (with financial support).

(US\$4million) to subsidize household connections to the four existing electricity grids.⁶⁵ Some of this may be provided to manage the provision of technical assistance to the DoE.

Under the OBA approach, utilities making the household connections or grid extensions can apply for a one-off subsidy from an OBA fund, which will be paid after the outputs (connections) are made. The subsidies are expected to cover a large portion of the total cost of connection for low income consumers.⁶⁶ Full details of the subsidy amounts will be finalized as part of the project design following a study that was concluded in September 2012.⁶⁷ The households that are likely to be connected under this program are currently within or adjacent to existing grid areas.

The Government requires additional funding to extend the subsidy programme to reach communities in concession areas that require LV, MV or Single Wire Earth Return (SWER) grid extensions (including the large grid extension projects on Santo and Efate detailed in Section 4.4.2). Further costing studies are a high priority for the Government, however initial estimates suggest that additional funds of US\$20 million are required to ensure that the Government's target to electrify 90 percent of the concession areas is achieved by 2020, and 100 percent of households are electrified by 2030.⁶⁸

Without the grid extensions, only households that are located in or near the existing grid will be able to be connected, and the overall electrification targets will not be achieved. The funding requirements for grid extensions will not be covered by the OBA subsidy. This means that private utilities will need to use alternative financing options to make these investments. Development partner support could play a critical role to provide a significantly lower-cost source of funds and enable this program to achieve its goals.

Rural Lighting Subsidy Scheme

The second component of the coordinated access program is the Rural Lighting Subsidy Scheme (RLSS). The VERD programme, funded by AusAID, includes the RLSS, which will use renewable energy products (primarily solar home systems) to increase rural electrification. This scheme will achieve Vanuatu's rural electrification target by electrifying approximately 10,000 rural households by 2020.

The RLSS will provide at least 20 percent of rural homes and other rural users in Vanuatu with functional lighting by 2015, extending to 50 percent over six years.⁶⁹ The RLSS uses a variety of solar products chosen by accredited local sector providers to provide permanent functional lighting to households. The estimated cost of the subsidies for this investment programme is VUV468 million (US\$5.2 million) over six years, which is equivalent to VUV46, 800 (US\$520) per household that receives electricity.⁷⁰

Based on an OBA approach to delivering subsidies, the RLSS will pay the subsidy to providers of solar technology products after households have received their installations. The subsidy is targeted at the viability gap between the retail price of solar products and the price that most rural households can afford to pay. This has the effect of catalyzing the demand for solar home lighting systems in the local market. Additionally, to encourage vendors to offer their products to households in more

⁶⁵ Subject GPOBA approval of proposed subsidy design.

⁶⁶ The additional costs of serving households at below cost-recovery tariffs will be recovered through a tariff review by the URA.

⁶⁷ Global Partnership for Output-Based Aid: Improved Electricity Access in Vanuatu, Castalia Strategic Advisors, September 2012.

⁶⁸ Forecasted from cost estimates for network extensions and household connections based on the OBA study, and allowing for population growth of 2.5 percent; Castalia, "Global Partnership for Output-Based Aid: Improved Electricity Access in Vanuatu," September 2012

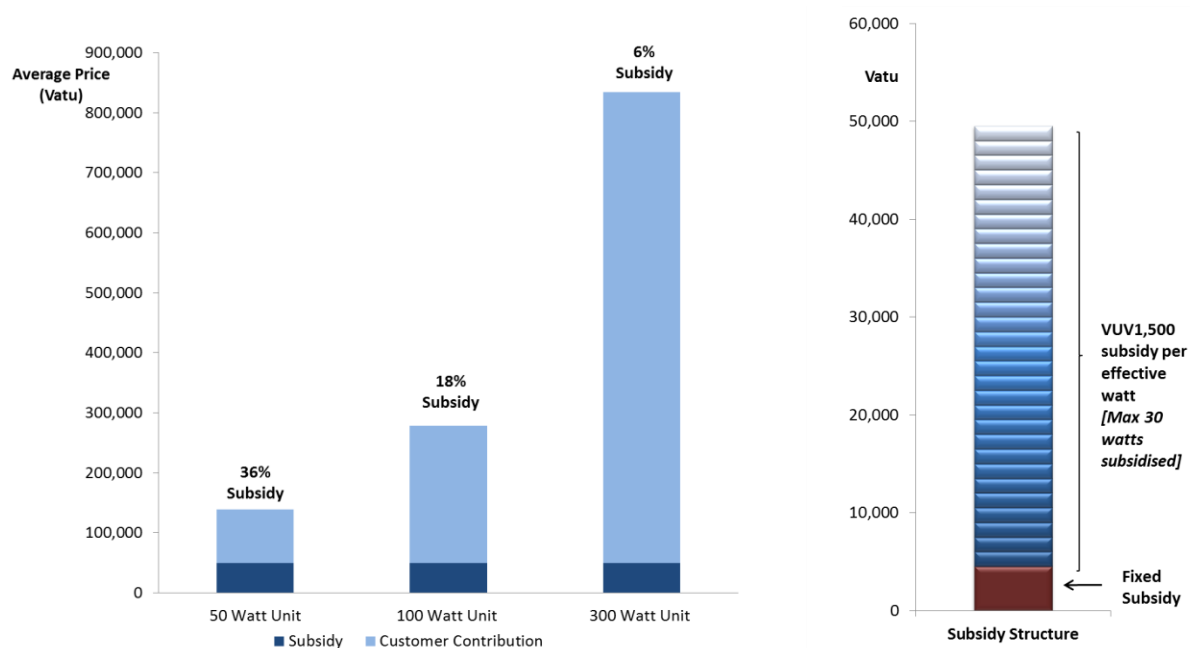
⁶⁹ Household lighting is: "A permanent, fixed lighting system, sufficient to undertake detailed work in multiple areas of a dwelling for more than 6 hours a day. It should be capable of charging a mobile phone. Householders will thus use solar lighting as their primary source". [I.e. not Pico lighting]

⁷⁰ AusAID, Vanuatu Electricity for Rural Development (VERD) Program, (Program Design Document) November 2012

remote rural areas, the programme will compensate suppliers for the increased travel and transportation costs through a geographical uplift in the subsidies.

As described in Section 2.2, rural household incomes are low, with very limited disposable income or savings. The household connection targets presented in Table 4.1 are based on catalyzing market demand for solar home systems in Vanuatu through a programme of targeted subsidies. The Government will provide a fixed subsidy of VUV4, 500 per unit installed, and an additional VUV1, 500 per effective watt of the system (up to a cap of 30 watts). With an average retail price of VUV2, 781 (US\$30) per effective watt, these subsidies will bring prices down and help to ensure that the access programme can be sustained throughout the country. Figure 4.2 shows that these subsidies will help to close the viability gap by reducing the average price of 50-300 watt solar installations by between 6 and 36 percent.

Figure 4.2: Effective Subsidies Provided Under Rural Lighting Subsidy Scheme



* Based on an average price of VUV2, 781 per watt, as assumed in AusAID, “Vanuatu Electricity for Rural Development Program” (Program Design Document), November 2012, A 50 watt unit will provide electricity for 2-3 lights and a phone charging.

Public Institution Electrification Scheme

The third component of the access program in this Road Map is the Public Institution Electrification Scheme (PIES), a subcomponent of the VERD program, funded by AusAID. The PIES will provide electricity installations to the rural schools and health facilities that currently do not have electricity supply, using renewable energy technologies. The VERD program will take a least cost approach overall. This approach will encourage energy efficiency initiatives (such as ensuring that any new appliances and lighting are energy efficient) to help manage the future demand on the energy services, and ensuring efficient costs of operating and maintaining the energy services.

Installation and maintenance arrangements will be initially managed by an independently contracted ‘Implementation Service Provider’. Over time the management will be passed onto the DoE after capacity has been built. The line ministries will own the assets installed at each public institution, and the public institutions will agree to responsible management of the installed systems.

Service providers will competitively bid for regionally packaged installation and maintenance contracts. The maintenance portion of the PIES agreement addresses sustainability concerns, and

has set a sub-target of ensuring that at least 90 percent of the installed systems are working to the designed capacity after six years.

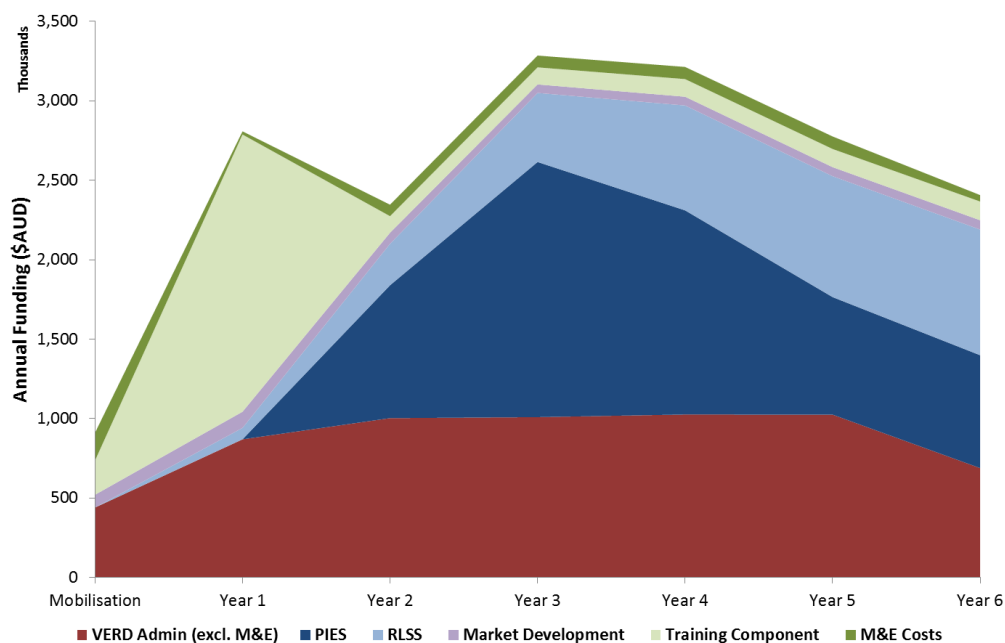
It is estimated that around 275 of the 835 public institutions⁷¹ in Vanuatu already have at least some power, mainly from solar panel installations. However, the on-going maintenance of most installations has not been sufficient, and many systems require additional services and repairs. The Government is committed to ensuring that adequate maintenance and repairs are made on the existing solar installations so that they operate efficiently. The PIES does not currently provide sufficient funding for this maintenance. Assuming that half of the existing facilities require comprehensive maintenance and renewal, the Government will need to raise an additional US\$670,000 support for this initiative.⁷²

Funding and Financing for the Rural Electrification Programme

The VERD programme has an initial budget of around VUV2.3 billion (US\$25 million) over six years.

Figure 4.3 presents an overview of the funding for the VERD programme. This shows that much of the early spending on the programme will focus on market development and training, with funding shifted into more direct investment under the RLSS and PIES components when these supporting arrangements are in place. A significant portion of the funding has also been allocated for administration and providing additional resourcing for the DoE. As mentioned in Section 4.2, building capacity in the DoE is essential for the successful implementation of the investments described in this Road Map.

Figure 4.3: Overview of rural electrification budget



Source: Adapted from AusAID, “Vanuatu Electricity for Rural Development Program” (Program Design Document) November 2012

4.4.2. Investments Requiring Additional Funding

While much of the work completed prior to this Road Map has focused on expanding access, the Government recognizes that other complementary investments are also essential. This section describes the additional rural access initiatives, network extensions, and generation investment projects that do not yet have committed funding and financing in place. In fact, several of these

⁷¹ AusAID, “Vanuatu Electricity for Rural Development Program” (Program Design Document) November 2012

⁷² Assuming and the average cost per servicing (US\$4,800) is 50 percent of the cost of installing a new solar system

projects are still at the pre-feasibility stage and further work is currently being undertaken to ensure that the projects are sustainable and least cost. The network extensions and investments in generation, together with the access investments, will ensure that Vanuatu can achieve the access and supply-side targets for the electricity sector.

Grid Extensions

The Government will focus on facilitating three grid extension initiatives over the next 3 years to extend the reach of existing networks to parts of the concession areas that are currently unserved. This will ensure that communities that lie outside the concession areas, but are suited to a grid-based connection approach, receive electricity supply. All household connections in the concession areas will be assisted through an OBA subsidy-financing scheme.

The three grid extension projects are located on Efate and Espiritu Santo. The households in each of these communities would be unable to pay for the grid extension under the current contribution requirements in the concession contract, but once the extensions are paid for, most households will be able to pay for their individual connections (especially with the help of connection subsidies in concession areas).

- **Grid Extension on the East Coast of Espiritu Santo**—This investment – subject to confirmation based on the results of a feasibility study to be undertaken - involves extension of the existing grid from Matevulu along the East Coast Road to Shark Bay, Port Olry and Stone Hill. Although this area is outside the Luganville concession, it could be an efficient way to provide access to electricity along the East Coast of Santo over the medium term. An initial estimated cost of this project is VUV217 million (US\$2.4 million).⁷³ It is expected that donor funds would support this development and that VUI would fund the extension of the existing network to Matevulu from Luganville.
- **Grid Extension on Efate**—An extension of the grid to Ulei on North West Efate (approximately 20 kilometers), and to Erueti on South East Efate (approximately 10 kilometers), will connect rural households, public institutions and stimulate growth around the ring road of Efate. This project could be incorporated into the network development supporting the Takara geothermal development, should the geothermal development prove commercially viable and proceeds. The required funding for this project is yet to be finalized, but is estimated to cost approximately VUV144 million (US\$1.5 million) (assuming a medium voltage extension, independent of Takara development).⁷³

The Government places a high priority on completing detailed cost assessments for each of these grid extensions. The location of proposed grid extensions is shown in Figure 4.4.

⁷³ Assuming a medium voltage grid extension with no low voltage underbuilt. The a cost per km consists of poles (US\$11,700), cross arms, insulators & fittings (US\$8,900), 50mm²Bare AAC MV three phase lines (US\$5,500), Supervision and Erection (US\$10,200), and taxes and duties (US\$4,500); Estimates taken from OBA design. Castalia, “Global Partnership for Output-Based Aid: Improved Electricity Access in Vanuatu,” September 2012

Figure 4.4: Grid Extensions on Santo and Efate



- **SWER Extensions**—In addition to “conventional” grid extensions, the Government will explore the option to use cheaper ways to expand electricity networks than the approaches previously used in Vanuatu. Some of the relatively dense communities in the isolated rural areas within the concessions areas (for example, Paama on Santo), are well suited to a lower cost wiring option such as Single Wire Earth Return (SWER). In Australia and New Zealand, capital costs are estimated to be 50 percent lower than 2 wire, single-phase solutions, and 70 percent lower than 3 wire and 3 phase solutions. Cost savings of 26-30 percent have been achieved relative to single-phase systems.⁷⁴ SWER also reduces maintenance costs by around 50 percent.⁷⁵
- **Low Voltage (LV) and Medium Voltage (MV) extensions**—There are many households within the concession area that require small Low Voltage or Medium Voltage grid extensions to connect their house to the network.⁷⁶ These grid extensions are not provided for under the other access investments however, some are already being undertaken as part of the utilities’ investment plans. It is estimated that an investment of US\$18 million in LV and MV extensions is required to achieve electricity access for these consumers. In addition a large numbers of these consumers are unable to afford the consumer connections and household wiring. The OBA subsidy program and the Government’s consideration on a subsidy policy will assist these consumers to connect to grid electricity.

Rural Access Initiatives

Micro-grids for communities outside concession areas

⁷⁴ “Designing a National Electrification Program for Universal Access” from One Goal, Two Paths: Achieving Universal Access to Modern Energy in East Asia and the Pacific

⁷⁵ John Tulloch and Ian Davis, “SWER New Zealand and Australian Experience” Energy Week presentation at the World Bank, 2006

⁷⁶ Castalia estimates that 5900 households are not using electricity in the four concession areas, “Global Partnership for Output-Based Aid: Improved Electricity Access in Vanuatu,” September 2012

In the areas outside the existing concession areas, there are some communities that have sufficient scale to support a micro-grid development. For these communities, micro-grids will be least cost, compared to extending the existing networks or installing individual solar solutions for every household in the community. The Government will commission a feasibility study to identify for which communities a micro-grid would be least cost and which technologies would be appropriate to use.

The Government expects that a micro-grid feasibility study and program design will be completed by 2015, and the first few micro-grid installations completed by 2020. No funding or financing has been committed for micro-grid initiatives, and cost estimates will be determined in the feasibility study. The Government requires support from donors to initiate feasibility studies and connect appropriate rural communities with micro-grids.

Supporting the Pico Solar and LED Market

Achieving the 2020 target of electrifying 50 percent of the households outside the concession areas will still leave at least 10,000 households without permanent lighting solutions. It is therefore crucial to ensure that alternative solutions are available for these households to have access to basic electricity services, at least until permanent lighting solutions are made. The pico solar market in Vanuatu has been growing well in the past few years, and provides small, but affordable solutions for many households for lighting and basic charging of cell phones and radios. The VERD program has been designed to ensure that the solar installations in rural households are not artificially priced below the pico lighting products. As a result, retailers will continue to provide the pico lighting and charging solutions and LEDs at the lower end of the market to rural (and some urban) households. The DoE will monitor the provision of pico-solar products to ensure that all households are able to access some form of basic electricity services by 2020.

Renewable Energy Generation

Renewable technologies (wind and hydro) have already been used to bring down the cost of generating electricity in Vanuatu. The hydro power plant on Espiritu Santo has reliably generated electricity at a lower cost than diesel generation since it was commissioned in 1995. The wind farm at Devils Point (commissioned in 2007) has saved more than VUV121 million (US\$1.3 million) in fuel costs in its first 3 years of operation.⁷⁷ On-going cost savings have been incorporated into the tariff through the URA's May 2010 tariff review,⁷⁸ helping to bring tariffs down for consumers. The reduction in prices would make electricity more competitive and would encourage consumers to move away from alternative sources of energy.

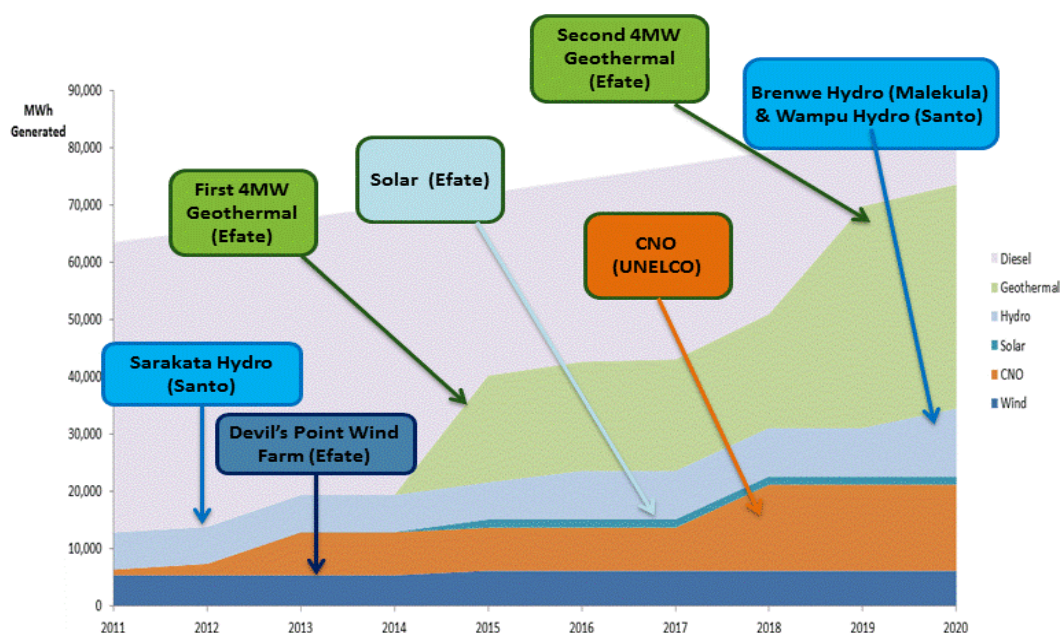
Through this Road Map, the Government is actively supporting (subject to resource confirmation and the results of further project feasibility assessments) the next tranche of investment in new renewable generation—a proposed geothermal power development on Efate, and hydro developments in Malekula and Espiritu Santo. Renewable energy technologies are an effective way to achieve the supply-side efficiency targets and potentially reduce electricity tariffs and increase security of supply. Figure 4.5 illustrates the forecast increase in renewable energy generation. By 2020, the Government anticipates that the proportion of electricity generated from renewable energy could reach at least 65 percent, which would bring the cost of supply down by an estimated

⁷⁷ URA, "Electricity Tariff Review Final Decision" May 2010

⁷⁸ The fuel component in the tariff formula is weighted by the proportion of energy that is generated by diesel, copra or hydro. Fuel savings from the hydro plants were incorporated into the Sarakata Fund.

20 percent (depending on prevailing oil prices).⁷⁹ Translating these changes into tariffs rests on the regulatory processes developed and administered by the URA.

Figure 4.5: Projected Share of Cost Competitive Renewable Energy Generation



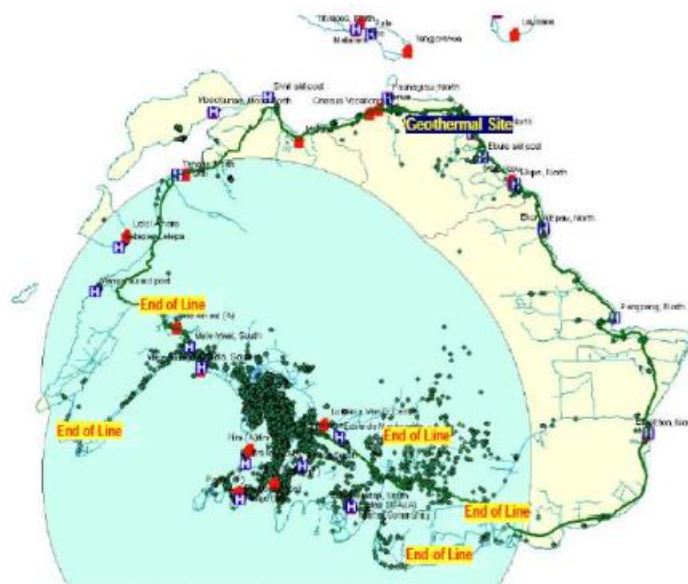
* Based on the energy to be supplied from investments in this Road Map, and the levelized cost of electricity as determined in the generation feasibility studies: Castlerock, "Vanuatu: Efate Geothermal Power and Island-Ring Grid Development Framework" January 2012; ADB & SMEC, Draft Final Pre-Feasibility Study. Includes proposed 1MW solar PV plant on Efate and CNO use as per UNELCO's estimates, including plans for up scaling CNO subject to feasibility.

Geothermal Generation on Efate

A pre-feasibility study has been undertaken for an 8MW geothermal plant at Takara on Efate. Once further feasibility studies and exploration drilling are completed, and the resource is confirmed, the proposed plant could provide power to the island by 2019 in two stages: 4MW by the end of 2015, and another 4MW by 2019. That is equivalent to 56 percent of the forecast electricity needs on Efate. According to the pre-feasibility study, geothermal energy is likely to be the least cost option, and could therefore provide sufficient low cost energy to create the step change needed in tariffs to improve electricity affordability on Efate. The proposed project also includes extensions of the existing transmission and distribution networks to connect the geothermal energy to the Port Vila concession area. As a result, electricity will be available over the entire island. Figure 4.6 shows the proposed location of the geothermal development in relation to the existing concession area (the shaded area).

⁷⁹ Assuming a 'high' fuel escalation of 2 percent per annum, and a low capital cost PPP investment in geothermal generation; Castlerock, "Vanuatu: Efate Geothermal Power and Island-Ring Grid Development Framework" January 2012

Figure 4.6: Location of Geothermal Development and Existing Electricity Network



Source: Castlerock, “Vanuatu: Efate Geothermal Power and Island-Ring Grid Development Framework” January 2012

The total cost of the 8MW geothermal plant (and the associated transmission and distribution investments) is estimated to be between US\$95-120 million (VUV8.6 -10.8 billion). A breakdown of the exploration and development costs are provided in Table 4.3.

Table 4.3: Costs of Geothermal Development at Takara, Efate (US\$’000)

Development Stages	Low	Base	High
Exploration, Site Development and Drilling	16,237	19,083	22,732
Transmission	9,176	10,796	12,953
Distribution	10,794	12,699	15,238
Geothermal Plant Construction	58,572	65,388	68,333
Total	94,779	107,965	119,258

Source: Castlerock “Vanuatu: Efate Geothermal Power and Island-Ring Grid Development Framework.” January 2012

At a world oil price of US\$1/litre, the geothermal generation would displace diesel, resulting in present value savings to the average residential customer of between US\$75 (VUV6750) and US\$348 (VUV31,320).⁸⁰

The report on the pre-feasibility study set out a geothermal road map for the Government. In order to maximize the consumer benefits of the investment, the study recommended that the Government consider supporting certain aspects of the investment, such as exploration, under Public-Private Partnership arrangements to help reduce the risk premium of the development. The private sector is likely to fund the construction of the geothermal plant, and operate and maintain the plant. The developer of the power plant will require an agreement with UNELCO to sell the output from the geothermal plant. The study also recommended consideration by the Government on partially funding the transmission and distribution network outside the current concession area

⁸⁰ Castlerock “Vanuatu: Efate Geothermal Power and Island-Ring Grid Development Framework.” January 2012

the maximize benefits to consumers from this development. The Government's Geothermal Task Force, established to lead this development, is assisting with the further development of this project in conjunction with relevant Government agencies and the regulator.⁸¹ As outlined in Section 4.2, the Government is working towards establishing a transparent and predictable legislative and regulatory framework that will enable IPPs, such as the geothermal developer, to participate in the energy sector with certainty and may consider funding aspects of the development under a suitable PPP arrangement.

Hydro Power Developments

Two mini-hydro power projects could stimulate economic development in Malekula and Espiritu Santo by improving affordability in these two concession areas.

In Malekula, the Brenwe Hydro Power Project (< 1.2MW) will increase capacity to meet demand until at least 2041.⁸² The levelised cost of electricity generated from the hydro plant is estimated to be 29.5VUV/kWh (US\$0.31/kWh), which is below the levelised cost of diesel generated electricity of VUV33.3 (US\$0.37).⁸³ As a result the electricity generated from this plant is essential for improving the affordability of electricity on Malekula. The hydro plant is estimated to cost US\$4.5 million, and will displace most of the diesel generation in the concession area. An increase in demand will be needed to ensure efficient utilization of the hydro plant. The government expects that the lower cost hydro-generated power will provide important opportunities for economic development in Malekula.

In South Espiritu Santo, the Wambu River Mini Hydro Project will provide about 2.2MW generating capacity for the Luganville concession area.⁸⁴ This project, located to the west of Luganville, will bring the cost of supply down and further reduce VUI's reliance on imported petroleum. The Wampu project has an estimated levelised cost of 32.3VUV/kWh (US\$0.34/kWh) and this is expected to reduce tariffs when it begins generating, providing strong support for large industrial investments in the Luganville area. Construction is expected take place between 2019 and 2021, costing about VUV1.4 billion (US\$16 million).⁸⁵ It is estimated that in the initial years of generation, with Sarakata producing at full capacity, demand will absorb around 70 percent of the Wampu plant's total capacity, with full utilization occurring from around 2027.⁸⁶

Both hydro plants are subject to further feasibility studies on design and appropriate resource availability. The Government will support the further studies that are required to see if the hydro plants can increase the much-needed renewable generation in Vanuatu.

In addition to the above, VUI has also indicated that there is potential for upsizing the existing Sarakata hydro with additional 500kW to 600kW capacity, that could contribute to increasing hydro capacity of Luganville.

UNELCO is undertaking pre-feasibility studies for hydro power on rivers such as La Colle and Teouma on the island of Efate, possibly contributing to another 5,000,000 kWh within 5 Years. A prior pre-

⁸¹ The Government has issued an exclusive production license to a Vanuatu subsidiary of KuTh Energy Limited in January, 2013. The production license is for 30 years which guarantees a minimum price and rights to earn any carbon credits applicable to the project.

⁸² This is assuming 4.63 percent annual growth in demand (SMEC Draft Final Pre-Feasibility Study), and construction completed by 2021. Therefore, if demand forecasts are optimistic, the hydro generation will continue to meet demand for a few years beyond 2041.

⁸³ LCOE estimates range between USD0.30 and USD 0.44: Castlerock "Vanuatu: Efate Geothermal Power and Island-Ring Grid Development Framework." January 2012

⁸⁴ Department of Meteorology and Climate Change, Ministry of Infrastructure and Public Utilities, "Overview of Potential CDM Project Opportunities in Vanuatu" May 2012.

⁸⁵ Estimates for both hydro power projects are subject to final feasibility studies Government of Vanuatu, Draft Vanuatu Infrastructure Strategic Investment Plan, September 2012

⁸⁶ Assuming 4.67 percent annual growth in demand on Santo; SMEC & ADB, "Promoting Access to Renewable Energy in the Pacific (Vanuatu Component): Brenwe and Wambu Hydropower Pre-Feasibility Studies", Draft Report, 08 June 2012.

feasibility study on Teouma river dated 1992 will be updated. The VUI and UNELCO hydro projects are subject to further feasibility studies and have therefore not been included in the investment prospectus.

Solar Photovoltaic (PV) and biodiesel potential

UNELCO is currently considering a 1 MW solar PV power plant for the Efate grid system to come into operation in 2014. The plant is expected to produce 1,400,000 kWh per year. The project costs are estimated at VUV 500 million (US\$5.6 million) and is to be funded by the European Union, UNELCO and the Government of Vanuatu. UNELCO considers that the system could accommodate another project of 1 MW to 2 MW of solar PV plants and it is undertaking further feasibility studies and is exploring different financing opportunities, which includes contribution from development partners.

The ADB is working on a demonstration solar PV power plant for Luganville at an estimated cost of VUV 13.5 million (US\$150,000). The construction of this plant is expected to commence shortly.

In addition, UNELCO continues to explore the potential for increasing use of biodiesel (Coconut Oil – CNO) in its existing power stations. The biodiesel (CNO) is being blended with diesel for electricity generation thus providing an alternative to UNELCO's reliance on imported petroleum. UNELCO has also invested in copra plantations to increase the security of supply and is continuing to develop the supply chain and technology for increased use of biodiesel. In January 2013, 15% of the electricity produced on Efate came from CNO. UNELCO's objective is to reach an overall production of 15,000,000 kWh from CNO per year.⁸⁷

Wind Power

UNELCO's existing farm produced 5,200,000 kWh in 2012 and studies are completed to install 2 additional turbines on the same site by 2014, increasing the output to 6,150,000 kWh per year.

UNELCO has also completed data collection and studies for another identified site in the South of Port Vila, for an additional output of around 3,000,000 kWh. UNELCO is working towards finalizing the feasibility study and expects to develop the farm during the Road Map period.

Funding and Financing of Renewable Energy Investments

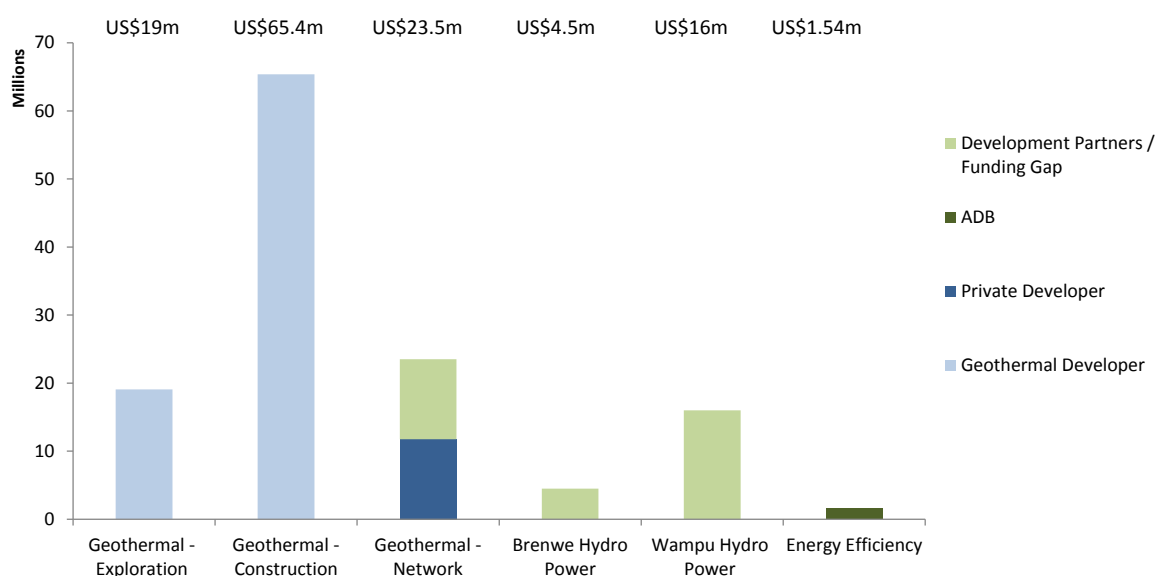
The geothermal power project development component on Efate is expected to be primarily funded by the private sector. To ensure that the maximum benefits of the geothermal resource development for power production are provided to consumers from this project – through lowering of *retail* tariffs - , the development requires support from development partners.

The project financing structure for the hydropower projects will be finalized following completion of the project feasibility studies. The Government encourages development partners to contribute to the funding of these projects, to reduce the future burden on the Government of Vanuatu to meet any financing repayment requirements.

A summary of the financing needs for investment in new renewable generation sources is provided in Figure 4.7. The total funding required for these investments is VUV11.7 billion (US\$130 million). An estimated VUV2.7 billion (US\$29.6 million) is needed to commit to the geothermal exploration work, and to progress the Brenwe and Wampu hydropower developments. Private sector players are expected to finance the construction of the geothermal plant on Efate.

⁸⁷ The copra/CNO supply chain will require significant improvement to achieve this target. UNELCO has commenced initiatives, such as developing its own copra plantation to manage supply risk.

Figure 4.7: Financing Needs for Investments to Achieve Supply-Side Targets



*Assuming the ADB Pacific energy efficiency program funding is split evenly between the five participating countries

Source: Castlerock, "Vanuatu: Efate Geothermal Power and Island-Ring Grid Development Framework" January 2012; ADB, "Country Operations Business Plan Vanuatu 2012-2014"; September 2011; Government of Vanuatu, Draft Vanuatu Infrastructure Strategic Investment Plan

The geothermal network which includes electrification of consumers along the ring-road on Efate, and is subject development of a viable geothermal plant, is likely to be partly funded by the private concession holder. The commercial arrangements and funding details are to be finalized as part of the consideration of the overall geothermal project development.

The project costing requirements for the energy efficiency initiatives are yet to be finalized. However, the ADB has committed VUV693 million (US\$7.8 million) to five Pacific nations, including Vanuatu.⁸⁸ Assuming this funding is distributed evenly, Vanuatu will receive US\$1.54 million to initiate the development of the energy database, and the energy efficiency initiatives. Full details of the required budget for individual initiatives will be finalized over the coming years as improved data identifies the current efficiency of Vanuatu's energy use, and whether or not a funding gap remains for the Government and development partners to fill.

Renewable Energy Investments after 2020

In addition to achieving the Government's targets and vision, most of the energy investments in this Road Map also have significant benefits in terms of minimizing negative impacts on the environment, and mitigating climate change. However, it is clear that in the global context, Vanuatu's actions have a minimal impact on climate change globally. Therefore, investments in this Road Map must make sense economically and socially, in addition to environmentally.

The generation investments described in this Road Map will ensure that at least 67 percent of the electricity generated in the concession areas is from a renewable resource by 2020. In addition, 50 percent of households and all public institutions in the rural areas will also be supplied by renewable

⁸⁸ US\$7.8 million remains as undisbursed funds in the ADB Promoting Energy Efficiency in the Pacific (Phase 2) program (shared between five countries). For more details see: <http://www.adb.org/projects/44099-012/main>

(solar) energy. This is a substantial improvement compared to the current rate of 17 percent of electricity produced from renewable resources. These investments will substantially improve energy security, by reducing carbon emissions (from the displaced diesel generation), lowering costs, and improving the sustainability of energy generation (from the reliable renewable resources).

As Vanuatu connects more households, and as each household increases their demand for electricity, the Government needs to ensure that sufficient investment occurs in electricity generation. This Road Map has described investments that will ensure that 67 percent of demand is met by renewable energy by 2020. After 2020, additional generation investments will need to be made to meet the growing demand. As petroleum prices are expected to increase and remain volatile in the future, Vanuatu needs to develop an action plan to scale up renewable energy after 2020. The Government acknowledges that feasibility studies need to be started now to evaluate which generation investments will be least cost, and where the new investments will need to be made.

The Government has agreed to participate in the "Scaling-up Renewable Energy Program" (SREP), supported by the Climate Investment Funds (CIF). The objective of the SREP is to pilot and demonstrate the economic, social and environmental viability of low carbon development pathways in the energy sector by creating new economic opportunities and increasing energy access through the use of renewable energy. An allocation of VUV 22 million (US\$250K) is available for Vanuatu under this program over 2 years to support the preparation of a Renewable Energy Investment Plan for Vanuatu, which may then be used to source funds to support investment.

4.4 Electricity Sector Implementation Plan—Technical Assistance and Identified Investments Summary

Table 4.4 summarizes the electricity sector actions identified in this Road Map for 2013-2020, with a breakdown of major component categories: technical assistance projects and identified and prospective investments. The total estimated cost of this six-year plan is about VUV 20 billion (US\$210.5million), of which VUV 2.2 billion (US\$24.5 million) is for technical assistance, priority studies, training and capacity building, an implementation support unit, consumer awareness and market development and regulation. The remainder is for investments for access scale up and power generation. ***It should be noted that the identified and prospective investments below have been estimated on a project basis and could overlap.*** In addition, the concession holders already have plans in place or plans that are subject to approval that include grid extensions. As an example, the estimates for the LV and MV extensions include extensions within the Efate concession area and should they proceed prior to the geothermal development, then the costs associated with the Efate ring-road transmission and distribution will be lower. Identified and prospective investments, where they have not been committed are subject to separate feasibility studies.

Table 4.4: Electricity Sector Implementation Plan Components (2013-2020)

	Total Estimated Cost (US\$)
Technical assistance, priority studies, capacity building, implementation support Unit	
Capacity Building	
Capacity Building at Department of Energy (Institutional costs - staff and operations)**	US\$4.5 m ⁸⁹
Capacity Building at Department of Energy (increasing skills/capacity)	US\$0.5 m
URA – Strengthening (studies and capacity building)**	US\$6.5 m ⁹⁰
Road Map Implementation Support Unit (includes staffing, results framework development, monitoring, evaluation and NERM revisions)	US\$2.0 m
Rural Energy Market Development and Training*	US\$5.3 m ⁹¹
Priority studies	
Subsidy policy paper for Council of Ministers’ approval, (including financing mechanisms)	US\$0.5 m
Priority assessment of Department of Energy resources and institutional structure	US\$0.5 m
Public Private Partnerships (PPPs) Framework Policy IPPs, licensing, PPAs, tariffs	US\$0.8 m
Renewable energy development plan for access scale up - geospatial least cost investment plan for access scale up in off-grid areas (including micro-grids)	US\$1.2 m ⁹²
Development of Social and Environmental Framework for energy sector developments	US\$0.5 m
Energy efficiency implementation plan	US\$1.0 m
	US\$1.0 m
Laws and regulations	
Review of the Electricity Act, and URA Act, Geothermal Act, Tenders and Contracts Act, Environmental legislation, regulations, standards etc. to strengthen and address key gaps identified	\$24.3 m
Subtotal technical assistance and capacity building	
Identified and Prospective Investments	

⁸⁹ The Department of Energy annual budget (funded by the GoV) including current and proposed is estimated at 27 million Vatu or US\$300K per annum – estimate for 8 years.

⁹⁰ The current URA annual budget is estimated at between US\$1.0 M - 1.2M of which about US\$0.20 is funded by the GoV. The lower forward estimate over the period is based on increasing local capacity, experience and staffing over time resulting in lower costs – estimate for 8 years.

⁹¹ Skills, awareness and institutional development component of VERD program.

⁹² Feasibility studies and specification of micro-grid systems for implementation where viable.

	Total Estimated Cost (US\$)
Access investments	
Grid Extension Efate (Ulei and Erueti)	US\$1.5 m
Grid extension Santo (Luganville to Port Orly – subject to feasibility)	US\$2.4 m
Concession area LV and MV extensions (subject to feasibility)	US\$18.0 m
Efate ring-road transmission and distribution (dependent geothermal viability)	US\$23.5 m
Subsidized Household Connections in (and close to) Concession Areas**	
Output-Based Aid subsidies (subject to approval)	US\$4.0 m
Other subsidies subject to funding	US\$3.5m ⁹³
Rural Lighting Subsidy Scheme (RLSS) – solar PV home systems*	US\$5.2 m
Public Institutions Electrification Scheme (PIES)*	US\$6.5 m
VERD – administration and services*	US\$8.0 m
Rural Access Initiatives – Micro-grid (designs subject to feasibility)	US\$3.0 m
Subtotal access investments	US\$75.6 m
Renewable Energy investments	
Efate 1MW solar photovoltaic project**	US\$5.6 m
Luganville 40kW solar photovoltaic demonstration project*	US\$150 K
Efate Geothermal power development (8 MW net), including geothermal resource and feasibility assessment	US\$84.4 m
Hydro Power Developments on Santo and Malekula (subject to feasibility)	US\$20.5 m
Sub-total identified and prospective investments	\$110.6 m
TOTAL	US\$210.5 m

Note: * indicates that funding is already in place for these actions, ** indicates that part of the required funding is in place

Sources: Castlerock, “Vanuatu: Efate Geothermal Power and Island-Ring Grid Development Framework” January 2012; ADB, “Country Operations Business Plan Vanuatu 2012-2014”; September 2011; Government of Vanuatu, Draft Vanuatu Infrastructure Strategic Investment Plan; SMEC & ADB, “Promoting Access to Renewable Energy in the Pacific (Vanuatu Component): Brenwe and Wambu Hydropower Pre-Feasibility Studies”, Draft Report, 08 June 2012; Castalia, “Global Partnership for Output-Based Aid: Improved Electricity Access in Vanuatu” September 2012, AusAID, “Vanuatu Electricity for Rural Development Program” (Program Design Document), November 2012

⁹³ Subsidies for connections and household wiring for low income consumers identified as requiring connections, but not funded through the Global Partnership for Output-Based Aid program.

5. Road Map Prospectus and Next Steps

This section presents the initial set of priority actions to be implemented under the Road Map, over the time frame 2013-2020. Together they will achieve the energy sector priority outcomes and targets. Each action—investment, technical assistance, capacity building—is costed. The level of investment called for under the Road Map represents a marked increase over historical levels. In light of this, the Government intends to seek financial support from development partners under the platform of “many players, one team, one (sector-wide) plan” for the implementation of this Road Map. This section also presents the practical next steps required to implement the activities identified in the Road Map, and the monitoring and evaluation requirements to ensure that the actions are having their desired outcomes, and identify areas where adjustments to the Road Map may be required.

5.1. Prospectus – Technical Assistance, Identified Investments and Financing Requirements

One of the driving principles underpinning the development of this Road Map is the focus on targeting least-cost investment for access scale up and least cost energy supply that directly and to the maximum extent benefits end users. The Government has developed the recommendations presented in this Road Map, by analyzing which technologies and actions will offer the most effective results for the Vanuatu energy sector, from a national development perspective, while ensuring that private operators earn a fair rate of return on their investment. This has been done by

- Developing recommendations for least cost access modalities – grid, and off-grid - appropriate to different end user beneficiary segments – households, communities, institutions – across Vanuatu. The strategic planning framework is outlined earlier in Section 2. Where grid extensions are too costly, off-grid technologies are recommended. Where gaps in data exist, the Government will also commission feasibility studies to identify which communities would be suited to receiving micro-grid connections, rather than a more costly individual solution for each household.
- Using the results from initial feasibility studies that have identified least cost approaches to increasing electricity generation. An initial study found that geothermal generation on Efate is expected to be the least cost way of serving future demand, subject to further testing and confirmation of the resource capacity, and
- Identifying likely opportunities for least-cost investments and supporting further feasibility work where needed. The mini-hydro plants in Santo and Malekula, and grid extensions on Santo and Efate have been identified as potential opportunities. The Government will place a high priority on supporting further feasibility studies to better understand how these projects could be developed at least cost, while providing maximum benefits to the local communities.

Table 5.1 presents a summary of the investments recommended in this Road Map and how they may be financed. The Table outlines committed funding is identified, in addition to the remaining funding gaps that need to be filled for Vanuatu to break from the past, and make a step change in progressing towards providing widely accessible and affordable energy services for all Ni-Vanuatu.

The table below also presents a breakdown of finance that is expected to come from the public sector (Government and development partners) and private sector operators. The table highlights that the public sector is expected to make a larger role in financing electricity sector investments than is required for the petroleum sector, as well as bearing the cost of developing and implementing new policies. However, most of the cost is still expected to be borne by private parties: households that receive new connections will contribute to the cost of new connections based on their ability to pay, and private operators will bear most of the costs of new renewable generation developments (ultimately recovered through electricity tariffs). The projects with funding gaps are subject to the final approval by the Government and confirmation of a secure funding source.

Table 5.1: Summary of Prospectus and Projected Financing Plan (2013-2020)

Investment	Cost	Public Sector ⁹⁴	Private Sector	Funding Gap
Petroleum				
Price Monitoring (petroleum) and Regulation (LPG). Develop and implement Financial Risk Management Framework.	US\$0.5 m			US\$0.5 m
Managing Health, Safety and Environmental Risk	US\$0.4 m			US\$0.4 m
Transport sector study, including fuel standards	US\$0.2 m			US\$0.2 m
Improving the Efficiency of Local Fuel Distribution with Barge Transportation and fuel storage capacity	US\$2.1 m	US\$0.5 m	US\$1.6 m	
Energy security (capital expenditure on two new 5 million litre storage tanks in Port Vila)	US\$10 m			US\$10 m
Upgrade Safety of Infrastructure	US\$7.2 m		US\$7.2 m	
Sub-total Petroleum	US\$20.4 m	US\$0.5 m	US\$8.8 m	US\$11.1 m
Electricity				
Capacity building	US\$18.8 m	US\$9.7 m		US\$9.1 m
Priority studies (see Table 4.4)	US\$4.5 m			US\$4.5 m

⁹⁴ Public sector funding includes financing from development partners.

Investment	Cost	Public Sector ⁹⁴	Private Sector	Funding Gap
Review of legislative provisions and addressing key gaps	US\$1.0m			US\$1.0m
Grid Extensions to Support Access in Concession Areas	US\$45.4 m ⁹⁵			US\$45.4 m
Subsidized Household Connections in (and close to) Concession Areas	US\$7.5 m	US\$4.0 m ⁹⁶		US\$3.5 m
Rural Lighting Subsidy Scheme (RLSS) – solar PV home systems	US\$5.2 m	US\$5.2 m		
Public Institutions Electrification Scheme (PIES)	US\$6.5 m	US\$6.5 m		
RLSS and PIES administration and services	US\$8.0 m	US\$8.0 m		
Rural Access Initiatives – Micro-grid	US\$3.0 m		US\$0.5 m	US\$2.5 m
Solar PV developments	US\$ 5.8	US\$3.5	US\$1.3 m	US\$1.0 m ⁹⁷
Efate Geothermal Power Plant	US\$84.4 m		\$84.4	
Hydro Power on Santo and Malekula	US\$20.5 m		\$14.3 m	US\$6.2 m
Sub-total Electricity	US\$210.5 m	US\$37.9	US\$100.5	US\$72.2
TOTAL	US\$230.9	US\$38.4	US\$109.3	US\$83.3

5.2. Project Implementation Arrangements

Road Map implementation arrangements

The Government is committed to ensuring that the implementation of the Road Map maintains momentum, and successfully leads to the achievement of the targets identified.

The first priority action that is required for successful implementation is to resource and build the capacity in the DoE. The implementation unit within the DoE will be responsible for leading the design of policies and legislative changes that create the facilitating environment for the

⁹⁵ Potentially overlapping investments – refer to notes to table in Chapter 4

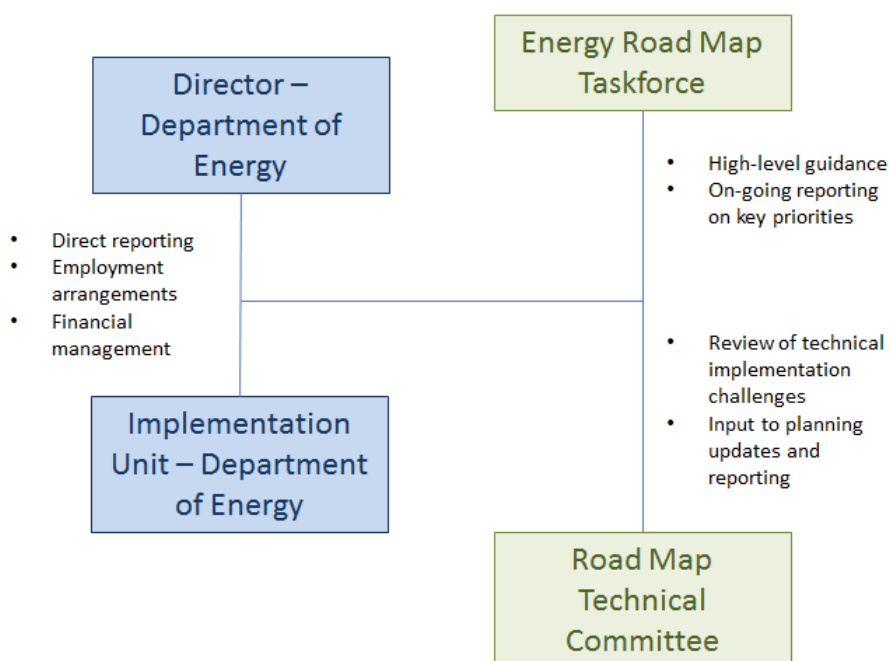
⁹⁶ Subject to approval by Global Partnership for Output-Based Aid program

⁹⁷ Proposed Government contribution for Efate Solar PV plant

implementation of many of the investment initiatives to improve access to energy, increase the supply of efficient, least cost renewable energy, and encourage efficient use of energy resources.

The reporting and governance arrangements for the DoE will also be important to success. The Government will retain the Energy Taskforce and the Technical Committee who have been involved in preparing this Road Map, and require the implementation unit to periodically report to these committees to update progress and seek guidance. The Taskforce in particular will play an important role in moving the Road Map forward through implementation stages, through representation on the Taskforce of high-level Government officials from the Prime Minister’s Office and relevant Ministries. The intention of this governance arrangement is to ensure high-level commitment and accountability within the Government of Vanuatu (through the Prime Minister’s Office), while at the same time building implementation capacity and staff at the DOE.

Figure 5.1: Reporting and Governance Arrangements for Road Map Implementation



There are four aspects to the funding requirements for the implementation of the Road Map. Firstly, the implementation unit will require VUV 180 million (US\$2 million) funds to support the staff requirements, and the development of the results framework (see Table 4.4). Secondly, the Government has identified that the DoE needs a substantial increase in funding to ensure that institutional costs (staff and operational budgets) can be covered. In 2011, the DoE received a budget of approximately VUV11,700,000 (US\$130,000), of which about VUV9,400,000 (US\$104,000) was used for salaries.⁹⁸ This funded approximately seven employees, including one administrator. The department currently has four staff members and estimates that another six staff members are required. Thirdly, an additional US\$0.5 million is required to build capacity of the members of staff that are based in the DoE. Fourth, a priority assessment study (US\$0.5 million) will review the

⁹⁸ Department of Energy, “2011 Annual Report – Energy the Pillar of Development.” The Government is understood to have committed VUV 23 million per annum for DEMMR. This is expected to be increased to VUV 27 million (US\$300K) per annum from 2013.

requirements for the DoE to lead and support the Road Map implementation through to 2020 and beyond.

Inter-departmental coordination and synergies

The Road Map set out an ambitious program for the energy sector. The resources committed to sector need to be appropriate given overall fiscal flows in the macro economy, donor appetite, private capital flows and other considerations. In addition, there are potential synergies to be derived by coordinating the energy sector projects with for example telecommunication projects or roads projects.

The Government is keen to ensure such considerations are taken into account when implementing the energy sector projects. The Vanuatu Infrastructure Strategic Investment Plan (VISIP) provides the enabling institutional environment for VISIP. Central oversight is provided through the Prime Minister’s Office (PMO)⁹⁹ and the Ministry of Finance and Economic Management (MFEM) with line agencies (DoE) implementing the projects. The Government is also establishing a Vanuatu Project Management Unit (VPMU) to oversee large infrastructure projects.

The implementation arrangements for the Energy Road Map (outline above) ensure this link to the Government’s overall oversight of infrastructure development projects through the Energy Taskforce.

5.3. Responsibilities and Deliverables for Next Steps

Summary of actions for the petroleum sector

Table 5.2 provides a comprehensive summary of the actions recommended for the petroleum sector. As described in Section 3, these actions include priorities for the Government to more actively monitor petroleum pricing and ensure good safety outcomes, to build capacity within the DoE to carry out price monitoring, and for operators to invest in critical distribution and storage infrastructure to ensure safe and reliable outcomes.

Table 5.2: Next Steps for Implementation of Road Map Petroleum Recommendations

Action	Next Steps (Responsibility)	Timing
Re-instate petroleum price monitoring and regulation	<ul style="list-style-type: none"> • URA – Enable price regulation and monitoring • Engage with regional agencies to establish regional benchmarking (DoE) • Develop method and template of monitoring (DoE) 	2013-ongoing
Domestic barge for distribution	<ul style="list-style-type: none"> • Undertake scheduling optimization study (PPC) • Finalize barge investment (PPC, GoV) • Determine storage requirements to support barge (PPC) 	2013
Fuel Quality Standards	<ul style="list-style-type: none"> • Initiate study on appropriate fuel specifications for Vanuatu and transport fleet 	2013
Upgrade Safety of Infrastructure	<ul style="list-style-type: none"> • Develop plan to reduce risk of capital investment (PPC, Origin, GoV) • Initial capital investment to improve safety of 	2013

⁹⁹ The Department of Strategic Planning, Policy and Aid Coordination (DSPPAC) in the PMU would be the Government unit that oversees implementation of the VISIP.

	infrastructure (PPC, Origin)	2014-ongoing
Balance Financial and Physical Hedging	<ul style="list-style-type: none"> Study to optimize storage investments (PPC, UNELCO) Initiate study into developing a financial risk management framework 	2013 2014-ongoing
Establish health, environment, and safety framework	<ul style="list-style-type: none"> Review regulations and legislation to determine updates required (GoV) 	2014-ongoing

Source: Hale and Twomey, and David Butcher and Associates "Draft Final Report: Options for Increasing the efficiency of Vanuatu's oil and gas supply chain" November 2012

Summary of actions for the electricity sector

Table 5.3 summarizes the next steps required for each of the Road Map recommendations. It also identifies the agency or sector participant who is responsible for each action, and the proposed timing of implementation. The proposed timing for the implementation of each project in this Road Map is presented in Table 5.3. The timeframes are consistent with the draft VISIP, and are realistic given constraints on available construction and financial resources.

Table 5.3: Next Steps for Implementation of Road Map Electricity Recommendations

Action	Next Steps (Responsibility)	Timing
Government Leadership and Commitment		
Develop enabling policies and legislation	<ul style="list-style-type: none"> Review possible legislative changes to facilitate investment in electricity generation (DoE, GoV) Review sustainable subsidy policy for the energy sector (DoE) Develop legal framework for public private partnerships (PPP) (GoV) Develop Independent Power Producer (IPP) framework (GoV) 	2013
Empowering Key Energy Sector Institutions		
Department of Energy	<ul style="list-style-type: none"> Initiate skills development, awareness raising (DoE) Hire legal and financial expertise at DoE to advise in areas such as PPPs transactions (DoE) 	2013
Implementing a Sector Wide Approach - Access Investments		
OBA subsidy	<ul style="list-style-type: none"> Approve final design (GPOBA) Enter into OBA grant, subsidy, and verification agreements (DoE, Ministry of Finance, UNELCO & VUI, and Independent Verification Agent) 	2013-ongoing
Grid extensions, Efate	<ul style="list-style-type: none"> Commission detailed costing studies (GoV) Establish financing arrangements (GoV) 	2015-2016

Action	Next Steps (Responsibility)	Timing
Grid extensions, Santo	<ul style="list-style-type: none"> • Commission costing studies (GoV) • Establish financing arrangements (GoV) 	2015-2016
MV/LV Grid Infill	<ul style="list-style-type: none"> • Commission costing studies (GoV) • Establish financing arrangements (GoV) 	2013-ongoing
SWER extensions	<ul style="list-style-type: none"> • Establish financing arrangements (GoV) 	2013-ongoing
RLSS	<ul style="list-style-type: none"> • Product accreditation and vendor health checks (Contractor) 	2013-ongoing
PIES	<ul style="list-style-type: none"> • Complete management service agreements and competitive tenders for installation and maintenance contracts (Contractor) 	2013-ongoing
Public Institutions Solar Panel Maintenance	<ul style="list-style-type: none"> • Establish financing arrangements (GoV) 	2013-ongoing
Implementing a Sector Wide Approach - Efficiency Improvements		
Efate/Luganville Solar PV	<ul style="list-style-type: none"> • Commence implementation for Luganville • Address financing gap and prepare project for implementation 	2013
Geothermal Generation, Efate	<ul style="list-style-type: none"> • Agreement on commercial structure and final exploration drilling (GoV) 	2013-2019
Brenwe Hydro, Malekula	<ul style="list-style-type: none"> • Final feasibility study and design (ADB) 	2018-2021
Wampu Hydro, Santo	<ul style="list-style-type: none"> • Final feasibility study and design (ADB) 	2019-2021
Implementing a Sector-Wide Approach - Other Studies and Investments		
Renewable Energy After 2010	<ul style="list-style-type: none"> • Feasibility study funded by Climate Investment Fund (US\$250,000)(SREP) 	2013-2014
Increasing Energy Efficiency Information	<ul style="list-style-type: none"> • Development of database (ADB) 	2013-ongoing
Energy sector data collection and analysis	<ul style="list-style-type: none"> • Development of database (DoE) 	2013-ongoing

Appendix A. Tariff Structure in Concessions

This appendix presents the tariff structures within the concession areas. The tariff structure for the Luganville concession area (operated by VUI) is detailed in Table A.1.

Table A.1: Tariff Structure for the Luganville Concession Area

Consumption Levels	Cost per kWh
0-60kWh	0.38P
61-120kWh	0.97P
121-180kWh	1.80P
Additional units over 180kWh	1.1P

Source: Castalia, "Global Partnership for Output-Based Aid: Improved Electricity Access in Vanuatu," September 2012

Figure A.1 presents the structure for the concessions operated by UNELCO. The base tariff, P, is calculated monthly, and published on the URA's website.¹⁰⁰

¹⁰⁰ URA, "Decisions and Determinations", last accessed 12 February 2013 at http://www.ura.gov.vu/index.php?option=com_content&view=article&id=68&Itemid=218&lang=en

Figure A.1: Tariff Structure for the Port Vila, Tanna and Malekula Concession Areas

BASE RATE		P= 56,34 Vatu/kWh	
P - COMPTEURS PREPAIEMENT			
Carte de 30 kWh avec la TVA incluse			
(30 x P x 0,62 + 60) x 1,125	5 Ampères	1.250	
(30 x P + 60) x 1,125	10 Ampères	1.970	
<i>The blank card price is : 60 Vatu</i>			
A - (B*) - "Small Domestic Consumers" tariff (PCD)			
Low voltage consumers 5 or 10 amps single phase for a maximum consumption of 120kWh per month			
a) Electricity consumed	1st block	up to 60 kWh	0,34 x P = 19,16 Vatu/kWh
	2nd block	from 61 to 120 kWh	1,21 x P = 68,17 Vatu/kWh
	3rd block	over 120 kWh	3 x P = 169,02 Vatu/kWh
b) Fixed charge	NONE		
c) Security deposit	flat rate : 70 x P =		3944 VATU
B - (D*) - "Business Licence Holders - Low Voltage" tariff (TUP)			
a) Electricity consumed	Flat rate		0,87 x P = 49,02 Vatu/kWh
b) Fixed charge	20xP per subscribed kVA		1126,80 x kVA
c) Security deposit	150xP per subscribed kVA		8451 x kVA
C - (T*) - "Sports Fields" tariff (T)			
a) Electricity consumed	Flat rate		1,00 x P = 56,34 Vatu/kWh
b) Fixed charge	NONE		
c) Security deposit	NONE		
D (E*) - "Public Lighting" tariff (EP)			
a) Electricity consumed	Flat rate		0,54 x P = 30,42 Vatu/kWh
b) Fixed charge	NONE		
c) Security deposit	NONE		
E (A*) - "Other Low Voltage Users" tariff (TU)			
a) Electricity consumed	Flat rate		1,21 x P = 68,17 Vatu/kWh
b) Fixed charge	5xP per subscribed kVA		281,70 x kVA
c) Security deposit	150xP per subscribed kVA		8451 x kVA
F (F*) - "High Voltage" tariff (MT)			
a) Electricity consumed	Flat rate		0,70 x P = 39,44 Vatu/kWh
b) Fixed charge	25xP per subscribed kVA		1408,50 x kVA
c) Security deposit	150xP per subscribed kVA		8451 x kVA

Appendix B. Output Based Aid (OBA) Subsidies

The proposed OBA subsidies have been designed by an independent study for the Global Partnership for Output Based Aid¹⁰¹. In the tables below we present key information that has informed the development of the Road Map. Table B.1 outlines the subsidy components for each of the concession areas.

Table B.1: Suggested Consumer Payments and Subsidy Amounts in Each Area

VUV	Luganville	Port Vila	Tanna	Malekula
Household connection cost	74,655	74,655	74,655	74,655
Connection fee paid upfront by customer to utility	10,000	15,000	10,000	10,000
Total subsidy per output to be paid by OBA account to utility (VUV)	64,655	59,655	64,655	64,655
Total subsidy per output to be paid by OBA account to utility (USD)	\$718	\$663	\$718	\$718

Source: Castalia, "Global Partnership for Output-Based Aid: Improved Electricity Access in Vanuatu" September 2012

The subsidy is proposed to be a one-off payment paid after the connection is complete, and covers the connection costs from grid to the household's property only—the pole, wiring and meter. Customers will pay a low connection fee equivalent to 15 percent of cost. This fee will vary by area, ranging between VUV10,000-15,000 (US\$111-150). Customers must also meet minimum safety standards and pay for their own internal wiring costs (an estimated VUV24,449 (US\$272)).

Table B.2 presents the model of subsidy disbursements in each area over a three-year period. The table also details the number of households to be connected each year.

¹⁰¹Castalia, "Global Partnership for Output-Based Aid: Improved Electricity Access in Vanuatu" September 2012

Table B.2: Estimated Annual Subsidy Disbursements and Household Connections

		Luganville			Port Vila			Tanna			Malekula			Cumulative totals				
		New outputs	Subsidies paid	Required investment	New outputs	Subsidies paid	Required investment	New outputs	Subsidies paid	Required investment	New outputs	Subsidies paid	Required investment	New outputs	Subsidies paid			
Year One	A	138	8,938,554	709,367	1185	70,686,701	6,079,905	37	2,408,399	191,131	77	4,994,599	396,373	1,438	87,028,252			
	B	109	7,063,559	27,057,148				26	1,658,401	2,714,372						21	1,351,290	3,986,423
	C																	
	D																	
Year Two	A				395	23,562,234	2,026,635							1,988	120,663,735			
	B				447	26,692,630	110,918,908							2,436	147,356,365			
	C	449	29,058,382	335,780,655	307	18,287,986	73,223,816	23	1,454,738	11,669,088				3,214	196,157,470			
	D							237	15,339,399	88,660,407	154	9,924,543	114,458,570	3,605	221,421,411			
Year Three	A													3,605	221,421,411			
	B													3,605	221,421,411			
	C	150	9,686,127	111,926,885	920	54,863,958	219,671,449							4,675	285,971,496			
	D	287	18,523,658	243,417,462	157	9,336,008	89,086,212	237	15,339,399	88,660,407	154	9,924,543	114,458,570	5,508	339,095,102			
TOTAL (VUV)			73,270,279	718,891,516		203,429,516	501,006,926		36,200,335	191,895,406		26,194,973	233,299,937		339,095,102			
TOTAL (USD)		1,133	\$814,114	\$7,987,684	3,410	\$2,260,328	\$5,566,744	560	\$402,226	\$2,132,171	405	\$291,055	\$2,592,222	5,508	\$3,767,723			

Source: Castalia, "Global Partnership for Output-Based Aid: Improved Electricity Access in Vanuatu" September 2012

Appendix C. Electricity Demand Forecasts

The tables below provide demand forecasts for each concession area as a result of the projected increase in household connections. To create these forecasts, we have used the following approach and assumptions:

- 2010 demand is taken from the 2010 UNELCO annual technical report
- Households are considered to be the 'domestic', 'prepaid' '5A' and '10A' customers in the UNELCO technical reports
- Demand from commercial customers, public administration, and households that are already connected grow at 4 percent per annum. In reality, demand from commercial customers could change substantially due to one or more new commercial customers locating in any concession area or shutting down their facilities, and
- New household connections are based on successfully achieving the actions set out in this Road Map. This creates a significant increase in demand above historical growth rates for the period from 2013 onwards.

Table C.1: Demand Forecast for Port Vila Concession Area, 2010-2030

Port Vila Concession Area	Constants	Units	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
HHs																		
Total HHs			12141	12,445	12,756	13,075	13,401	13,736	14,080	14,432	14,793	15,162	15,542	15,930	16,328	16,737	17,155	17,584
HH Growth Rate	2.5%	%																
Current connection rate (avge 2008-2010)	5%	%																
Total HHs connected			9445	9445	9445	10077	10709	11341	11941	12541	13141	13641	14091	14491	14891	15291	15691	16091
Portion of HHs connected		%	78%	76%	74%	77%	80%	83%	85%	87%	89%	90%	91%	91%	91%	91%	91%	92%
Estimated HHs to serve			2,696	3,000	3,311	2,998	2,692	2,395	2,139	1,891	1,652	1,521	1,451	1,439	1,437	1,446	1,464	1,493
New Connections																		
New HHs connected (from OBA subsidy)			0	0	0	632	632	632	0	0	0	0	0	0	0	0	0	0
Other new connections			0	0	0	0	0	0	600	600	600	500	450	400	400	400	400	400
Total new connections			0	0	0	632	632	632	600	600	600	500	450	400	400	400	400	400
Demand (existing HHs)																		
Average demand per HH per month		kWh	48	50	52	54	57	59	61	64	66	69	72	74	77	81	84	87
Average demand per HH per year		kWh	580	604	628	653	679	706	734	764	794	826	859	893	929	966	1005	1045
Assumed increase in demand		%		4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
Total demand (annual)		MWh	5,481	5,700	5,928	6,578	7,270	8,007	8,768	9,577	10,437	11,267	12,104	12,946	13,835	14,775	15,768	16,817
Demand (new connections)																		
Average demand per HH per month		kWh	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
Average demand per HH per year		kWh	217	241	265	289	313	337	361	385	409	433	457	481	505	529	553	577
Assumed increase in demand		%	...	11%	10%	9%	8%	8%	7%	7%	6%	6%	6%	5%	5%	5%	5%	4%
Total demand (annual)		MWh	0	0	0	183	198	213	216	231	245	216	206	192	202	212	221	231
Commercial & Administration Demand																		
Annual demand - Commerical Customers		MWh	43,933	45,690	47,518	49,418	51,395	53,451	55,589	57,812	60,125	62,530	65,031	67,632	70,338	73,151	76,077	79,120
Annual demand - Public Administration		MWh	4,521	4,701	4,889	5,085	5,288	5,500	5,720	5,949	6,187	6,434	6,692	6,959	7,238	7,527	7,828	8,141
Total annual demand - Commerical & Admin		MWh	48,453	50,391	52,407	54,503	56,683	58,951	61,309	63,761	66,312	68,964	71,723	74,592	77,575	80,678	83,905	87,262
Total Annual Demand - all HHs		MWh	5,481	5,700	5,928	6,761	7,468	8,220	8,985	9,808	10,682	11,484	12,310	13,138	14,037	14,987	15,989	17,048
Total Annual Demand - all customers		MWh	53,934	56,092	58,335	61,264	64,151	67,171	70,293	73,569	76,994	80,448	84,033	87,730	91,613	95,665	99,895	104,309
HH demand growth rate		%		4%	4%	14%	10%	10%	9%	9%	9%	8%	7%	7%	7%	7%	7%	7%
Total demand growth rate		%		4%	4%	5%	5%	5%	5%	5%	5%	4%	4%	4%	4%	4%	4%	4%

Table C.2: Demand Forecast for Luganville Concession Area, 2010-2030

Luganville Concession Area	Constants	Units	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
HHs																		
Total HHs			3599	3,689	3,781	3,876	3,973	4,072	4,174	4,278	4,385	4,495	4,607	4,722	4,840	4,961	5,085	5,212
HH Growth Rate	2.5%	%																
Current connection rate (avge 2008-2010)	5%	%																
Total HHs connected			2069	2069	2069	2401	2733	3065	3365	3665	3865	4065	4265	4465	4665	4865	5065	5165
Portion of HHs connected		%	57%	56%	55%	62%	69%	75%	81%	86%	88%	90%	93%	95%	96%	98%	100%	99%
Estimated HHs to serve			1,530	1,620	1,712	1,475	1,240	1,007	809	613	520	430	342	257	175	96	20	47
New Connections																		
New HHs connected (from OBA subsidy)			0	0	0	232	232	232	0	0	0	0	0	0	0	0	0	0
Other new connections			0	0	0	100	100	100	300	300	200	200	200	200	200	200	200	100
Total new connections			0	0	0	332	332	332	300	300	200	200	200	200	200	200	200	100
Demand (existing HHs)																		
Average demand per HH per month		kWh	44	46	48	49	51	54	56	58	60	63	65	68	70	73	76	79
Average demand per HH per year		kWh	528	549	571	594	618	642	668	695	723	751	781	813	845	879	914	951
Assumed increase in demand		%	...	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
Total demand (annual)		MWh	1,092	1,136	1,181	1,426	1,688	1,969	2,248	2,546	2,793	3,055	3,333	3,629	3,943	4,277	4,631	4,911
Demand (new connections)																		
Average demand per HH per month		kWh	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
Average demand per HH per year		kWh	217	241	265	289	313	337	361	385	409	433	457	481	505	529	553	577
Assumed increase in demand		%	...	11%	10%	9%	8%	8%	7%	7%	6%	6%	6%	5%	5%	5%	5%	4%
Total demand (annual)		MWh	0	0	0	96	104	112	108	115	82	87	91	96	101	106	111	58
Commercial & Administration Demand																		
Annual demand - Commerical Customers		MWh	4,902	5,098	5,302	5,514	5,735	5,964	6,203	6,451	6,709	6,977	7,256	7,546	7,848	8,162	8,489	8,828
Annual demand - Public Administration		MWh	1,510	1,570	1,633	1,698	1,766	1,837	1,910	1,986	2,066	2,149	2,234	2,324	2,417	2,513	2,614	2,719
Total annual demand - Commerical & Admin		MWh	6,412	6,668	6,935	7,212	7,501	7,801	8,113	8,437	8,775	9,126	9,491	9,870	10,265	10,676	11,103	11,547
Total Annual Demand - all HHs		MWh	1,092	1,136	1,181	1,522	1,792	2,081	2,356	2,662	2,874	3,141	3,424	3,725	4,044	4,382	4,741	4,969
Total Annual Demand - all customers		MWh	7,504	7,804	8,116	8,734	9,292	9,881	10,469	11,099	11,649	12,267	12,915	13,595	14,309	15,058	15,844	16,515
HH demand growth rate		%		4%	4%	29%	18%	16%	13%	13%	8%	9%	9%	9%	9%	8%	8%	5%
Total demand growth rate		%		4%	4%	8%	6%	6%	6%	6%	5%	5%	5%	5%	5%	5%	5%	4%

Table C.3: Demand Forecast for Malekula Concession Area, 2010-2030

Malekula Concession Area	Constants	Units	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
HHs																		
Total HHs			1099	1,126	1,155	1,184	1,213	1,243	1,275	1,306	1,339	1,373	1,407	1,442	1,478	1,515	1,553	1,592
HH Growth Rate	2.5%	%																
Current connection rate (avge 2008-2010)	5%	%																
Total HHs connected			445	445	445	525	605	685	775	865	955	1045	1125	1175	1225	1275	1325	1375
Portion of HHs connected		%	40%	40%	39%	44%	50%	55%	61%	66%	71%	76%	80%	81%	83%	84%	85%	86%
Estimated HHs to serve			654	681	710	659	608	558	500	441	384	328	282	267	253	240	228	217
New Connections																		
New HHs connected (from OBA subsidy)			0	0	0	80	80	80	0	0	0	0	0	0	0	0	0	0
Other new connections			0	0	0	0	0	0	90	90	90	90	80	50	50	50	50	50
Total new connections			0	0	0	80	80	80	90	90	90	90	80	50	50	50	50	50
Demand (from existing HHs)																		
Average demand per HH per month		kWh	25	26	28	30	32	34	36	38	40	42	43	44	45	46	47	48
Average demand per HH per year		kWh	294	312	336	360	384	408	432	456	480	504	516	528	540	552	564	576
Assumed increase in demand		%		6%	8%	7%	7%	6%	6%	6%	5%	5%	2%	2%	2%	2%	2%	2%
Total demand (annual)		MWh	131	139	150	189	232	279	335	394	458	527	581	620	662	704	747	792
Demand (from new connections)																		
Average demand per HH per month		kWh	18	19	20.5	22.5	25	27	29	31	33	34	35	36	37	38	39	40
Average demand per HH per year		kWh	217	228	246	270	300	324	348	372	396	408	420	432	444	456	468	480
Assumed increase in demand		%	...	5%	8%	10%	11%	8%	7%	7%	6%	3%	3%	3%	3%	3%	3%	3%
Total demand (annual)		MWh	0	0	0	22	24	26	31	33	36	37	34	22	22	23	23	24
Commercial & Administration Demand																		
Annual demand - Commerical Customers		MWh	326	339	353	367	381	397	413	429	446	464	483	502	522	543	565	587
Annual demand - Public Administration		MWh	122	127	132	137	142	148	154	160	166	173	180	187	195	203	211	219
Total annual demand - Commerical & Admin		MWh	448	466	484	504	524	545	567	589	613	637	663	689	717	745	775	806
Total Annual Demand - all HHs		MWh	131	139	150	211	256	305	366	428	494	563	614	642	684	727	771	816
Total Annual Demand - all customers		MWh	579	604	634	714	780	850	933	1,017	1,107	1,201	1,277	1,331	1,401	1,472	1,546	1,622
HH demand growth rate		%		6%	8%	41%	22%	19%	20%	17%	15%	14%	9%	5%	6%	6%	6%	6%
Total demand growth rate		%		4%	5%	13%	9%	9%	10%	9%	9%	8%	6%	4%	5%	5%	5%	5%

Table C.4: Demand Forecast for Tanna Concession Area, 2010-2030

Tanna Concession Area	Constants	Units	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
HHs																		
Total HHs			1490	1,527	1,565	1,605	1,645	1,686	1,728	1,771	1,815	1,861	1,907	1,955	2,004	2,054	2,105	2,158
HH Growth Rate	2.5%	%																
Current connection rate (avge 2008-2010)	5%	%																
Total HHs connected			467	467	467	583	699	815	931	1011	1091	1171	1251	1331	1411	1491	1571	1651
Portion of HHs connected		%	31%	31%	30%	36%	43%	48%	54%	57%	60%	63%	66%	68%	70%	73%	75%	77%
Estimated HHs to serve			1,023	1,060	1,098	1,022	946	871	797	760	724	690	656	624	593	563	534	507
New Connections																		
New HHs connected (from OBA subsidy)			0	0	0	116	116	116	116	0	0	0	0	0	0	0	0	0
Other new connections			0	0	0	0	0	0	0	80	80	80	80	80	80	80	80	80
Total new connections			0	0	0	116	116	116	116	80	80	80	80	80	80	80	80	80
Demand (existing HHs)																		
Average demand per HH per month		kWh	33	34	35	37	38	40	41	43	45	47	49	50	52	55	57	59
Average demand per HH per year		kWh	393	409	425	442	460	478	498	517	538	560	582	605	630	655	681	708
Assumed increase in demand		%		4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%	4%
Total demand (annual)		MWh	184	191	199	258	322	390	463	523	587	655	728	806	888	976	1,070	1,169
Demand (new connections)																		
Average demand per HH per month		kWh	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
Average demand per HH per year		kWh	217	241	265	289	313	337	361	385	409	433	457	481	505	529	553	577
Assumed increase in demand		%	...	11%	10%	9%	8%	8%	7%	7%	6%	6%	6%	5%	5%	5%	5%	4%
Total demand (annual)		MWh	0	0	0	34	36	39	42	31	33	35	37	38	40	42	44	46
Commercial & Administration Demand																		
Annual demand - Commerical Customers		MWh	158	164	171	178	185	192	200	208	216	225	234	243	253	263	273	284
Annual demand - Public Administration		MWh	77	80	83	86	90	93	97	101	105	109	113	118	123	128	133	138
Total annual demand - Commerical & Admin		MWh	235	244	254	264	274	285	297	309	321	334	347	361	376	391	406	422
Total Annual Demand - all HHs		MWh	184	191	199	291	358	429	505	554	620	690	765	844	929	1,018	1,114	1,215
Total Annual Demand - all customers		MWh	418	435	452	555	632	714	802	863	941	1,024	1,112	1,205	1,304	1,409	1,520	1,638
HH demand growth rate		%		4%	4%	47%	23%	20%	18%	10%	12%	11%	11%	10%	10%	10%	9%	9%
Total demand growth rate		%		4%	4%	23%	14%	13%	12%	8%	9%	9%	9%	8%	8%	8%	8%	8%

Appendix D. Petroleum Sector Investments

The tables in this appendix present detailed information that informed the analysis of the petroleum sector, and the actions in this Road Map that are required to improve the security of supply and affordability of petroleum products in Vanuatu. Table D.1 details the existing reserves in Vanuatu for the different imported petroleum products.

Table D.1: Days of Cover for Petroleum Products in Vanuatu

Port Vila					
	Petrol	Kerosene	Diesel	Power Diesel	Average days cover
Minimum days cover	21	14	21	60	
Average days cover	54	46	52	93	64.4
Spare Capacity (days)	34	20	4	2	10
Santo					
Minimum days cover	21	14	21 ²⁵		
Average days cover	86	90	83		85
Spare Capacity	62	267	18		44
Average days cover for Vanuatu 68.5 days					

Source: Hale and Twomey, and David Butcher and Associates "Draft Final Report: Options for Increasing the efficiency of Vanuatu's oil and gas supply chain" November 2012

Table D.2 and Table D.3 summaries the investments required by Pacific Petroleum and Origin Energy to overcome the risks that have been identified in the Petroleum and LPG terminals.

Table D.2: Recommended Investments for Pacific Petroleum

Issue	Required Action	Estimated Cost of Investment		
		Port Vila	Santo	Bauerfield
Fire risk	Install and upgrade tank cooling and fixed foam systems	VUV198million (US\$2.2 million)	VUV134million (US\$1.5 million)	VUV1.9million (US\$21,000)
Spills - overfill of tanks. and health and safety of employees	<ul style="list-style-type: none"> Install fail safe high level alarm systems using a SIL2 rated probe Change from top-loading to bottom loading tanks in Jet A-1, and fit overfill protection Upgrade Santo tank compound, fit HDPE liner and ensure capacity is 110% of the largest tank 	VUV33.5 million (US\$372,000)	VUV114 million (US\$1.26 million)	VUV3.78 million (US\$42,000)

Issue	Required Action	Estimated Cost of Investment		
		Port Vila	Santo	Bauerfield
Port Vila: large number of small Jet A-1 tanks are not efficient	Consider installing two medium tanks (rather than one large) and one small tank (to allow capacity when one medium is to be serviced)	[unknown]	N/A	N/A
Port Vila: petrol tanks too close to boundary	Consider installing internal floating blankets, vent tanks away from boundary or relocate tanks	VUV54 million (US\$600,000)	N/A	N/A
Other	<ul style="list-style-type: none"> Replace lining for 5 existing tanks with epoxy lining Repaint all tanks Ability to withstand earthquakes 	VUV13.5 million (US\$150,000)	>VUV3.6 million (US\$40,000)	[unknown]
Total Investments (VUV)		>299million	>251.6million	>5.68million
Total Investments (US\$)		>US\$3.3million	>\$2.8million	>\$63,000

Source: Consolidated from Hale and Twomey, and David Butcher and Associates Draft Final Report: Options for Increasing the Efficiency of Vanuatu's Oil and Gas Supply Chain, Vanuatu Petroleum Supply Chain Draft Final Report, September November 2012

Table D.3: Recommended Investments for Origin Energy

Issue	Required Action	Estimated Cost of Investment	
		Port Vila	Santo
Fire - Boiling liquid expanding vapor explosion (BLEVE)	Fit fixed water drench cooling or earth mound tank	VUV40million (US\$453,000)	VUV38million (US\$423,000)
Leak leading to explosion	Install gas detection systems	VUV5.2 million (US\$58,000)	VUV3.78 million (US\$42,000)
Total Investments (VUV)		>45.2million	>41.8million
Total Investments (US\$)		>\$511,000	>\$465,000

Source: Consolidated from Hale and Twomey, and David Butcher and Associates "Draft Final Report: Options for Increasing the Efficiency of Vanuatu's Oil and Gas Supply Chain, November 2012

Appendix E. Summary of Road Map Electricity Investments

Note: Identified and prospective investments below are on a project basis and may be substitutes for certain investments.

Investments	2012	2015			2020				Totals (2013-2020)			Total Investment		
	Current (%)	Target	Investment	Cost /Unit	Investment Cost	Targets	Investment	Cost/ Unit	Investment Cost	Total Investment	Committed Funding		Funding Gap	
Access Investments														
Households within grid areas (OBA)			4,200 HH	\$830 /HH	\$4.0m		3,600HH	\$830	\$3.5m	7,800 HH	\$4m ³	\$3.5m	\$7.5m	
Grid extensions (Efate) ¹			30km	\$53,500 /km	≈\$1.5m		...	...	...	30km	...	≈\$1.5m	≈\$1.5m
Grid extension (Santo) ¹	68%	75%	45km	\$53,500 /km	≈\$2.4m	90%	...	...	...	45km	...	≈\$2.4m	≈\$2.4m
LV and MV extensions within concessions					Tbc				Tbc	...	Partly utilities	Tbc	\$18.0m	
Efate ring-road transmission and distribution										...	...	\$23.5m	\$23.5m
SWER extensions			Tbc	Tbc			...	...		...	...	...
Households outside grid areas (RLSS)	10%	20%	2,500 HH		\$3m	50%		\$550 /HH	\$2.2m	10,000 HH	\$5.2m ⁴	...	\$5.2m	
Public Institutions (PIES plus other) ⁶	50%	90%	297	\$14,244	\$4.3m	100%	223	\$14,244	\$3.2m	502	\$6.5m ⁴	\$1m	\$7.5m	
RLSS and PIES administration and services										\$8.0m	\$8.0m		\$8.0m	
Access initiatives - micro grids										...	...	\$3.0m	\$3.0m
Renewable energy investments²														
1 MW Efate Solar PV					\$5.6m				\$5.6m		\$5.6m	...	\$5.6m	
40 kW Luganville Solar PV					\$150k				\$150k		\$150k	...	\$150k	
Efate geothermal power plant			4MW	...	...		4MW	...	...	8MW	...	\$84.4m	\$84.4m
Brenwe Hydro, Malekula	19%	40%	...	...	...	65%	<1.2MW	...	\$4.5m	<1.2MW	...	\$4.5m	\$4.5m
Wampu Hydro, Santo			...	...	...		2.2MW	...	\$16m	2.2MW	...	\$16m	\$16m
Other Studies and Investments														
Renewable Energy After 2020			<i>A SREP feasibility study will be funded by the Climate Investment Fund</i>								...	\$250,000	Tbc	\$250k
Micro-grid Feasibility Studies			<i>Complete feasibility studies</i>									Tbc	Tbc	Tbc
Increasing energy efficiency information			<i>Comprehensive data collection established, Set targets and initiate energy efficiency programs</i>									\$1.0m		\$1m
Efate, Tanna, Malekula - solar/small hydro			<i>Complete feasibility studies</i>									Tbc	Tbc	Tbc
Luganville - upscaling hydro			<i>Complete feasibility studies</i>									Tbc	Tbc	Tbc

Notes

¹ Assuming MV grid extensions with no underbuilt LV, with a cost per km that consists of poles (US\$11,700), cross arms, insulators & fittings (US\$8,900), 50mm2Bare AAC MV three phase lines (US\$5,500), Supervision and Erection (US\$10,200), and taxes and duties (US\$4,500); Estimates taken from OBA design. Further costing studies are a high priority for the Government

² Geothermal power plant excludes the Efate grid extension investments. Hydro plants are subject to further feasibility studies

³ Funding proposed under the GPOBA program

⁴ Funding committed by AusAID. The VERD program estimates 80 percent of households will be connected. The Road Map estimates that some of those households will be connected through rural energy market development as described in Section 4. The exact size of small, medium and large units (and therefore cost) is unknown.

⁵ Funding committed by Climate Investment Fund under the SREP

⁶ Using average investment cost. Size and cost of installations will vary for each public institution. The VERD program provides funding to reach just over 90 percent of public institutions. Filling the funding gap (\$1m) will ensure the remaining 10 percent are reached

Appendix F. References

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Appendix G. Energy Taskforce, Technical Team and Support Teams

Table G.1: Energy Taskforce

Name	Position	Department
Simeon Athy	Director General and Chairman	Office of the Prime Minister
Joe Ligo	Director General	Ministry of Lands & Natural Resources
Johnson Binaru	Director General	Ministry of Infrastructure & Public Utilities
Benjamin Shing	Director	Dept. of Strategic Planning and Aid Coordination, Office of the Prime Minister
Tony Sewen	Director	Ministry of Finance and Economic Management
Leith Veremaito	Program Manager	AusAID Governance for Growth
Leo Moli	Director	Dept. of Energy, Ministry of Lands & Natural Resources

Table G.2: Energy Technical Team

Name	Position	Department
Philippe Mehrenberger	Managing Director	UNELCO Limited
Peter Allen	General Manager	Vanuatu Utilities Infrastructure
Randall Vallette	General Manager	Pacific Petroleum
Tony Pittar	Manager, Eratap Beach Resort	Industry Sector Hotels Association
Maturine Tary	Director General	Ministry of Health
Jesse Dick Joe	Director General	Ministry of Education
AG Alatoi Ishmael Kalsakau	Attorney General	State Law Office
Simil Johnson	Government Statistician	National Statistic Office
Carmine Piantedosi	Chief Executive Officer	Utilities Regulatory Authority

Table G.3: National Energy Road Map Support Team

Name	Position	Department
Jesse Benjamin	Power Off-Grid Officer	Department of Energy
Christopher Simelum	GIS/Database Officer	Department of Energy
Kamlesh Khelawan	Senior Energy Specialist	The World Bank
Arun Sanghvi	Consultant	The World Bank
Ben Gerritsen	Consultant	Castalia Strategic Advisors