Vanuatu NDC On-Grid Electricity Investment Strategy

TECHNICAL OVERSIGHT AND GUIDANCE

The Government of Vanuatu would like to recognize the contributions of Global Green Growth Institute (GGGI). We thank the Department of Energy of the Ministry and the Department of Climate Change (DCC) of the Ministry of Climate Change Adaptation, Meteorology, Geo-hazards, Energy, Environment and Disaster Management (MoCC) for their consistent inputs, technical guidance and stakeholder facilitation that were fundamental to the successful development of this document.

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DISCLAIMER

This NDC On-Grid Electricity Investment Strategy is prepared for the Vanuatu Government based on best available information and stakeholder consultations results gained between July 2023 and August 2024, and it is noted that underlying information used to prepare the NDC On-Grid Electricity Investment Strategy and results presented are subject to change.

Information and conclusions presented in this NDC Investment Strategy may not necessarily represent those of the Regional Pacific NDC Hub and its implementing partners, including the implementing partners member states.

Vanuatu NDC On-Grid Electricity Investment Strategy

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ABBREVIATIONS & ACRONYMS

CCDRR	Climate Change and Disaster Risk Reduction Policy
CNO	Refers to Crude Coconut Oil
COP	Conference of the Parties to the UNFCCC
CoM	Council of Ministers
DoCC	Department of Climate Change
DoE	Department of Energy
EF	Emission Factor
ESA	Electricity Supply Act
GCF	Green Climate Fund
GDP	Gross Domestic Product
GGGI	Global Green Growth Institute
GHG	Green House Gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GoV	Government of Vanuatu
GWh	Gigawatt hour
HH	Household
IMF	Internal Monetary Fund
IPP	Independent Power Producer
KWh	Kilowatt hour
kWp	Kilowatt peak
LEDS	Low Emissions Development Strategy
M&E	Monitoring and Evaluation
MoCC	Ministry of Climate Change Adaptation, Meteorology, Geo-hazards, Energy, Environment and Disaster Management
MWh	Megawatt hour
NDC	Nationally Determined Contribution to the Paris Climate Agreement
NDC Hub	Pacific Regional Nationally Determined Contribution Hub
NEESAP	National Energy Efficiency Strategy and Action Plan
NERM	National Energy Road Map 2016 – 2030
NGEF	National Green Energy Fund
NSDP	Vanuatu National Sustainable Development Plan
PA	Paris Agreement
PPA	Power Purchasing Agreement
RE	Renewable Energy
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
URA	Utilities Regulatory Authority
URA Act	Utilities Regulatory Authority Act (as amended)
US$	US Dollar
VANPAWA	Vanuatu National Power and Water Authority
VCCI	Vanuatu Chamber of Commerce and Industry
VNDC	Vanuatu's Revised and Enhanced 1st Nationally Determined Contribution
VNPF	Vanuatu National Provident Fund
VUI	Vanuatu Utilities and Infrastructure Limited

EXECUTIVE SUMMARY

CONTEXT

The Republic of Vanuatu in the effort to achieve its NDC targets had requested technical support from the Regional NDC Hub. The NDC Hub through its implementing partner, the Global Green Growth Institute (GGGI) engaged a national consultant to develop Vanuatu's NDC On-Grid Electricity Investment Strategy and Project Pipeline.

The On-Grid Electricity Investment Strategy considers efforts underway through the country's policies and strategies and identifies gaps to meet the country's NDC mitigation target of achieving 100% of electricity generation from Renewable Energy (RE) by 2030. The Project Pipeline considers feasible and transparent investment options to address the gap identified under the investment strategy. An added intention of the On-Grid Electricity Investment Strategy and Project Pipeline is to solicit interest from donor and implementation partners, including private investors to implement the project pipeline investments and achieving the country's ambitions identified in its NDC.

VANUATU'S NDC

Vanuatu's Revised and Enhanced 1st Nationally Determined Contribution (VNDC) includes mitigation and adaptation as well as loss and damage priority areas. The increased ambitions outlined in the NDC are conditioned on external sources of financing, capacity building, and technology investments. The VNDC lists 20 mitigation, 116 adaptation, and 12 loss and damage commitments. Majority of the mitigation considers the sector of transportation and municipal solid waste, while adaptation considers mostly the agriculture sector commitments. The on-grid electricity as a subsector of energy and a mitigation priority is addressed in this NDC On-Grid Electricity Investment Strategy where it proposes feasible steps to meet the mitigation target.

VANUATU'S EMISSION PROFILE

Vanuatu is a carbon negative country due to a significant portion of its land covered by forest, therefore acting as a carbon sink for the rest of the world. Given the country's size, it contributes an insignificant amount to global Green House Gas (GHG) emissions of less than 0.01%. However, through the VNDC, Vanuatu aims to further reduce its current emissions level, to drive the country beyond its net zero carbon emission status. Acceleration of its mitigation and adaptation efforts will contribute to the global effort to fight climate change impacts.

CONSTRAINTS ON NDC IMPLEMENTATION AND OPPORTUNITIES TO STRENGTHEN THE ENABLING ENVIRONMENT

This NDC On-Grid Electricity Investment Strategy and Project Pipeline considers prioritized constraints to achieving the mitigation priority objective. Identified constraints are the lack of conducive legal framework and policy, rigid market structures and limited national financing, lack of identification of feasible RE sources, limited technical capacity and technology. These constraints and opportunities to strengthen the enabling environment are discussed further in Section 2 of this report.

MITIGATION AND ADAPTATION PROJECTS IDENTIFIED

The NDC On-Grid Electricity Investment Strategy considers existing literature, legal and regulatory framework, national policies and strategies as well as consultation with the Government of Vanuatu (GoV), electricity concessionaires, private entities, and other relevant stakeholders to derive and prioritize feasible project pipeline investments as outlined in the Table below.

The combined total investment required is US$ 13,997,000 to reduce CO_2 emissions by an estimated 155,066 tons over the period 2024 to 2030. Funding for these project pipeline investments would stem from potential donors and implementing partners, GoV, concessionaires, and the private sector.

OPPORTUNITIES	INDICATIVE INVESTMENT NEEDS 2024 - 2030 (US$)	COST OF MITIGATION (tCO_2/YR)	ANNUAL MITIGATION 2030 (tCO_2/YR)	TOTAL MITIGATION 2024 - 2030 (tCO_2/YR)
CNO for Electricity Generation for UNELCO Concession Area	$8,125,000	52.64	34,300	154,350
Solar PV and Battery Storage for VUI Mini Grids	$2,500,000	3,488.40	189	717
Develop a CNO price Stabilization Mechanism	$50,000	N/A	N/A	N/A
Enhance Policy and Legal Framework to Promote RE	$100,000	N/A	N/A	N/A
Solar PV and Battery Storage for VUI Luganville Grid	$3,222,000	N/A	N/A	N/A
TOTAL	$13,997,000	$3,541.04	34,489	155,066

INTRODUCTION

The Republic of Vanuatu submitted its initial Nationally Determined Contribution to the United Nations Framework Convention on Climate Change (UNFCCC) on 21st September 2016. The primary focus was on the electricity sector as a subsector of Energy to transition to 100% renewable energy for electricity generation by 2030. This also captures Vanuatu's renewable energy objective under the country's National Energy Road Map (NERM) 2016 – 2030 policy.

In December 2020, Vanuatu submitted its Revised and Enhanced 1st NDC (VNDC) to UNFCCC. This VNDC had expanded to include more ambitious goals set, showing its increased ambition to combat climate change subject to funding availability from external sources. The VNDC identifies key mitigation and adaptation priority areas as well as loss and damage contribution priority areas. These are summarized in Table 1 below.

Table 1: *Vanuatu's VNDC Priority Areas 2021 – 2030*

MITIGATION PRIORITY AREAS (20)

- Electricity Generation (1)
- Transport (4)
- Commercial, Institutional and Residential (3)
- Tourism (1)
- Lifestock: Agriculture, Forestry and Other Land Use (AFOLU) (3)
- Forestry: AFOLU (2)
- Municipal Solid Waste (4)
- Waste Water (2)

ADAPTATION PRIORITY AREAS (116)

- Agriculture(18)
- Biosecurity (1)
- Fisheries (3)
- Forestry (13)
- Livestock (2)
- Water (5)
- Health (4)
- Environment (6)
- Oceans (6)
- Waste (5)
- Information and Communication Technology (1)
- Infrastructure (3)
- People with Disabilities (3)
- Gender and Social Inclusion (8)
- Human Right and Climate Justice (2)
- Indigenous People (4)
- Youth (5)
- Collaboration (3)
- Decentralisation (3)
- Governance (3)
- Climate Policy and Plans (2)
- Meteorology and Climate Information Services (3)
- Tourism (9)
- Finance (4)

LOSS AND DAMAGE PRIORITY AREAS (12)

- Climate Change and Disaster Risk Reduction Policy (5)
- Disaster Induced Displacement Policy (4)
- Health Cluster Strategic Plan (1)
- Climate Diplomacy (2)

The NDC is encompassed in Vanuatu's NERM 2016-2030 as well as the Climate Change & Disaster Risk Reduction (CCDRR) Policy. The NERM proposes 11 policy targets for electricity generation that fall under the framework's key priority strategic areas of energy access, energy affordability, energy security as well as climate resilience. The CCDRR Policy proposes priority activities that enable and strengthen capacities to absorb and quickly bounce back from climate and/or disaster shocks and stresses. Both frameworks have the strategic goal to promote sustainable and resilient development as well as to achieve significant emission reductions. This includes activities that enable and strengthen capacities to absorb and quickly bounce back from climate and/or disaster shocks and stresses. Both the NERM and the CCDRR policy falls within Vanuatu's National Sustainable Development Plan (NSDP) known as 'the People's Plan', considered as the country's overarching policy framework.

Due to Vanuatu's large forest covering 70% of its islands, it is currently emitting less carbon than it is absorbing, therefore contributing globally to offsetting other country's emissions. Despite only being responsible for 0.0016% of the world's Green House Gas (GHG) emissions, it aims to reduce its emissions further and beyond its current net negative emissions level through its VNDC.

To accelerate the mitigation priority of Electricity Generation, GoV through its Department of Climate Change had requested technical assistance from the Regional Pacific NDC Hub (NDC Hub) to develop an NDC on-grid electricity investment strategy. The Global Green Growth Institute (GGGI), as the implementing partner to the NDC hub had facilitated the development of this NDC On-Grid Electricity Investment Strategy and Pipeline Investments. This NDC investment strategy will consider a pragmatic approach to achieving the VNDC mitigation target set of achieving 100% of on-grid electricity generation from renewable energy by 2030.

Relevant to Vanuatu's on-grid electricity generation as a subsector of energy, key policy documents include, NSDP, CCDRR, NERM 2016 – 2030, VNDC and NDC Implementation Road Map as well as strategies and frameworks which include NSDP monitoring and Evaluation Framework, Vanuatu Coconut Oil for Fuel Strategy, Vanuatu National Coconut Strategy 2016 – 2025, Vanuatu National Energy Efficiency Strategy and Action Plan (NEESAP) 2022 – 2030, and Vanuatu's Low Emissions Development Strategy (LEDS). These policies and strategies have been analyzed to identify the most feasible and transparent pathway to achieving the VNDC objective.

Further analysis had also been conducted on the legal and regulatory framework for Vanuatu's electricity sector in which the following legal documents have been assessed for relevant provisions to enable the achievement of the VNDC objective. This includes the Electricity Supply Act (ESA), Utilities Regulatory Authority Act (URA Act), as well as Electricity Supply Concession contracts. The legal and regulatory framework compliance will limit the risk of legal roadblocks and ensure successful implementation of the NDC On-Grid Electricity Investment Strategy's proposed pipeline projects, therefore improving chances of soliciting funding support from donors and private investors.

1.1 CONTEXT OF VANUATU'S NDC ON-GRID ELECTRICITY INVESTMENT STRATEGY

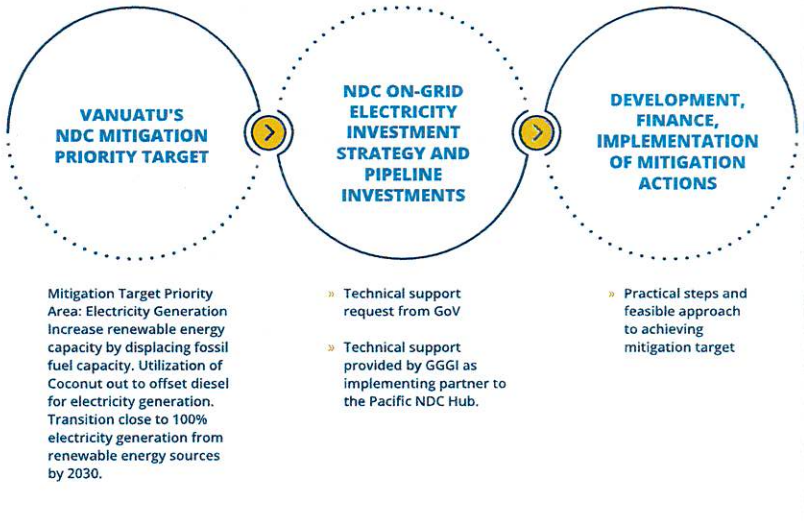
The Paris Agreement (PA) was adopted in the UN Conference of the Parties (COP) on 12 December 2015 and entered into force on 4th November 2016. The PA overarching goal is to limit temperature increase to 1.5°C above pre-industrial levels. To affect this, the PA under Article 4.2 and 4.11 required each party to produce a National Determined Contribution that may be revised to enhance the party's increased level of ambition and commitment towards achieving the overall aim of reducing GHG emissions.

The Republic of Vanuatu had signed the PA on 22nd April 2016, demonstrating its commitment to effectively and transparently implement the PA through its NDCs. The VNDC had clearly outlined its ambitions and conditioned mitigation, adaptation and loss and damage priority targets. The priority targets set are estimated to cost US$ 1.2 billion with the largest portion allocated to adaptation priority targets of US$ 721 million.

In 2023, the International Monetary Fund (IMF) estimated Vanuatu's nominal Gross Domestic Product (GDP) at US$ 1,064 million of which an estimated 49.2% contribution by incurred public debt just below the country's ceiling of 60%. Vanuatu also has a high inflation rate recorded at 11.6% from 2022 – 2023 and unstable economic conditions due to climate change impacts from tropical cyclones, travel restrictions due to COVID 19, political instability, and other external factors (Vanuatu National Statistics Office, Gross Domestic Product 2021 Preliminary Report, 2021). Therefore, in the limited timeframe for the implementation of the VNDC targets from 2021 – 2030, Vanuatu through its national financing capacity cannot deliver on the set priority mitigation targets without external funding support.

According to the Revised and Enhanced VNDC, the estimated mitigation cost does not cover the costs of existing measures which have been included in the initial NDC and budgeted for under the NERM 2016 – 2030. The NDC on-grid electricity investment strategy will factor these planned mitigative actions into the Business As Usual (BAU) scenario to identify shortfalls in achieving the mitigation target set and proposed pipeline investments to address these shortfalls along with corresponding implementation requirements capturing expected funding costs and proposed financing structures as well as Monitoring and Evaluation (M&E) frameworks.

Figure 1: *Alignment of the NDC On-Grid Electricity Investment Strategy & Pipeline Projects with VNDC*



The NDC Investment Strategy and Pipeline Projects are designed to ensure compliance with the legal and regulatory framework as well as better alignment with the relevant policies and proper monitoring and evaluation frameworks available to ensure practical steps and feasible investments are proposed to meet the VNDC mitigation target set. Five pipeline projects have been identified after consultation with the relevant stakeholders, including the GoV and the electricity concession holders.

1.2 GOALS AND OBJECTIVES OF THE NDC ON-GRID ELECTRICITY INVESTMENT STRATEGY

This NDC on-grid electricity investment strategy and pipeline investments focuses only on on-grid electricity services which includes Vanuatu's main grids and mini grids within and outside of electricity concession areas. The focus is on electricity generation as a subsector of energy that has been identified to contribute to approximately 30% of the GHG emissions for the sector. The Investment Strategy will identify the most practical approach to achieving the VNDC mitigation priority target set as well as propose relevant financing structures to support the pipeline investments. These will be monitored and evaluated by the proposed M&E framework.

OBJECTIVE 1	Provide an overview of the legal and regulatory framework for the on-grid electricity sector in Vanuatu. And confirm the current penetration of renewable energy for on-grid electricity generation as well as identifying the existing gap to meet VNDC mitigation priority target of near 100% electricity generation from renewable energy by 2030.
OBJECTIVE 2	Brief description of Vanuatu's proposed and prioritized opportunities that will contribute to achieving the VNDC target and the corresponding investment requirements.
OBJECTIVE 3	Map the overall need for financial products and instruments that can support the financing of opportunities in the sectors and identify potential partners for financial cooperation and a pathway to implement mitigation opportunities.

1.3 SUMMARY INFORMATION ON PRIMARY MITIGATION OPTION

This NDC on-grid electricity investment strategy and pipeline investments focuses only on on-grid electricity services which includes Vanuatu's main grids and mini grids within and outside of electricity concession areas. The focus is on electricity generation as a subsector of energy that has been identified to contribute to approximately 30% of the GHG emissions for the sector. The Investment Strategy will identify the most practical approach to achieving the VNDC mitigation priority target set as well as propose relevant financing structures to support the pipeline investments. These will be monitored and evaluated by the proposed M&E framework.

1.3.1 DETERMINATION OF GHG MITIGATION, INVESTMENT AND SUPPORT NEEDS

In this Investment Strategy, GHG emissions is expressed as CO_2 emissions and have been computed utilizing the most recent CO_2 Emission Factor (EF) for electricity and heat generation for Vanuatu published the International Renewable Energy Agency (IRENA). For the year 2022, Vanuatu's computed CO_2 EF for electricity and heat generation was 664 tCO_2/GWh. Further details on the computed emissions can be found in the concept notes.

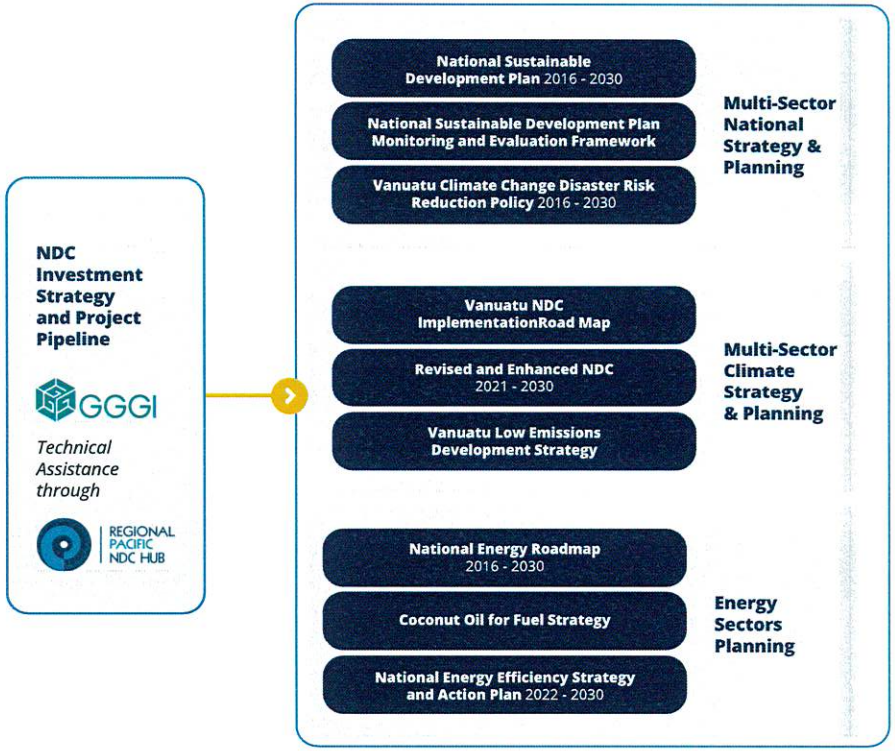
Identification of current and pipeline investments have been completed with assistance from electricity concession holders, Department of Energy (DoE), URA, Coconut oil producers and other relevant stakeholders through consultations, bilateral meetings and shared documents. All investment related costs are in US Dollars (US$). Where there are estimates, the cost has been rounded to the nearest thousand US$.

Understanding of the technical capacity already available to install and operate the investments required for on-grid electricity services has also been considered in the funding requirements. This is essential for successful implementation of the identified investments.

1.3.2 ALIGNMENT OF THE NDC ON-GRID ELECTRICITY INVESTMENT STRATEGY TO NATIONAL POLICIES/STRATEGIES

The Government of the Republic of Vanuatu has comprehensively integrated climate change into policies, strategies and plans at the national level. This NDC Investment Strategy is aligned with the primary policies, strategies and plans, which are divided into the following three categories: Cross-Sectoral National Policies, Cross-Sectoral Climate Change Policies and the Energy Sector.

Figure 2: : Investment Strategy Alignment with National Strategy and Planning



1.4 IMPLICATION OF THE NDC ON-GRID ELECTRICITY INVESTMENT STRATEGY

The NDC On-Grid Electricity Investment Strategy provides the contextual information required for stakeholders to understand the constraints and opportunities to achieving Vanuatu's VNDC mitigation priority target. The opportunities are aligned with the proposed investment pipeline. Table 2 below provides the structure of the Investment Strategy and Project Pipeline.

Table 2: *NDC On-Grid Electricity Investment Strategy and Project Pipeline Report Structure*

NDC ON-GRID ELECTRICITY INVESTMENT STRATEGY

1. INTRODUCTION
   - » Context of the NDC On-Grid Electricity Investment Strategy
   - » Goals and Objectives of the NDC On-Grid Electricity
   - » Investment Strategy
   - » Summary Information on Primary Mitigation Option
   - » Implication of the NDC On-Grid Electricity Investment

2. INFORMATION ON VANUATU'S ON-GRID ELECTRICITY SECTOR
   - » On-Grid Electricity Legal Framework
   - » Renewable Energy Penetration in Electricity Generation Mix
   - » In-Progress On-Grid Electricity RE Investment 2023-2030
   - » On-Grid Electricity Sector Relationship with National
   - » Key On-Grid Electricity Relevant and Related Policies and Legislation
   - » Key National Stakeholders Including Other Sectors
   - » Key Constraints and Opportunities to Strengthen the Enabling Environment
   - » Mitigation Opportunities

3. INVESTMENT STRATEGY FOR THE ON-GRID ELECTRICITY SECTOR
   - » Priority Mitigation Opportunities
   - » Financing Pathways for Individual Mitigation Opportunities
   - » Consolidated Financing Pathway
   - » Need for Financial Instruments and Potential Funding

ANNEXES

PROJECT PIPELINE

1. Overview of the Project
2. Context of the Proposed Project
3. Project Outcomes
4. Project Implementation
5. Project Monitoring
6. Insitutional Arranagement/ Implementing and Supporting Entities
7. Project Finance
8. Gaps & Barriers to Implementation, Including Proposed Enabling Mechanisms
9. Financial Sustainability
10. Enabling Capacity Building and Technical Assistance

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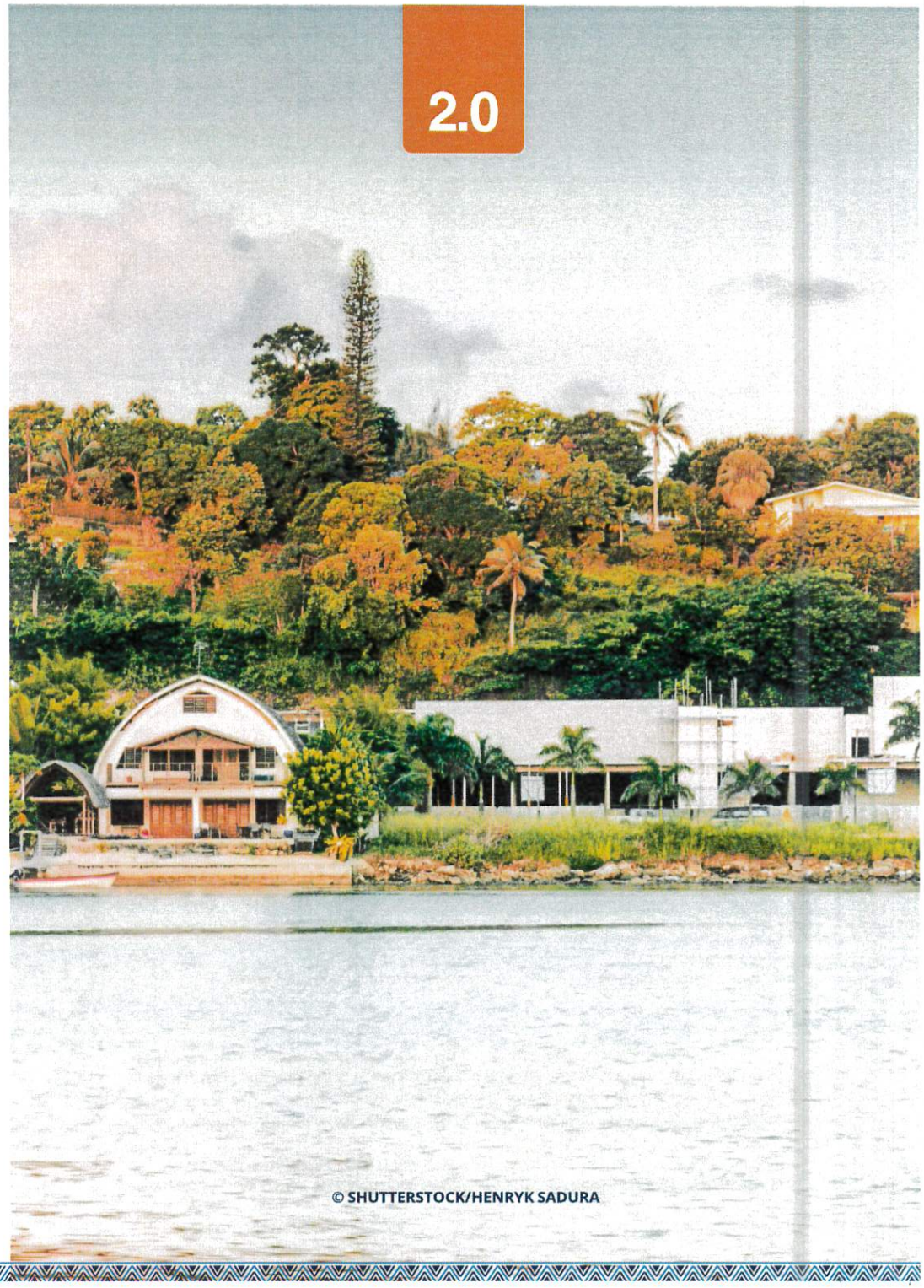

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INFORMATION ON VANUATU'S ON-GRID ELECTRICITY SECTOR

Vanuatu's on-grid electricity sector consist of three main electricity service providers, namely, UNELCO, with Engie Group and the Vanuatu National Provident Fund (VNPF) as the shareholders of the company, Vanuatu Utilities and Infrastructure (VUI) Ltd, a local subsidiary of the US based Pernix Group, and the Vanuatu National Power and Water Authority (VANPAWA), a subsidiary of VNPF. UNELCO and VUI operate the electricity networks of Port Vila and Luganville respectively, and VANPAWA administers the Tanna and Malekula concessions. VUI also operates five mini-grids on the islands of Ambae, Maewo and Vanua Lava, in the northern parts of the country.

2.1 ON-GRID ELECTRICITY LEGAL FRAMEWORK

For the on-grid electricity sector in Vanuatu, two key pieces of legislation that provide for the setup of an electricity service provider and the regulation of the electricity service are the Electricity Supply Act (ESA) and the Utilities Regulatory Authority Act (URA Act) respectively.

2.1.1 ELECTRICITY SUPPLY ACT

The ESA identifies three individuals that can generate electricity, a Concessionaire, an Independent Power Producer (IPP), and an entity or person generating electricity for self-use.

I. CONCESSIONAIRE

The ESA defines a Concessionaire as an entity or person that has been granted the sole concession by the minister responsible for energy[1] under a concession agreement for the generation and supply of electricity service within a concession area for a specified period.

The Minister under Section 1A of the ESA may enter into an agreement with an electricity service provider only after receiving endorsement from the Vanuatu Council of Ministers (CoM), usually based on the outcome of a competitive tender process[2].

Under this legal framework, the GoV had made the following current concessional agreements for the provision of electricity services in Vanuatu for the identified areas within a specified period as summarized in Table 3.

[1] During the drafting of this On-grid Electricity Investment Strategy, the Vanuatu Minister responsible for energy is the Minister of the MoCC.

[2] Refer to Vanuatu Government Contracts and Tenders Act 1998.

Table 3: *Vanuatu Concession Contracts and Concessionaires in 2023*

CONCESSIONAIRE	CONCESSION PERIOD (YEAR)	CONCESSION AREA	TOTAL INSTALLED GENERATION CAPACITY (MW)
UNELCO ENGIE	2011 - 2031	Efate	3.13MW Wind + 2.45MW Solar + 18.52MW Diesel Genset
VANUATU UTILITIES AND INFRASTRUCTURE LTD (VUI)	2019 - 2039	Santo: Luganville and Port Olry	1.2MW hydro + 4.37MW Diesel Genset
		Ambae	0.01MW Solar + 0.16MW Diesel Genset
		Maewo	0.08MW Hydro
		Vanua Lava	0.09MW Disel Genset
VANUATU POWER AND WATER AUTHORITY (VANPAWA)	2022 - 2042	Tanna	1.35MW Diesel Genset
		Malekula	0.7MW hydro + 0.78MW Diesel Genset

Source: URA

II. INDEPENDENT POWER PRODUCERS

The ESA defines an Independent Power Producer (IPP) as a person or entity operating within a concession area and owns a renewable energy facility capable of generating and selling this energy to the concessionaire under a Power Purchase Agreement (PPA) granted.

The DoE director after having received an application from a person or entity is Authorized under the ESA to grant an IPP license subject to the advice of a committee whose composition and responsibilities are listed under Section 1AA and 1AB of the ESA respectively.

It has been noted that the DoE has yet to set up the steering committee responsible to review IPP applications, therefore, the current practice is for the utility to deal directly with the IPP to establish a PPA.

Currently, there are limited IPP/PPAs as listed in Table 4 below, all of which are in the Port Vila and Luganville Electricity Concession areas. The GoV IPPs in Luganville are much smaller with a combined total installed solar PV capacity of 40 kWp that are managed and maintained by VUI to assist the GoV minimize its electricity bills. The IPPs in Port Vila are much larger with a combined total installed solar PV capacity of nearly 1 MWp. The Chuan Store solar PV IPP is privately owned, and the Meteo and Parliament IPP is owned by the GoV.

Table 4: *IPP/PPA with UNELCO in 2023*

IPP	UTILITY	TYPE	CAPACITY (MW)
Chuan Store	UNELCO	Solar	0.25MW
Government - Meteo	UNELCO	Solar	0.12MW
Government - Parliament	UNELCO	Solar	0.62MW
Government - Lycee de Lugan-ville	VUI	Solar	0.010MW
Government - SANMA Province	VUI	Solar	0.010MW
Government - ND Hospital	VUI	Solar	0.020MW

Source: URA

III. GENERATION FOR SELF-USE

The ESA Section 4(3)(a) caters for any person who wishes to self-generate electricity for their personal use and does not sell the electricity generated. Within concession areas, electricity self-generation has been dominated by solar PV rooftops.

IV. MINI GRIDS

While the GoV has managed to secure a concessionaire to manage and operate few of the mini grids located in the islands of Vanuatu under a concession contract as identified in Table 5 below, few of these mini grids which have been completed are located outside of the current established concession boundaries. These mini grids are managed through different management models depending on the location and context. These mini grids are listed below.

***Table 5:** Mini Grids in Vanuatu 2023*

MINI GRID	PROJECT FUNDING	MANAGEMENT	CAPACITY INSTALLED
Mini grid is located on Wintua Lorlow in Southwest Bay on Malekula. It is a Solar PV Mini grid	The mini grid was funded by the Austrian Governmentw through the Nationally Appropriated Mitigation Ac-tion (NAMA) project in collaboration with the DoE	Managed by a cooperative known as the Wintua and Lorlow Electricity Cooperative Socie-ty Ltd	63.36 kWp Solar PV + 470 kWh Battery (7.92 kWp to charge battery) + Backup 30 kVA generator
Mini grid is located on Loltong in North Pentecost. It is a hybrid Pico Hydro and Solar PV Mini grid	The mini grid was funded through the Barrier Removal to Achieve Energy Road Map (BRANTV) project with assistance from the GoV through the DoE	Managed by the Loltong Hydro Committee that has registered with the Vanuatu Financial Service Commission as a Company. The DoE provides technical support and capacity building to the management and staff	7 kW Hydro + 2.6 kWp Solar PV + 33 kWh Battery + Backup 10 kVA generator

Source: URA

2.1.2 UTILITIES REGULATORY AUTHORITY ACT

The Regulatory Framework is provided for under the Utilities Regulatory Authority Act (URA Act) of 2007 allowing for the establishment of the Vanuatu Utilities Regulatory Authority (URA) as the regulator responsible for all aspects of a regulated service defined in the URA Act as electricity and water supply.

Therefore, a utility is defined in the URA Act as a person or entity who supplies the regulated service to a consumer for payment.

While the URA functions outlined under Section 12 of the URA Act are broad to capture all aspects of the regulated service. Section 18 of the URA Act provides the URA the authority to determine the maximum tariff that can be charged to consumers in relation to any aspect of a regulated service in Vanuatu.

However, since the UNELCO electricity concession contract with the GoV pre-dates the establishment of the URA office under the URA Act, therefore UNELCO's tariff review and determination is carried out under Section 20 (1) of the URA Act whereby the URA is assigned the Government's contractual rights under the concession contract, meaning the tariff review and determination where relevant is carried out according to the provisions stipulated under UNELCO's concession contract.

For other concessionaires apart from UNELCO, the tariff effective period, which is the amount of time a tariff is allowed to be charged to electricity customers, is determined by the URA. For UNELCO the tariff can only be reviewed after certain triggers have been met, mainly after a period of 5 years has lapsed3.

Furthermore, the recently launched URA's Five Years Strategic and Action Plan mandates the Authority to align its regulatory functions with the broader GoV strategic development priorities. Though there is no specific RE reference in the URA Act, this strategic document enables URA to promote use of RE investments through approved electricity tariffs. The usual regulatory reporting requirement subsequently enables the regulator to capture national electricity production by RE generation sources from the electricity concessionaires on a periodic basis.

***Table 6:** URA Tariff Determination for Concessionaires*

UTILITY	BASE TARIFF (VATU/KWH)	TARIFF EFFECTIVE PERIOD (YEAR)	IMPLEMENTATION OF TARIFF ADJUSTMENT FORMULA	TARIFF REVIEW AND DETERMINATION WITHIN URA ACT - SECTION 18
UNELCO	48.60 VT/kWh	2020 - 2025	Yes	No - URA Act Section 20(1)
VANPAWA	64.89 VT/kWh	2023 - 2024	On-Hold	Yes
VUI	60.75 VT/kWh	2023 - 2026	Yes	Yes
WIN-TUA/LORLOW ELECTRICAL COORPORATIVE SOCIETY LIMITED	51 VT/kWh	2024 - 2025	No	Yes
LOLTONG HYDRO COMMITTEE	78.06 VT/kWh	2024 - 2025	No	Yes

Source: URA

2.1.3 ELECTRICITY TARIFF CHANGES IN VANUATU

Electricity tariff changes must occur to ensure that the cost to provide electricity services is met through the tariff charged to electricity customers therefore electricity services can be sustainable.

The electricity tariff is adjusted either post tariff determination process conducted by the URA at the end of a tariff period or within a tariff period as a result of an automatic adjustment utilizing a Tariff Adjustment Formula (TAF) that has been reviewed and approved by the URA prior to applying to electricity customer bills.

A TAF is implemented at the beginning of the tariff period when tariffs are set for more than a year or when there are significant changes expected within a year to accommodate for any variations in costs or risks that are outside the control of the utility. The most common cost that is captured by the TAF is the diesel cost. Diesel costs make up a significant portion of the electricity service cost especially when there is heavy reliance on diesel for electricity generation.

[3] Section 5 – Rates Calculation, Specifications Relating to the Concession for the Generation and Public Supply of Electric Power in Port Vila.

Table 7: Diesel Contribution to Total Electricity Cost and Tariff Implications

CONCESSIONAIRE	FUEL COST % OF TOTAL COST	ADJUSTMENT FREQUENCY	ADJUSTMENT DESCRIPTION	RE PENETRATION IMPACT ON FUEL COST
UNELCO	37.5%	Monthly	The prior month weighted diesel price is considered when adjusting the diesel cost	Higher RE penetration in the generation mix will reduce the weighted diesel price
VUI	26%	Monthly	The prior month weighted diesel price is considered when adjusting the diesel cost	Higher RE penetration in the generation mix will reduce the weighted diesel price

Source: URA

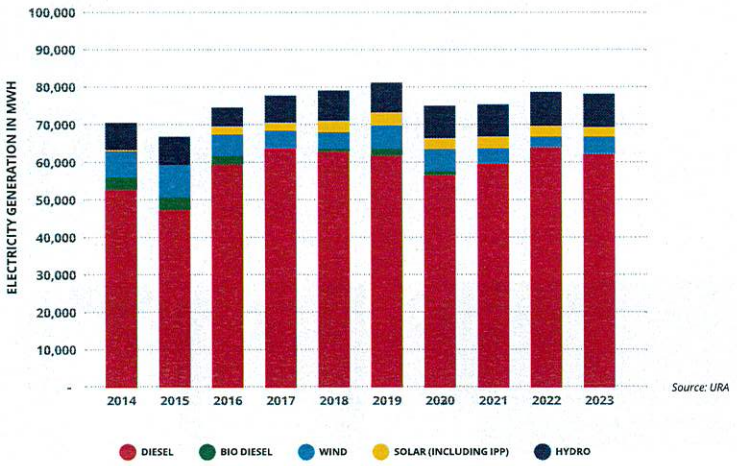
Therefore, diesel price changes highly impact electricity tariffs in Vanuatu and the impact are greater for electricity service providers that rely heavily on diesel for electricity generation.

2.2 RENEWABLE ENERGY PENETRATION IN ELECTRICITY GENERATION MIX

Over the period observed from 2014 to 2023, total energy generation has increased marginally by 1% on average. However, the reliance on diesel grew over the period observed on average by 2% as investment in renewable energy sources were limited in key areas where diesel reliance and generation capacity were highest such as Port Vila. While there was the introduction of bio diesel for electricity generation in Port Vila and Malekula which came from locally produced coconut oil, these biofuel gensets have reached the end of their technical life and therefore have been replaced by diesel gensets. Wind electricity generation in Port Vila has also declined as few of the wind turbines have reached the end of their technical life as well. These changes have contributed to a reduction of renewable energy electricity generation of 1% over the period observed.

The Graph below displays Vanuatu's generation mix from all generation sources from the Concessionaires and mini grids.

Figure 3: Vanuatu Electricity Generation Mix 2014 - 2023

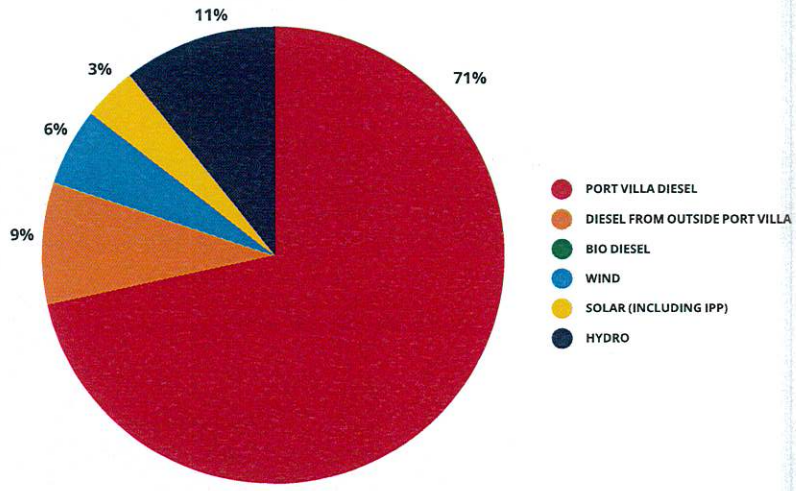


Source: URA

Vanuatu's NERM 2016 – 2030 sustainable energy objective has highlighted that electricity generation from renewable energy should contribute to 65% of the total electricity generation by 2020 and 100% by 2030. This has been captured in Vanuatu's Revised and Enhanced 1st NDC 2021 – 2030 as mitigation priority area conditioned on international financial and technical support. This objective if reached would contribute to reducing Green House Gas emissions in 2030 by 72Gg as part of the estimated 240Gg in the energy sector.

However, as of 2023, diesel generation contributed 80% of the total electricity produced in Vanuatu, with only 20% from renewable energy sources. And of the 80% diesel generation, 71% is from Port Vila alone. The breakdown has been provided in the Pie Chart below.

Figure 4: Vanuatu's Generation Mix 2023



Source: URA

2.3 IN-PROGRESS ON-GRID ELECTRICITY RE INVESTMENT 2023 – 2030

While there have been shortcomings identified in the path to achieving 100% renewable energy penetration in the on-grid electricity generation, there are planned investments underway to address these shortcomings that need to be captured in order to identify gaps in planning, investment, and funding options which build on the BAU pathways identified in the LEDS. These planned investments have been funded by the GoV, donors and development partners, and utilities, as presented in Table 8 below.

Table 8: *RE investments 2023 - 2030*

UTILITY	LOCATION	2024 % FE PENETRATION IN GENERATION MIX	RE PLANNED INVESTMENT	RE PLANNED INVESTMENT COMPLETION YR	EXPECTED RE PENETRATION IN GENERATION MIX
UNELCO ENGIE	Efate	11%	UNELCO funded 3MW solar PV system	2025	21%
			RESSET project funded 4.8MW solar PV and 6MW battery to be installed. (System capacity may change depending on funding available)	2027	
	SANTAO				
	Luganville	70%	JICA finded 3rd phase of sarakata hydro to increase capacity by 1MW	2027	94%
	Port Olry	0%			0%
VANUATU UTILITIES AND INFRASTRUCTURE LTD (VUI)	AMBAE				
	Saratamata	0%	NGEF funded solar PV system and BRANTY installed 300kW battery storage system.		0%
	Longana	0%			0%
	Lolowai	0%			100%
	Maewo	100%			100%
	VANUA LAVA				
	Solar	0%			0%
	Mosina	0%			0%
VANUATU POWER AND WATER AUTHORITY (VANPAWA)	Tanna	0%	RESSET project funded 1.1MW solar PV system and 2.5MW battery to be installed. (System capacity may change depending on funding available)	2027	80%
	Malekula	0%	ADM and Govt funded hydro system. There were issues which have been resolved in 2024 allowing for turbines to be operational again.		100%
WINTUA AND LORLOW ELECTRICITY COOPERATIVE SOCIETY LTD	Southwest Bay, Malekula	100%			100%
LOLTONG HYDRO COMMITTEE	Loltong, North Pentecost	0%	Issues with hydro turbines have beem resolved in 2024.		100%
UNKNOWN	Larmaat, Nambaranguit, Waterfall and Melsisi on Pentecost	N/A	UNDP and Government funded 65.12kW hydro and 25kW solar PV systems	2026-2027	100%
UNKNOWN	Tremb, Tembib, Rensarie, Lamap, Peskarus, Farun and Lesesa on Malekula	N/A	Government funded 120kW solar PV systems to be installed	2027-2028	100%
UNKNOWN	Lalinda on Ambrym	N/A	NAMA project funded 20kW solar PV systems to be installed	2025	100%

Given the projected interventions by the relevant stakeholders to increase renewable energy's share in the generation mix, Vanuatu's BAU projections of renewable energy penetration in the total generation mix is displayed in Figure 5 below.

***Figure 5:** Vanuatu's BAU Electricity Generation Mix 2024 - 2030*

Though expectations are high for Vanuatu to make significant progress towards achieving its NDC priority mitigation target of electricity generation from renewable energy by 2030, unfortunately, a projected gap of 64% is imminent, to be sourced from diesel generation by 2030, of which 63% is from diesel electricity generation in Port Vila. The projected renewable energy penetration in the generation mix is displayed in Figure 6 below.

***Figure 6:** Vanuatu BAU Generation Mix 2030*

2.4 ON-GRID ELECTRICITY SECTOR RELATIONSHIP WITH THE NATIONAL ECONOMY

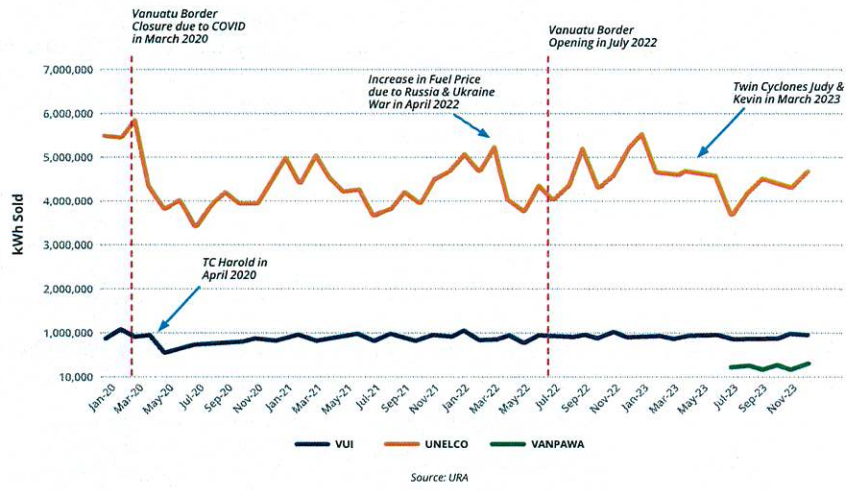
Affordable, accessible and reliable on-grid electricity services in general, play a key role in economic development (Benthem & Romani, 2009). All sectors of the economy, especially the service sector in Vanuatu relies heavily on electricity services to function therefore key relationships can be observed.

2.4.1 SHORT RUN RELATIONSHIP

For this report, the short run is defined as a period of up to 5 years. Within this timeframe few of the capital inputs such as gensets and distribution networks required for on-grid electricity generation remain fixed.

Growth in the economy has been observed to have a positive correlation with electricity consumption. Therefore, post tropical cyclone Harold that devastated the northern islands of Vanuatu in April of 2020 combined with the COVID 19 border closures in March of 2020 led to a contraction of real Gross Domestic Product (GDP) of 6.7% of the Service, and -2.5% of the Agriculture, Fisheries and Forestry sector, despite implementation of an expansionary fiscal and monetary policy[4] therefore in Figure 7 below, this period coincides with a drop in electricity consumption. In July of 2022, Vanuatu opened its borders which saw a rebound in tourism activity that coincided with an increase in electricity consumption.

Figure 7: *Electricity Consumption Vs Economic Situations*



Source: URA

And for concession areas with high reliance on fossil fuel such as Port Vila, the military conflict between Ukraine and Russia in February of 2022 resulted in an increase in fuel prices globally causing an increase in fuel price for Vanuatu.

[4] Reserve Bank of Vanuatu Quarterly Economic Review – December 2022 – December 2023

The fuel retail prices rose overnight by 22 Vatu/liter from 173 Vatu/liter to 195 Vatu/liter in April of 2022 (Department of Energy, Petroleum Price Increase, 2024) causing the fuel wholesale price used by utilities to also increase. Given that fuel contributes close to 37.5% of UNELCO's base tariff and with only 9% on average of renewable energy penetration in the generation mix in 2022, the significant increase in fuel price through the TAF drove the electricity price up that led to a significant drop in electricity consumption for UNELCO customers for the period especially small domestic households with a higher electricity demand elasticity. Therefore, short run movements for electricity consumption are predictable based on the drivers identified.

2.4.2 LONG-RUN RELATIONSHIP

For this report, the long run is defined as a period exceeding 5 years. Within this timeframe all capital inputs such as gensets and distribution networks required for on-grid electricity generation are variable.

Table 9: *On-Grid Electricity Access Incentives*

CONCESSIONAIRE	DOCUMENT	NETWORK	NEW CUSTOMER ACCESS IN-CENTIVE	IMPLEMENTATION YEAR
UNELCO	**Section 7** - UNELCO – Specifications Relating to the Concession for the Generation and Public Supply of Electric Power in Port Vila	Low Voltage Within 300 me-ters	Customer Contribute 20%	2001
VANPAWA	**Section 2.6** - Authority's Commission Order: Case U-0005-22 In the Matter of the Tariff Determination for Malekula and Tanna	Low Voltage (kVA 1.1 - 2.2)	Customers pay fixed amount VT15,000	2023
		Low Voltage (kVA >2.2)	Customers pay fixed amount VT30,000	
VUI	**Section 6.3** - Authority's Commission Order: Case U-0014-23 In the Matter of VUI's Electricity Tariff Reviewa	Low Voltage (5 - 10 Amperes)	Customers pay 50% of total cost	2024

Source: URA

For the long run, electricity consumption and economic growth is driven by multiple variables, but a few significant ones are highlighted below:

i. *Electricity network access through network expansions and or increasing number of grid-connected electricity customers. Therefore, it is important that there are incentives to increase access to grid electricity connection. Currently, there are incentives to address affordability access issues. These are provided in Table 9 below. While the incentives do exist, it should be noted that the current Household (HH) connection to the grid where the highest electricity consumption is recorded, in the urban areas of Port Vila and Luganville, the most recent census carried out in 2020 had identified that the remaining portion of urban households yet to access grid electricity services for Port Vila is 15% and 13% for Luganville (Vanuatu National Statistics Office, National Population and Housing Census, 2020)[5]. Therefore, it is expected that the growth in consumption should slow down once the remaining HHs connect to the grid. Apart from grid connection incentives, the UNELCO concession contract allows for an Investment Support Fund to be established to support grid extension works in Port Vila.*

[5] Note that there are minor discrepancies in the data provided by the National Census when compared to the electrification data provided by UNELCO, however the difference is deemed immaterial.

ii. *Stable prices for inputs into the electricity generation mix such as diesel prices because the generation cost contributes to a significant portion of the electricity service cost.*

iii. *Stable economic conditions, however, Vanuatu is susceptible to tropical cyclones and other force majeure events that are outside of its control.*

iv. *Demand side energy efficiency may also play a role to reducing consumption levels as addressed in NEESAP, however the impact on total consumption especially in the urban areas are yet to be determined as well as the effectiveness of any mechanisms to increase usage of energy efficient appliances as there is an increase in Vanuatu's energy intensity from 4MJ/USD GDP in 2016 to 5.2 MJ/USD GDP in 2021 (IRENA, 2023) despite variations in consumption as depicted in Figure 7.*

2.5 KEY ON-GRID ELECTRICITY RELEVANT AND RELATED POLICIES AND LEGISLATION

Apart from the ESA and URA Act providing the most relevant legal framework, there are other relevant legislations and legal documents that play a role to guiding the electricity sector in Vanuatu. There are also policy documents that identify and set objectives for the electricity sector in Vanuatu and strategies and frameworks that map out the achievement of the policy objectives set. These documents are highlighted in Table 10 below.

***Table 10:** On-Grid Electricity Relevant Legislation and Policy*

TYPE	DOCUMENT TITLE
Legislation	» Electricity Supply Act
	» Utilities Regulatory Authority Act
Other Relevant Legislation	» Government Contracts and Tenders Act
	» Public Finance and Economic Management Act
	» National Green Energy Fund Act
	» Companies Act
	» Land Leases
	» Land Acquisition Act
	» National Green Energy Fund Act
	» Plant Protection Act
	» Excise Act
	» Import Duties Act
Concession Contracts	» **UNELCO** – Convention Relating to the Concession for the Generation and Public Supply of Electric Power in Port Vila. (Agreement of 15th August 1986, Agreement of 23rd January 1990, Agreement of 25th September 1997, and Agreement of 28th September 2012)
	» **UNELCO** – Specifications Relating to the Concession for the Generation and Public Supply of Electric Power in Port Vila. (Agreement of 25th September 1997, Agreement of 1st August 1998, Agreement of 18th December 2007, Agreement of 28th September 2012, Agreement of 29th October 2013, 2011 Arbitration Award, and 2020/2021 Arbitration Award)
	» **VNPF (VANPAWA)** – Concession Deed for the Generation, Transmission, Distribution and Supply of Electricity in Malekula.
	» **VNPF (VANPAWA)** – Concession Deed for the Generation, Transmission, Distribution and Supply of Electricity in Tanna
	» **VUI** – Concession Deed for the Generation, Transmission, Distribution and Supply of Electricity in Parts of the Islands Espiritu Santo, Maewo, Vanua Lava and Ambae

CONT'D

TYPE	DOCUMENT TITLE
Policies	» National Sustainable Development Plan 2016 - 2030
	» National Energy Road Map & Implementation Plan 2016 - 2030
	» Vanuatu National Determined Contributions - Revised and Enhanced
	» National Determined Contribution Implementation Roadmap
	» Vanuatu Climate Change and Disaster Risk Reduction Policy 2016 - 2030
Strate-gies/ Frameworks	» National Sustainable Development Plan 2016 - 2030: Monitoring & Evaluation Framework
	» Vanuatu Coconut Oil for Fuel Strategy
	» Vanuatu National Coconut Strategy 2016 - 2025
	» Vanuatu's National Energy Efficiency Strategy and Action Plan 2022 - 2030
	» Vanuatu Low Emissions Development Strategy
Departmental Plans	» 2021 - 2023 Department of Climate Change Strategic Plan
	» Ministry of Climate Change Business & Corporate Plan
	» URA Strategic and Action Plan 2022 - 2026

2.6 KEY NATIONAL STAKEHOLDERS INCLUDING OTHER SECTORS

The electricity sector covers many of the sectors of the economy and therefore has a broad range of national stakeholders. However, the most relevant of these stakeholders have been listed in Table 11 below.

***Table 11:** Electricity Key National Stakeholders*

STAKEHOLDER	ROLE WITHIN ELECTRICITY SECTOR
Department of Energy	The DoE plays the main role in shaping the national electricity market as it is responsible for the development of national energy policies, legislations and regulations to guide the development of energy services in Vanuatu and improve service delivery. The DoE is also responsible for the identification, implementation, management and evaluation of energy projects, monitoring and facilitating energy activities as well as providing awareness and training activities. Recently, the DoE has worked with the UNDP partly funded project to establish the pico hydro mini grid on Loltong in North Pentecost which currently provides management oversight and training support. It has also assisted in setting up a solar powered mini grid Wintua Lorlow, in Malekula through the NAMA project.
The Utilities Regulatory Authority (URA)	The URA is established as an independent regulator of electricity and water services in Vanuatu. Its primary purpose is to ensure utilities charge an affordable and reasonable rate of electricity or water tariff to their customers while also ensuring the viability of the utility companies. The URA in alignment with its strategic plan has worked closely with electricity service providers to achieve the NERM policy objective of reaching close to 100% RE penetration in the generation mix by 2030.
Electricity Service Providers	Electricity service providers identified as Concessionaires under the ESA, play an essential role in providing electricity and other services to customers within and outside of their concession area as specified in their concession contracts. In collaboration with the URA and the Government, they have tailored their investment plan to meet the NERM policy objective of reaching 100% renewable energy penetration in the generation mix by 2030.
National Green Energy Fund	The NGEF is a financial vehicle designed to assist the Government to achieve its National Energy Roadmap targets through both public and private investment in technology and infrastructure across Vanuatu. Their main objective is to boost households and public institutions' energy access and energy efficiency.

CONT'D

STAKEHOLDER	ROLE WITHIN ELECTRICITY SECTOR
Vanuatu Chamber of Commerce and Industry (VCCI)	The VCCI is a statutory body with a 16-member Council that represents Vanuatu's private sector. All businesses with a valid Vanuatu business license are automatically VCCI members. The VCCI advocates for the private sector to ensure that any policy decision implemented considers the interests of the private sector.
Independent Power Producers (IPP)	The IPP as defined under the ESA is a private investor with a Power Purchasing Agreement with a concessionaire to sell power produced from renewable energy sources to the concessionaire. Currently, there are limited number of IPPs, however with the recent amendments to the ESA, there might be an increased number of IPPs under a controlled environment.
Donor and Development Partners	Donors and development partners have played an important role in the electricity sector and the drive towards achieving VNDC objectives in alignment with national policy objectives. Donors and development partner support towards technical capacity building, funding, technical support towards policy development, etc. have been instrumental in achieving VNDC targets.
Electricity Service Customers	Electricity service customers play a key role in providing the required revenue to sustain electricity services. Customers also contribute to investments made by the electricity service providers in renewable energy and network development. Therefore, investments carried out by electricity service providers need to be managed so that tariffs remain affordable and fair for electricity service customers.

2.7 KEY CONSTRAINTS & OPPORTUNITIES TO STRENGTHEN THE ENABLING ENVIRONMENT

While Vanuatu has and continues to take major steps towards achieving its ambitious and conditional renewable energy target of 100% by 2030, due to existing barriers, it however may not be able to reach its target within this timeframe. A few constraints identified through this assessment of the on-grid electricity sector have been highlighted below.

Table 12: *Key Constraints and Enabling Environment Opportunities in Electricity*

CONSTRAINT BARRIER	ENABLING ENVIRONMENT AND STRENGTHENING OPPORTUNITIES
Policy and Legal Framework	Review the legal framework to ensure that Concession Agreements between the Vanuatu Government and Electricity Service Provid-ers are aligned with Government policies and objectives. Government to facilitate the establishment of the DoE Internal Screening Committee to allow the DoE to issue IPP licenses. Cur-rently, this is managed by utilities. Government to review the composition of the National Energy Task Force and immediately activates it. Government through the Council of Ministers endorses the Coco-nut Oil for Fuel Strategy to allow further donor and development partner support in this sector. Government to review other relevant legislation to enable a con-ducive environment for accelerating achievement of NDC on-grid electricity investment strategy.
Market Structures and Financing	Develop targeted fiscal instruments (e.g. different tax incentives) to support actions in renewable energy by IPPs and electric utilities through lower investment costs. The National Green Energy Fund provides a facility to support actions in energy-efficiency by consumers. Government to develop the market for carbon credit to be traded. The market for carbon credit will incentivize private RE investment. The carbon credit market will enable the establishment of a green fund enabling the price stabilization mechanism as prescribed in the Vanuatu Coconut for Fuel Strategy.

CONT'D

CONSTRAINT BARRIER	ENABLING ENVIRONMENT AND STRENGTHENING OPPORTUNITIES
Identification of Pathways	Identification of concise contribution of renewable energy sources penetration into the generation. Identification of technically and financially feasible renewable energy sources required to meet NERM policy renewable energy objective within timeframe.
Know-how, Training, Institutional Strengthening, and Data/Analytics	Enhanced capacity building for energy planning is required for all major stakeholders such as MoCC, DoE, URA, Concessionaires. Enhance data collection and sharing between the DoE on behalf of the Vanuatu Government, URA, Concessions. Establishment of the Project Development and Implementation Unit (PDIU) within the DoE to strengthen DoE's capacity to develop, implement and manage Energy infrastructure post commissioning. (segregation of Policy matters with focus on project development, implementation and management/sustainability).
Management of Peak Power Demand	Introducing off-peak tariffs for medium to large industrial and commercial users for Concession areas with excess renewable energy capacity.
Improving Supply Side Energy Efficiency	Support is needed for stakeholders such as DoE, Concessionaires, URA, and private companies to develop the market and responsible tariffs for on and off grid battery storage as well as energy efficient appliances. Improve data collection for energy efficient appliances to enable better alignment with NEESAP strategic policy objectives.
Feasible RE Investments for Mini Grids	Targeted investments for mini grids currently utilizing diesel to switch to RE for generation.
Feasible RE Investments for Concession Areas	Targeted investment for concession areas to switch existing diesel generation to RE for generation to meet demand.

2.8 MITIGATION OPPORTUNITIES AND INVESTMENT NEEDS

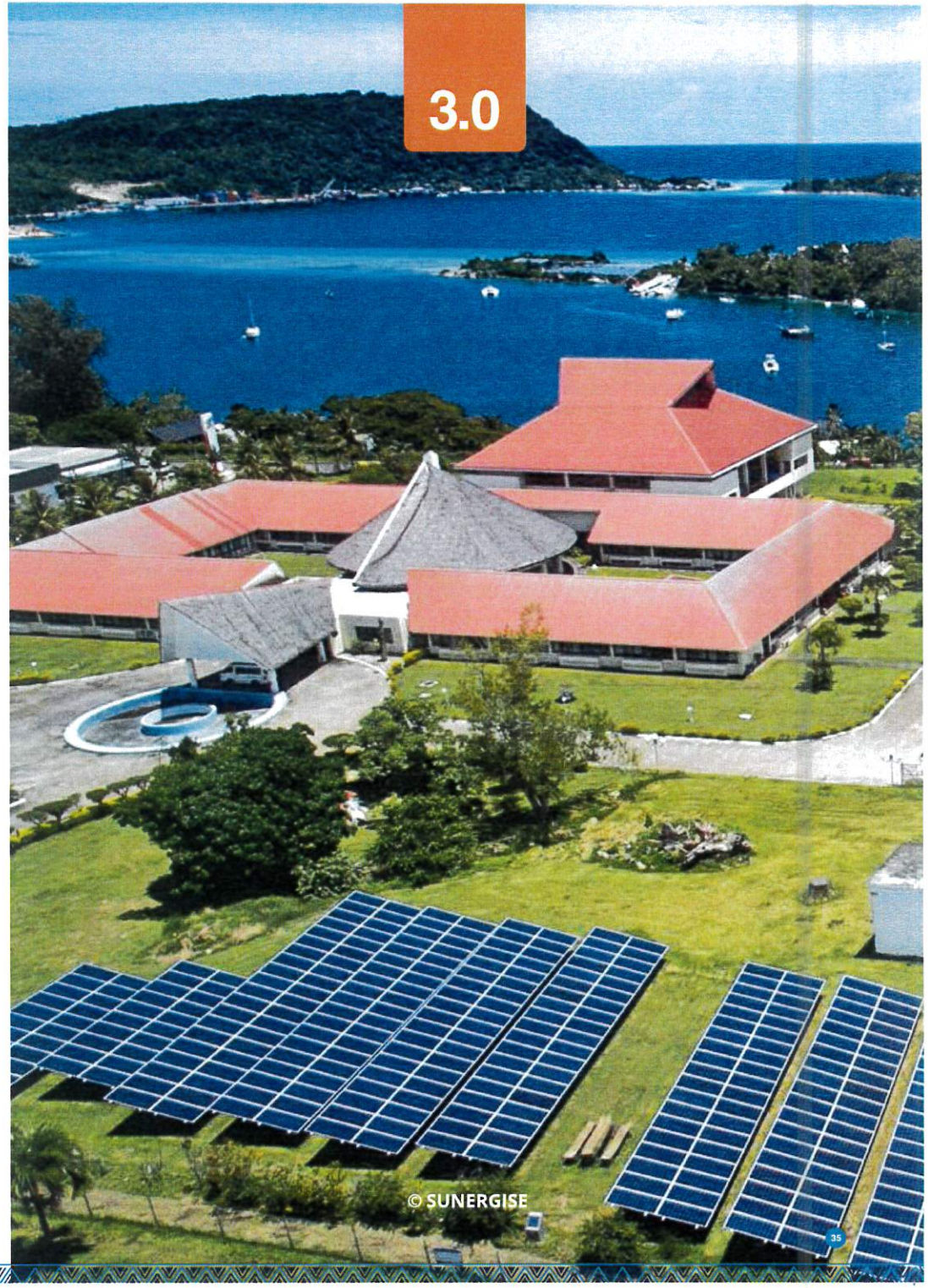
Following the literature review as well as extensive and expanded consultations with national stakeholders, strategic entry points for prioritized investments have become clear. The four prioritized mitigation opportunities presented herein focus solely on increasing renewable energy penetration in the generation mix and one mitigation opportunity focused on improving generation efficiency as uptake of RE generation sources increase. These have been selected as the most feasible and effective approach to achieving the national target of 100% electricity generation from renewable energy sources.

In the event these priority interventions are promptly implemented, they should effectively address the BAU scenario. The VNDC noted that emissions in the energy sector were estimated to rise to 240 Gg by 2030 from 130 Gg in 2010. The mitigation opportunities proposed would contribute to reducing emissions by 34.49 Gg in 2030.

Table 13: *Aggregated Information for On-Grid Electricity Sub Sector Opportunities*

OPPORTUNITIES	INDICATIVE INVESTMENT NEEDS 2024 - 2030 (US$)	COST OF MITIGATION US$/$TCO_2$	ANNUAL MITIGATION 2030 (tCO_2/YR)	TOTAL MITIGATION 2024 - 2030 (tCO_2/YR)
CNO for Electricity Generation for UNELCO Concession Area	$8,125,000	52.64	34,300	154,350
Solar PV and Battery Storage for VUI Mini Grids	$2,500,000	3,488.40	189	717
Develop a CNO price Stabilization Mechanism	$50,000	N/A	N/A	N/A
Enhance Policy and Legal Framework to Promote RE	$100,000	N/A	N/A	N/A
Solar PV and Battery Storage for VUI Luganville Grid	$3,222,000	N/A	N/A	N/A
TOTAL	$13,997,000	$3,541.04	34,489	155,066

3.0



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INVESTMENT STRATEGY FOR THE ON-GRID ELECTRICITY SECTOR

This section outlines the strategic investment priorities envisioned to expand the penetration of RE into the national electricity generation mix, that would enable better progress for Vanuatu towards achieving its 2030 VNDC target. Accordingly, the twofold strategic focus would be, first, the policy/legislative framework, and second, the choice of technologies feasible to make it achievable within the remaining timeframe. Hence, given that 80% of Vanuatu's total electricity is produced within on-grid areas, of which 80% is currently generated by diesel, the most reasonable and effective solution is to focus this NDC investment strategy on the on-grid generation to expedite the shift from diesel generation to RE sources. Furthermore, since the Port Vila Electricity Concession is the largest on-grid electricity network in the country, which produces 80% of the national electricity output, largely from diesel generators, this investment plan will focus largely on upscaling the RE penetration in this concession with the use of the most relevant, technically and financially feasible technology sources. Therefore, the concept notes developed as part of this strategy will focus largely on the Port Vila Concession , the four mini-grids on the islands of Ambae and Vanua Lava to switch from currently used diesel generators to RE as the main power sources, and generation efficiency for Luganville to maintain its uptake of RE sources in the generation mix as included in the BAU scenario.

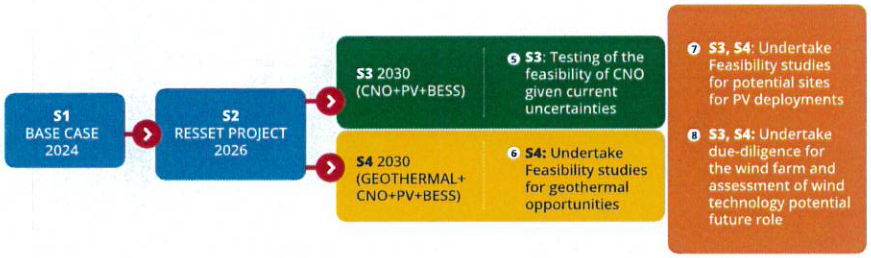
This strategy excludes any RE technology sources which are deemed to be technically and financially infeasible to implement within the remaining timeframe of the NDC. However, consideration for other RE technologies are also highlighted to supplement CNO generation and solar PV, especially in the Port Vila concession. These also include geothermal which GoV envisions as a potential energy source to supplement the Port Vila generation mix in the long run. Hence, the GoV needs funding support to cover the cost of exploration which will determine the actual cost of capital investment.

The pathway to achieving the 2030 VNDC target of close to 100% RE is discussed in the ensuing subsections.

3.1 MITIGATION OPPORTUNITIES

The Planning Frameworks and Capacity Expansion modelling tools for Vanuatu was developed by the University of New South Wales and sponsored by the Australian Department of Foreign Affairs and Trade, whereby the capacity expansion modelling tool was handed over to the MoCC in July 2024. As part of the planning framework, the project identified pathways to achieving the 100% RE generation for Port Vila with the largest diesel generation in Vanuatu. This is displayed in Figure 8 below.

Figure 8: *Determined Port Vila Pathways to Achieve 100% RE Generation*



Source: UNSW

The identified pathways consider the BAU for Port Vila and branches out to consider feasible RE technology mixes with the dominant RE technology to meet baseload demand being CNO and geothermal opportunities. Intermittent RE technology includes Solar PV and battery storage, and windmill.

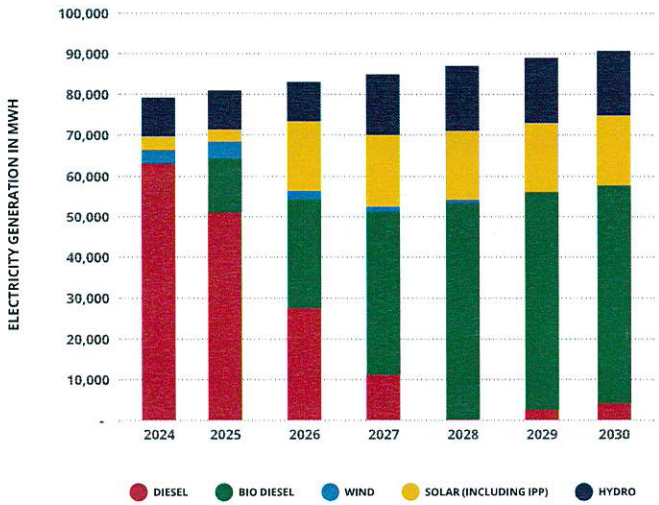
There are two key scenarios (S3 and S4), one with Geothermal and one without Geothermal, however both include CNO and solar PV and battery storage with consideration for wind technology with the relevant assessment conducted.

3.2 PRIORITIZING THE MITIGATION OPPORTUNITIES

Whilst Vanuatu places emphasis on the use of RE and has prioritized it as one of the mitigating measures for achieving its VNDC targets, unfortunately, past articulated pathways were overly ambitious with no commitments and backing from the stakeholders nor is there strong oversight to ensure planned investments are implemented to expedite progress towards achieving the national target. Therefore, this effort could be further strengthened and supported by a national RE strategy with accompanying legislative inputs that sets minimum requirements for RE usages in Vanuatu. The RE Policy should promote RE technologies that are most relevant and feasible to utilize in Vanuatu. The document should also define the role of each stakeholder, and their contributions towards ensuring that Vanuatu is able to achieve and maintain its status as a carbon free electricity market. The accompanying legislative input should consider either the review of the Electricity Supply Act or formulation of a new legislation to set minimum RE requirement utilization. A concept is being formulated as part of this strategy for the development of the National Renewable Energy Strategy and the legislative formulation.

This investment strategy narrows down the mitigating priorities to electricity generation sources of Port Vila, on Efate, the Saratamata and Longana mini-grids on the island of Ambae and the Sola and Mosina mini-grids on the island of Vanua Lava, and improving generation efficiency for Luganville grid as it increases its uptake of RE sources. And the selected primed RE technologies are coconut fuel or CNO generation for Port Vila (6.4MW), solar PV with battery storages for the mini grids of Saratamata (150kWp), Longana (120kWp), Sola (120kWp) and Mosina (50kWp), and battery storage (2MW) and Solar PV (2MW) for Luganville. It is highly anticipated that once these RE investments have been approved and implemented over the next four to five years, coupled with those RE technologies already in operations, plus those which have been approved and in the process of being implemented, such as the UNELCO's 3MWp solar PV farm and the MFAT funded RESSET Project solar PV and Battery storage (5MWp) Project on Efate, the 1 MWp for Tanna under the RESSET Project, the next phase of the Sarakata Hydro (1MWp), funded by the Japanese Government, the five Government funded mini-grids on South Malekula, and the planned micro-grids on the island of Pentecost, should place Vanuatu in a better position to achieving close to its100% RE target by 2030. Figure 8 below depicts the anticipated trend of generation mix under this investment strategy, such that by 2030, diesel generation should reduce to 5% compared to 80% in the current national electricity generation mix.

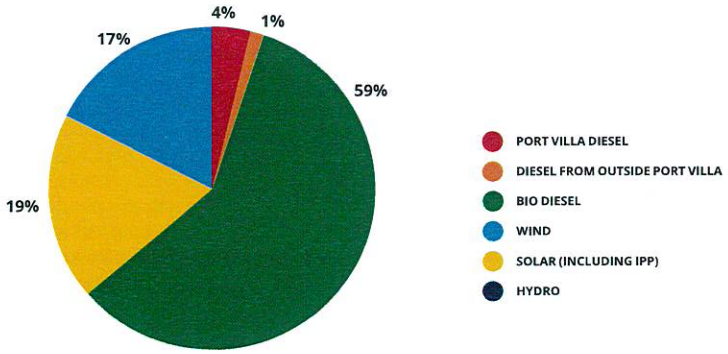
Figure 9: Pipeline Investment Impact on RE Generation 2024 – 2030



Source: URA

To effectively achieve the above RE generation target, it is imperative that planned investments are coordinated with the existing concessionaires, which are UNELCO in Port Vila and VUI, which administers the mini grids in Ambae and Vanua Lava. UNELCO will contribute to determine the specifications of the CNO gensets given the experience with CNO generator operations, whilst VUI will contribute to the generation specifications for the solar PV and Battery storage for these outer islands' mini grids. Figure 10 below presents the on-grid generation mix this strategy aims to achieve by 2030.

Figure 10: Pipeline Investment RE Contribution 2030

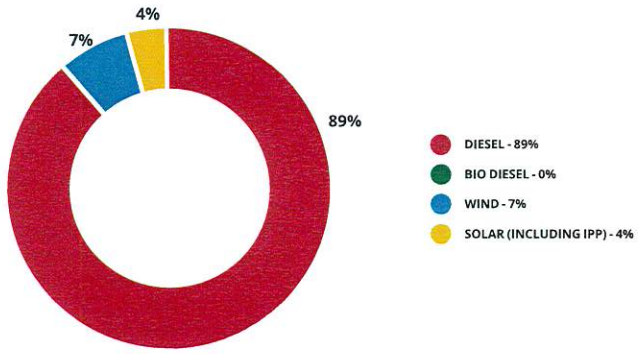


Source: URA

3.2.1 MITIGATION PATHWAY FOR THE PORT VILA ELECTRICITY CONCESSION

The generation mix for the Port Vila concession as of December 2023, as shown in Figure 11 below shows diesel generation remains the largest contributor on the Port Vila's electricity generation mix.

Figure 11: UNELCO's Electricity Generation Mix – December 2023



Source: URA

According to UNELCO, wind energy is expected to gradually phase out during the next few years due to technical limitations on getting spare parts for the wind turbines and therefore UNELCO is not planning to replace any of the failed turbines but will instead use their parts to maintain the functioning ones until they are no longer operational. UNELCO's current plan is to decommission another three wind turbines soon to provide space for installation of the Solar PV system under the RESSET Project.

Therefore, under the BAU scenario without further assessment, this would imply that the only feasible generation options available for the Port Vila grid after the exit of wind energy would be solar PV with battery storage and the reminding larger portion would be contributed by diesel generation.

The planned 3MWp solar PV investment by UNELCO, coupled with the 5MWp solar and battery storage, funded under the MFAT RESSET Project, once completed would contribute an additional 10-11GWh/year in the first years to the Port Vila Electricity generation. According to UNELCO, the 2.5 to 4.3 GWh/year from wind and around 1.7 GWh from the existing grid connected farm (UNELCO & Government) and a potential 1 to 1.5 GWh from rooftop solar (mostly for self-consumption), implies that current RE generation and on-going projects will generate between 17 and 20 GWh/year. Considering a total generation of 62 GWh in 2023 being relatively stable for the next few years (around 1%/year growth), it means Port Vila needs to generate around 42-45 GWh/year of RE to achieved VNDC's targets and CNO may be the only reasonable solution.

Since UNELCO does not currently have the CNO gensets, this strategy calls for investments into 8 CNO gensets over the next four years, at a rate of two gensets of 800kVA each per year. The recommended genset capacity is based on the versatility to operate along with variable RE sources and ability to cope with logistical constraints in Vanuatu. Each genset is expected to use around 1.6 to 1.9 million liters of CNO per year and generate 5.6GWh per year.

The least cost approach to acquiring these gensets is through grant funding, which is the preferred option, through any climate funding sources. However, UNELCO has also indicated their willingness to participate in any co-financing arrangements for purchasing these gensets, should there be insufficient grant funding. This means the portion of UNELCO's investment must be properly accepted and incorporated into the tariff during the next tariff review in 2025. Whether these gensets are fully grant funded or co-financed by UNELCO, it is strongly recommended that UNELCO must define their specifications in order to assure their operational success.

Furthermore, this investment strategy calls for close coordination and better harmonization of RE objectives and usages with the regulatory requirements to address market constraints that could impede the use CNO generation, especially in Port Vila concession.

PRIORITY ACTIONS

1. **The MoCC and Adaptation seeks donor and development partner support to finance the eight (8) 800kVA CNO gensets for Port Vila Electricity.**
2. **UNELCO to provide the technical specifications for the CNO gensets based on experience.**

3.2.1.1 SECURING SUPPLY OF COCONUT FUEL FOR PORT VILA GENERATORS

The anticipated total installed capacity of 6.4MW Crude Coconut Oil (CNO) genset would be phased out at a rate of two gensets per year over a period four years, commencing possibly in 2025, and would consume around 13 to 15 million liters of fuel per year once fully installed. Table 14 below presents the investment plan for the CNO gensets and the expected corresponding volume of coconut oil required. A competitive tendering process would be undertaken to secure the supply of coconut oil by the operator at a reasonable price.

Table 14: *Planned CNO Genset Investments and Coconut Oil Requirements*

Year	INSTALLED NUMBER OF CNO GEN-SETS	INSTALLED CAPACITY (kVA)	CNO REQUIREMENT (MILLION LITERS)	COPRA REQUIREMENTS (TONS)
2025	2	1,600kVA	3.6	5,933
2026	4	3,200kVA	7.1	11,866
2027	6	4,800kVA	10.7	17,799
2028	8	6,400kVA	14.2	23,732

The current production levels by the two main national millers are as follows; 2 million liters for Vanuatu Basket and 2.16 million liters for Coconut Oil Production Santo Ltd (COPSL). Both millers have confirmed their commitments to expand their milling capacities should a supply contract with UNELCO is secured, hence, the production capacity required to produce the 14.2 million liters of coconut oil per annum is achievable.

Additionally, the current production level of coconut oil is sufficient to meet the required CNO fuel demand if the first two CNO gensets of 800kVA each are installed. Future coconut oil supply for CNO generation is anticipated to increase as millers expand their production capacities to meet the increasing demand from installation of additional CNO gensets.

To further consolidate this effort, it is recommended that the GoV and stakeholders implement the recommendations of the Coconut Oil for Fuel Strategy to address the coconut oil supply issues raised in the report. A proper pricing stabilization mechanism should also be formulated and implemented as soon as possible to ensure long-term security and sustainability of coconut oil supply. Furthermore, this price stabilization mechanism must be able to address the price of copra for local farmers to secure and sustain the supply of copra to local millers.

PRIORITY ACTIONS

1. **The DoE in partnership with Department of Commerce and Industry, Department of Finance and Treasury, the URA, Utility operators, especially UNELCO and the Oil Millers formulate a framework and implementation arrangements for a national coconut oil price stabilization mechanism.**
2. **The DoE submits the final draft of the Coconut Oil for Fuel Strategy for Council of Ministers approval.**
3. **Government and stakeholders implement the recommendations of the Coconut for fuel strategy to secure supply of copra and coconut oil for electricity generation.**

3.2.2 MITIGATION PATHWAY FOR AMBAE AND VANUA LAVA MINI-GRIDS

The three mini-grids on the island of Ambae produced a combined capacity of 149kWh in 2023, generated mainly from diesel fuel. One of the grids, Lolowai, now operates fully on solar PV and battery storage, whilst the Saratamata and Longana grids are operated 100% on diesel gensets. Likewise On the island of Vanua, the two mini grids combined produce 76kWh based on 2023 generation figures, from 100% diesel generators.

These five mini grids were originally installed with CNO generators, together with mini copra crushing mills for coconut fuel, funded by the European Union, and were originally operated by UNELCO when it was then operating the Luganville Electricity Concession. Unfortunately, the generators are no longer working due to coconut fuel supply constraints and lack of technical skills to operate and sustain these machines. Consequently, the CNO gensets are now replaced with diesel gensets that were proven to be more effective and efficient means of generation.

The Lolowai mini-grid diesel generation is now replaced by solar PV and battery storage, after an upgrade was made to the solar PV with added battery storage, originally used to power a now degraded desalination system, funded by the Japanese Government. The diesel genset still provides backup generation to the grid.

This strategy calls for the conversion of the remaining four mini grids to solar PV and battery storage. The proposed installed capacity for each mini-grid and related cost is shown in Table 15 below. Note that the breakdown provided below does not include the additional grid enhancements required to efficiently supply electricity service by connecting the Mini grids on Ambae and Vanua Lava with extension lines which has been estimated to cost US$ 616,000, and any additional feasibility study at an estimated US$ 125,000.

Table 15: Capacity Requirements on VUI Mini-Grids

MINI-GRID	SOLAR PANELS CAPACITY	BATTERY STORAGE CAPACITY	INVERTOR CAPACITY	ESTIMATED COST IN US$
Saratamata, Ambae	150kW	960kWh	50kW	$700,000
Longana, Am-bae	120kW	450kWh	50kW	$450,000
Sola, Vanua Lava	120kW	450kWh	50kW	$450,000
Mosina, Vanua Lava	50kW	195kWh	25kW	$159,000

Source: VUI

Total customer connections for all four mini grids combined is around 232 customers, therefore any capital investments undertaken by the concessionaire alone will see a subsequent spike in the tariff for all VUI customers due to their low customer base, which are mostly small domestic users. Under VUI's current tariff structure, these outer service mini grids' customers are heavily subsidized by Luganville customers. Hence, any investment undertaken by the operator alone would negatively impact on its tariff.

Therefore, the most reasonable and least cost approach is to utilize climate grant funding. Accordingly, it is recommended that the GoV prioritizes these four mini-grids under any existing and future climate funding opportunities to facilitate their transitions. The investments will therefore focus largely on the generation of the existing networks. The advantage of choosing these sites is that they are already operated by an experienced utility company, as opposed to new rural sites.

Past experiences in the country on rural mini-grids investments have shown that unless the administrators of the grids have the technical and financial capacities, with right personnel skills set to manage the systems, these systems are prone to mismanagement and poor maintenance and therefore put at risk the long-term sustainability of these investments.

It is recommended that Government considers the Solar PV and batteries investments for these 4 mini-grids under the current GCF SAP Project Proposal, *"Leveraging the National Green Energy Fund to Achieve Rural Electrification in Vanuatu"*, Component 2 of the proposal which focuses on mini-grid investments. Other grant funding opportunities could also be considered.

3.2.3 MITIGATION PATHWAY FOR LUGANVILLE GRID

In the BAU, Luganville grid will be expanding the existing hydro capacity by 1MW and is experiencing an uptake of electricity customers with grid tied rooftop solar PV systems which has the effect of increasing the utility's spinning reserve. Currently, VUI has identified 38 electricity customers with grid tied rooftop solar PV systems and it is expected that these numbers may increase over time as there is a clear incentive to invest in rooftop solar PV systems excluding batteries and utilize the grid as backup. These solar PV rooftop setups shorten the recovery time of private investments made by electricity customers.

To ensure generation efficiency is maintained and a reliable electricity service is provided by VUI to Luganville electricity customers as well as keep Luganville grid on the path to achieving 100% of its electricity generation from RE sources, it is recommended that the following battery storage and solar PV system as shown in Table 16 be installed in Luganville.

Table 16: Capacity Requirements for Luganville Grid

GRID	SOLAR PANELS CAPACITY	BATTERY STORAGE CAPACITY	INVERTOR CAPACITY	ESTIMATED COST IN US$
Luganville	2MW	2MW	1MW	$3,122,000

Source: VUI

As VUI operates the Luganville electricity concession, like the mitigation pathway for Ambae and Vanua Lava, the financing is to be sourced from climate funds by way of a grant to limit the impact on VUI electricity tariffs. Furthermore, given the technical expertise readily available with VUI, it is preferred that the most cost-effective approach to installing the proposed battery storage and solar PV system is by utilizing the utility. This will also allow better management of the investment once installed as operation and maintenance can be carried out by VUI having knowledge of the system inplace that will guarantee the sustainability of the system.

It is recommended that Government considers the Solar PV and batteries investments for VUI Luganville grid utilizing climate funds that provide grants and other grant funding opportunities.

3.3 FINANCING PATHWAY FOR INDIVIDUAL MITIGATION OPPORTUNITIES

While there are ongoing efforts in the RE space to mobilize funding for investments on mitigating priorities, however, there is space for improvement in the sphere of stakeholder engagement and support, and the need for better alignment of funding opportunities towards national strategic priorities.

Hence, the DoE and the MoCC continue to lead bilateral discussions and negotiations, seeking support from all relevant stakeholders, including the development partners and donor organizations to streamline investment priorities and to ensure there is optimal utilization of any available funding opportunities.

The mitigation investment process is shown in Figure 8 below for the on-grid electricity sector, noting from the process the importance of strong stakeholder engagement and support to ensure successful outcome of the investments and their longevity.

Figure 12: Mitigation Investment Process

Since the proposed investments will be implemented within the existing electricity concessions, the investment pathway calls for strong GoV and development partner- engagements with the utility operators, namely, UNELCO, and VUI for the design and the technical specifications of the CNO gensets and the solar PV and battery storage systems, respectively. Furthermore, the URA's inputs will be also required as these investments will ultimately affect future tariffs for both concessions.

The ongoing bilateral discussions by the MoCC with development partners will assist in determining the various funding sources which may be available in the climate finance space, plus to determine whether there is need for co-financing by local partners. Should the investments require co-financing from the operators, the operator's financial contributions will need to be factored in future tariff settings, for both concessions. The details of the financing arrangements will be provided in the actual project proposals for donor partner consideration.

The funding requirements for the prioritized activities under this NDC investment strategy are presented in Table 17 below.

Table 17: *Funding Requirements for the Prioritized NDC Activities/Investments*

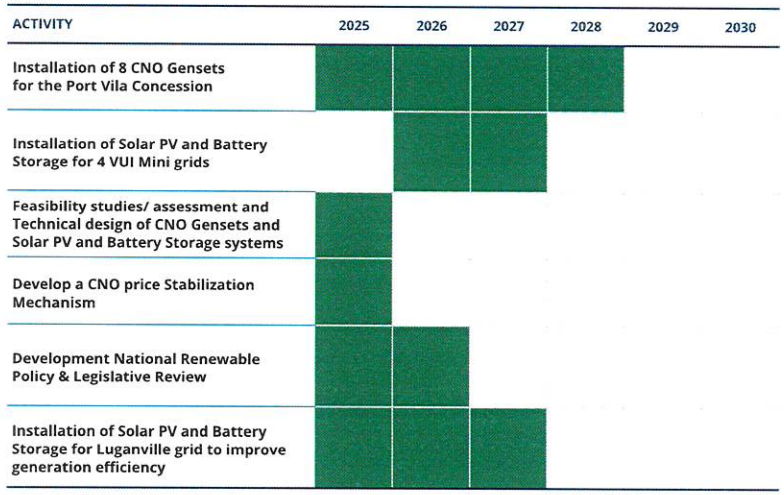
ACTIVITY	TOTAL COST (US$)	FUNDING REQUEST (US$)
Installation of 8 CNO Gensets for the Port Vila Concession and Feasibility studies/ assessment and Technical design of CNO Gensets	$8,125,000.00	$8,100,000.00
Installation of Solar PV and Battery Storage for 4 VUI Mini grids and Feasibility studies/ assessment and Technical design of Solar PV and Battery Storage systems. Including required grid enhancements	$2,500,000.00	$2,475,000.00
Develop a CNO price Stabilization Mechanism	$50,000.00	$50,000.00
Development National Renewable Policy & Legislative Review	$100,000.00	$100,000.00
Installation of Solar PV and Battery Storage for Luganville grid to improve generation efficiency and Feasibility studies/ assessment and Technical design of Solar PV and Battery Storage systems	$3,222,000	$3,222,000
TOTAL	$13,997,000	$13,872,000

3.4 CONSOLIDATED FINANCING PATHWAY

The expected timeframe for implementing the prioritized investment activities under this Investment strategy is five years. However, the immediate challenge is to identify donors who are willing to fund these investments, preferably through grant funding. The funding option could also consider co-financing options from the operators, in situations where grant funding is limited.

Table 18 presents the indicative timeline for implementation of the prioritized project activities.

Table 18: *Project Implementation Timeframe*



3.4.1 MONITORING AND EVALUATION FRAMEWORK

As these investments will be implemented within the existing concession framework, the monitoring and evaluation of these investments could naturally fall under the mandate of the regulator, which requires operators to submit quarterly and annual technical and financial data. This information is then compiled into monthly and annual reports and published by the URA.

The URA Five Years Strategic and Action requires the Authority to align its regulatory and reporting requirements with Vanuatu's National Sustainable Development Plan, and the NERM, which also capture the Vanuatu NDC obligations and targets. The on-grid consolidated report on RE generation is then published regularly by the Authority for access by GoV, development partners and the wider public audiences.

3.4.2 PROMOTING GENDER AND SOCIAL INCLUSION

The domestic users of electricity services are mostly women and children, who are actively involved in household chores and family business which uses electricity. Port Vila electricity concession has the largest number of electricity customers in the country, implying that a good portion of the women in Vanuatu will have access to clean and reliable electricity service. There are also pockets of disable, elderly and other vulnerable group who have access to clean energy as a result of this investment.

For Saratamata, Longana, Sola and Mosina, their electricity services are currently only available for less than 13 hours per day, due to the high cost of fuel and maintenance. Replacing these systems with a solar based RE system, plus storage would enable their customers to access 24-hour electricity services. This means businesses and households would have longer hours of operations and access to power which would enable them to participate in other business opportunities, such as sewing for women and children would have longer hours of studying.

The regulator could also introduce gender and social inclusion indicators as part of regulatory reporting requirements. This may include reporting on number of female workers at employed by each operator, and number of female workers who hold senior positions at each institution.

3.4.3 SAFEGUARDING THE ENVIRONMENT

Environmental safeguards are paramount to any project development in this modern age. These assessments should be part of the feasibility studies and assessment conducted during the early stage of the project. Any environment related impacts or risks at each project site are identified early in the project and remedial actions are formulated and implemented to minimize negative impacts.

3.5 NEEDS FOR FINANCIAL INSTRUMENTS AND POTENTIAL FUNDING SOURCES

According to current budget estimates, the investment strategy requires an amount of US$10,159,000.00 to complete the NDC prioritized investments/activities. Vanuatu's energy sector has attracted a number of climate funding in the past which focused RE in off-grid areas of the country. However, given Vanuatu's current push in the global arena on climate agendas, and given its highly vulnerability status to natural disasters, there are high chances that additional grant funding be made available to fund these investments. A list of possible funding agencies is drawn up in Table 19 below.

Table 19: *International and Local Funding Sources*

DONOR/DEVELOPMENT PARTNER AGENCY	TYPE OF FUNDING SUPPORT	NATURE OF AGENCY
Green Climate Fund	Grants, equity, soft loan, technical assistance, capacity building support	Climate related funding
Global Environmental Facility	Grants, technical assistance, capacity building support	Environment dedicated funding
New Zealand Ministry of Foreign Affairs and Trade (MFAT)	Bilateral ODA Grants	Bilateral agency
Japanese International Cooperation Agency	Bilateral ODA Grants	Bilateral agency
Australian Department of Foreign Affairs and Trade	Bilateral ODA Grants	Bilateral agency
United Nationals Development Program	Grants, technical assistance, capacity building support	UN agency
World Bank	Grants, technical assistance, capacity building support, soft loan financing	Multilateral
Asian Development Bank	Grants, technical assistance, capacity building support, soft loan financing	Multilateral
Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ)	Bilateral ODA grants	Bilateral
Global Green Growth Institute	Technical Assistance	Inter-governmental
European Union	Multilateral ODA Grants	Bilateral agency
Internationl Solar Alliance	Technical assistance and, and grants	Bilateral agency

GOVERNMENT/REGULATORY AGENCY SUPPORT	TYPE OF FUNDING SUPPORT	NATURE OF AGENCY
Department of Energy	Technical support	Government
Utilities Regulatory Authority	Technical and grant	Regulator

PRIVATE SECTOR SUPPORT	TYPE OF FUNDING SUPPORT	NATURE OF AGENCY
UNELCO	Technical, and equity In-vestment	Operator
VUI	Technical and equity In-vestment	Operator

PRIVATE SECTOR SUPPORT	TYPE OF FUNDING SUPPORT	NATURE OF AGENCY
National Green Energy Fund	Grant, soft loan	Fund Manager

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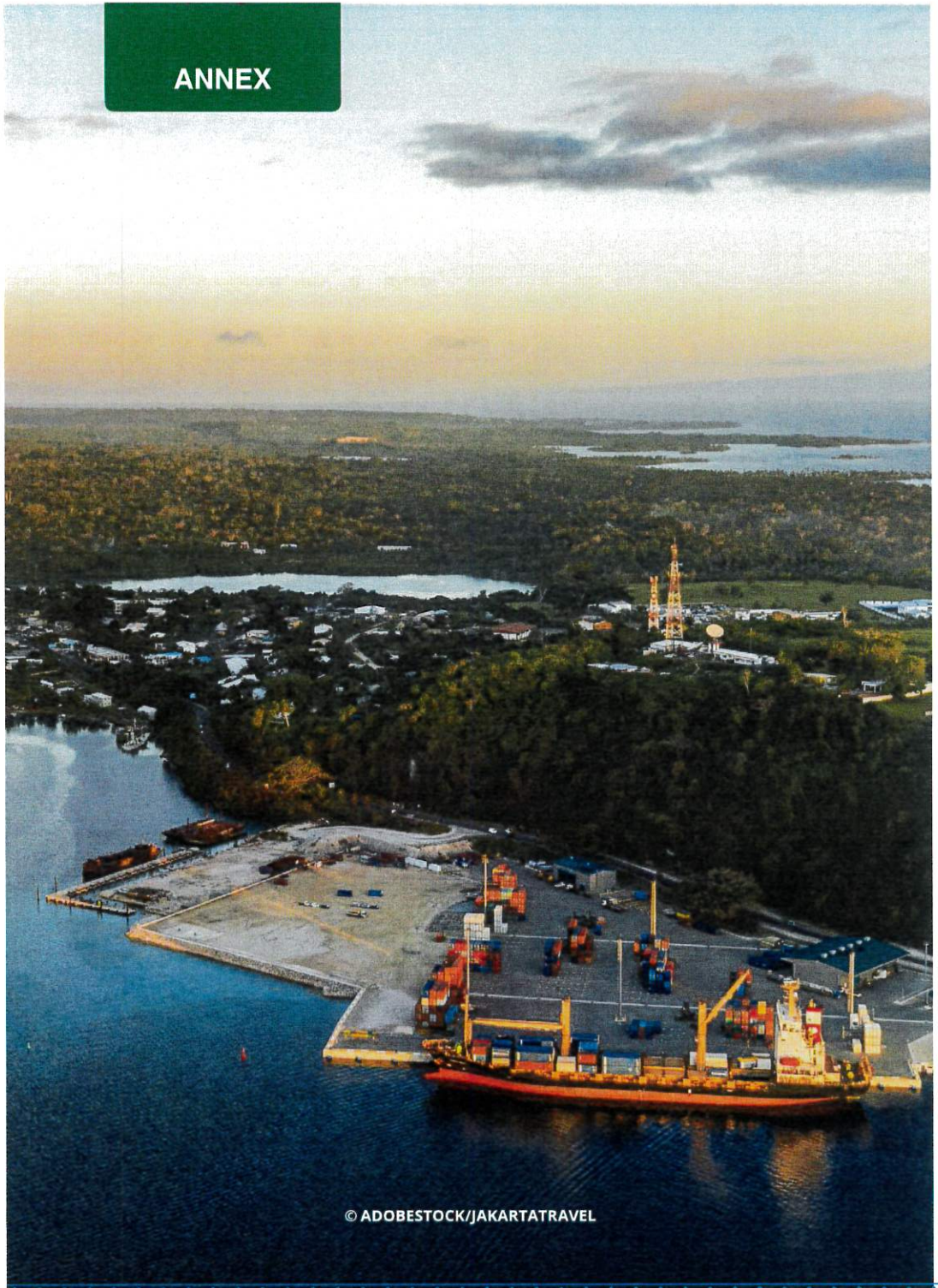
ANNEX



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PROJECT PIPELINE

E1 - COCONUT OIL FOR PORT VILA ELECTRICITY GENERATION

NO.	E1
ACTION NAME	Coconut Oil for Port Vila Electricity Generation
SUB-SECTOR	On-Grid Electricity

DESCRIPTION

Crude Coconut Oil (CNO) has been identified and prioritized as the most effective and feasible Renewable Energy (RE) source for Port Vila where most diesel is utilized for electricity generation and meet the NDC mitigation target of 100% electricity from RE sources by 2030. CNO has also been identified to provide social and economic benefits through providing a lively hood for CNO producers to inject income back into the economy that would otherwise be leaked through diesel imports.

UNELCO has in the past utilized CNO for electricity generation in Malekula up until 2016 and in Port Vila up until 2020. These efforts were discontinued due to the main reasons listed below:

i. Enabling legal and regulatory framework to ensure that tariffs would capture the CNO cost for electricity generation. This includes both investment and operational costs including efficiency measures.

ii. Absence of a price stabilizing mechanism to encourage coconut production for CNO required for electricity generation, and CNO price per litre against diesel price per litre to ensure that electricity tariff remains neutral as usage of CNO for electricity generation increases.

iii. Supply chain risks associated with declining copra production due to aging coconut trees and were subsequently replaced by other cash crops, the reuse of land for other development purposed, and introduction of Coconut Rhinoceros Beetles (CRB) in 2019 on Efate.

iv. Milling capacity required to produce the required quantity of CNO for electricity generation.

Efforts have been made by the Government, UNELCO, URA, donor partners to address the constraints highlighted above. These have been listed below:

- UNELCO in its investment plan 2020 – 2025 had included estimated financing of VT 150M for a CNO genset. However, due to the risk of uncertainty surrounding the supply chain, UNELCO received Government approval to utilize the allocated funding to finance a 3MW solar PV plant in 2024.
- CNO millers have a combined capacity to meet the CNO litres required for electricity generation in the first 2 – 3 years and are willing through their strategic investments plans to increase milling capacity as the country continues to phase out diesel for electricity generation. Each CNO genset requires approximately 1.6 to 1.9 million litres per year versus current CNO total production of 4.16 million litres of per year with the potential to rapidly increase production as demand for CNO in electricity generation increases.
- The Coconut Oil for Fuel Strategy has been developed with financial support from MFAT to reintroduce generation of CNO fuel and risk mitigation measures to address supply chain issues. The document is awaiting Government endorsement. To compliment the coconut oil for fuel strategy, MFAT also funded the feasibility study to confirm the financial, economic, and technical feasibility of CNO for fuel in Port Vila as well as the status of the coconut oil supply and potential to meet CNO demand until 2050. The study highlighted that in 2020, the identified copra produced if utilized for CNO could deliver 18 million litres or 36 Million litres if all coconut were harvested and utilized for CNO.
- Continued collaboration and discussion amongst key stakeholders.

DESCRIPTION

Despite efforts made, a few key constraints remain and are prioritized below:

1. Investment cost: An estimated investment of US$ 8M is required to purchase the 8 gensets, two gensets procured each year over the period 2025 (or earlier) to 2029 with the technical specification suitable for the Port Vila grid as identified by UNELCO. And this investment cannot be financed by UNELCO alone as it would have a negative impact on the tariff. Furthermore, any investment made by the concessionaire would be delayed to 2025 when their tariff is being reviewed by the Government and URA. Therefore, with current logistical constraints, it is expected that operations may begin in 2026 – 2027 which may not be timely to meet NDC mitigation objective of reaching near 100% electricity generation from RE sources by 2030.
2. Price Stabilization Mechanism: a well-defined price stabilization mechanism formulating a detailed description of the mechanisms required to mitigate the risk due to variances in diesel price and CNO price as well as CNO alternative use demand aligned with Vanuatu's legal and regulatory framework. And identify the relevant institutions to manage and implement the stabilisation mechanism. This is further discussed in Activity E2.
3. Efficiency Measures: A specific component of the operational cost is the Heat Rate (HR) which defines the litres required to produce a Kilowatt hour (kWh). The current HR requires adjusting to capture certain efficiency levels present in the current technology available to utilize CNO for electricity generation. This HR can be captured during UNELCO's next round of tariff review that will occur in 2025 and will be addressed by URA.

OUTCOMES

Key primary outcomes:

- Reduce use of diesel for electricity generation in Port Vila.
- Significantly and rapidly increase RE penetration in the electricity generation mix for Port Vila and Vanuatu in general.
- Electricity generated from CNO gensets capable of meeting baseload demand without any battery storage required.
- In the long run, use of CNO provides energy security and lower electricity tariffs for Port Vila.

Key secondary outcomes:

- CNO is produced locally therefore income generated from CNO sales is injected back into the national economy.
- Income benefits from CNO production are experienced at all levels of the supply chain from the farmer producing the copra to the millers milling CNO for electricity generation.
- The increased production of CNO to meet electricity generation need would subsequently increase other by-products including copra meal which is rich animal feed.
- Social benefits experienced as stable demand for CNO supply is established allowing for predictable income from CNO farming improving the livelihoods of coconut farmers.
- Millers are users of electricity and can utilize excess RE generated electricity from grids on Santo and Malekula with hydro. This will generate additional revenue for the concessionaire to reduce the tariff for all electricity customers.

MITIGATION / ADAPTATION POTENTIAL

The mitigation potential is computed utilizing the most recent data published by the International Renewable Energy Agency (IRENA) in its Vanuatu Energy Profile Report. The report had identified that Vanuatu's CO_2 Emission Factor (EF) for electricity and head generation in 2022 is 644 tCO_2/GWh.

- Utilizing the EF, the proposed CNO capacity of 6.4MW is expected to generate approximately 239.7 GWh from 2025 to 2030, therefore with the EF of 644 tCO_2/GWh, the total CO_2 emission reduction with the use of CNO is 154,350.
- The CNO for electricity generation is expected to significantly contribute to increasing RE penetration in the generation mix whereby Vanuatu's BAU results in approximately 65% from diesel has been reduced to only 5% by 2030.

CO-BENEFITS / SDG LINKAGES

Potential direct co-benefits of CNO for electricity generation is SDG 7 of affordable and clean energy.

- CNO for electricity generation is a green source of energy.
- CNO potential to sustain baseload demand allows for it to promote reliable electricity access.
- Reducing reliance on diesel imports offers energy security for Vanuatu.
- Due to limited global supply for diesel, CNO remains an affordable option for electricity generation in the long run allowing for future lower electricity tariffs.

Potential indirect co-benefits of CNO for electricity generation are linked to SDG 8 by providing employment opportunities especially in the rural parts of Vanuatu where coconut is farmed that may increase as CNO electricity generation capacity increases towards 2030.

INVESTMENT NEEDS (US$)

Estimated total investment needed is US$ 8,125,000.

- Total CNO genset capacity required is 6.4MW (8 x 0.8MW) at US$ 1M per CNO genset giving a total capital cost of US$ 8,000,000.
- CNO for electricity feasibility study required estimated at US$ 125,000.

POTENTIAL FINANCING AND NEED FOR FINANCIAL SUPPORT AND/ OR FINANCIAL INSTRUMENTS

- Requested CNO genset funding: US$ 8,000,000
- Requested feasibility study funding: US$ 100,000

POTENTIAL SUPPORTING AND FINANCING PARTNERS / SOURCES

Potential supporting and financing partners sources include but not limited to:

- Green Climate Fund
- Global Environment Facility
- New Zealand Ministry of Foreign Affairs and Trade
- Japanese International Cooperation Agency
- Australian Department of Foreign Affairs and Trade
- United Nationals Development Program
- World Bank
- Asian Development Bank
- Deutsche Gesellschaft fur Internationale Zusammenarbeit
- Global Green Growth Institute
- European Union

IMPLEMENTING AND SUPPORTING ENTITIES / STAKEHOLDERS

Implementing Entity / Stakeholders:

- UNELCO will be responsible for the design and specifications of the gensets. It will also oversee the installation works at the electricity generating site according to its technical grid specifications to ensure an efficient and effective setup.
- The Department of Energy (DoE) on behalf of the Vanuatu Government will be responsible for endorsing any CNO investment contribution from UNELCO as part of its investment plan 2025 – 2030.

Supporting Entity / Stakeholders:

- URA will be responsible for monitoring any UNELCO financed investment according to Investment plan 2025 – 2030. As well as incorporating relevant tariff mechanisms conducive to use of CNO for electricity generation.
- The DoE provides any additional technical support.
- CNO millers will be responsible for continuous supply and timely delivery of coconut oil. They coordinate with coconut farmers to guarantee copra production and supply to meet CNO fuel demand. (further addressed in Activity E2)

GENERAL TIMELINE FOR DEVELOPMENT, FINANCING, IMPLEMENTATION, AND OPERATION

- Any feasibility study required is expected to commence and end in 2025.
- The installation of the first CNO gensets is expected to begin in 2026 (or earlier) and the last installations are expected in 2029 with expectation that 2 CNO gensets a procured and installed each year.

POLICY / PLAN LINK

Policies/Strategies directly linked are listed below:

- Vanuatu's Revised and Enhanced 1st Nationally Determined Contribution Mitigation priority area 1 highlights the country's commitment to achieving close to 100% RE electricity generation by 2030 by replacing diesel with CNO for fuel.
- The Climate Change Disaster Risk Reduction Section 7.5. regarding Low Carbon Development had identified the National Energy Road Map 2016 – 2030 with the Sustainable objective is to achieve 100% of electricity generated from RE sources.
- Vanuatu Coconut Oil for Fuel Strategy address risks/barriers to implementing CNO for electricity generation including assessment of coconut oil supply required for electricity generation.
- Vanuatu National Coconut Strategy 2016 – 2025 ensures that the country maintains its coconut stock.

POTENTIAL BUSINESS MODEL AND FINANCING STRATEGY

The Port Vila electricity tariff may be increased should the investment be done by UNELCO therefore it is preferred that it is a grant funding received from external sources that would limit the impact on the tariff and be aligned with "least cost" requirement under the URA Act.

Given the time lag of 1-2 years for procurement of CNO genset and timeframe remaining to achieve mitigation target, it is preferred that the external funding for at least the first two CNO gensets be available by 2025 to allow for implementation of CNO for electricity generation by 2026.

For any feasibility study that may be required, for the same reason, should be funded through grant funding from external sources or from the Vanuatu Government through the Ministry of Climate Change (MoCC) for 2025.

GAPS & BARRIERS TO IMPLEMENTATION, INCLUDING PROPOSED ENABLING MECHANISMS

Key gaps and barriers:

- Timeliness of external grant funding
- Suitable CNO price stabilizing mechanism
- CNO usage for electricity generation efficiency measures accurately captured in the Port Vila electricity tariff
- Stabilize the CNO supply chain
- Legal framework

Proposed enabling mechanisms:

- MoCC to coordinate with donors and support partners.
- Study on suitable CNO price stabilizing mechanism (Activity E2).
- Agreements between UNELCO, URA, Vanuatu Government regarding Port Vila electricity tariff to incorporate required CNO efficiency measures.
- DoE to coordination with millers, coconut producers, other relevant Government departments.
- Government through the Council of Ministers endorses the Coconut Oil for Fuel Strategy.
- URA, Government and UNELCO to update any required legal framework to accommodate the objective of CNO for electricity generation.

FINANCIAL SUSTAINABILITY

The CNO for electricity generation related cost is sustained through the Port Vila electricity tariff whereby cost associated with the operation and maintenance of the CNO gensets are captured in UNELCO's revenue requirement that is passed by URA to Port Vila electricity customers.

ENABLING, CAPACITY BUILDING AND TECHNICAL ASSISTANCE NEEDS

Given that UNELCO will be operating and maintaining the CNO gensets, the technical capacity will be captured in the utility's operating cost that is captured in the Port Vila electricity tariff.

INFORMATION AND MRV NEEDS	CNO pricing, electricity generation efficiency, downstream costs, investment tracking will be monitored and reported by the URA through the existing regulatory framework.
SUPPORTING REFERENCES	» Vanuatu's Revised and Enhanced 1st Nationally Determined Contribution » The Climate Change Disaster Risk Reduction » Coconut Oil for Fuel Strategy » Vanuatu National Coconut Strategy 2016 – 2025 » Utilities Regulatory Act No. 11 of 2007 » UNELCO Convention Relating to the Concession for the Generation and Public Supply of Electric Power in Port Vila » UNELCO Specifications Relating to the Concession for the Generation and Public Supply of Electric Power in Port Vila » Electricity Supply Act » UNELCO Report: Coconut oil specific consumption in power generation, comparison to diesel » UNELCO Report: Specific auxiliaries power consumption with the use of Copra oil in the Tagabe Power Station MAN 4 MW genset

E2 - COCONUT OIL PRICE STABILIZATION MECHANISM STUDY

NO.	E2
ACTION NAME	Coconut Oil Price Stabilization Mechanism Study
SUB-SECTOR	On-Grid Electricity
DESCRIPTION	The Vanuatu Business As Usual (BAU) projection to meet the Nationally Determined Contribution (NDC) priority of achieving 100% electricity generation from Renewable Energy (RE) sources by 2030 shows that Vanuatu would most likely only achieve approximately 34% with the remaining generation from diesel of which 63% is estimated to come from Port Vila concession area operated by UNELCO. Given the lack of cost-effective RE technology options available for Port Vila, the fastest and most cost-effective approach to increase RE generated electricity is to utilize Crude Coconut Oil (CNO) for electricity generation. The required CNO gensets would increase RE penetration in the generation mix to approximately 95% for Vanuatu by 2030. Aside from comparative technological advantage over other RE technologies whereby the electricity generated can sustain base load demand, it is a technology tried and tested by UNELCO in the past and utilized for electricity generation at their Tagabe Port Vila station up until 2020. Furthermore, since coconut oil is produced locally, there are positive social impacts as CNO contributes to increased and stable income for rural coconut farmers when compared to imported diesel, and it is environmentally friendly. There are a few challenges to utilization of CNO for electricity generation that has led to UNELCO discontinuing its use in 2020. These challenges have been addressed by relevant stakeholders which include the URA, UNELCO, Department of Energy (DoE), CNO millers, and other relevant Government Departments. These challenges and associated risks have also been highlighted in the New Zealand Ministry of Foreign Affairs and Trade funded feasibility study for Vanuatu Coconut Oil for Fuel and the Strategy in 2023. And through collaborations between the stakeholders, there has been consensus on approaches to mitigate these risks. A priority risk yet to be addressed is the financial feasibility due to price variations between international and domestic for CNO and the price variation between diesel and CNO, therefore given the least cost approach as required under the URA Act for electricity generation, the price stabilization mechanism plays a significant role in ensuring CNO for electricity generation is supplied at least cost. Therefore, a Price Stabilization Mechanism Study is required to arrive at a feasible Price Stabilization Mechanism (PSM) able to utilize the existing institutions and legal framework for its implementation, monitoring and evaluation allowing for an accelerated achievement of the NDC mitigation priority of 100% RE generated electricity by 2030. The PSM will also incentivize sufficient CNO production to meet electricity generation requirements.
OUTCOMES	**Key primary outcomes:** » Contribute to the reduction of electricity generation from diesel and meeting the NDC mitigation target of 100% RE electricity generation by 2030. » The PSM would ensure coconut farmers are incentivized to farm coconut for CNO and incentivize millers to supply CNO to UNELCO required to generate electricity by providing sufficient income to coconut farmers and return on investment for millers and its employees in country contributing to increasing their overall welfare and the economy at large. **Key secondary outcomes:** » Creation of a domestic market for coconut oil that can continue to grow as requirement for CNO supply for electricity generation grows. This may also boost alternative use of CNO for export purposes. » Provides affordable electricity tariff for Port Vila in the long run as diesel prices are expected to increase over time. » Provide energy security for Vanuatu in the long run.

MITIGATION / ADAPTATION POTENTIAL	The mitigation potential is captured in Activity E1 as this activity compliments the CNO for electricity generation.
CO-BENEFITS / SDG LINKAGES	The PSM enables CNO for electricity generation with potential direct co-benefits of addressing SDG 7 of affordable and clean energy. » CNO for electricity generation is a green source of energy. » CNO potential to sustain baseload demand allows for it to promote reliable electricity access. » Reducing reliance on diesel imports offers energy security for Vanuatu. » Due to limited global supply for diesel, CNO remains an affordable option for electricity generation in the long run allowing for future lower electricity tariffs. The PSM co-benefits are also linked to SDG 8 by providing sustained employment opportunities especially in the rural parts of Vanuatu where coconut is farmed that may increase as CNO electricity generation capacity increases towards 2030.
INVESTMENT NEEDS (US$)	The CNO for electricity generation PSM study is estimated at US$ 50,000
POTENTIAL FINANCING AND NEED FOR FINANCIAL SUPPORT AND/ OR FINANCIAL INSTRUMENTS	Requested PSM study financing: US$ 50,000
POTENTIAL SUPPORTING AND FINANCING PARTNERS / SOURCES	**Potential supporting and financing partners sources include but not limited to:** » Green Climate Fund » Global Environment Facility » New Zealand Ministry of Foreign Affairs and Trade » Japanese International Cooperation Agency » Australian Department of Foreign Affairs and Trade » United Nationals Development Program » World Bank » Asian Development Bank » Deutsche Gesellschaft fur Internationale Zusammenarbeit » Global Green Growth Institute » European Union
IMPLEMENTING AND SUPPORTING ENTITIES / STAKEHOLDERS	**Implementing Entity / Stakeholders:** » UNELCO » CNO Millers » PSM fund manager **Supporting Entity / Stakeholders:** » URA will be responsible for monitoring the implementation of the PSM to ensure that CNO received is least cost as per the URA Act or agreement between the Government and UNELCO. » Relevant Government institutions identified as part of the PSM study.
GENERAL TIMELINE FOR DEVELOPMENT, FINANCING, IMPLEMENTATION, AND OPERATION	The PSM should be developed prior to the use of CNO for electricity generation that is estimated to commence by 2026, therefore the expected timeline to complete the PSM study is by 2025 and ready for implementation.

POLICY / PLAN LINK	**Policies/Strategies directly linked are listed below:** » Vanuatu's Revised and Enhanced 1st Nationally Determined Contribution Mitigation priority area 1 highlights the country's commitment to achieving close to 100% RE electricity generation by 2030 by replacing diesel with CNO for fuel. » The Climate Change Disaster Risk Reduction Section 7.5. regarding Low Carbon Development had identified the National Energy Road Map 2016 – 2030 with the Sustainable objective is to achieve 100% of electricity generated from RE sources. » Vanuatu Coconut Oil for Fuel Strategy address risks/barriers to implementing CNO for electricity generation including assessment of coconut oil supply required for electricity generation. » Vanuatu National Coconut Strategy 2016 – 2025 ensures that the country maintains its coconut stock.
POTENTIAL BUSINESS MODEL AND FINANCING STRATEGY	The PSM study is expected to be financed, if possible, within 2024 to ensure it is completed by 2025 and preparations required for its implementation are carried out prior to CNO use for electricity generation, expected to rollout by 2026.
GAPS & BARRIERS TO IMPLEMENTATION, INCLUDING PROPOSED ENABLING MECHANISMS	**Key gaps and barriers:** » Timeliness of external grant funding for the CNO gensets and PSM study. » CNO usage for electricity generation efficiency measures accurately captured in the Port Vila electricity tariff. » Stability of the CNO supply chain. » Legal framework. **Proposed enabling mechanisms:** » Ministry of Climate Change to coordination with donor and support partners for required funding. » Agreements between UNELCO, URA, Vanuatu Government regarding Port Vila electricity tariff to incorporate required CNO efficiency measures. » DoE to coordination with millers, coconut producers, other relevant Government departments. » Government through the Council of Ministers endorses the Coconut Oil for Fuel Strategy. » URA, Government and UNELCO to update any required legal framework to accommodate objective of CNO for electricity generation.
FINANCIAL SUSTAINABILITY	» The PSM fund required to implement the PSM is expected to be sustained from multiple sources of funds including donors, Government, carbon credits and other green funds. » The PSM fund management is to be incorporated into a national institution with similar roles and responsibilities ensuring its implementation can be sustained as part of the institution's operational budget. » The PSM implementation cost is captured by UNELCO and Millers as part of their operations for utilization of CNO for electricity generation. » Monitoring of the PSM by the URA is part of their regulatory functions to ensure recovery of UNELCO's relevant CNO costs through the Port Vila electricity tariff.
ENABLING, CAPACITY BUILDING AND TECHNICAL ASSISTANCE NEEDS	The implementing and supporting entities contain the relevant technical capacity to implement and monitor the PSM. However, the PSM study may identify relevant technical assistance needs for other institutions indirectly linked to the implementation and monitoring of the PSM.
INFORMATION AND MRV NEEDS	The PSM will be monitored and captured in URA's monthly tariff adjustment reporting by UNELCO to allow for certain cost recoveries through the Port Vila electricity tariff.

SUPPORTING REFERENCES

- Vanuatu's Revised and Enhanced 1st Nationally Determined Contribution
- The Climate Change Disaster Risk Reduction
- Coconut Oil for Fuel Strategy
- Vanuatu National Coconut Strategy 2016 – 2025
- Utilities Regulatory Act No. 11 of 2007
- UNELCO Convention Relating to the Concession for the Generation and Public Supply of Electric Power in Port Vila
- UNELCO Specifications Relating to the Concession for the Generation and Public Supply of Electric Power in Port Vila
- Electricity Supply Act
- UNELCO Report: Coconut oil specific consumption in power generation, comparison to diesel
- UNELCO Report: Specific auxiliaries power consumption with the use of Copra oil in the Tagabe Power Station MAN 4 MW genset

E3 - SOLAR PV AND BATTERY SYSTEM FOR AMBAE AND VANUA LAVA MINIGRIDS

NO.	E3
ACTION NAME	Solar PV and Battery System for Ambae and Vanua Lava Minigrids
SUB-SECTOR	On-Grid Electricity
DESCRIPTION	Vanuatu Utilities and Infrastructure Limited (VUI) in 2019 has been awarded by the Vanuatu Government the electricity concession contract for the concession areas of; » Luganville and Port Olry on Santo; » Saratamata, Longana, and Lolowai on Ambae; » Talise on Maewo; and, » Sola and Mosina on Vanua Lava. In February 2024, the Utilities Regulatory Authority (URA) issued its Electricity Tariff Determination allowing for a uniform tariff to be implemented, meaning that the tariff paid be VUI customers in the concession areas are the same. A uniform tariff is mainly to allow for an affordable tariff to be experienced by VUI's electricity customers outside of Luganville when compared to determining a stand-alone tariff for each of VUI's concession areas. The uniform tariff enables Luganville electricity customers to cross-subsidize the cost of electricity service for VUI's other concession areas. And to limit the cost bring cross-subsidized by Lugnaville customers, electricity service for Ambae and Vanua Lava where diesel generation costs are high, electricity service is restricted to certain hours of the day with no electricity service from 9pm to 7am. The uniform tariff implemented by VUI as determined by the URA is for the period 2023 to 2026 and has been increased by 16% to 60.75 VT/kWh due to increased costs to provide electricity service of which 16% is related to capital expenditure that has increased over the last tariff period to account for VUI investments to restore electricity service post tropical cyclone Harold in 2020. Therefore, for the tariff period 2023 to 2026, VUI is to minimize its investments to limit the impact on the tariff. To align VUI with the Nationally Determined Contributions (NDC) mitigation target of 100% of electricity generation from Renewable Energy (RE) sources, on Santo, the Business As Usual (BAU) will result close to 100% of generation from RE sources as the existing hydro capacity will be increased by 1MW by 2027 funded by the Japanese International Cooperation Agency. On Maewo the existing hydro capacity is sufficient to meet electricity demand in 2030 as demand in 2023 only utilizes 5% of the installed capacity's electricity produced. For Vanua Lava and Ambae, due to the limited VUI investment allowed through the tariff, the BAU estimates only 11% of RE generated electricity on Ambae and 100% diesel generated electricity on Vanua Lava. This is estimated to contribute to part of the diesel generated electricity of 1% (excluding Port Vila) by 2030. Apart from Port Vila that will be responsible for 63% of the 65% of diesel generated electricity by 2030 in the BAU scenario (Addressed by activity E1 and E2), the remaining 1% diesel generated electricity can be addressed in part by installing Solar PV systems and Battery Storage Systems (BSS) identified by VUI as the most appropriate RE source for the islands of Ambae and Vanu Lava. These RE sources will be complimented by grid enhancements that will allow for the extension lines to connect the grids on Ambae and Vanua Lava to allow for a efficient set up and also increase electricity access.

OUTCOMES

Key primary outcomes:

- Allow for 100% of electricity generation on Ambae and Vanua Lava to be derived from RE sources and drive Vanuatu towards achieving its NDC mitigation priority of 100% electricity generation from RE sources by 2030.
- Significantly reduce the cost to generate electricity on the islands as diesel generation cost is higher when compared to Luganville.
- Any reduction in diesel cost will allow for a reduction in electricity tariffs that will be experienced by all VUI electricity customers due to the existing uniform tariff.

Key secondary outcomes:

- The proposed RE system will ensure the electricity service can extend to a 24-hour service on Ambae and Vanua Lava.
- Grid enhancements will allow for much efficient set up of the mini grids on Ambae and Vanua Lava as well as increase electricity access.
- Limited electricity service to certain hours of the day on Ambae and Vanua Lava stands as a barrier to increased economic activity. Increasing economic activity can enable income generating activities to increase and improve the social welfare of people living on these islands.
- Water service on the island of Ambae is restricted to hours when electricity service is available as the water pumps require electricity to operate. Allowing a 24-hour electricity service on the island will enable 24-hour water service that will contribute to improving sanitation and wellbeing of households.

MITIGATION / ADAPTATION POTENTIAL

The mitigation potential is computed utilizing the most recent data published by the International Renewable Energy Agency (IRENA) in its Vanuatu Energy Profile Report. The report had identified that Vanuatu's CO_2 Emission Factor (EF) for electricity and head generation in 2022 is 644 tCO_2/GWh.

Utilizing the EF, the proposed Solar PV and BSS will offset current diesel generated electricity totaling 1.112GWh from 2027 – 2030 when the RE system is expected to be operational. This will result in approximately 717 tonne of CO_2 emission reduction in total for the period.

CO-BENEFITS / SDG LINKAGES

Potential direct co-benefits of Solar PV and Battery for electricity generation are linked to SDG 7.

- SDG 7.1 – Access to energy, where the electricity service on the islands of Ambae and Vanua Lava is extended to 24 hours allows for increased reliable access to electricity and may increase electricity customer numbers on the islands as economic activity increases as a result of the 24hour electricity service.
- SDG 7.2 – Renewable energy, where the solar PV and BSS allows for electricity to be generated utilizing a RE source by offsetting current diesel generation by 2030.

INVESTMENT NEEDS (US$)

Estimated total investment needed is US$ 2,500,000.

- Total solar PV installed capacity of 370kWp with required total inverter capacity of 150 kW, and total BSS of 1.8MW. The total investment cost is estimated at US$ 1,759,000.
- Required grid enhancements to ensure RE system operates efficiently is estimated to cost US$ 616,000
- Any feasibility study required prior to installation of the RE source of electricity generation is estimated at US$ 125,000.

POTENTIAL FINANCING AND NEED FOR FINANCIAL SUPPORT AND/ OR FINANCIAL INSTRUMENTS

- Requested Solar PV and BSS funding: US$ 1,759,000
- Requested grid enhancement funding: US$ 616,000
- Requested feasibility study funding: US$ 100,000

POTENTIAL SUPPORTING AND FINANCING PARTNERS / SOURCES

Potential supporting and financing partners sources include but not limited to:

- Green Climate Fund
- Global Environment Facility
- New Zealand Ministry of Foreign Affairs and Trade
- Japanese International Cooperation Agency
- Australian Department of Foreign Affairs and Trade
- Vanuatu National Green Energy Fund
- United Nationals Development Program
- World Bank
- Asian Development Bank
- Deutsche Gesellschaft fur Internationale Zusammenarbeit
- Global Green Growth Institute
- European Union

IMPLEMENTING AND SUPPORTING ENTITIES / STAKEHOLDERS

Implementing Entity / Stakeholders:

- VUI will be responsible for the design and specifications of the solar PV and BSS. It will also oversee the installation works at the electricity generating sites on the islands of Ambae and Vanua Lava according to its technical grid specifications to ensure an efficient and effective setup.

Supporting Entity / Stakeholders:

- URA will be responsible for monitoring the investment and its contribution to reducing diesel for electricity generation through its monthly and annual regulatory reporting requirements.
- The DoE for provide any additional technical support.

GENERAL TIMELINE FOR DEVELOPMENT, FINANCING, IMPLEMENTATION, AND OPERATION

- Any feasibility study required is expected to commence and end in 2025.
- Installation of the solar PV and BSS are expected to be completed by 2027 or sooner depending on logistics.

POLICY / PLAN LINK

Policies/Strategies directly linked are listed below:

- Vanuatu's Revised and Enhanced 1st Nationally Determined Contribution Mitigation priority area 1 highlights the country's commitment to achieving close to 100% RE electricity generation by 2030.
- The Climate Change Disaster Risk Reduction Section 7.5. regarding Low Carbon Development had identified the National Energy Road Map 2016 – 2030 with the Sustainable objective is to achieve 100% of electricity generated from RE sources.

POTENTIAL BUSINESS MODEL AND FINANCING STRATEGY

As per the VUI tariff determination report by the URA, VUI has significantly invested in Luganville to restore electricity service post tropical cyclone Harold in 2020 and currently recovering through the tariff for the tariff period 2023 to 2026 that is one of the contributing factors to increasing its tariff. Therefore, it is preferred that the investment be made through grant funding received from external sources that would limit the impact on the tariff.

Should grant funding be available by 2025, installation of the solar PV including BSS can commence simultaneously on the islands of Ambae and Vanua Lava and be completed by 2027.

Feasibility studies have been carried out by VUI to meet Government policy objective of 100% renewable energy for electricity generation by 2030, therefore any additional feasibility study required to update existing studies should be carried out by 2025 prior to solar PV and BSS installations.

GAPS & BARRIERS TO IMPLEMENTATION, INCLUDING PROPOSED ENABLING MECHANISMS	**Key gaps and barriers:** » Timeliness of external grant funding » VUI available technical capacity to ensure installations are completed by 2027 **Proposed enabling mechanisms:** » URA to allow pass-through of any additional cost required to operate and maintain solar PV, BSS and grid enhancements » URA through the Tariff Adjustment Formula cater for any VUI investment incurred due to support solar PV, BSS and grid enhancement
FINANCIAL SUSTAINABILITY	The solar PV and BSS operation and maintenance costs are to be sustained through the VUI tariff as reviewed and approved by the URA.
ENABLING, CAPACITY BUILDING AND TECHNICAL ASSISTANCE NEEDS	VUI has sufficient technical capacity to ensure all operation and maintenance needs of the solar PV, BSS and grid enhancements are met. The URA has sufficient technical capacity to ensure that relevant costs associated with the solar PV, BSS and grid enhancements are captured in the tariff and monitored.
INFORMATION AND MRV NEEDS	The solar PV, BSS and grid enhancements operation and maintenance and any VUI supporting investment are to be monitored and reported by the URA through the existing regulatory framework.
SUPPORTING REFERENCES	» Vanuatu's Revised and Enhanced 1st Nationally Determined Contribution » The Climate Change Disaster Risk Reduction » Utilities Regulatory Act No. 11 of 2007 » Concession Deed between the Government of the Republic of Vanuatu and VUI – for the generation, transmission, distribution and supply of electricity in parts of the islands of Espiritu Santo, Maewo, Vanua Lava and Ambae » Electricity Supply Act » Case U-0014-23 – In the Matter of VUI's Electricity Tariff Review, February 2024

E4 - NATIONAL RENEWABLE ENERGY POLICY 2030 (NREP 2030)

NO.	E4
ACTION NAME	National Renewable Energy Policy 2030 (NREP 2030)
SUB-SECTOR	Electricity Sector
DESCRIPTION	Whilst Vanuatu places emphasis on the use of Renewable Energy (RE) as one of the mitigating measures for achieving its Vanuatu Nationally Determined Contribution (VNDC) targets, unfortunately, past articulated pathways were overly ambitious with no commitments and backing from the stakeholders nor was there strong oversight to ensure planned RE investments are implemented to enable Vanuatu on track towards achieving its national target. Therefore, it is imperative that the Vanuatu Government formulates and implements a national RE policy which will focus largely on RE technologies that are most relevant and feasible to utilize in Vanuatu. The NREP2030 would define the role of each stakeholder, and their contributions towards ensuring that Vanuatu is able to achieve and maintain its status as a carbon free electricity market economy. It will streamline RE priorities that will enable Vanuatu to achieve its 2030 RE target and articulate funding needs that correspond to prioritized investments. The document should also provide management options based on past experiences on how RE investments can be sustained through reasonable price settings. Furthermore, the RE strategy should also consider the review of the Electricity Supply Act to reflect Vanuatu's commitment to RE, and that there is commitment by electricity concessionaires towards RE investments and should be incorporated into future electricity concession contracts. Lastly, this RE policy could also consider regulatory recommendations and actions for setting minimum standards for importation of RE technologies, more specifically solar PV panels, plug and play solar charged systems and batteries, to curb importation of low-quality solar systems.
OUTCOMES	**Key primary outcomes:** » Phasing out of diesel generation within the main electricity markets in Vanuatu » Clearer RE targets and sources for all electricity concessions within the country. » Better alignment of domestic and external resources towards prioritised RE investments in the country. » Better alignment of Government endorsed concessionaire investments towards RE targets. » Improved regulation on imported RE technologies based on approved minimum standards. » Stronger sense of RE drive and ownership particularly within the on-grid electricity sectors. **Key secondary outcomes:** » Harmonised regulatory framework with national development and climate priorities. » Enforced regulatory standards that enable importation of good quality RE hardware components to Vanuatu, hence, enhancing durability and reducing environment concerns. » Winder economic and environmental benefits from use of clean and sustainable energy sources » Social benefits and gender inclusion and benefits arising from secondary activities relating to RE uses.
MITIGATION / ADAPTATION POTENTIAL	The mitigation potential does not apply to this activity.
CO-BENEFITS / SDG LINKAGES	The National Renewable Energy Policy 2030 will align with SDG 7 of affordable and clean energy. It will also complement the National Energy Road Map and the VNDC objectives and targets, which call for RE generation in Vanuatu to close 100% by 2030. This policy document will furthermore compliment the Vanuatu Electrification Master Plan which is currently being development by setting specific RE targets for the various electricity sectors in Vanuatu.
INVESTMENT NEEDS (US$)	Estimated total funding need for the development of the National Renewable Energy Policy is $100,000.

POTENTIAL FINANCING AND NEED FOR FINANCIAL SUPPORT AND/ OR FINANCIAL INSTRUMENTS

This activity is expected to be executed by a consulting firm, in partnership with the Department of Energy. Given, the budget constraints currently faced by the Department, this undertaking would preferably be financed by grant support from a donor or development partner program.

POTENTIAL SUPPORTING AND FINANCING PARTNERS / SOURCES

Potential supporting and financing partners sources include but not limited to:

- Green Climate Fund
- Global Environment Facility
- New Zealand Ministry of Foreign Affairs and Trade
- Japanese International Cooperation Agency
- Australian Department of Foreign Affairs and Trade
- United Nationals Development Program
- World Bank
- Asian Development Bank
- Deutsche Gesellschaft fur Internationale Zusammenarbeit
- Global Green Growth Institute
- European Union

IMPLEMENTING AND SUPPORTING ENTITIES / STAKEHOLDERS

Implementing Entity / Stakeholders:

- The Department of Energy (DoE) will own and lead the work on the development of the NREP2030.

Supporting Entity / Stakeholders:

- Consulting firm will support the DoE to formulate the draft policy
- URA will be provide support from the regulatory perspective
- The utility operators such as UNELCO, VUI and VANPAWA will contribute- setting RE sources and targets for RE use within electricity concessions.
- Solar vendors will contribute to RE utilization within and outside the concession boundaries.

GENERAL TIMELINE FOR DEVELOPMENT, FINANCING, IMPLEMENTATION, AND OPERATION

This activity is expected to be implemented within a six months' timeframe once funding has been secured.

POLICY / PLAN LINK

Policies/Strategies directly linked are listed below:

- Vanuatu's Revised and Enhanced 1st Nationally Determined Contribution Mitigation priority area 1 highlights the country's commitment to achieving close to 100% RE electricity generation by 2030 by replacing diesel with CNO for fuel.
- The Climate Change Disaster Risk Reduction Section 7.5. regarding Low Carbon Development had identified the National Energy Road Map 2016 – 2030 with the Sustainable objective is to achieve 100% of electricity generated from RE sources.
- Vanuatu Coconut Oil for Fuel Strategy address risks/barriers to implementing CNO for electricity generation including assessment of coconut oil supply required for electricity generation.
- Vanuatu National Coconut Strategy 2016 – 2025 ensures that the country maintains its coconut stock.

POTENTIAL BUSINESS MODEL AND FINANCING STRATEGY

This exercise is most preferably financed by a grant to fund the technical assistance inputs towards development of the document.

GAPS & BARRIERS TO IMPLEMENTATION, INCLUDING PROPOSED ENABLING MECHANISMS

Key gaps and barriers:

- Timeliness of external grant funding
- Proposed enabling mechanisms:
- MoCC's strong collaboration with donor and development partner organisation could identify possible grant support.
- Strong stakeholder support and appetite to foster RE generation within and in off-grid areas of the country.
- National Green Energy Fund (NGEF) is very active in RE space.

FINANCIAL SUSTAINABILITY

The NREP2030 will streamline RE priorities that will enable Vanuatu to achieve its 2030 RE target. It will also articulate funding needs corresponding to prioritized investments. The document should also provide management options based on past experiences on how RE investments can be sustained though reasonable price settings. For electricity concessions and mini-grids, price is set by the URA.

ENABLING, CAPACITY BUILDING AND TECHNICAL ASSISTANCE NEEDS

The draft document will be formulated by technical experts with RE background. The nominated counterparts from the Department of Energy working alongside the TAs on this assignment are expected to enhance their technical capacities and skills on RE strategies and implementation arrangements.

INFORMATION AND MRV NEEDS

The progress on NREP2030 implementation will be at the responsibility of DoE, some of the functions may be delegated to URA to oversee the progress of RE utilization within the concession areas.

SUPPORTING REFERENCES

- Vanuatu's Revised and Enhanced 1st Nationally Determined Contribution
- The Climate Change Disaster Risk Reduction
- National Energy Road Map 2016-2030
- Vanuatu Electrification Master Plan (Draft)
- Coconut Oil for Fuel Strategy
- Vanuatu National Coconut Strategy 2016 – 2025
- Utilities Regulatory Act No. 11 of 2007
- National Electricity Supply Act

E5 - SOLAR PV AND BATTERY STORAGE FOR VUI LUGANVILLE GRID

NO.	E5
ACTION NAME	Solar PV and Battery Storage for VUI Luganville Grid
SUB-SECTOR	Electricity Sector
DESCRIPTION	The Vanuatu Utilities and Infrastructure Limited (VUI) tariff has recently been reviewed and determined by the Utilities Regulatory Authority in January of 2024 for a tariff period starting 2024 and ending in 2026. The revised tariff is a uniform tariff of 60.75 Vt/kWh that is applied throughout all VUI concession areas which include the islands of Santo, Vanua Lava, Ambae, and Maewo. The uniform tariff enables electricity customers with higher levels of consumption to cross-subsidize consumers with lower levels of consumption who are presumed to be from the lower income groups to ensure a reasonable level of affordability is achieved. And since the majority of the high electricity users, mostly business houses, reside in Luganville on Santo, the cross-subsidy burden falls on these customers that has forced a few to resort to alternative sources of electricity generations to meet their needs and lower their electricity cost. These business houses have installed grid tied solar PV rooftop systems without any battery and have relied on the VUI grid as backup with or without informing VUI that has resulted in unplanned power outages and increased the utility's spinning reserve to accommodate sudden high levels of electricity consumption drawn from the grid. The status quo of VUIs operations to accommodate its customers in Luganville can be sustained but inefficiently leading to high generation costs and higher tariffs in the future. Furthermore, the Japanese International Cooperation Agency has agreed to fund the 3rd phase of the Sarakata hydro capacity expansion that will increase the existing hydro electricity generation capacity in Luganville by 1MW in 2027. This will add to Renewable Energy (RE) penetration in the generation mix for Luganville on Santo allowing it to generate close to 100% of its electricity from hydro technology. However, as grid access is increased around Luganville area as well as the area towards Port Olry with the recently completed east coast extension allowing an estimated 2000 households to get access to the grid, electricity demand will increase, rendering production from hydro to be insufficient to meet demand and therefore this excess electricity demand is to be met from diesel generated electricity. The set up will rely on hydro generation to be the primary source of electricity generation with diesel generation for back up when required resulting in lower diesel genset efficiency requiring more liters of diesel to produce the same amount of electricity that will increase VUI's overall generation cost and future tariffs. VUI's generation efficiency due to the incorporation of RE sources being solar PV from customers with grid tied solar PV rooftop systems, and the hydro as the primary source of electricity generation can be addressed by the installation of a Battery Storage System (BSS) and a solar PV system that will reduce the risk of high generation cost leading to high tariffs.
OUTCOMES	**Key primary outcomes:** » Generation efficiency improvement limiting the risk of high generation cost impacting electricity tariff affordability. » Sustain the uptake of RE sources for Luganville electricity generation that will allow it to achieve near 100% of electricity generation from RE sources by 2030. **Key secondary outcomes:** » Improve reliability of the electricity service in Luganville by reducing the unplanned outages because of grid tied rooftop solar PV systems. » Limit the risk of unaffordable tariffs for VUI operated concession areas due to the uniform tariff implemented.
MITIGATION / ADAPTATION POTENTIAL	The mitigation potential does not apply to this activity.

CO-BENEFITS / SDG LINKAGES	The proposed BSS and solar PV will align with SDG7 to ensure access to affordable electricity by reducing generation inefficiency resulting in lower generation costs, allow reliable electricity service by reducing unplanned outages, and sustain electricity generation is from RE sources.
INVESTMENT NEEDS (US$)	The Estimated total funding for the BSS and Solar PV system is US$ 3,222,000. » Solar PV system estimated at US$ 1,622,000 » BSS estimated at US$ 1,200,000 » Inverter at US$ 300,000 » Feasibility Study at US$ 100,000
POTENTIAL FINANCING AND NEED FOR FINANCIAL SUPPORT AND/ OR FINANCIAL INSTRUMENTS	» Requested Solar PV and BSS funding: US$ 3,122,000. » Requested feasibility study funding: US$ 100,000
POTENTIAL SUPPORTING AND FINANCING PARTNERS / SOURCES	**Potential supporting and financing partners sources include but not limited to:** » Green Climate Fund » Global Environment Facility » New Zealand Ministry of Foreign Affairs and Trade » Japanese International Cooperation Agency » Australian Department of Foreign Affairs and Trade » United Nationals Development Program » World Bank » Asian Development Bank » Deutsche Gesellschaft fur Internationale Zusammenarbeit » Global Green Growth Institute » European Union
IMPLEMENTING AND SUPPORTING ENTITIES / STAKEHOLDERS	**Implementing Entity / Stakeholders:** » VUI will be responsible for the design and specifications of the solar PV and BSS. It will also oversee the installation works at the electricity generating sites on Luganville according to its technical grid specifications to ensure an efficient and effective setup. **Supporting Entity / Stakeholders:** » URA will be responsible for monitoring the investment and its contribution to reducing electricity generation cost through its monthly and annual regulatory reporting requirements. » The DoE for provide any additional technical support.
GENERAL TIMELINE FOR DEVELOPMENT, FINANCING, IMPLEMENTATION, AND OPERATION	» Any feasibility study required is expected to commence and end in 2025. » Installation of the solar PV and BSS are expected to be completed by 2027 or sooner depending on logistics.
POLICY / PLAN LINK	**Policies/Strategies directly linked are listed below:** » Vanuatu's Revised and Enhanced 1st Nationally Determined Contribution Mitigation priority area 1 highlights the country's commitment to achieving close to 100% RE electricity generation by 2030. » The Climate Change Disaster Risk Reduction Section 7.5. regarding Low Carbon Development had identified the National Energy Road Map 2016 – 2030 with the Sustainable objective is to achieve 100% of electricity generated from RE sources.

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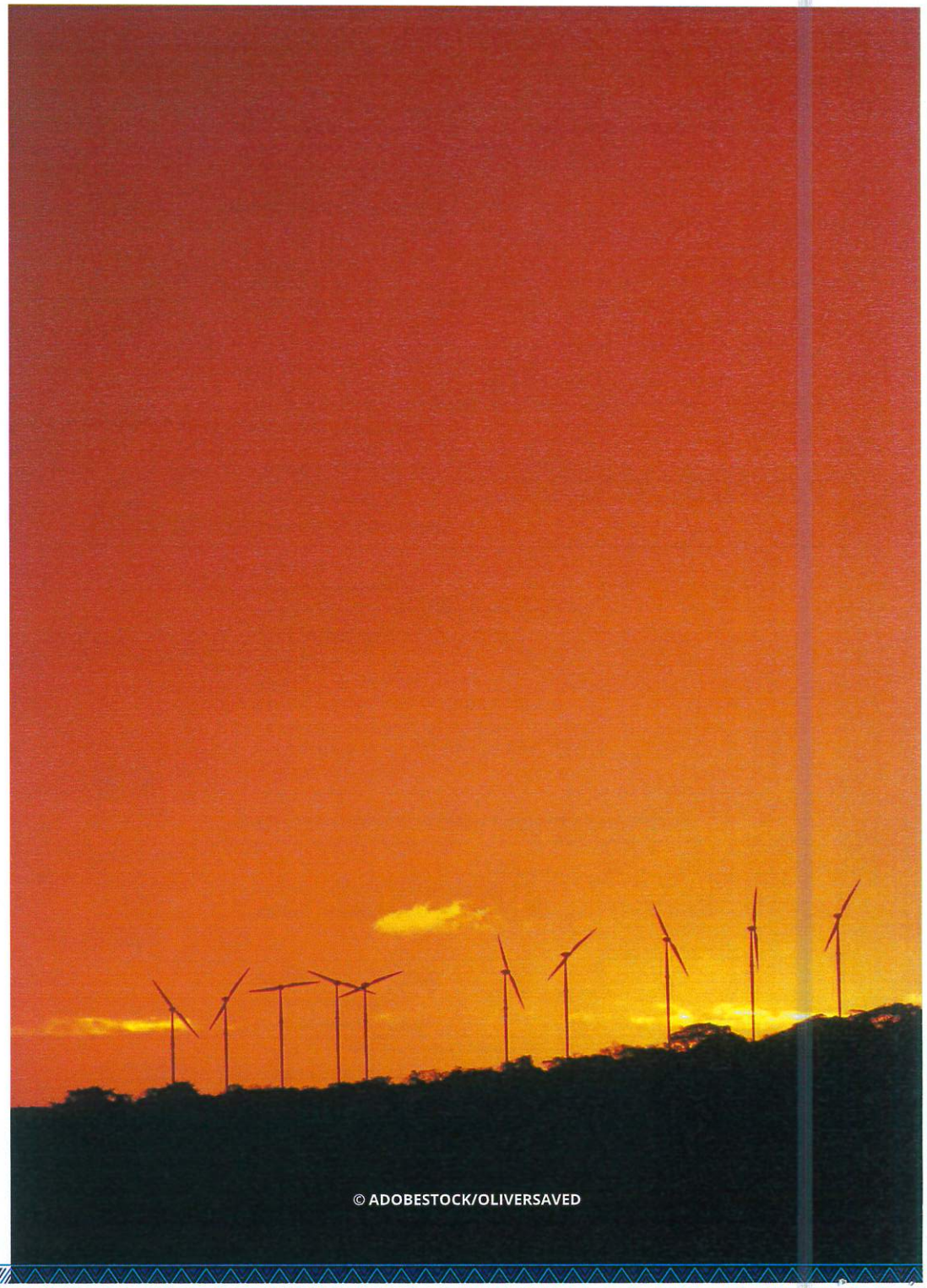
POTENTIAL BUSINESS MODEL AND FINANCING STRATEGY	Due to existing high VUI tariffs and cross subsidy provided by business customers and other high consumers, to limit the impact on tariff that may impact affordability for electricity services for VUI electricity customers, it is preferred that the financing by through grant funding. Grant funding should be provided to VUI to conduct the procurement and installation of BSS and solar PV system as it is the most cost effective approach utilising the existing technical capacity and will guarantee successful integration of the system to the VUI grid ensuring sustainability of the system.
GAPS & BARRIERS TO IMPLEMENTATION, INCLUDING PROPOSED ENABLING MECHANISMS	**Key gaps and barriers:** » Timeliness of external grant funding » VUI available technical capacity to ensure installations are completed by 2027 **Proposed enabling mechanisms:** » MoCC's strong collaboration with donor and development partner organisation could identify possible grant support. » URA to allow pass-through of any additional cost required to operate and maintain solar PV and BSS » URA through the Tariff Adjustment Formula cater for any VUI investment incurred due to support solar PV and BSS
FINANCIAL SUSTAINABILITY	The solar PV and BSS operation and maintenance costs are to be sustained through the VUI tariff as reviewed and approved by the URA.
ENABLING, CAPACITY BUILDING AND TECHNICAL ASSISTANCE NEEDS	VUI has sufficient technical capacity to ensure all operation and maintenance needs of the solar PV and BSS are met. The URA has sufficient technical capacity to ensure that relevant costs associated with the solar PV and BSS are captured in the tariff and monitored.
INFORMATION AND MRV NEEDS	The solar PV and BSS operations and maintenance and any VUI supporting investment are to be monitored and reported by the URA through the existing regulatory framework.
SUPPORTING REFERENCES	» Vanuatu's Revised and Enhanced 1st Nationally Determined Contribution » The Climate Change Disaster Risk Reduction » National Energy Road Map 2016-2030 » Utilities Regulatory Act No. 11 of 2007 » Concession Deed between the Government of the Republic of Vanuatu and VUI – for the generation, transmission, distribution and supply of electricity in parts of the islands of Espiritu Santo, Maewo, Vanua Lava and Ambae » Electricity Supply Act » Case U-0014-23 – In the Matter of VUI's Electricity Tariff Review, February 2024



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