PAPUA NEW GUINEA

HYDRO ENERGY POLICY

2025 - 2030

NATIONAL ENERGY AUTHORITY

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Cover Page Pictures.

Main Picture: Yonki Dam, Eastern Highlands Province
Lower Left: Warangoi Dam, East New Britain Province
Lower Right: Edevu Dam Under Construction, Central Province

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FOREWORD BY THE MINISTER FOR ENERGY

Hon. Peter Namea Isoaimo, MPA, MP
Minister for Energy

As Minister responsible for Energy, it gives me great pleasure and a sense of urgency to present the Hydro Energy Policy as part of the five (5) Subsector Renewable Energy Policies. The other policies are Solar Energy Policy, Geothermal Energy Policy, Wind Energy Policy, and Bioenergy Policy.

It is a culmination of collective visions, ideas and consultation from various government institutions, development partners and the private sector, and all who took part in the development of these renewable energy policies. I am grateful for their invaluable contributions. These policies represent a significant step forward in addressing the pressing energy challenges we face as a nation.

PNG is currently grappling with critical issues surrounding the energy sector and the electricity supply industry. Many communities across our nation that are connected to the main or mini electricity grids continue to experience frequent power outages and inconsistent electricity supply. This hampers economic activities and affect the quality of life of our citizens. The growing demand for electricity, driven by population growth and industrialization, necessitates immediate action to enhance our energy generation capacity and improve our energy infrastructures for adequate and effective electricity supply and distribution to our people and businesses nationwide.

I sincerely thank the Marape/Rosso Government in its wisdom to have enacted the *National Energy Authority Act* 2021 and established National Energy Authority (NEA). NEA is the regulatory body for both the energy sector and electricity supply industry, also responsible for the implementation of the National Electricity Rollout Plan (NEROP) and the National Energy Policy 2017-2027 (NEP). Furthermore, the GoPNG's Medium-Term Development Plan (MTDP) IV highlights twelve (12) Strategic Priority Areas (SPA) of which energy/electricity connectivity is one of the key deliverables for PNG of achieving the target of "middle income" country status.

GoPNG has set targets through its Connect PNG initiative to provide electricity to 70% of households nationwide by 2030 and achieve 100% electrification and household connectivity from renewable energy sources by 2050. Additionally, in line with PNG's commitment to combat climate change and reduce carbon emissions, GoPNG has set a goal to increase our energy generation from renewable sources. As such, the renewable energy policies and related regulations demonstrates the government's genuine effort and priority in rolling out a comprehensive nationwide electricity coverage which is, apart from road infrastructure and communications, the backbone for PNG's economic growth and prosperity. This policy has been meticulously crafted not only pave to way for the legislative reforms but also lay the platform to attract investment within the energy sector.

Finally, I urge all stakeholders from government agencies, private investors, development partners, NGOs, and communities around the country to collaborate in implementing these policies effectively. Together we can build a sustainable future where every Papua New Guinean has access to reliable and affordable electricity that powers their homes and businesses. Thank you and God Bless Papua New Guinea.

HON. PETER NAMEA ISOAIMO, MPA, MP
Minister for Energy

STATEMENT BY THE MANAGING DIRECTOR

Mr. Ronald Meketa
Managing Director
National Energy Authority

Energy is vital for any economy, acting as a catalyst for industrial growth, social development, and overall national progress. Papua New Guinea (PNG) has immense potential for renewable energy generation, given its abundant natural resources. However, our current energy landscape faces significant challenges that require urgent attention. Many communities still lack reliable access to electricity, power outages are frequent, and our reliance on fossil fuels threatens both our environment and economic stability.

As the Managing Director of the Authority, I am honored to announce that the NEA has successfully developed this policy as part of five specifically tailored renewable energy policies. These policies address a significant gap in our current framework and pave the way for the growth of the renewable energy sector. They will complement the regulatory guidelines that have been established, creating a more conducive environment for investment and encouraging greater participation in both the on-grid and off-grid energy spaces.

The importance of these policies cannot be overstated. They are designed not only to increase electricity supply but also to ensure that this supply is reliable, affordable and sustainable. By harnessing our abundant solar, geothermal, hydroelectric, wind, and bioenergy resources, we can create a diversified energy portfolio that meets the growing demands of our population while safeguarding our environment for future generations.

Diversifying our energy sources through renewables will help reduce our dependence on imported fossil fuels. Each policy includes measures aimed at modernising infrastructure and integrating advanced technologies, which will allow for more consistent power delivery. Additionally, the policies outline clear pathways for investment in renewable energy projects that will significantly enhance electricity generation capacity across PNG.

These renewable energy policies and regulations, supported by the Medium-Term Development Plan IV (MTDP IV), reflect the government's commitment to rolling out comprehensive nationwide electricity coverage. This initiative is part of the Connect PNG program, which aims to improve infrastructure and communications to foster economic growth and prosperity.

The electricity grid connectivity rate in Papua New Guinea (PNG) is currently below 20%. It is essential that we address this gap and work collaboratively to achieve our ambitious goal of 70% household connectivity by 2030 and 100% by 2050. These objectives align with the Government of Papua New Guinea's Vision 2050 and the Medium-Term Development Plan IV (MTDP IV), which focus on promoting sustainable development and addressing climate change issues, as outlined in Sustainable Development Goals (SDGs) 7 and 13.

This initiative establishes a foundation for future legislative reforms aimed at attracting investment in the energy sector and promoting economic growth across all sectors of society. It is essential that we work together with local communities, private investors, development partners, and government agencies to achieve these ambitious goals.

Let us work together and move forward united in purpose as we embark on this transformative journey towards a sustainable energy future for PNG.

RONALD MEKETA
Managing Director

ACRONYMS

AI	Artificial Intelligence
CEPA	Conservation and Environment Protection Authority
DLPP	Department of Lands and Physical Planning
DSP	Development Strategic Plan
EIS	Environment Impact Statement
EIR	Environment Impact Report
ESI	Electricity Supply Industry
FPV	Floating Photovoltaic
GHG	Greenhouse Gas
GoPNG	Government of Papua New Guinea
ICCC	Independent Consumer and Competition Commission
IEC	International Electrotechnical Commission
IPP	Independent Power Producer
IPCC	Inter-governmental Panel on Climate Change
ISO	International Organization for Standardization
KCH	Kumul Consolidated Holdings
kW	Kilowatt
MEPS	Minimum Energy Performance Standards
MTDP	Medium-Term Development Plan
MW	Megawatt
NDC	Nationally Determined Contributions
NEA	National Energy Authority
NEC	National Executive Council
NEROP	National Electricity Rollout Plan
NGDP	National Goals and Directive Principles
NISIT	National Institute of Standards and Industrial Technology
PPA	Power Purchase Agreement
PPL	PNG Power Limited
RoR	Run-of-River
SAE	Society of Automotive Engineers
SDG	Sustainable Development Goal
UNFCCC	United Nations Framework Convention on Climate Change
WaSH	Water Sanitation and Hygiene

EXECUTIVE SUMMARY

The Hydro Energy Policy 2025-2030 (HEP) of Papua New Guinea (PNG) aims to harness the country's vast hydropower potential to enhance energy access, support economic growth, and contribute to climate goals. Given PNG's geographical advantages, including abundant rainfall and extensive river systems, the policy targets scaling up hydropower development as a primary renewable energy source.

This Policy seeks to promote investment in hydropower to achieve 70% electrification by 2030 and 100% by 2050. It aligns with the National Energy Policy 2017-2027 (NEP), PNG Vision 2050, and the PNG Development Strategic Plan 2010-2030 (DSP), contributing to national goals of increased renewable energy usage and reduce greenhouse gas (GHG) emissions. The scope covers both large-scale on-grid and smaller off-grid hydropower systems, with a focus on integrating these into the national grid.

PNG's hydropower potential is estimated at 15,000 MW, yet the current installed capacity is underutilized at around 580 MW. The policy emphasizes identifying and developing suitable sites, addressing barriers related to land ownership, environmental regulations, and financing. It encourages a multi-purpose approach for hydropower projects, incorporating uses such as irrigation, flood control, and drinking water supply, thus maximizing socio-economic benefits.

The policy outlines a comprehensive framework for licensing, regulation, and compliance, governed by the *National Energy Authority Act* 2021. It includes streamlined processes for project approval, from feasibility studies to commissioning. To attract private sector investment, the policy proposes incentives like feed-in tariffs, tax benefits, and potential state equity participation. It aims to create a conducive environment for both domestic and international investors.

The policy encourages the development of hybrid systems combining hydropower with other renewable sources like solar and wind energy amongst others. This approach aims to enhance grid stability, reduce reliance on fossil fuels, and ensure a more resilient energy supply. The policy encourages decentralized mini-grids in rural areas and facilitate smoother integration into the main grid as it expands.

Environmental protection and community involvement are core aspects of the policy. It requires compliance with the *Environment Act* 2000. The policy also addresses land access, ensuring fair compensation and active participation of local communities. Measures to protect water catchments and promote sustainable land use are prioritized to safeguard the long-term viability of hydropower projects.

The policy contributes to PNG's commitments under the Paris Agreement by promoting hydropower as a low-carbon energy solution. It includes provisions for accessing climate finance and emphasizes a Just Transition, focusing on workforce training and local capacity building to adapt to emerging renewable energy technologies.

The National Energy Authority (NEA) will oversee policy implementation, with a robust monitoring and evaluation framework to assess progress toward electrification and renewable energy targets. The policy's long-term vision is to establish a competitive, reliable, and sustainable hydropower sector that can significantly contribute to PNG's energy security and socio-economic development.

CHAPTER 1: INTRODUCTION

1.1. INTRODUCTION TO HYDRO ENERGY POLICY

Papua New Guinea (PNG) is located near the equator with regular rainfall, many river basins, mountainous terrains, and fast flowing rivers, making it a suitable location for hydro energy development. Hydro is currently the primary source of energy, which provides around half of the 797 MW total electricity generation capacity, while around one-third is from diesel generators, which is dominant in off-grid applications. Gas, hydro, geothermal and biogas generation represent most of the balance with the bulk of this energy used for mining. According to the National Energy Policy 2017-2027 (NEP), its aggregate generation potential is estimated to be around 15,000 MW.

However, the development of renewable energy face challenges due to the country's complex land tenure systems, rugged terrains, and predominantly rural population. A major challenge has been the lack of Government direction through policy or legislation to drive the development of renewable energy resources.

The approval of the NEP laid the foundation for the establishment of the National Energy Authority (NEA) which is mandated to administer and regulate the energy industry. The NEP also provides for the development of the renewable energy policies including this Policy.

This Policy focuses on creating an enabling environment to promote investment in hydro as a source of sustainable energy to diversify PNG's energy mix. This Policy aligns with the NEP and other Government development plans and policies and makes reference to relevant laws and regulations. It also provides a strategic direction to establish processes and systems that support hydro energy development.

1.2. HYDRO ENERGY IN PAPUA NEW GUINEA

According to various sources, PNG has below 20% electricity access to the main grid systems, while districts, small centres, and villages are mostly powered by Off-Grid systems. Hydropower is important as it caters to the baseload of power generation in most grid systems. Hydropower contributes 223.5 MW (39.7%) of the total installed capacity of 580 MW for the main grid systems in Port Moresby, Ramu (includes Highlands), and the Gazelle grid..

The Port Moresby Grid is mainly powered by the Rouna Hydro Power Station, which supplies about 62.2 MW. The recently established Edevu Hydro Power Plant supplies another 54 MW into the Port Moresby Grid system. The Ramu Grid is supported by the Yonki Hydro Power Plant (75 MW), Paunda Run-off-River (RoR) in Southern Highlands Province (12 MW), and Upper Baiune Hydro Station in Bulolo, Morobe Province (2 MW). The Gazelle Grid is supported by the Warangoi Hydro Power Station (10 MW). Other small systems are supporting various C-Centers, such as the Ru Creek Hydro which supports the West New Britain Grid. The Ok Tedi Mining Project is also powered by the Ok Menga and the Yuk Creek hydro systems.

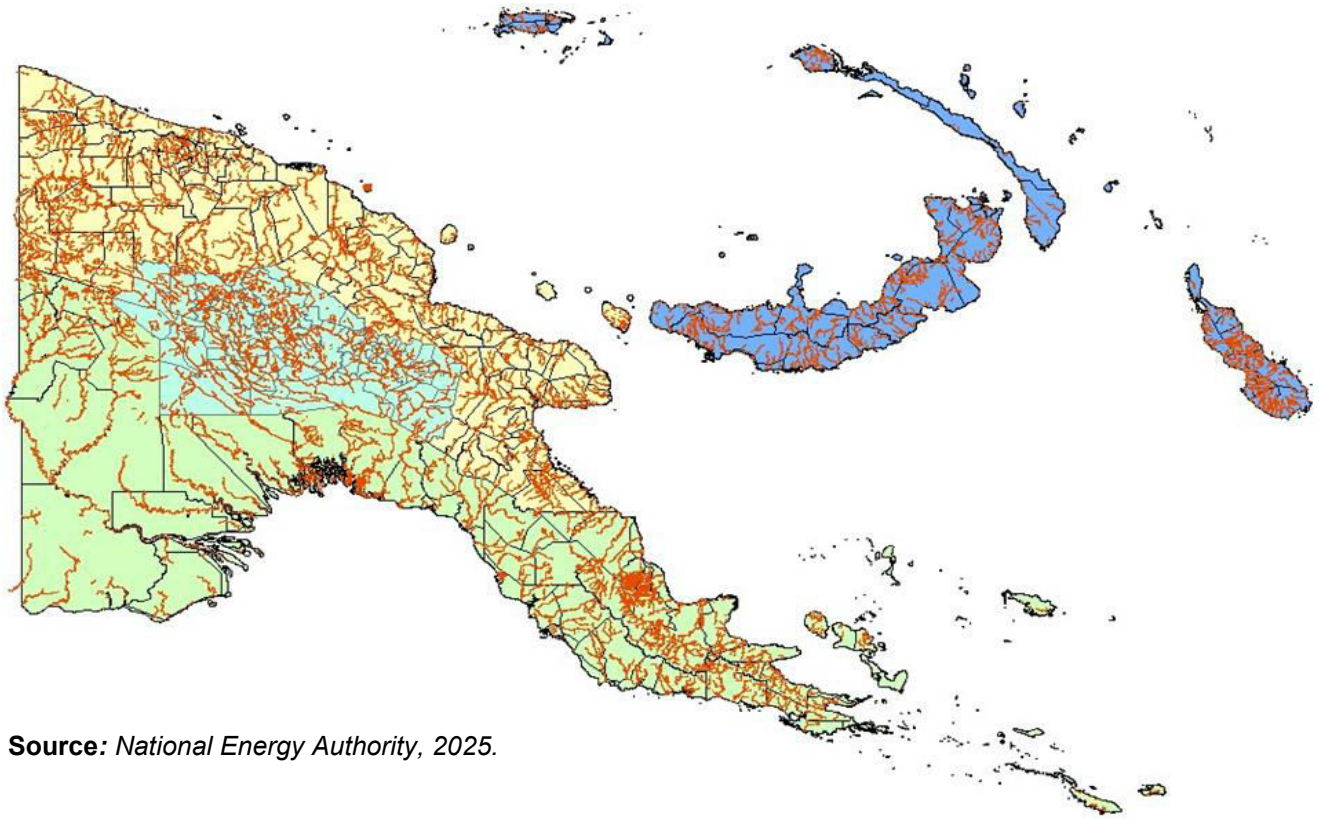
Figure 1: The intake dam at the PNG Forest Products' Bululo power plant.

Source: Business Advantage, 2024

1.3. HYDRO ENERGY POTENTIAL IN PAPUA NEW GUINEA

PNG's challenging geography with high mountains, rugged terrains, and fast flowing rivers has given it significant hydro energy potential. The country's topography includes nine large hydrological drainage basins, fed by a vast network of large rivers. PNG's largest river basins include the Sepik River basins, with a 78,000-sq-km catchment area; the Fly River basin, which extends for 61,000 sq km; the Purari River basin, covering 33,670 sq km; and the Markham River basin's catchment area, which covers 12,000 sq km. Additional, river catchments are located on extremely steep terrains. Average annual rainfall in mainland PNG varies from less than 200 cm in the driest areas to 800 cm in mountainous regions, while the island regions receive around 300 cm to 700 cm.

Figure 2: *River systems (in red) in PNG indicating the potential for hydro energy development*



Source*: National Energy Authority, 2025.*

PNG has abundant untapped potential for hydro energy resources as a source of renewable energy. There are also other sources of renewable energy such as bioenergy, solar, wind, and tidal wave. According to APEC reports, PNG's gross theoretical hydropower potential is 175 TWh annually. Hydropower is expected to drive future renewable energy generation, as evidenced by the launch of several new hydro projects in recent years. There are proposed plans to develop major hydro projects, such as Karamui, Ramu 2, and Mendi hydro projects, by Kumul Consolidated Holdings (KCH). Other proposed hydro projects currently being considered by private investors include the proposed Naoro-Brown hydro project in Central Province, Yaganon hydro project in Madang Province, Burum hydro project in Morobe Province and the Tagali hydro project in Hela Province. This Policy encourages private sector participation in hydropower development in advancing projects that might otherwise be too capital-intensive.

1.4. POLICY RATIONALE

Lack of access to reliable and affordable electricity remains one of the country's most critical barriers to economic growth and social wellbeing. The country's current electrification rate, in terms of grid connectivity, stands around 20%. This means that over 80 per cent of PNG's population, mainly in rural areas, lack reliable access to power. More recently, there have been efforts by the Government and Development Partners to increase the accessibility rate through implementation of off-grid energy projects, mainly off grid solar and mini hydro energy systems. Fifty years after independence, PNG is still plagued by chronic energy shortages and high electricity costs. Critical issues affecting access to reliable and affordable electricity are:

- **Unreliable power:** PNG Power Limited (PPL), struggles to provide reliable electricity due to aging infrastructure and financial constraints to investment in generation capacity.
- **High network costs**: The cost of the network is high due to the country's geography, population dispersal, and aging infrastructure.
- **Limited competition:** The electricity market is small and has limited capacity for users to pay, which limits the scope for competition thereby affecting investments in energy generation.
- **Fossil fuel reliance:** PNG's energy sector is the country's largest source of emissions, and a large portion of the grid relies on diesel fuel. Diesel fuel is more expensive and environmentally unfriendly than other alternatives, such as renewable energy sources.
- **Gaps in regulatory framework:** Recently, the Government established the NEP and enacted the *National Energy Authority Act* 2021. However there remains gaps in the policy and regulatory framework to support the development of renewable energy sources in PNG.
- **Fragmented power grid:** PNG's power grids are fragmented and experience frequent outages. There are only three main grids with Ramu grid being the major one. However, other towns still operate standalone grids.
- **Complex land tenure system**: Approximately 97% of land in PNG is held under customary tenure, owned collectively by clans or kinship groups. Customary land is managed through unwritten customary rules and arrangements. The remaining 3% is alienated land, which is administered by the *Land Act* 1996 and other relevant laws. The complex land tenure system makes access to land for the development of renewable energy projects a challenge.
- **Lack of Incentives:** There is lack of incentives, especially fiscal incentives to attract private investments in renewable energy projects. Medium-large scale hydro energy projects are capital intensive long pay-back periods. Fiscal incentives can reduce costs and cost recovery period therefore making investments attractive.

Despite these challenges, PNG has significant renewable energy resources, including hydro energy potential. This calls for policy and legislative reforms that enable a shift in addressing issues in the energy sector to allow for investments in renewable energy sources such as hydro energy projects.

1.5. SCOPE OF THE POLICY

This Policy focuses on creating an enabling framework to promote investment in the hydro energy subsector, contributing to the nation's renewable energy mix. This Policy aims establish the platform that drives investments in harnessing PNG's abundant hydropower potential to achieve national electrification goals by contributing to providing 70% of the households with access to electricity by 2030 and 100% by 2050. This policy addresses technical, regulatory, and socio-economic aspects, aligning with international climate

commitments and national development plans to ensure sustainable and inclusive growth in PNG's energy sector.

This Policy recognizes that achieving electrification targets in PNG requires both on-grid and off-grid solutions. By supporting the development of large-scale, on-grid hydropower projects and promoting smaller, off-grid power systems in rural areas, the Policy aims to ensure that all households and businesses across the country have access to reliable, affordable, and sustainable electricity. Furthermore, this Policy encourages the integration of decentralized off-grid systems into the national grid where feasible, facilitating a seamless transition for rural and isolated areas as the grid expands.

The implementation of this Policy will be administered and coordinated by NEA, as the authority mandated to undertake policy and planning functions of the energy sector in PNG. Full implementation of this Policy requires collaboration with various State Agencies, Development Partners, Sub-National Governments and their respective Administrations, Civil Society groups, Landowners, and Project Impact Communities.

This Policy is consistent with the existing laws of PNG and aligns to various legal and policy frameworks, both at national and sectoral levels. This Policy provides strategic direction for policy and legislative reforms to address technical, regulatory, and socio-economic gaps within the hydro energy subsector. Should there be any conflict between this Policy and any existing legislation, the provisions of the legislation shall apply.

CHAPTER 2: POLICY DIRECTION

2.1. VISION

A sustainable hydro energy subsector that contributes to achieving 70% of electricity coverage by 2030.

2.2. MISSION

To establish a robust policy and regulatory framework that promotes investment and sustainable development of hydro energy projects.

2.3. OBJECTIVES

a) To establish an effective regulatory framework that promotes sustainable development of hydro energy projects.

b) To establish mechanisms that support public and private investment in hydro energy projects.

c) To contribute to achieving PNG’s renewable energy targets under its enhanced Nationally Determined Contributions (NDC) while promoting a Just Transition.

d) To contribute to PNG’s energy needs by ensuring an accessible, reliable, and affordable electricity supply.

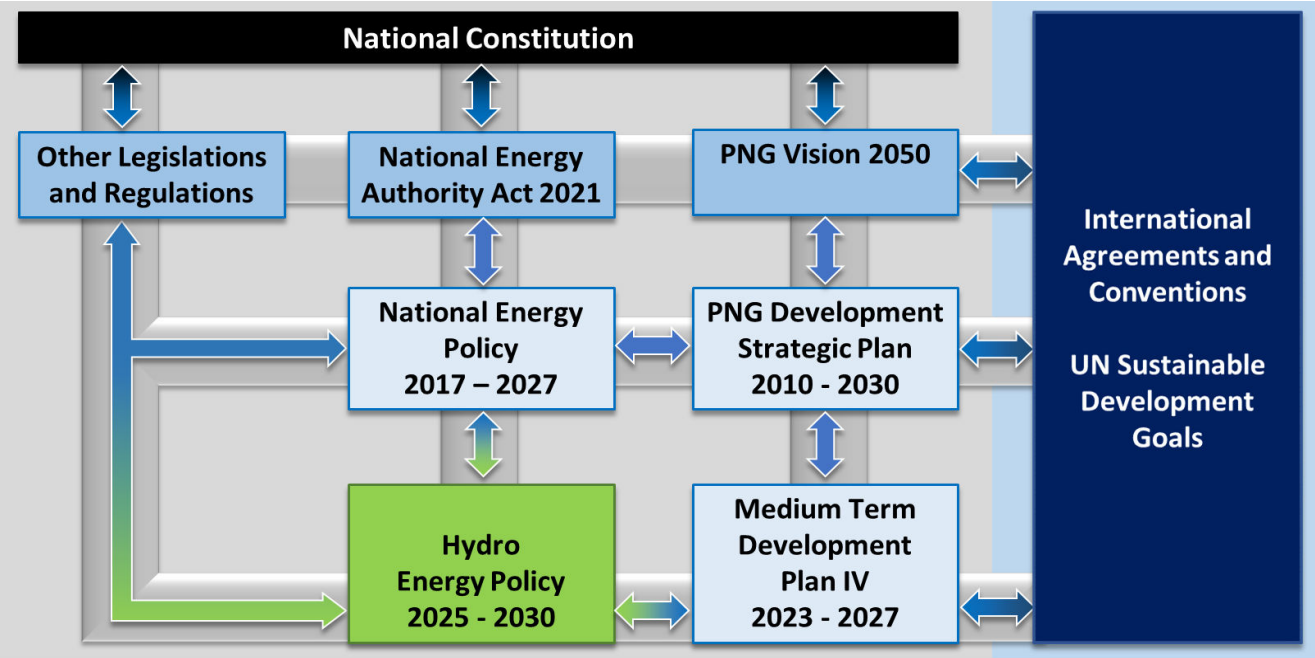
e) To promote sustainable growth and improve the socio-economic well-being of our people through partnerships.

CHAPTER 3: LEGAL AND POLICY FRAMEWORK

This Policy is aligned with various legislations and policies. The principal legislation for the policy is the *National Energy Authority Act* 2021 which is also defined under the NEP.

The implementation of this Policy will also be guided by various legislations and other sectoral policies, as well as international conventions and agreements.

Figure 3*:* Alignment of the Hydro Energy Policy



Source: *National Energy Authority, 2025*

3.1. LEGAL FRAMEWORK

a) *The Constitution of the Independent State of Papua New Guinea*

This Policy takes into consideration the *Constitution of the Independent State of Papua New Guinea* (the Constitution) and the National Goals and Directive Principles (NGDPs) under the Constitution. The NGDPs aim for Papua New Guinea (PNG) to have an independent and mostly self-reliant economy and for Papua New Guineans to have equal opportunity to participate in and benefit from the development of our country. The NGDPs also provide for the country's natural resources and environment to be conserved and used for the collective benefit of us all and replenished for the benefit of future generations.

b) *National Energy Authority Act* 2021

The *National Energy Authority Act* 2021 is the principal legislation that establishes and mandates the National Energy Authority (NEA) to undertake its various functions. NEA's functions include policy, regulatory, and project coordination and implementation in the energy and electricity supply industry. This Policy is established under Section 10(b) of the *National Energy Authority Act* 2021.

c) *Electricity Industry Act (Chapter 78)*

The *Electricity Industry Act (Chapter 78)* provides for the generation, supply, and sale of electricity. It also provides for the economic and technical regulation of the electricity

industry. With its amendment in 2022 (*Electricity Industry (Amendment) Act 2022*), the *Electricity Industry Act (Chapter 78)* further empowers the NEA to regulate the electricity supply industry consistent with the *National Energy Authority Act 2021*.

d) *Electricity Industry (Amendment) Act* 2022

The *Electricity Industry (Amendment) Act 2022* amended the *Electricity Industry Act (Chapter 78)*. The amendments made to the *Electricity Industry Act (Chapter 78)* among other things, further mandates the NEA as the regulator of the electricity supply industry to undertake economic and technical regulatory functions under the *Electricity Industry Act (Chapter 78)*.

e) *Environment Act* 2000

The *Environment Act* 2000 provides for the protection, conservation, and sustainable use of the environment and natural resources. The Act also provides for the regulation of the environmental impacts of development activities. Hydro energy projects will require land for energy generation as regulated under the *Environment Act* 2000.

f) Other Legislations

This Policy is consistent with all relevant laws of PNG. However, should there be any inconsistencies with this Policy and any relevant legislation, the provisions of the respective legislation shall apply.

3.2. POLICY FRAMEWORK

a) PNG Vision 2050

The Vision 2050 embodies the principles of the Constitution and sets the overall direction for PNG to attain its vision to be a smart, wise, fair, and happy society. It is underpinned by seven (7) pillars. Pillar 5 on Environmental Sustainability and Climate Change targets PNG to use 100% of renewable energy for power generation by 2050. This Policy aligns with the pillars and energy goals under Vision 2050.

b) PNG Development Strategic Plan 2010 – 2030

The PNGDSP sets out the long-term development framework to guide PNG onto a path of achieving sustainable economic growth, economic prosperity, and high quality of life for all Papua New Guineans.

It sets the target that by 2030, 70% of households in PNG will have access to a reliable and affordable power supply. It targets that the total power generation capacity by 2030 will be 1910 MW of which Hydro will generate 1020 MW, Gas generating 390 MW and other renewables will generate, in total, a capacity of 500 MW.

c) National Energy Policy 2017 – 2027

The National Energy Policy 2017 – 2027 (NEP) sets out the platform and direction for the development of the energy sector in PNG. It provides for the development of various subsector policies, including the Hydro Energy Policy.

d) United Nations Sustainable Development Goals

The United Nations Sustainable Development Goal 7 (SDG 7) calls for “affordable, reliable, sustainable and modern energy for all” by 2030. This Policy aligns with that target by establishing a platform for development of the hydro energy to contribute to achieving an affordable, reliable, and sustainable supply of energy by 2030.

This Policy also addresses SDG 13 on Climate Action and will contribute towards PNG's effort to reduce greenhouse gas (GHG) emissions within the Energy Sector and achieve PNG's National Determined Contributions (NDC) targets under United Nations Framework Convention on Climate Change (UNFCCC) commitments.

e) Medium-Term Development Plan IV (2023-2027)

The Medium-Term Development Plan IV 2023-2027 (MTDP IV) is themed " National Prosperity Through Growing the Economy". The theme captures the Government's intent to invest in Strategic Priority Areas (SPA) to trigger greater national transformation and economic independence. Under MTDP IV, the Government identifies energy (including electricity) as an important sector for PNG's economy and commits to improving access to a reliable, affordable and clean energy supply to cater for more than 70% of households by 2030.

The MTDP IV identifies five (5) Strategic Priority Areas, which includes National Power Generation Investment Program. The MTDP IV further sets out various investment targets, key result areas and strategies for the energy sector. This Policy will is aligned to that by establishing the platform and sets the direction to drive investments in hydro electricity generation.

CHAPTER 4: HYDRO ENERGY SYSTEM

4.1. HYDRO ENERGY SYSTEM

Hydro Energy or Hydropower is a mature technology that has been used since the late 19th century to harness hydropower. Hydropower is a highly flexible electricity generation technology, with a capacity factor varying between 23% and 95% depending on the specific plant and its operational services (baseload – peak load). The potential energy of water is converted into kinetic energy, which then spins the blade of a turbine and, in turn drives a generator to produce electricity. One of the advantages of hydropower is its operational flexibility. Hydropower reservoirs act as natural energy storage systems that enables a quick response to electricity demand fluctuations across the grid, optimisation of electricity production, and compensation for supply losses from other sources.

Most hydropower systems are based on the popular hydro technology which is to build a dam on a river system that has a large drop in elevation. The dam stores a significant amount of water in the reservoir. Near the bottom of the dam wall, there is the water intake (inlet). Gravity causes it to fall through a pipe (penstock) inside the dam. At the end of the penstock, there is a turbine propeller, which is turned by the moving water. The shaft from the turbine goes up into the generator, which produces the power. After spinning the turbine, the water continues past the propeller through the tailrace into the river system again or is used for other purposes.

At the generator, a hydraulic turbine converts the energy of flowing water into mechanical energy. A hydroelectric generator then converts this mechanical energy into electricity. Electricity generation works in a way that when a magnet is moved past a conductor, it causes electricity to flow. The electromagnets are made by circulating direct current through loops of wire wound around stacks of magnetic steel laminations, called field poles, and are mounted on the perimeter of the rotor. The rotor is attached to the turbine shaft and rotates at a fixed speed. When the rotor turns, it causes the field poles (the electromagnets) to move past the conductors mounted in the stator. This, in turn, causes electricity to flow and a voltage to develop at the generator output terminals. Transmission lines are connected to the generator which carries electricity through a grid to distribution points for usage.

Figure 4: Hydropower Generation System

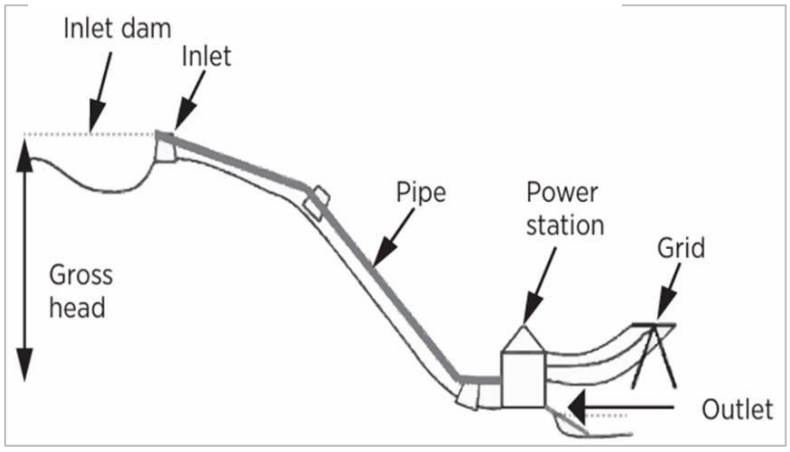
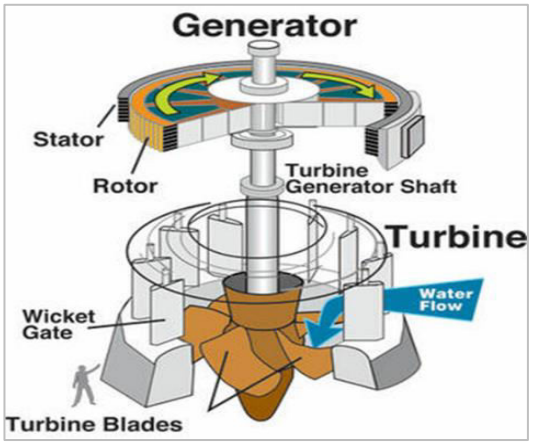


Figure 5: Hydro Electricity Generator



Source: *U.S. Geological Survey. (n.d) A turbine connected to a generator produces power inside a dam*

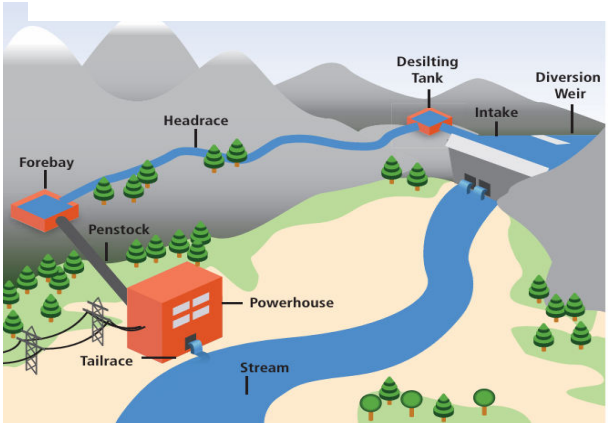
4.2. TYPES OF HYDRO SYSTEMS

Hydropower Plants (HPP) and projects are usually designed to suit particular needs and specific site conditions and are classified by project type, head (i.e., the vertical height of water above the turbine), or purpose (single- or multi-purpose). The HPPs are often classified into three main categories according to operation and type of flow. Run-of-river (RoR), storage (reservoir), and pumped storage. HPPs vary from the very small to the very large scale, depending on the hydrology and topography of the watershed. In addition, there is a fourth category called in-stream technology, which is an emerging technology and is mostly used for small systems.

4.2.1. Run-of-River

A Run-of-River (RoR) HPP draws the energy for electricity production mainly from the available flow of the river. A RoR HPP may include some short-term storage (hourly, daily), allowing for some adaptations to the demand profile, but the generation profile, to varying degrees, is dictated by local river flow conditions. As a result, generation depends on precipitation and runoff which may have substantial daily, monthly, or seasonal variations. When even short-term storage is not included, RoR HPPs will have more variable generation profiles, especially when situated in small rivers or streams that experience widely varying flows.

Figure 6: Run-of-River Hydropower System



Source: *Kumar & Schei, 2011*

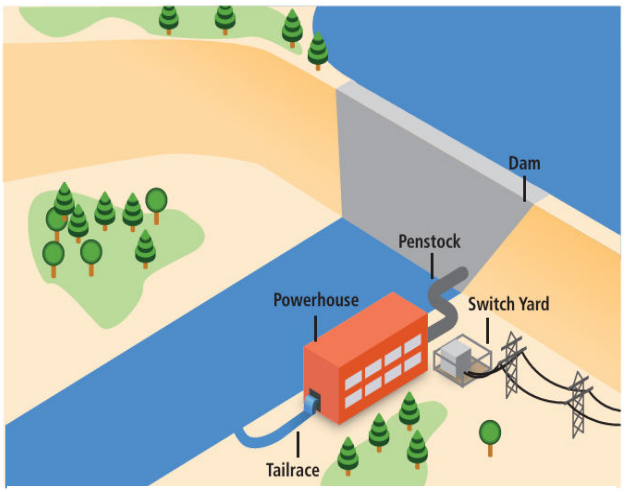
In a RoR HPP, a portion of the river water might be diverted to a channel or pipeline (penstock) to convey the water to a hydraulic turbine, which is connected to an electricity generator (*see Figure 6*). RoR projects may form cascades along a river valley, often with a reservoir-type HPP in the upper reaches of the valley that allows both to benefit from the cumulative capacity of the various power stations. Installation of RoR HPPs are relatively inexpensive and such facilities have, in general, lower environmental impact than similar-sized storage hydropower plants.

4.2.2. Storage Hydropower

Hydropower projects with a reservoir are also called storage hydropower since they store water for later consumption or usage. The reservoir reduces the dependence on the variability of inflow. The generating stations are located at the dam toe or further downstream, connected to the reservoir through tunnels or pipelines (*see Figure 7*).

The type and design of reservoirs are decided by the landscape and in many parts of the world are inundated river valleys where the reservoir is an artificial lake. In geographies with mountain plateaus, high-altitude lakes make up another kind of reservoir that often will retain many of the properties of the original lake. In these types of settings, the generating station is often connected to the lake serving as a reservoir via tunnels coming up beneath the lake (lake tapping).

Figure 7: A Storage Hydropower System



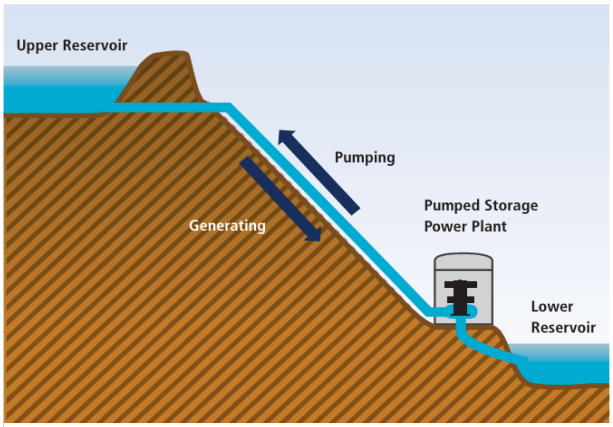
Source: *Kumar & Schei, 2011*

The design of the HPP and the type of reservoir that can be built is very much dependent on opportunities offered by the topography.

4.2.3. Pumped Storage

Pumped storage plants are not energy sources but are instead storage devices. In such a system, water is pumped from a lower reservoir into an upper reservoir (*see Figure 8*), usually during off-peak hours, while the flow is reversed to generate electricity during the daily peak load period or at other times of need. Although the losses of the pumping process make such a plant a net energy consumer overall, the plant can provide large-scale energy storage system benefits. Pumped storage is the largest-capacity form of grid energy storage.

Figure 8: *A Pumped Storage Hydropower System*

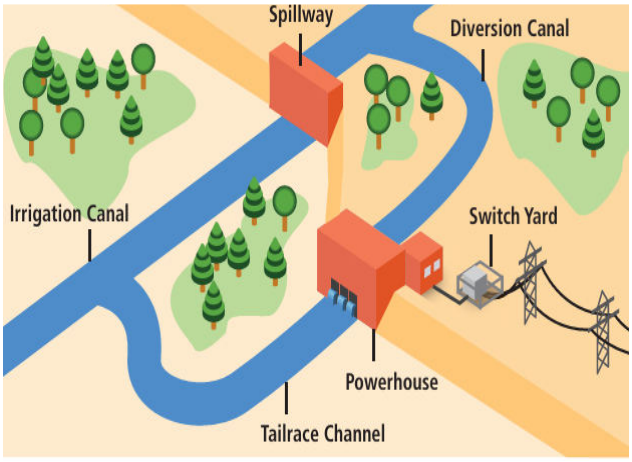


Source: *Kumar & Schei, 2011*

4.2.4. In-Stream Technology Using Existing Facilities

To optimize existing facilities like weirs, barrages, canals, or falls, small turbines or hydro-kinetic turbines can be installed for electricity generation. These function like a Run-of-River scheme, as shown in Figure 9. Hydro-kinetic devices which are being developed to capture energy from tides and currents may also be deployed inland in both free-flowing rivers and in engineered waterways (*see Figure 9*).

Figure 9: In Stream Hydropower System that uses existing facilities



Source: *Kumar & Schei, 2011*

4.3. CLASSIFICATION OF HYDRO ENERGY SYSTEMS

Hydropower systems are usually categorized according to their size, which is their installed capacity or output in Megawatts (MW). There is no direct link between installed capacity as a classification criterion and general properties common to all hydropower plants above or below a certain output (MW) limit. Size categories (installed capacity) are based on national definitions and differ worldwide due to varying policies. PNG does not have a classification based on installed capacity or size. The classification in this Policy is based on the existing hydro systems and the anticipated projects, including those currently under construction.

Table 1: Classification of Hydro Power Systems (with Hybrid Systems Information)

Classification	Output	Descriptions
Large Scale Hydro	51 MW and above	A large hydro system produces power ranging from 51 MW and above. Power produced from large-scale hydro systems will be fed into the main grid.
Medium Scale Hydro	1 MW – 50 MW	A medium hydro system produces power from a range between 1 MW to 50 MW. Power produced from medium-scale hydro systems will be fed into the main grid. Medium scale hydro systems of less than 5MW can be used for small grid systems and off- grid systems.
Mini Hydro System	101 KW – 1 MW	Mini hydro systems are small hydro systems with small turbines that can produce 101 kW to 1 MW. Mini hydropower can be fed into mini-grid systems, such as that of a village or small household setting.
Micro Hydro System	11 kW – 100 kW	Micro hydro systems are small hydro systems with small turbines that can produce from 11 kW to 100 kW or less. Micro hydropower is not fed into a power grid, but electricity generated is delivered to small establishments or for a single purpose use.
Pico Hydro System	1 kW – 10 kW	Pico hydro systems are small hydro systems with small turbines that can produce from 1 kW to 10 kW or less. Pico hydropower is not fed into a power grid, but electricity generated is delivered to small establishments or for a single purpose use.

4.4. CONSIDERATION FOR OTHER USES

When developing a medium-large scale hydro energy project, consideration must be given to other uses to support economic activities and developments around the host region and local communities. This calls for multi-purpose hydro projects. Multi-purpose hydro projects offer a range of advantages beyond electricity generation and have the potential to significantly enhance the socio-economic development of the region. Multipurpose hydro systems refer to hydropower projects designed to serve multiple functions by integrating various uses of water resources, ensuring a broader socio-economic impact by addressing different sectors, such as agriculture, tourism, and trade.

Key Components and Functions of Multipurpose Hydro Systems

(a) **Electricity Generation**: This remains the core function of any hydropower system. The power generated can serve local, regional, and national grids, contributing to energy security and reliability.

(b) **Tourism and Leisure**: The reservoirs and surrounding areas of multipurpose hydro systems can be developed to promote tourism, recreation, and leisure activities like swimming, boating, and hiking, which can generate additional revenue and local employment.

(c) **Agriculture**: Multipurpose hydro systems can support irrigation projects, enabling agricultural activities, and improving food security in surrounding communities. Water from the dam can be used to irrigate farms, particularly in regions affected by inconsistent rainfall.

(d) **Aquaculture**: Fish farming within the reservoirs can be integrated into the project, providing a sustainable source of food and income for local communities.

(e) **Flood Control**: These systems can be designed to manage water flow and reduce the risk of floods, especially in areas prone to seasonal flooding.

(f) **Water Supply**: The water retained in the reservoir can be used to provide clean drinking water for nearby communities and support industrial needs.

(g) **Promote Regional Energy Trade**: Multipurpose hydro systems located near borders can facilitate regional energy trade, benefiting both the local economy and neighbouring countries. Cross-border cooperation in energy production and distribution can enhance economic ties and regional stability.

4.5. HYBRID SYSTEMS

Hybrid systems are designed to harness the strengths of each energy source, improving efficiency, reliability, and sustainability. By integrating other renewable sources with hydropower like solar, wind, geothermal, or even conventional energy like natural gas, hybrid systems can balance energy supply and demand more effectively. They help mitigate the limitations of relying on a single energy source, such as the intermittency of solar or wind, by combining them with more stable sources like hydropower or natural gas. This enables hybrid systems to provide consistent power, reduce reliance on fossil fuels, and enhance the overall resilience of the energy grid. Hybrid systems are increasingly important in regions where energy demand varies or where renewable energy penetration needs to be maximized.

4.5.1. Hydro With Solar

The hybridized floating solar photovoltaic (FPV) systems with hydropower can reduce PV curtailment and enhance power generation efficiency. By combining the two technologies, hydropower's flexibility is preserved for periods of low water availability,

while solar power helps during sunny periods. This approach optimizes both seasonal and daily energy use, reducing operations and maintenance costs for hydro plants and minimizing the reliance on gas-fired generation.

4.5.2. Hydro With Wind

Wind-hydro hybrid systems combine the complementary strengths of hydro and wind power to provide a more reliable and consistent energy supply by leveraging both energy sources to ensure reliability when one source is less available. This dual approach is particularly advantageous in remote and off-grid areas by reducing dependency on a single energy source and avoiding the high costs of extending the grid.

The hybrid system combining wind turbines and hydroelectric power works by utilizing wind energy for electricity generation, while excess electricity is used to pump water into storage reservoirs. When demand is high, this stored water is released through hydro turbines, generating additional electricity. The combination enhances the efficiency and reliability of renewable energy production, allowing stored water to act as a backup energy source when wind conditions are low, ensuring continuous electricity supply.

4.5.3. Hydro With Wind & Solar

A hybrid energy system that integrates hydropower, wind, and solar combines the strengths of these three renewable energy sources to provide a reliable, flexible solution for electricity generation. In this system, solar panels generate electricity during daylight hours, while wind turbines harness energy from the wind. Both solar and wind are intermittent, so any excess energy they generate is stored through pumped hydro storage, where surplus power is used to pump water to an upper reservoir.

To maintain a continuous energy supply, stored water is released during high-demand periods or when renewable sources are insufficient. This hybrid approach maximizes natural resource utilization by balancing the variability of solar and wind with the reliable backup of hydropower. Acting like a large battery, the pumped hydro storage ensures energy availability when solar or wind resources fluctuate.

4.5.4. Hydro With Thermal

Hydrothermal Hybrid System combines the generation of electricity from both hydropower and thermal power plants to improve reliability and efficiency in power generation. Hydropower plants use the kinetic energy of flowing water to generate electricity, whereas thermal power plants burn fossil fuels or biomass to produce steam, which drives turbines to generate power.

Thermal power plants complement hydropower plants by generating electricity when the demand exceeds what the hydropower plants can supply or when water levels in reservoirs are low. In this setup, thermal generators can operate continuously, while hydropower is adjusted based on the availability of water and electricity demand, making the system flexible. The thermal component ensures a steady supply when hydropower generation is insufficient.

4.5.5. Hydro With Natural Gas

A hybrid hydro-natural gas energy system offers a powerful combination of renewable and non-renewable energy sources, providing a reliable, flexible, and cost-efficient electricity solution. Hydroelectric power delivers consistent, renewable energy, ideal for meeting base load needs, while natural gas offers quick-start capabilities to handle peak demand or compensate for low water availability.

This complementary system ensures continuous energy production, even during seasonal variations, allowing for rapid adjustments to changes in demand. By prioritizing hydropower when water levels are sufficient, the system reduces natural gas use, leading to lower fuel costs and decreased emissions—addressing both economic and environmental goals. This combination ensures a continuous, reliable energy supply, with natural gas offering flexibility during peak demand or renewable shortfalls.

4.6. GRID INTEGRATION

Grid integration and stability are essential for ensuring that decentralized hydro mini-grids, particularly in isolated service areas, can seamlessly connect to the central electricity grid without compromising overall system reliability. This involves adhering to technical standards, such as synchronization of voltage and frequency, and ensuring compatibility of equipment and supply with grid codes. Proper preparation for grid arrival is crucial, especially in managing seasonal variations in water volume, to maintain a balanced and stable electricity supply while enhancing the resilience and flexibility of the broader grid infrastructure.

The following key elements should be considered to ensure compatibility:

(a) **Technical Standards**: Mini-grids should be designed and operated to meet national grid technical standards, including voltage levels, frequency stability, and synchronization. This ensures that when the mini-grid connects to the central grid, the power generated can be safely and efficiently transferred.

(b) **Interconnection Equipment**: Appropriate interconnection equipment, such as inverters, transformers, and protection devices, must be installed. This ensures the system can handle bidirectional power flow (where mini-grids can either feed into or draw from the centralized grid) while protecting both the mini-grid and central grid from faults.

(c) **Regulation and Load Balancing**: Hydro mini-grids should incorporate automatic control systems to regulate power output in real time and balance load demand with supply. This prevents overloading and ensures consistent voltage and frequency when integrated with the grid.

(d) **Harmonization of Generation and Consumption**: Hydro mini-grids should be designed to anticipate the potential shift in energy demand and supply once connected to the larger grid. This includes considerations for seasonal variations in water availability and ensuring generation capacity aligns with anticipated grid demand.

(e) **Utility Coordination**: Continuous coordination with utility companies is critical for successful grid integration. This involves compliance with grid codes, monitoring supply, and ensuring that both the mini-grid and the centralized grid are prepared for interconnection.

(f) **Energy Storage and Backup Systems**: To ensure stability, energy storage or backup systems (like battery storage) may be necessary to manage fluctuations in water flow or seasonal changes in hydro availability. This helps balance supply and demand, particularly during grid outages or times of low hydro output.

CHAPTER 5: PROJECT DEVELOPMENT STAGES

Depending on its size, the development of a hydro project typically takes 2 to 10 years to complete, from conception to final commissioning. This time is required to undertake studies and design work, to receive the necessary approvals, and to construct the project. Once constructed, hydro plants require little maintenance over their useful life, which can be well over 50 years.

Development of medium – large scale hydro projects vary across countries and jurisdictions based on requirements through policies and regulations. This Policy now sets the development process for medium – large scale hydro projects, which will be regulated by law.

Figure 10: Hydro Energy Project Development Phases

Source: *National Energy Authority, 2025*

5.1. RECONNAISSANCE AND PRE-FEASIBILITY

The first phase of work is reconnaissance. This stage requires initial site identification and visits, including mapping studies; delineation of the drainage basins; preliminary estimates of flow and floods; site visits, preliminary layout; cost estimates and a final ranking of sites based on power potential.

After the initial reconnaissance, work will progress to the pre-feasibility stage with actual site selection, which would require: site mapping and geological investigations (with drilling confined to areas where foundation uncertainty would have a major effect on costs); a reconnaissance for suitable borrow areas (e.g. for sand and gravel); a preliminary layout based on materials known to be available; preliminary selection of main project characteristics (installed capacity, type of development, etc.); the identification of possible environmental impacts; and production of a report on each site.

5.2. FEASIBILITY STUDIES

Under the Feasibility Study phase, work continues on the selected site with a major foundation investigation program that covers; delineation and testing of all borrow areas; estimation of diversion, design, and probable maximum floods; determination of power potential for a range of dam heights and installed capacities for project optimisation; determination of the project design; determination of the dewatering sequence and project schedule; optimisation of the project layout, water levels and components; production of a detailed cost estimate; and an economic and financial evaluation of the project including assessment of the impact on the existing electrical grid.

Feasibility studies also include studies and final design of the transmission system; integration of the transmission system; integration of the project into the power network to determine precise operating mode; production of tender drawings and specifications; analysis of bids and detailed design of the project; production of detailed construction drawings and review of manufacturer's equipment drawings.

A comprehensive feasibility study report is then submitted to the National Government through NEA and other relevant stakeholders as part of its application for a licence.

5.3. LICENCE APPLICATION, ASSESSMENT AND APPROVAL

Once the feasibility study report is finalised, it will be submitted to NEA, together with an application as a proposal for the development of a hydropower project.

Water is defined under law as a resource and is regulated under the *Environment Act* 2000 by the Conservation and Environment Protection Authority (CEPA). Therefore the licensing and regulatory process under the *Environment Act* 2000 must be complied with. The Licensing process is further discussed separately under Chapter 6. The Environment Permit will be a pre-requisite for the approval of an energy Generation Licence.

NEA will undertake its assessment of the application and proposal for development which will be submitted to the NEA Board for consideration and approval subject to the *National Energy Authority Act* 2021.

During the application and assessment of the application, if need be, for medium-large scale projects, various other commercial and socioeconomic requirements must also be undertaken and completed. These may include:

- Settlement of National Content Issues and Compensation Agreements.
- Settlement of all Technical and Legal Issues.
- Agreement on State Equity Participation, if any.
- Determination of Tariff Rates and Power Purchase Agreements.
- Other requirements to be determined by NEA or as required under the law.

5.4. DESIGN, PROCUREMENT AND CONSTRUCTION

Once a generation licence is approved, the project moves to the detailed design and procurement of materials for the construction phase of the project. Detailed design and construction involves with the following activities:

a) Detailed design of infrastructure facilities design and civil works;

b) Detailed design of power plant and water control systems;

c) Detailed design of power transmission lines and point of access determined;

d) Service providers contracted for detailed design, engineering, procurement, construction, and project management;

e) Procurement of equipment and materials; and

f) Construction of hydro dam and related facilities.

All designs for hydro energy systems will be reviewed and approved by NEA before any construction of a hydro project is undertaken.

5.5. TESTING AND COMMISSIONING

Commissioning a hydropower plant involves a series of steps to ensure all systems and components are properly installed, tested, and verified before the plant goes into full operation. The commissioning procedure may vary depending on the specific type and size of the hydro power plant.

A general procedure for testing and commissioning will be established by NEA to ensure compliance with all required processes and standards, including environment and safety.

Once a hydropower plant has successfully been commissioned, the hydro energy project can then be allowed to operate and supply electricity.

5.6. OPERATIONS AND MAINTENANCE

After commissioning, the hydropower project can now be operated to generate and supply electricity. Hydropower project is the most consistent and reliable form of supplying electricity, which can operate for more than 50 to 100 years. However, it requires consistent inspections and maintenance during its operational phase.

NEA will develop guidelines and procedures to ensure operators undertake routine inspections and maintenance and provide periodic reports to NEA or as and when required.

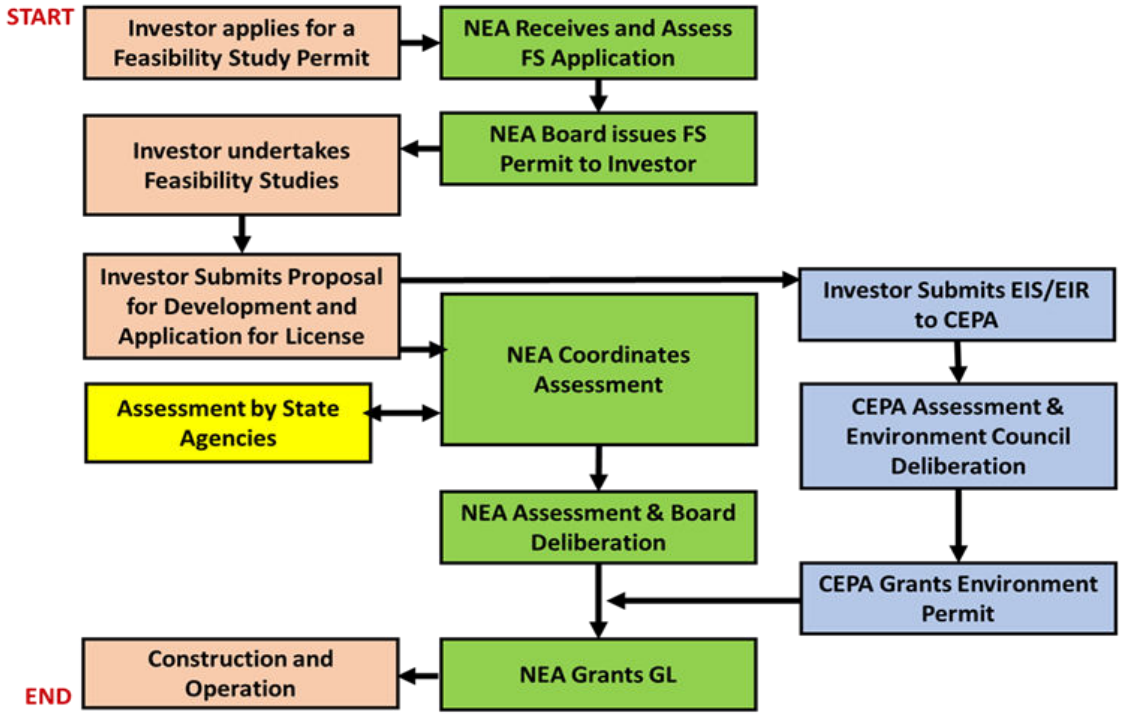
CHAPTER 6: LICENSING

6.1. HYDRO ENERGY LICENSING PROCESS

The *National Energy Authority Act* 2021 does not provide a specific licencing process or requirements for the assessment and utilisation of hydro energy. Division 1 under Part IV of the *National Energy Authority Act* 2021 provides for licencing of electricity entities and undertakers. This will be used by NEA to provide a Generation Licence to the electricity undertakers.

The licensing for energy projects is tied to the Project Development Stages discussed in Chapter 5 and the process under Annexure 1. In general, the licensing process is as outlined in *Figure 11* below:

Figure 11: Licensing process for hydro energy projects



Source: *National Energy Authority, 2025*

6.2. TYPES OF LICENCES

NEA will establish different licences to enforce standards and ensure compliance with requirements when developing and operating medium – large scale hydro energy projects. The different licences for hydro energy projects are discussed below.

6.2.1. Feasibility Study Permit

An investor or developer of a hydro energy project must apply and be issued a Feasibility Study Permit by NEA to undertake feasibility studies as discussed under Chapter 5.

The requirements of the Feasibility Study Permit and related conditions will be developed by NEA through regulations. The key requirements will be the technical and financial capability to undertake and deliver the feasibility study.

The feasibility study permit will apply to any project seeking to generate electricity from 100 kW and upwards, that is for small to large-scale projects as per the classification under Table 1 in Chapter 4.3

6.2.2. Ex-Ante Licence

This Policy recognises the challenges associated with securing finance for hydro energy projects, including obtaining a guarantee from the government to support the development of hydro energy projects. Investors for renewable energy projects such as hydro energy projects often require a guarantee or assurance from the State to secure financing and other project logistics.

The Government, through NEA may provide an Ex-Ante Licence to an investor for a medium – large scale hydro energy project. The Ex-Ante License will only be provided after the requirements of the Feasibility Study Permit are met and a proposal for development with the application has been submitted to NEA.

The investor must satisfy the following conditions for the Government through NEA to grant an Ex-Ante License.

a) Fully completed project feasibility studies submitted to NEA.

b) Submission of a project development proposal to NEA.

c) Submission of a project financial plan or economic model to NEA.

d) Declaration of the need for Ex-Ante Licence to NEA.

6.2.3. Environment Permit

Hydro energy involves the use of water resources to produce energy. The use of water is permitted and regulated under the *Environment Act* 2000. Furthermore, all project developments have environmental impacts which are also regulated under the *Environment Act* 2000.

An investor or developer of a hydro project must also comply with the requirements under the *Environment Act* 2000 and be issued an environmental permit before the construction and operation phase of the hydro project. The Conservation and Environment Protection Authority (CEPA) will also be involved in the licensing and regulation of hydro energy projects as required under the *Environment Act* 2000.

6.2.4. Generation Licence

Any hydro project that will generate 1 MW and upwards of electricity, must comply will the full licensing process and all requirements when applying to NEA for a Generation Licence to operate a hydropower project to generate and supply electricity.

The hydropower plant can only be operated to generate and supply power after being issued a Generation Licence by NEA.

The requirements of the Generation Licence and related conditions will be developed by NEA through regulations.

6.3. LICENSING OF SMALL POWER SYSTEMS AND PROJECTS

Small power systems refer to the mini, micro, and pico hydropower systems or projects are small hydropower systems that are usually off-grid and are developed to supply electricity for specific purposes. These small hydropower systems produce electricity of less than 1 MW and the full licensing process may not apply.

The small hydropower systems' investors and developers must undertake feasibility studies, if required by NEA. The feasibility study report will be submitted together with an application for the Generation Licence.

Developers of small power systems producing less than 100 kW may be exempted from undertaking any feasibility studies. They may be required to provide a project design of the small power system to NEA to be issued an electricity permit to operate a small power system to generate and supply electricity.

The requirements of the Electricity Permit and related conditions will be developed by NEA through regulations.

CHAPTER 7: PRICING AND ELECTRICITY MARKET

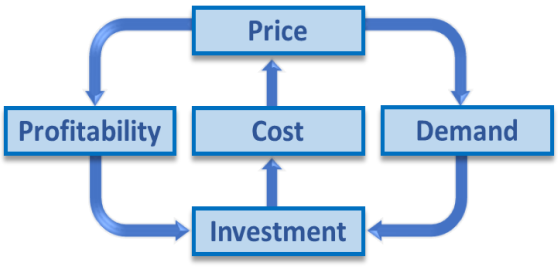
The most fundamental issue in electricity market is the price of electricity. At what price should electricity be sold to maximize economic welfare and ensure return on investment? The structure of the economy and the energy or electricity market also determines the demand for energy or electricity. Demand and supply affect the price of energy, and price also affects demand and supply.

The factors that affect the investment decision are the price, profitability (return on investment), the cost of investing, and electricity demand. Hence, in setting electricity tariffs, consideration must be given to the factors that affect investment decisions as well as the objective(s) of the government to set an affordable tariff rate.

The determination of a pricing mechanism is critical to encourage investment and development of hydro energy projects and the installation of hydro systems for small power systems in off-grid areas.

A pricing mechanism that promotes fair return on investment, especially for hydro energy projects is important as it determines the profitability and sustainability of the project in the long term.

Figure 12: Relationship between Price and Sustainability of energy generation

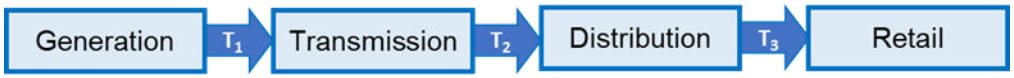


Source: *National Energy Authority, 2025*

7.1. TARIFF SYSTEM FOR HYDRO ENERGY GENERATION

Tariff is the charge between the different parts of the electricity value chain. That is generation, transmission, distribution, and retail. The current PNG tariff or price system as defined in the NEP is shown below.

Figure 13: Energy Value Chain and Tariff Points



Source: *National Energy Policy 2017-2027*

T_1, T_2, and T_3 are the three different points at which the tariffs are charged. T_1 is the tariff agreed between the IPP and the Off-Taker. T_2 is the potential tariff a transmission company charges to and is bought by the distribution company. T_3 is the retail tariff charged by the distributor to the retail customers.

The focus of the tariff system under this Policy is T_1, which is the tariff rate to be agreed between the IPP and the Off-Taker from the generation point to transmission. This tariff shall be agreed to between the IPP and the Off-Taker through a Power Purchase Agreement (PPA) as stipulated under Section 57 of the *National Energy Authority Act* 2021.

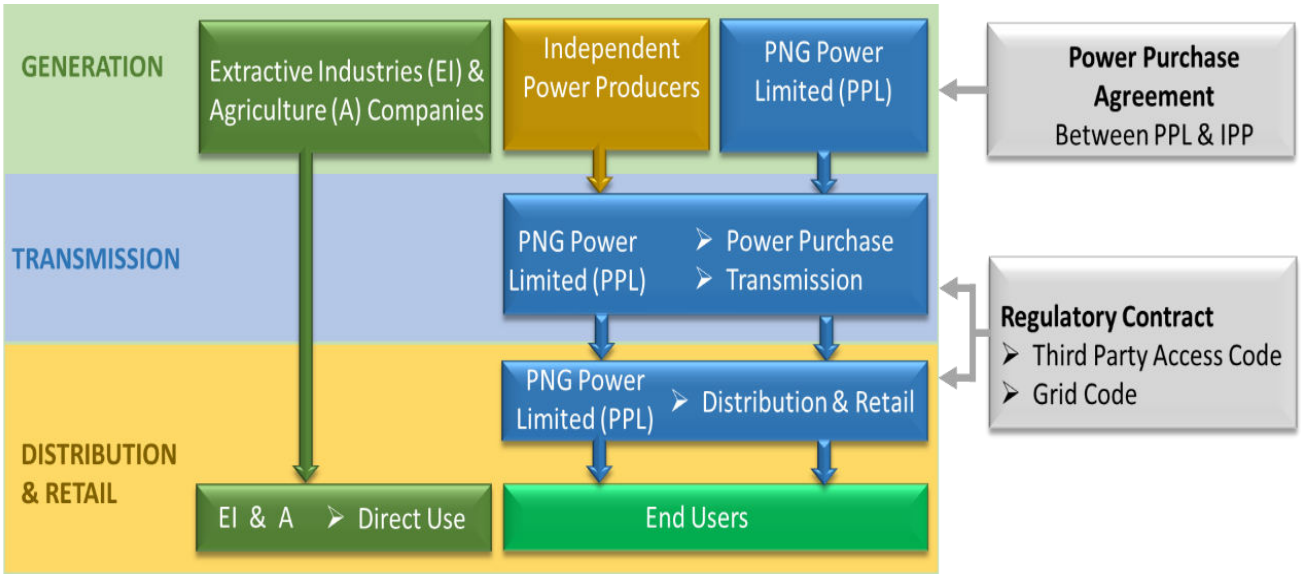
NEA will provide oversight and establish regulations for PPAs to ensure that any tariffs agreed under a PPA are in line with Section 56 of the *National Energy Authority Act* 2021.

7.2. RESTRUCTURING THE ELECTRICITY TARIFF SYSTEM

Currently PNG Power Limited applies a uniform tariff across its entire network, from generation (except power supplied by IPPs), to transmission, distribution, and retail under a Regulatory Contract. With the establishment of the NEA, the setting and regulation of the tariff will be under the On-Grid Electricity Tariff Regulation.

The current tariff system is explained in the diagram below.

Figure *14:* *PNG's Current Electricity Supply Industry*



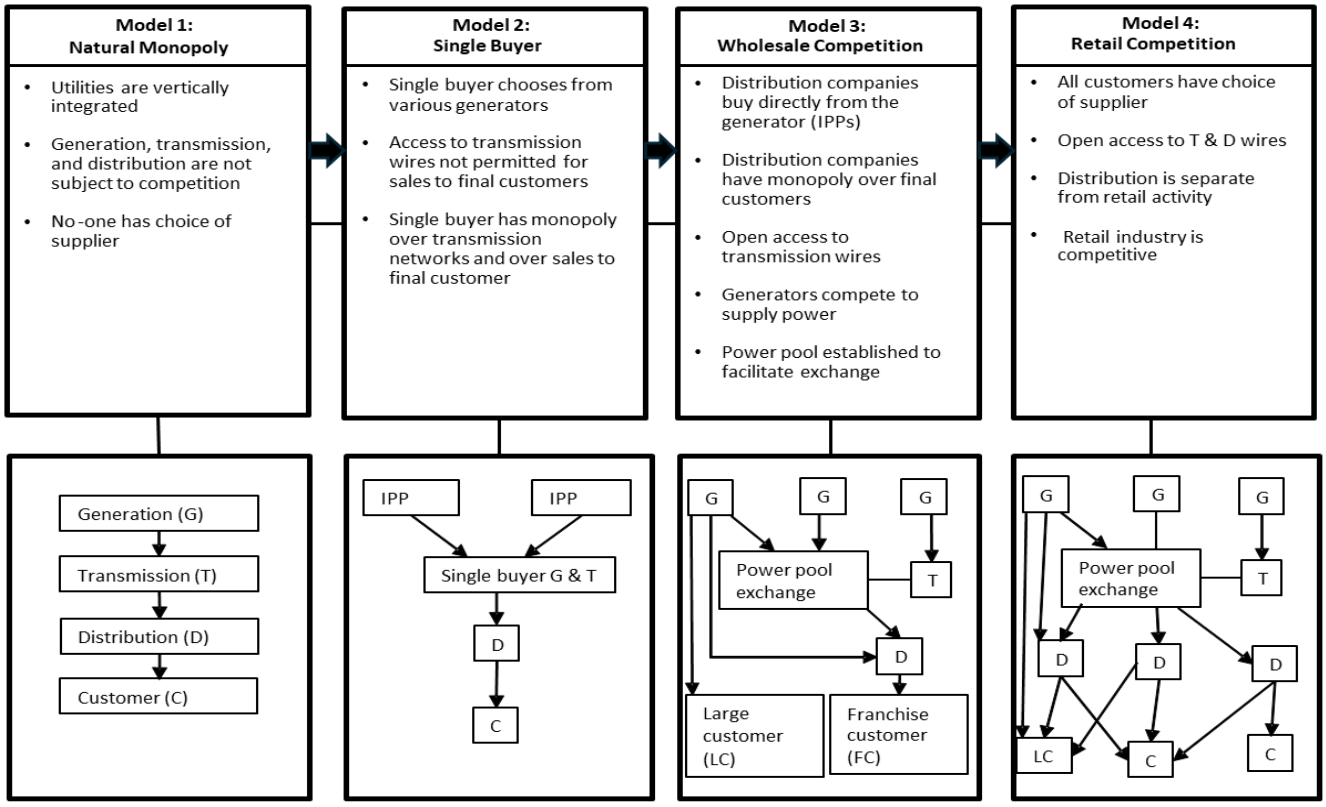
Source: *National Energy Authority (2024)*

Going forward, through NEA, the Government is taking steps to restructure the electricity industry. This includes the need to restructure the tariff system in accordance with Section 56 of the *National Energy Authority Act* 2021.

To restructure the tariff system, it is important to consider the different tariff systems and models that countries' electricity systems transition through. The Electricity Supply Industry (ESI) market structure is developed over time, and transitions from a monopolistic market to a competitive market with the developmental progress of a country. The pricing mechanism is

therefore designed based on the market structure. Four models are widely discussed and accepted around the world. These models are distinguished by the type of competition at each stage in the supply chain rather than ownership as shown in *Figure 15* below.

Figure 15: *Different Models for Integrating IPPs*



Source: *Gardiner and Montpelier (2000)*

The current PNG ESI market structure can be best described under Model 2 in the diagram above. In the long term, it is envisaged for PNG's ESI market to be at Model 4, where there is competition in the generation, transmission, distribution, and retail segments of the market. To achieve this target, the Government will have to make substantial investments in the transmission and distribution systems and encourage greater private sector participation in the generation segment.

The current tariff structure is determined by the Regulatory Contract entered between the ICCC and PPL. The Regulatory Contract is reviewed every 5 years. With the establishment of NEA, an On-Grid Electricity Tariff Regulation will be established which will supersede the current Regulatory Contract upon its expiry. All electricity tariffs will be regulated by law.

7.3. REFORMING THE ELECTRICITY MARKET

PPL is faced with many challenges in operating its three main grids of Port Moresby, Ramu, and Gazelle, and its other 19 Provincial Grids. PPL's critical challenge is the funding of its operations. The two key funding issues are the high levels of power theft and untimely payments of government utility bills resulting in PPL struggling to fund its operations and maintain its infrastructure and pay its IPPs.

Reform of the PNG's electricity market is crucial to achieving the government's objectives of having an electricity supply industry that is accessible, reliable, and affordable.

The Government through NEA will work with PPL and other relevant government agencies, including development partners to reform the electricity supply industry in the medium term, and later the long term.

7.3.1. Short to Medium-Term Electricity Market Reform

In the short to medium term, the government will focus on improving the transparency and accountability of the PPAs between the suppliers and off-takers. The government, through NEA, will develop guidelines on PPAs and provide oversight on tariff arrangements. The government will also develop an Electricity Dispatch Code for the suppliers, especially IPPs and Off-takers to maintain the supply of electricity to the demand at any given time. Such code will ensure there is a reliable power supply in the system at any given time.

The government will establish and implement the Decentralized Electricity Supply (DES) Policy with selected Provincial Governments. The operation of a Provincial Grid under the implementation of the proposed DES Policy will be cost-reflective of that Provincial Grid, which will be subjected to the On-Grid Tariff Regulation..

7.3.2. Long-Term Electricity Market Reform

In the long term, the government will focus on reforming the electricity market from the current single-buyer model to the wholesale competition model, where a robust regulatory framework is required for the establishment of a systems operator, market operator, and auction model for electricity generation.

A key factors for an effective wholesale competition model is the restructuring of the business model of the state-owned utility company. It is incumbent on the government to ensure that the PPL's business model is restructured to effectively operate in the wholesale competition market. PPL and Kumul Consolidated Holdings (KCH) will collaborate with NEA to effectively restructure PPL's business model for its operation in the wholesale competition market.

7.3.3. Off-Grid Power System

For the supply of electricity in the off-grid, the government will establish the Off-Grid Small Power System Regulation to regulate the design, installation, and operation of small power systems. The tariff regime of the small power systems will be on a willing buyer–willing seller basis.

7.4. FEED-IN TARIFF

To accelerate the development of renewable energy resources, a Feed-In-Tariff System for electricity produced from renewable energy resources, including such portion of electricity from hybrid systems directly attributable to renewable energy resources will be introduced.

NEA will establish Feed-In Tariff Regulation which will determine the rules defining:

a) Eligibility for the tariff;
b) Eligible renewable energy resources for feed-in tariff;
c) Duration of feed-in tariff power purchase agreement;
d) Principles and methodology for determining the Feed Tariff level;
e) Adjustment of feed-in tariff based on indexation formula;
f) Priority connection to the grid for renewable energy electricity producers; and
g) Priority purchase and transmission of electricity.

7.5. PRICE REGULATION

NEA is mandated under Section 121(2)(i) *National Energy Authority Act* 2021 to establish Regulations to regulate the sale and supply of electricity. This is to ensure accessibility, affordability, and consistency of electricity supply to consumers, while ensuring that the licence holder of a hydro power plant is compensated.

NEA will establish regulations and related guidelines to ensure compliance to any pricing ang tariff structure established under Section 56 of the *National Energy Authority Act* 2021. For PPAs, NEA will provide oversight to ensure the pricing structure or tariff arrangement is transparent and complies with Section 57 of the *National Energy Authority Act* 2021.

CHAPTER 8: REGULATION AND COMPLIANCE

8.1. REGULATION

Currently there are no specific laws on hydro energy projects and investments. However, as it relates to energy and the use of hydro resources, the main legislations to be used to regulate the industry will be the *National Energy Authority Act* 2021 the *Environment Act* 2000, including their related regulations. The licensing of hydro energy projects will also be undertaken under these legislations.

The Government through NEA will establish specific provisions under law, including regulations, guidelines and standards to better licence and regulate hydro energy projects.

Medium – Large scale Hydro energy projects involve other sector legislations as well, hence requiring a holistic Government approach in regulating the hydro energy subsector. NEA, being the agency mandated to regulate the energy sector, will play the leading role in coordinating Government efforts in regulating the hydro energy subsector.

Table 2: Government agencies with specific roles in the hydro energy subsector.

Government Agency	Role
National Energy Authority	Licensing and regulation of hydro energy projects exploration and development. Ensure all legal requirements are met.
Conservation Environment Protection Authority	Licensing requirements at the exploration/extraction phase. Ongoing environment regulation, mainly water extraction/discharge.
Department of Lands & Physical Planning	Deal with land and landownership issues, including compensation issues.
PNG Immigrations & Citizenship Authority	For visa requirements of employees of hydro energy projects.
Department of Labour & Industrial Relations	Enforcement of labour laws and regulations. Work permits for foreign workers.
PNG Customs	Deal with importation of project equipment and other goods.
Internal Revenue Commission	Enforcement of relevant Tax Laws.
National Institute of Standards & Industrial Technology	Establish or maintain relevant standards for hydro energy projects.
PNG Investment Promotion Authority	Company registrations and enforcement of company laws, including intellectual property laws.
Climate Change and Development Authority	For any registration or permits required for carbon credits generated from hydro energy project activities either for domestic or international transactions.

8.2. HEALTH AND SAFETY

All hydro energy operations in PNG must ensure the health and safety of its employees, the environment, project infrastructure, and surrounding communities. The developer or operator of a hydro project must comply with all relevant legislations when establishing health and safety standards.

The licence holder of a hydro licence must comply with any other legislation that affect the health and safety of its operations and adopt these standards into their risks assessment and management plans, including safety plans during all phases of development and operations. The developer must adopt the best industry technology, practice, standards, and codes into its health and safety management regime.

8.3. COMPLIANCE AND ENFORCEMENT

Compliance with laws and regulations is usually addressed or enforced by setting out defined breaches and punitive measures for the breaches. NEA will establish regulations and guidelines under Section 121 of the *National Energy Authority Act* 2021 that spells out possible breaches if not complied with.

NEA will coordinate with other State agencies in ensuring compliance with all relevant laws through the enforcement of various regulations, codes, and guidelines, including applying penalties where required.

8.4. CONTROL MECHANISM FOR IMPORTED PRODUCTS AND EQUIPMENT

To address the influx of cheap and substandard products and equipment entering the hydro energy sector, a robust control mechanism must be established to monitor and control the importation and use of such products.

NEA, in collaboration with PNG Customs Service and the Independent Consumer and Competition Commission (ICCC), will establish regulatory measures to:

(a) Ensure electricity products and technology adhere to internationally recognized quality standards, certifications, and mandatory product registration. PNG Customs Service are to enforce these regulations through pre-importation inspections.

(b) Allow for random Inspection and testing of products and technology at all ports and at distribution points.

(c) Establish and impose penalties for non-compliance, such as prosecution, fines, and confiscation of substandard products.

CHAPTER 9: TECHNOLOGY AND STANDARDS

9.1. TECHNOLOGY

PNG does not have specific guidelines on renewable energy technology, nor guidelines that are specific to hydro energy. This Policy recognizes the need to develop these guidelines that support appropriate applicable technology that conforms to industry and international standards. The long-term aim of this Policy is to establish a regulatory framework that guides the use of appropriate technology that is supported by research and development.

Any technology applied must comply with international best practices and standards. NEA will work with the National Institute of Standards and Industrial Technology (NISIT) to establish specific standards and guidelines for hydro technology. The project developers must be responsible for managing the risk associated with the operations of hydro technologies deployed within their projects and areas of responsibility. NEA, with support from relevant

State agencies, will ensure compliance with any regulations and international standards for technology.

9.2. STANDARDS

Hydro technology must meet international requirements, standards and best practises. The Government through NEA will promote standards that are compatible with hydro technology deployment, and those that are globally certified by recognised international technology regulatory bodies including International Electrotechnical Commission (IEC) and International Organization for Standardization (ISO).

Any investor or electricity provider under a hydro energy project must comply with all standards and requirements established under the *National Energy Authority* Act 2021 or any other legislation and related regulations.

9.3. ENERGY EFFICIENCY

Promoting energy efficiency in hydro energy systems is critical to achieve sustainable energy development goals of PNG. Energy efficiency can be realized through both **supply-side** and **demand-side** measures, with the adoption of modern technologies and best practices that adhere to international standards.

9.3.1. Supply-Side Efficiency Measures

Supply-side measures involve improving the efficiency of hydroelectric power generation, transmission, and distribution systems. Key technologies and strategies include:

(a) **Turbine Efficiency**: Advanced turbine designs that minimize energy losses and optimize energy output, including variable-speed turbines and low-head turbines for smaller or less consistent water flow conditions.

(b) **Automation and Control Systems**: Installing smart sensors and control systems to monitor and optimize water usage, reducing inefficiencies and ensuring that the power plant operates at peak performance.

(c) **Reduction of Transmission Losses**: Ensuring high-quality transmission infrastructure to minimize energy losses during the distribution of hydroelectric power, particularly in remote or rural areas.

9.3.2. Demand-Side Efficiency Measures

Demand-side energy efficiency focuses on reducing the overall energy consumption of end users while maintaining or improving service quality. This can be achieved through:

(a) **Energy-efficient Appliances**: Encouraging the use of appliances and equipment that meet energy-efficiency standards, such as those certified by the ISO or energy labelling programs.

(b) **Energy Storage Technologies**: Incorporating advanced energy storage systems, such as batteries, can optimize the use of electricity generated by hydro plants, ensuring that energy is available even during low-flow periods or peak demand times, thereby improving overall system efficiency.

(c) **Smart Grid Integration**: Developing smart grids that integrate real-time monitoring and control systems to optimize the distribution and consumption of electricity, avoiding energy wastage.

9.3.3. Regulatory Support For Energy Efficiency

NEA will collaborate with relevant institutions to develop standards and guidelines that enables the deployment of energy-efficient technologies. The key regulatory actions are:

(a) Setting benchmarks for Minimum Energy Performance Standards (MEPS) for hydropower systems and related technologies.

(b) Promoting the use of certified energy-efficient equipment in hydro projects through incentives in compliance with recognized international standards.

(c) Requiring developers and license holders to conduct energy system and technology audits and implement energy-efficiency improvement measures in hydro projects.

9.4. INTELLECTUAL PROPERTY (IP) RIGHTS

The Government will ensure the protection of intellectual property (IP) rights for local individuals and organizations that invent or develop energy technologies. Foreign energy investors operating in PNG must adhere to national IP laws, such as the *Trade Marks Act (Chapter 385),* the *Copyright and Neighbouring Rights Act* 2000 and the *Patents and Industrial Design Act* 2000, and other related regulations and legislations, and enter into fair agreements that recognize and compensate local inventors for the use and commercialization of their technologies.

Furthermore, local inventors and innovators are also encouraged to register, patent and trademark their inventions, should they wish to commercialize their designs and inventions through the Investment Promotion Authority's mandated Intellectual Property Office of PNG (IPOPNG). Collaboration and technology transfer must respect local ownership of innovations and foster sustainable development in the national energy sector.

CHAPTER 10: COMMERCIAL

There are certain commercial aspects that are crucial to the development and sustainability of renewable energy projects such as hydro energy projects. The main commercial aspects are taxation, incentives, and price (tariff). Other commercial aspects that are also important in PNG include the State's equity participation and monetary benefits, especially royalties that are paid to landowners.

10.1. TAXATION

The developer or licence holder for a hydro energy project must comply with the Tax laws of PNG, including any amendments to the tax laws. Any matters concerning taxation and tax arrangements will be determined by the Department of Treasury and the Internal Revenue Commission.

The Government will ensure that tax rates for the hydro energy sector are compatible, investor-friendly, and do not discriminate against any investors.

The Government may consider supporting local participation in hydro energy projects to utilize or benefit from any tax incentives under the PNG tax laws and related policies.

10.2. INCENTIVES

The Government may provide incentives to support the development and commercialisation of hydro energy projects. Any incentives provided shall be consistent with the existing laws

and policies that provide for such incentives. Relevant State agencies responsible for such incentives under respective laws and policies will be consulted for their views and approval.

The National Executive Council will determine any incentives to be provided under this Policy or for renewable energy projects.

10.3. STATE EQUITY PARTICIPATION

The State has the right but is not obligated to acquire, directly or through a nominee, all or any part of participating interest, not exceeding 20%, in each hydro energy project as stipulated under Section 83 of the *National Energy Authority Act* 2021. The State may enter into an agreement consistent with the *National Energy Authority Act* 2021 and any other relevant laws relating to the exercise of its equity entitlement.

The State may allocate its equity entitlement, consistent with the *National Energy Authority Act* 2021, to the affected Provincial Governments and landowners.

10.4. ACCESS TO CLIMATE FINANCE

Climate finance refers to funding sourced from international, regional, and national climate-related financial mechanisms, designed to support projects that contribute to reducing greenhouse gas emissions, enhancing climate resilience, and promoting sustainable development. To accelerate the development of renewable energy projects in PNG, and aligning with global climate action goals, it is essential to facilitate direct access to climate finance for both public and private investment in the energy sector.

The Government, through NEA and CCDA, will work with relevant State agencies to establish transparent and efficient processes and systems that allow for public and private investors to access climate finance for renewable energy projects such as the development of hydro energy projects.

10.5. ROYALTY

Royalty is a resource rent typically applied to finite, non-renewable resources like minerals, oil, and gas. When these resources are extracted and sold to generate revenue, royalties ensure a portion of this revenue is shared with the resource-owning country. In PNG, royalty is paid to the State who then grants a portion to the landowners in the extractive industry. It is a rate applied on the amount of minerals, petroleum products, and timber exported, or the amount of revenue generated from sales of these resources.

Unlike minerals or other finite, non-renewable resources, hydro energy is a renewable energy resource, which utilises available natural water sources and the Earth's gravity to generate electricity by passing water through and spinning a generator turbine after which the water is released back into the natural waterway. The electricity generated is then sold to an off-taker at a price (tariff). The water is not extracted or consumed, furthermore, no person owns the water or the Earth's gravity, therefore, the royalty concept in the extractive industry cannot be applied in hydro projects.

Government through NEA will review Section 82 of the *National Energy Authority Act* 2021 to ensure that Royalty is not paid for hydro energy projects to the State or any landowners for water utilised to produce energy. Instead, there will be consideration for compensation for land for which the water is stored or the land that is used to establish the infrastructure for hydro energy projects.

10.6. SUBSIDY

Capital cost subsidies are the primary mechanism for funding rural electrification programs as it contributes to reducing the cost of generators and the distribution grid. The subsidies can be through government funding, grant or concessionary loans. This allows for renewable energy projects, such as hydro, to be able to charge affordable tariff to recover the initial capital costs, including any difference in remaining cost of operating the system.

NEA will collaborate with relevant Government agencies to introduce regulations and schemes to support rural electrification, mostly small - medium scale community-based projects.

CHAPTER 11: ENVIRONMENT

11.1. COMPLIANCE WITH ENVIRONMENT REQUIREMENTS

The development and construction of hydro energy projects may have a wide range of environmental effects. These impacts can be categorized into several key areas including ecological, hydrological, geological, social, and economic. The developer or holder of a licence for a hydro energy project shall comply with all requirements for environmental management under the *Environment Act* 2000.

11.2. WASTE MANAGEMENT

The developer or holder of a generation licence for a hydro energy project, where required, shall submit a waste management plan to NEA and CEPA. The waste management plan must be consistent with the requirements under the *Environment Act* 2000. The waste management plan must include, but not limited to:

a) Water extraction, usage, storage and discharge

b) Surface Disturbances

c) storage and disposal of waste;

d) strategies for waste avoidance, reduction, or mitigation;

e) monitoring systems considering the health and safety aspects of the environment and the surrounding communities;

f) disaster management and response strategies; and

g) such other information as may be required by CEPA or NEA as prescribed under any law in PNG.

The developer or holder of a licence for a hydro energy project will be required to periodically update the waste management plan as and when required by CEPA and NEA. Treatment of waste must be done in accordance with the *Environment Act* 2000 and any other related standards and regulations.

11.3. CONSERVATION OF HYDRO CATCHMENT AREAS

The long-term sustainability of hydro energy projects in PNG depends on the health and preservation of the surrounding natural environment, particularly forests. The conservation of forests is essential for maintaining the water balance, preventing erosion, and promoting biodiversity within hydro catchment areas. Healthy forests absorb rainfall, regulate water flow, and reduce sedimentation, which enhances the efficiency and longevity of water catchment areas that sustain hydro energy projects in the long run.

NEA will collaborate with the CEPA and the PNG Forest Authority (PNGFA) to consider options to ensure the sustainability of water catchment areas of hydro energy projects.

11.4. REHABILITATION AND CLOSURE

A plan for ongoing rehabilitation of the environment and hydro resources must be developed and submitted to CEPA and NEA by the holder of a generation licence. CEPA and NEA shall ensure the holder of a generation licence complies with the rehabilitation plan.

Should the licence holder of a generation licence for a hydro energy project or operator decide to shut down a hydro energy project or any parts of the hydro energy project, they have to undertake a proper closure in accordance with existing policies and laws. This may include the requirement to submit a closure plan.

CHAPTER 12: CLIMATE CHANGE

12.1. COMPLIANCE WITH CLIMATE CHANGE REQUIREMENTS

The Government through NEA in collaboration with CCDA shall ensure that a developer or holder of a licence for a hydro energy project complies with:

a) The *Climate Change Management Act* 2015 and its subsequent amendments.

b) Specific provisions under the Climate Change Carbon Markets Regulations, the Nationally Determined Contributions (NDC), and any related guidelines.

c) Articles of the Paris Agreement 2015 and its subsequent Conference of Parties (COP) decisions and any other future climate change international treaties under the United Nations Framework Convention on Climate Change (UNFCCC).

d) The international UNFCCC's Inter-governmental Panel on Climate Change 2006 (IPCC-2006) Guidelines.

12.2. DOMESTIC SHARE OF CARBON CREDITS

Carbon credits serve as an incentive for private investment in renewable energy projects such as hydro. By investing in hydro energy projects, an investor or holder of a generation licence can earn credits for their sustainable practices as they contribute to the reduction of their carbon footprint, and support initiatives that drive global climate action.

In recognizing the ownership rights of hydro energy project area landowners, a twenty percent (20%) domestic share of proceeds shall apply to every disclosed credit contained in the inventory of a medium-large scale hydro energy project. This emission reduction or emission avoidance credits shall be obtained from the entire operations, including any activity related to the project and or within the project licensed area. This 20% will be managed as part of other project benefits to landowners.

12.3. JUST TRANSITION PATHWAYS

Renewable energy projects such as hydro energy projects support climate change mitigation through energy transition. Just Transition, as defined by IPCC, is a set of principles, processes and practices that aim to ensure that no people, workers, places, sectors, countries or regions are left behind in the transition from a high-carbon to a low carbon economy.

This Policy aims to promote a Just Transition pathway in technology deployment, training and reskilling of the workforce, infrastructure, management, and socioeconomic development. The Government through NEA will support and promote a Just Transition in the implementation of this Policy through socioeconomic strategies and directions provided under this Policy.

12.4. PROMOTING DECARBONIZATION

The development of hydro energy projects will contribute to reducing greenhouse gas (GHG) emissions. This Policy aims to support PNG's decarbonization efforts by reducing dependency on fossil fuels and lowering greenhouse gas emissions. This will be achieved through strategies such as developing hydro energy projects, integrating hybrid energy systems, and improving energy efficiency in both supply and demand.

NEA, in collaboration with CCDA, will ensure there is carbon accounting, monitoring, and the adoption of low-carbon development practices. To incentivize decarbonization, the Government may consider providing tax breaks, facilitate for climate finance, and consider Feed-in Tariff, where applicable.

CHAPTER 13: LAND AND LANDOWNER MOBILISATION

13.1. ACCESS TO LAND

Access to land for hydro energy projects shall be facilitated or acquired under the *Land Act* 1996 by the developer or licence holder of a hydro energy project.

For customary land, the customary landowners and persons having an interest in the land are properly consulted and their free prior informed consent is obtained before the acquisition process is executed or any development takes place. If required, the holder of a hydro energy feasibility permit or generation licence must enter into a land access agreement with the landowners before entering the land to undertake feasibility studies, project development, or electricity generation.

Any damages or inconvenience caused to the land, environment, or landowners, shall be subject to compensation under a compensation agreement.

Small power systems and community-based projects may not require land access and compensation agreements. For any medium – large scale projects that have landowner support to waiver any land access agreement or compensation, must inform and register that consent or agreement with NEA.

13.2. LANDOWNER IDENTIFICATION

During the feasibility stage, before undertaking any project development, the developer or holder of a licence must undertake landowner identification and social mapping studies of the area proposed to be impacted by the hydro energy project.

The scope and method for social mapping or landholder identification study will be determined under the *National Energy Authority Act* 2021 or through related regulations.

13.3. SOCIAL IMPACT ASSESSMENT

The developer or holder of a licence must conduct social impact assessment and related studies as part of the feasibility studies. The process for the identification, analysis, assessment, management, and monitoring of the potential social impacts of a project, will be determined by NEA in collaboration with relevant Government agencies.

13.4. LANDOWNER PARTICIPATION

The Government will ensure that landowners participate and benefit from the development and operation of hydro energy projects if there are benefits and opportunities for landowners.

Landowners will participate through recognised ILG groups or associations, as the case may be, agreed to by the landowners.

13.5. LAND BOUNDARY DEMARCATION AND RECORD KEEPING

Proper land boundary demarcation and the timely recording of land information are critical to the successful development of hydro energy projects. Clear land boundaries help avoid disputes, ensure transparent land transactions, and safeguard both landowner rights and investor confidence. All established land administration processes under the *Land Act* 1996 must be complied with to ensure proper land management for hydro energy projects.

For customary land involving more than one landowner, there must be a clear demarcation of land boundaries, which would involve formal surveys conducted by registered surveyors and active participation from customary landowners to ensure traditional boundaries are respected.

CHAPTER 14: NATIONAL CONTENT

National content refers to the activities and benefits, including community assistance, that can be provided to landowners and impacted communities of the specific resource project, such as a hydro energy project. If required, national content will be discussed and agreed to in a National Content Forum in accordance with Section 80 of the *National Energy Authority Act* 2021, with the outcome captured in a benefit-sharing agreement or such other arrangements on benefits sharing.

When developing hydro energy projects, a developer or investor must consider other uses of stored water, as discussed under Chapter 4.4., and provide opportunities for landowners and Papua New Guineans.

NEA, in consultation with relevant Government agencies, will develop guidelines or specific policies to proper define and guide national content in renewable energy projects.

14.1. APPLICATION OF NATIONAL CONTENT

The National Content provisions under this Policy only applies to medium – large scale energy projects, which may have a bigger impact on the environment and cause displacement of people due to large water storage (dam area).

The application of National Content is subject to the classification of the hydro energy project, and the opportunities that can potentially be created by the project. Opportunities for National Content must be explored as part of the feasibility studies and discussed as part of any project agreement.

Table 3: Application of National Content for Hydro Energy Projects

Classification	Application of National Content	Comments
Large-Scale Hydro Project	Yes	National Content shall apply for large-scale hydro energy projects which usually have a bigger impact on the environment and communities. National Content only applies if there are spin-off activities that can be off-loaded to landowners. Consideration for other uses of water to promote National Content. Compensation to be considered.
Medium Scale Hydro Project	Yes / No	National Content may apply if the hydro energy project has a bigger environmental impact, and if there are some spin-off activities that can be off-loaded to landowners. Consideration for other uses of water to promote National Content. Compensation to be considered.
Mini Hydro Project	No	National Content, including compensation, does not apply.
Micro Hydro Project	No	National Content, including compensation, does not apply.
Pico Hydro Project	No	National Content, including compensation, does not apply.

14.2. NATIONAL CONTENT FORUM

For medium – large scale projects that may have a bigger impact and produce greater benefits to the landowners and impacted communities, the Minister may call a National Content Forum before the commencement of construction for all stakeholders as stipulated under Section 80 of the *National Energy Authority Act* 2021.

14.3. EMPLOYMENT AND TRAINING

The developer or licence holder for a medium – large scale hydro energy project shall provide employment and training in accordance with the labour laws of PNG. Where required, they shall submit an Employment and Training Plan consistent with Section 84 of the *National Energy Authority Act* 2021.

The developer or licence holder for a hydro energy project shall submit an annual report to the Managing Director of NEA on the implementation of the Employment and Training Plan.

14.4. BUSINESS DEVELOPMENT

The developer or licence holder for a medium – large scale hydro energy project must provide business development and spin-off opportunities to landowners and Papua New Guineans consistent with Section 85 of the *National Energy Authority Act* 2021. The business development opportunities may be in the form of sub-contracts, transport services, security services, construction, building maintenance, office supplies, and other opportunities that may be agreed to in any agreement on business spin-off activities.

The developer or licence holder for a hydro energy project, where required, must submit a Business Development Plan if there are any business opportunities that will be provided to the landowners.

The developer or licence holder for a hydro energy project must submit an annual report on the implementation of the Business Development Plan to the Managing Director of NEA.

14.5. COMMUNITY DEVELOPMENT ASSISTANCE

The developer or licence holder for a medium – large scale hydro energy project must consider providing community development assistance to the affected communities and landowners consistent with Section 86 of *the National Energy Authority Act* 2021.

The community development assistance can be part of its National Content obligations or corporate social responsibility to any impacted communities.

14.6. COMPENSATION

The developer or licence holder for a medium – large scale hydro energy project shall pay compensation, in respect of his entry or occupation of land that is the subject of the licence, to the landowners of the land for all loss or damage suffered or foreseen to be suffered by them. Compensation under this policy is subject to Section 135 of the *National Energy Authority Act* 2021. The compensation to which landowners are entitled includes compensation for:

(a) being deprived of the possession or use of the natural surface of the land; and

(b) damage to the natural surface of the land; and

(c) severance of land or any part thereof from other land held by the landholder; and

(d) any loss or restriction of a right of way; and

(e) the loss of, or damage to, improvements; and

(f) in the case of land under cultivation, loss of earnings; and

(g) disruption of agricultural activities on the land; and

(h) social disruption or displacement.

The rates for compensation shall be determined with reference to the values or rates as determined by the Valuer-General and such values or rates shall only be used as a reference, or base rate or minimum rate.

The NEA will coordinate any meetings and discussions on compensation and facilitate any compensation agreement. NEA will establish regulations and guidelines that guide the process for compensation agreements.

Should the developer or licence holder and landowners not agree to the rates for compensation, the Minister may make a determination of the rates. The determination by the Minister shall be final and captured in the compensation agreement. Furthermore, if there is a dispute about landownership, compensation payments shall be withheld and managed by the Managing Director of NEA until such a time the dispute is settled.

Any compensation agreement reached for a hydro energy project shall be kept in the Register established under Section 79 of the *National Energy Authority Act* 2021 as part of a respective hydro energy project licence.

14.7. RESETTLEMENT

If required, the developer or holder of a generation licence of a hydro energy project shall submit a resettlement plan during the application for a license. The resettlement plan must contain the developer's plan on how to undertake the resettlement of landowners whose villages or settlements will be affected as a result of the development of a hydro energy project.

NEA will coordinate with relevant Government agencies to review and approve the resettlement plan. The developer or holder of a generation licence shall implement the

approved resettlement plan and provide reports to NEA on an annual basis. NEA, with support from relevant Government agencies, will monitor the implementation of the resettlement plan.

The details and structure of a resettlement plan will be determined by NEA in collaboration with other Government agencies.

14.8. BENEFITS MANAGEMENT

The National Goals and Directive Principles under the Constitution call for equal sharing of wealth for all Papua New Guineans. It is the Policy of the Government through any resource project or development for benefits to flow to Sub-National Governments and landowners of project areas. The Government intends that any hydro energy project must bring benefits to the Government, landowners, and impacted communities.

If there are benefits from any medium – large scale hydro energy project as defined by relevant laws and policies, the Government through NEA, will ensure that these benefits flow to landowners and impacted communities. The impacted landowners and communities will be required to have a benefit-sharing agreement with any developer or licence holder of any hydro energy project to ensure that the benefits are shared amongst the intended beneficiaries.

The Government through NEA will ensure that appropriate mechanisms are established to manage benefits for the landowners and impacted communities for the long term. This may include holding accounts, trust arrangements, and investment funds. The distribution and management of benefits shall be discussed and agreed to in a National Content Forum.

14.9. WOMEN IN ENERGY

The role of women in renewable energy development and operation must be given importance through a gender inclusive approach by promoting gender equality and women's rights.

Some issues and constraints related to renewable energy project success are gender specific and stem from gender disparities and traditional roles men and women play. As part of the social and landowner identification studies, a developer or holder of a generation licence must undertake gender analysis to understand the distinct cultural and socially defined roles and tasks that women and men undertake within the households and in the community.

14.10. ALTERNATE USES OF STORED WATER

Stored water in hydropower reservoirs can be utilized for various purposes beyond electricity generation. Key alternative uses include supporting, agriculture through irrigation, providing water for fish farming, promoting tourism and recreation, supplying drinking water to nearby communities, and aiding in flood control. These additional benefits help maximize the economic and social value of hydropower projects, making them crucial for sustainable regional development. Refer to the *Annexure 3* to further explain the above.

CHAPTER 15: AGREEMENTS

Any project development requires different commitments from different stakeholders. Most times, investors and developers require project development contracts with the Government or State on different commercial arrangements on fiscal and regulatory matters. Other agreements include benefit-sharing arrangements between different beneficiaries of a project, and compensation agreement which sets the basis and areas for compensation.

For energy projects, an important agreement is the Power Purchase Agreement (PPA) between the producer and off-taker of the energy. The PPA sets the terms of the commercial arrangements for the supply of electricity, especially on tariff arrangements.

15.1. PROJECT DEVELOPMENT CONTRACT

The State through NEA, upon approval by the National Executive Council, may enter into any agreement consistent with relevant laws of PNG relating to the development of a medium - large scale hydro energy project. The agreement may contain provisions relating to:

(a) the circumstances or the manner in which the Minister or Managing Director or a Departmental Head shall exercise any discretion conferred by any law dictating that discretion;

(b) the Government's obligations to support the development of a hydro energy project; and

(c) sharing of benefits; and

(d) the acquisition of an equity interest by the State either directly or indirectly in a hydro energy project; and

(e) the settlement of disputes arising out of, or relating to the agreement or the administration of any law, including provisions relating to the settlement of any such dispute; and

(f) any other matter connected therewith as the parties to the agreement may consider necessary.

In the event there is a conflict between the provisions of any agreement entered into under this Policy and any other law, the provisions of the respective laws shall apply.

15.2. BENEFIT SHARING AGREEMENT

If there are any benefits from hydro energy projects to landowners or Sub-National Governments, these benefits shall be captured in a Benefit Sharing Agreement (BSA). The BSA will determine the benefits and how these benefits are distributed and administered. The BSA will be agreed to by the stakeholders in a National Content Forum. Parties to a National Content Forum will include the licence holder of a hydro energy project, the National Government, host Sub-National Governments, and the landowners. The BSA shall only be for medium – large scale hydro energy projects.

NEA will develop mechanisms for benefits distribution and management to ensure any benefits emanating from hydro energy projects are sustainably managed and used for the benefit of all landowners and impacted communities.

15.3. COMPENSATION AGREEMENT

Hydro energy projects and related activities have the potential to disrupt the environment and inconvenience the livelihoods of the landowners. Hence, any developer or holder of generation licence for a hydro energy project is required to pay compensation to the landowners and impacted communities.

The developer or the holder of a generation licence and landowners must enter into a Compensation Agreement before the developer enters onto or occupies the land to develop a hydro energy project.

15.4. POWER PURCHASE AGREEMENT

The Power Purchase Agreement (PPA) is the main contractual agreement between energy buyers and sellers. The holder of a generation licence for a hydro energy project and the Off-Taker shall enter into a PPA on the details of power purchase and other arrangements.

NEA will establish the regulations and related guidelines as stipulated under the *National Energy Authority Act* 2021. NEA will provide oversight of the PPAs to ensure the pricing

structure or tariff arrangements comply with Section 56 and 57 of the *National Energy Authority Act* 2021.

A PPA will not be required for the licence holder of a hydro energy generation licence who generates electricity for private consumption (auto producer).

15.5. OTHER AGREEMENTS

Hydro energy project stakeholders and parties may enter into any other agreement or understanding concerning matters relating to a hydro energy project. However, such agreement or understanding must be subject to and comply with the relevant laws of PNG and the policies of the Government.

CHAPTER 16: DISPUTE RESOLUTION

16.1. DISPUTE RESOLUTION MECHANISM

Disputes refer to all disagreements that arise between various stakeholders concerning a hydro energy project that cannot be sorted out amicably within a reasonable time. Should such disputes arise, NEA will initiate a dispute resolution process to settle the disputes.

The Government through NEA will establish regulations and guidelines, including a dispute resolution mechanism, to administer and resolve any disputes.

16.2. ARBITRATION

If parties continue to disagree and cannot settle the disputes, the parties may refer the disputes to an independent third party for arbitration under the *Arbitration Act* 1951. Further disputes may be referred to the PNG Courts under the Alternate Dispute Resolution process.

CHAPTER 17: INFORMATION AND REPORTING

17.1. ACCESS TO INFORMATION

The Government through the NEA under respective legislations shall require any investor or company operating a hydro energy project to provide all required information concerning a hydro energy project. The request for information shall be through official correspondence signed by the Managing Director for NEA.

All information provided shall be kept confidential and used for intended purposes only. Failure to provide information by any investor or company shall be subject to respective legislative processes for penalties.

17.2. REPORTING REQUIREMENTS

All investors and companies undertaking or operating hydro energy projects shall be required to provide reports to NEA or any of the other Government agencies, whose roles are defined under this policy. Reporting requirements will be enforced under the various legislations, especially Section 51 of the *National Energy Authority Act* 2021. Other agencies may also enforce their reporting requirements such as relevant provisions of the *Environment Act* 2000, and other relevant legislations.

CHAPTER 18: POLICY IMPLEMENTATION

This chapter is presented in two parts. The first part discusses the administration of this Policy. The second part identifies the strategies for implementing this Policy in delivering hydro energy projects, and to achieve the mission and objectives of this Policy.

18.1. POLICY ADMINISTRATION

18.1.1 National Energy Authority

The government solely decides on the formulation and implementation of this Policy for public purposes. This Policy will come into operation with effect commencing from the date of its publication and will remain in force until superseded or modified by another policy. The Policy will be reviewed as and when required.

The NEA as the mandated agency under the *National Energy Authority Act* 2021 will administer this Policy in collaboration with relevant State agencies, development partners, and other stakeholders.

18.1.2 Other Agencies

The implementation of this Policy will require support and action from other Government agencies through various legislations.

18.2. POLICY IMPLEMENTATION STRATEGIES

This section is focused on the approaches to implement this Policy. The strategies are based on addressing external factors that are likely to affect renewable energy growth in the future and internal capabilities.

Figure 16: Policy Implementation Strategy Linkages

Source*: National Energy Authority, 2025*

18.2.1. Legislative Reforms

There is no specific legislation on hydro energy development and operation. The Government through NEA, with support from relevant State Agencies, will review the existing legislative and regulatory framework and initiate legislative reforms. These reforms will support the development and operation of hydro energy projects, including the deployment of new technologies that support reliable and affordable energy.

Legislative Reforms will include, but not limited to:

- Provide a clear definition of hydro energy project or system.
- Define the licensing process of hydro energy projects.
- Industry-specific regulations and mechanisms for enforcing compliance.
- Provisions for ensuring the sharing of information and reporting.
- Establishing a tariff system with related regulations.
- Clearly define benefits and sustainable management of the benefits.
- Create links to other legislations for regulatory purposes.
- Legislative framework that supports partnerships and collaboration.
- Other legislative reforms that will give effect to the implementation of this Policy.

18.2.2. Partnerships

Establishing partnerships is important to address social, environmental, financing, and economic issues and to ensure the effective delivery and operation of hydropower projects. Partnerships and engagement should be multi-level and at different stages of a hydro energy project development and operation. Key stakeholders, among others, for effective partnerships are:

a) Provincial Government (PG), Local Level Government (LLG), and District Development Authority (DDA)

The PGs and LLG's are established under the *Organic Law on Provincial Governments and Local-level Governments* 1998 (OLPLLG). The purpose of establishing PGs and LLGs was to promote equal opportunity and participation in the government at all levels. Furthermore, it was to ensure basic human needs and development goals are administered and achieved at all levels.

DDAs, established under the *District Development Authority Act* 2014, are statutory authorities in PNG that are responsible for managing and spending funds on local service infrastructure and delivery, including providing administrative support to LLGs at the district level.

These Sub-National Governments (PGs, LLGs, and DDA's) will play an important role in the implementation of this Policy to support the development of hydro energy and other renewable energy projects. These subnational governments will provide leadership to support NEA and any investor in land and landowner mobilisation, including addressing disputes and conflicts.

Sub-National Governments can also invest in hydro energy projects, or through PPP arrangements to generate and supply electricity within the provinces and districts.

NEA will build partnership and work collaboratively with the Sub-National Governments.

b) Development Partners

Development Partners (DP) continue to play an important role in the energy sector in PNG by providing technical support, infrastructure development and investing in rural electrification programs. The implementation of this Policy will require close collaboration with development partners to continue to implement energy programs and to further improve the policy and regulatory framework for the energy sector.

NEA will continue to collaborate with DPs in the implementation of this Policy.

c) Private Investors

Private investors play a key role in the development of renewable energy projects such as hydro. PNG needs investments in the renewable energy sector such as hydro energy projects, which are capital intensive with a lot of risks. Private investors bring in the financial resources and take risks to invest in renewable energy projects.

The Government recognises the role of private investors in PNG's energy sector through the deployment of finance and technology in renewable energy development. This provides the direction to create an enabling environment that supports and promotes private investments in hydro energy projects.

d) Landowners & Impacted Communities

Most of the land in PNG is customarily owned, either individually or communal. Landowners are considered an important partner under this Policy for any hydro energy project development. Therefore, the Government through NEA, and any developer of a hydro energy project, will work closely with landowners to ensure landowners participate and benefit from any project development.

Consideration will also be given to impacted communities of medium-large scale hydro energy projects to ensure there are considered for any possible benefit and participate in any development.

e) Civil Society and Non-Government Organisations (NGO)

The Civil Society and NGO's play an important role in the development of renewable energy. They can empower communities in energy transition to develop renewable energy projects such as community hydro energy projects, including sourcing finance to finance energy projects. Civil Society and NGO's can also empower communities through capacity building, decision making, and in ensuring a Just Transition.

The Government through various platforms, will support Civil Society Organisations and NGO's that support Government's goals and targets in the energy sector.

f) Academia and Research Institutions

Academic and research institutions are important partners in the energy transition as they are responsible for research and to provide the source of knowledge on new technology and development. These institutions have research and technical expertise that can support the implementation of this Policy, especially in the deployment of technology for small power systems for rural communities.

NEA will establish partnerships with the academic and research institutions to support the implementation of this Policy and technical support to development of renewable energy projects.

g) Financial Institutions

Finance institutions, both domestic and international, are considered important partners as they are responsible for providing the much-needed private capital for renewable energy projects such as hydro development.

The Government through NEA aims to create linkages with financial institutions to support the development of hydro energy projects, especially the small – medium scale projects.

18.2.3. Community Engagement

Hydropower projects are usually located and established in rural areas. In PNG, land is owned by communities, including ownership and user rights to rivers and waterways. These rights are usually affected through the development of hydropower projects. Therefore, there must be community engagement strategies and partnerships with local communities to address these issues and ensure the delivery of hydropower projects.

Community engagement approaches must enhance community participation and empowerment through inclusive engagement, collaboration, and transparent decision-making. There must be capacity-building programs, local employment initiatives, and benefit-sharing mechanisms that contribute to community development.

18.2.4. Increase Private Investment

This Policy is aimed at driving private investment in hydro energy projects. Often governments, in trying to address growing electricity demand, undertake hydropower projects that take time to complete or are abandoned. This is because medium – large scale hydro energy projects are capital-intensive and require technical expertise.

The Government's role through this Policy is to create an enabling environment that allows for private investment in hydro energy projects. The Government can participate through public-private-partnership arrangements.

18.2.5. Public-Private Partnership

To achieve a successful development and implementation of hydro energy projects, the government recognizes the importance of fostering collaboration between the public and private sectors. The establishment of clear Public-Private Partnership (PPP) arrangements is crucial to mobilizing private capital, technology, and expertise while leveraging public resources and regulatory frameworks to accelerate project development.

The objectives of PPP in hydro energy development focuses on attracting private investments by creating transparent and stable conditions, leveraging public resources for private sector involvement, and ensuring project sustainability through long-term collaboration. Key elements of these arrangements include a formal contractual framework that outlines roles and responsibilities, various PPP models such as Build-Operate-Transfer (BOT) and Joint Ventures, and incentives for private participation, including tax breaks and guaranteed revenue streams through Power Purchase Agreements (PPAs).

Institutional support for implementing PPPs will primarily be provided by NEA, which will oversee project bidding and contract negotiations, while the Public-Private Partnership Centre will offer technical assistance and advisory services. Robust risk management strategies will be established, detailing risk allocation and dispute resolution mechanisms to address potential conflicts. Furthermore, NEA will implement a comprehensive monitoring framework for performance assessment and conduct periodic reviews to

ensure that projects meet financial and environmental objectives, allowing for necessary adjustments to the PPP framework as needed.

18.2.6. Incentives

Medium – large scale hydro energy projects require a long and complex development phase as they are capital-intensive and require a lot of planning and design work. Many private investments in large hydro energy projects in emerging markets have shown that there is a disconnect between the lifespan of hydro energy projects and the debt maturities that are offered by their financiers. While hydro power plants can be exploited for more than 50 years, debt tenors from financial institutions are rarely longer than 15-18 years. Therefore, tariffs have been heavily front-loaded to meet debt service obligations, with debt-equity gearing driven down to preserve higher debt-cover ratios. This has made privately funded hydro power projects less competitive than many other power sources.

The Government will therefore consider incentives to drive private investments in hydro energy development. These incentives may include:

- A Feed-In-Tariff system.
- Tax concessions and tax holidays.
- Zero-rate or reduce tax and import duties on materials and equipment for hydro power projects.
- Subsidies for small and hybrid hydro energy systems.
- Undertake PPP arrangements.

18.2.7. Electricity Market Reforms

The current electricity market in PNG is dominated by PPL, which controls most of the generation, transmission, distribution, and retailing of electricity in major cities, towns, and few districts. There are few IPPs that also participate in the generation of electricity. PPL is currently faced with a lot of problems in ensuring a reliable, affordable, and consistent power supply. PPL is also faced with high costs related to the operational cost of aging infrastructure and power purchase from IPPs.

This needs a holistic approach to reform the electricity market in PNG. In the medium to long term, the Government through NEA will work with PPL and relevant Government agencies to reform the electricity market. Some of the key reform areas are:

(a) Unbundling of the electricity market to open up the market for generation, transmission, distribution, and retail of electricity.

(b) Decentralising unprofitable mini-grids in provincial towns by allowing private investments or public-private partnerships to generate, transmit, and distribute electricity.

(c) Provide incentives to support private sector investments in renewable energy generation.

(d) Establish regulations and guidelines to ensure a competitive, affordable, and cost-reflective tariff system.

(e) Consider a new business model for PPL that will ensure cost recovery and viability going forward in its operations.

18.2.8. Human Capacity Development

Human capital encompasses the collective skills, knowledge, and experiences within a workforce, derived from both formal education and informal learning. The growth and development of an economy and society are also reliant on the energy sector through

renewable energy investments such as hydro energy projects, which are driven by human capital development. Any increases in human capital investment leads to significant improvements in the hydro energy project capabilities and social well-being of the host communities and the country.

The transformation of the energy sector, particularly the ongoing transition towards clean and renewable energy sources, is heavily influenced by the rapid deployment of advanced technologies. Therefore, any strategy for human capital development in hydro energy projects must enhance human capacity in technology advancement. There is a burgeoning demand for a workforce that is not only technically proficient but also creative and adaptable to new challenges. This demand extends to the need for specialists in digital technologies, underscoring the importance of educational investments in relevant courses, and degree programs, as well as the micro-credentials that are gaining popularity in recent years as an alternative to traditional higher education. Additionally, the shift requires human capital with expertise in new policy and regulatory frameworks. Furthermore, skills in sustainability and environmental management are becoming crucial as these areas increasingly intersect with the energy sector's transformation.

18.2.9. Framework for Robust Monitoring and Reporting

Monitoring and reporting are important strategies to ensure the effective implementation of the policy. Continuous monitoring will be undertaken by NEA in accordance with the monitoring and evaluation framework discussed under Chapter 20.1. of this Policy.

Annual reports will also be provided to the Government on the implementation of this Policy in achieving the objectives against the long-term targets for the energy sector.

18.2.10. Research & Development

The energy sector in PNG is evolving rapidly, driven by increasing demand for electricity and advancements in technology. Recognizing the vast potential of PNG to harness its natural resources to contribute significantly to the nation's energy mix, this Policy emphasizes the importance of research and development to foster innovation and efficiency in the electricity industry. Specific regulations and standards will be developed in alignment with the *National Energy Authority Act* 2021, ensuring a framework that supports sustainable energy growth, enhanced technical capacity and adaptation to technology.

CHAPTER 19: RISKS

Hydro energy is an important option as a clean renewable source of energy under the current climate change and energy security environment. The existence of hydro potential presents PNG with the potential to diversify its energy mix. Hydro energy in PNG remains largely underdeveloped but has enormous potential, which is yet to be fully explored and utilized. This imposes risks on investment decisions for hydro energy projects.

Furthermore, the process involved in developing a hydro energy project involves certain risks that affect decisions at different stages of project development and commercialisation. There are also regulatory and policy risks that impact project decisions and development.

Under this Policy, the risks are identified and divided into two main categories. The first category is risks that may affect the implementation of this Policy. The second category comprises of risks that are related to a hydro energy project.

19.1. POLICY IMPLEMENTATION RISKS

Policy risks which may affect the implementation of this policy are identified and discussed below:

a) Overlapping institutional arrangements

Different laws and regulations under different institutions can result in overlapping institutional arrangements and jurisdictional conflicts. This is a norm in governments that must be addressed, not just in PNG, but across different jurisdictions.

State agencies in PNG have worked together to permit and regulate resource projects. Hydro is no different, and with NEA now established, it can coordinate all Government efforts and collaborate with relevant Government agencies to license and regulate hydro energy projects.

b) Resistance from stakeholders

Most policies usually receive resistance from the local communities, landowners, and the civil society at large. This is mainly due to a lack of policy direction in addressing concerns around socio-economic issues, especially land, environment, and landowner benefits.

This policy provides guidance on land access, landowner participation, and national content. This is in line with the National Government's direction to ensure landowner participation and benefit distribution.

c) Lack of resources

Policy implementation is usually affected by a lack of resources, especially financial, human, and technical expertise.

The key agencies responsible for licencing and regulating the hydro energy sector are statutory bodies established under relevant statutory laws to ensure resources are available to effectively deliver on their mandated tasks. NEA will coordinate the implementation of this Policy and will generate revenue to fully implement it.

d) Lack of capacity for policy implementation and effective regulation

Hydro energy in PNG remains largely underdeveloped despite the significant potential provided by its rugged terrain and a vast number of river systems. Several hydro energy projects have been established in the country which support the main grid systems. This scenario also raises the challenge of adequate capacity in terms of knowledge, skills, and experience in implementing the Policy and ensuring effective regulation.

NEA is mandated to regulate and have the capacity to implement this Policy.

19.2. HYDRO ENERGY PROJECT RISKS

Project risks are the potential risks that may be associated with the development and operations of a hydro energy project. Table 4 below outlines the key risks in developing a hydro project in PNG.

Table 4: Identification of Potential Hydro Energy Project Risks

Risk	Duration or Period of Risk	Risk Rating		
		High	Medium	Low
1. Finance Risks				
1.1. Financing /Debt Service	Life of Project			
1.2. Project Viability	Feasibility			
1.3. Transmission Access	Construction			
1.4. Credits	Life of Project			
2. **Regulatory Risks**				
2.1. Permitting	Feasibility & Construction			
2.2. Compliance	Life of Project			
2.3. Environmental	Life of Project			
3. **Market Risks**				
3.1. Entry	Operations			
3.2. Pricing	Feasibility & Operations			
3.3. Competition	Life of Project			
4. **Social Risks**				
4.1. Land Access	Feasibility & Construction			
4.2. Cultural Norms	Life of Project			
5. **Other Risks**				
5.1. Geographic Location	Feasibility & Construction			
5.2. Political Risks	Life of Project			
5.3. Technology & Cybersecurity Risks	Life of Project			
5.4. Health & Safety Risks	Life of Project			

19.3. RISK MANAGEMENT AND MITIGATION FRAMEWORK

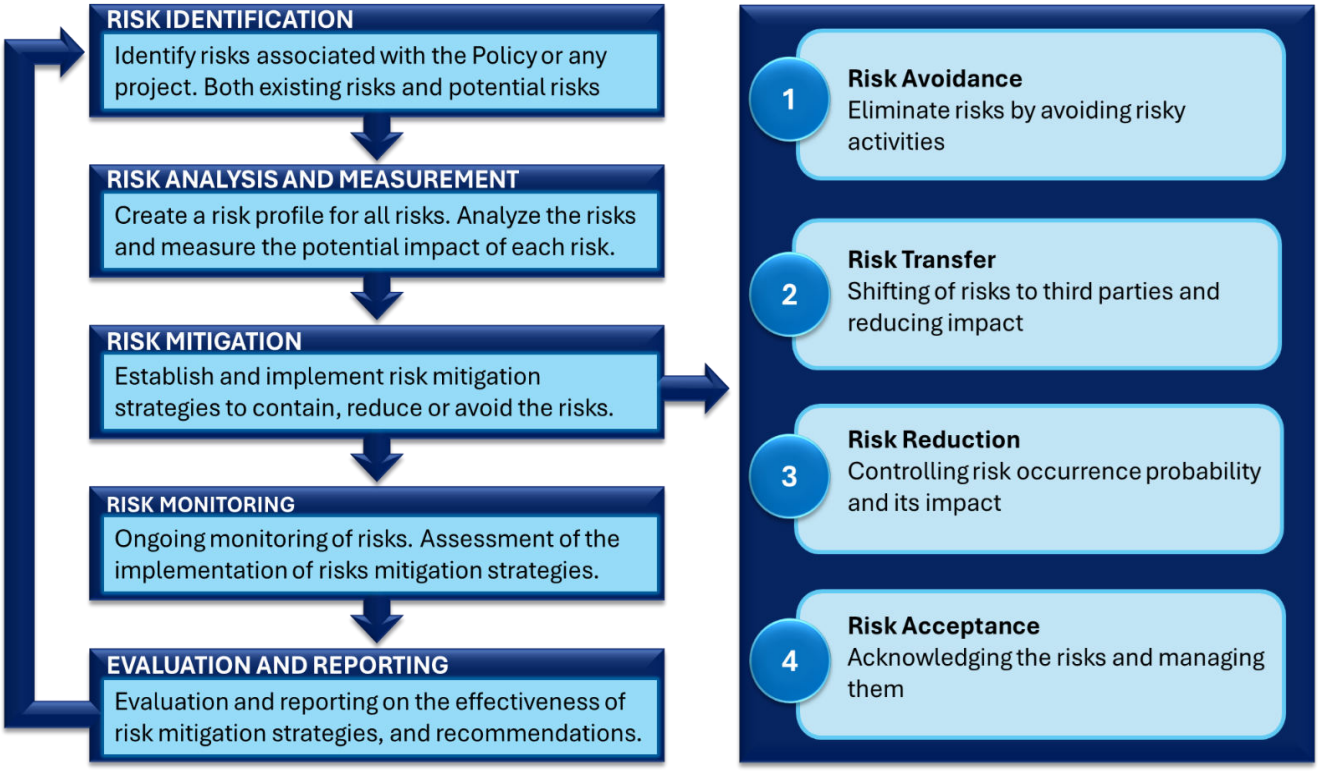
There are risks associated with developments in the energy sector, including the electricity industry. Section 19.1 and 19.2 of this Policy highlighted potential risks associated with the implementation of this Policy and development of hydro energy projects respectively.

This Policy recognizes the importance of adopting effective and proper risk management and mitigation strategies to reduce risks associated with the Policy implementation and the developments of hydro energy projects. Risk mitigation involves the process of identifying risks and strategizing to minimize and/or to avoid the impact of the risks.

Government, through NEA in collaboration with other government agencies, will manage the risks associated with implementation of this Policy. Any investor or developer must establish risk management processes and systems to mitigate project operational risks while ensuring preparation for natural risks.

A general framework for risk management and mitigation is provided below. This framework aims to guide the identification, assessment, and mitigation of risks associated with the implementation of this Policy, including the development and operation of hydro energy projects.

Figure 17: Risk Management and Mitigation Framework



Source: *National Energy Authority, 2025*

CHAPTER 20: MONITORING & EVALUATION

20.1. MONITORING, EVALUATION AND REPORTING

The monitoring and evaluation (M&E) process is an essential tool for assessing the progress and success of this Policy. Ongoing M&E for this Policy will be undertaken to identify strengths and weaknesses, identify areas where resources may be optimized, and measure progress toward achieving the goals of this Policy and to achieve the desired outcomes. Evaluation of the implementation of this Policy aims to improve strategies and inform decision-making based on the outcomes of this Policy, which will inform future policies and legislative reforms.

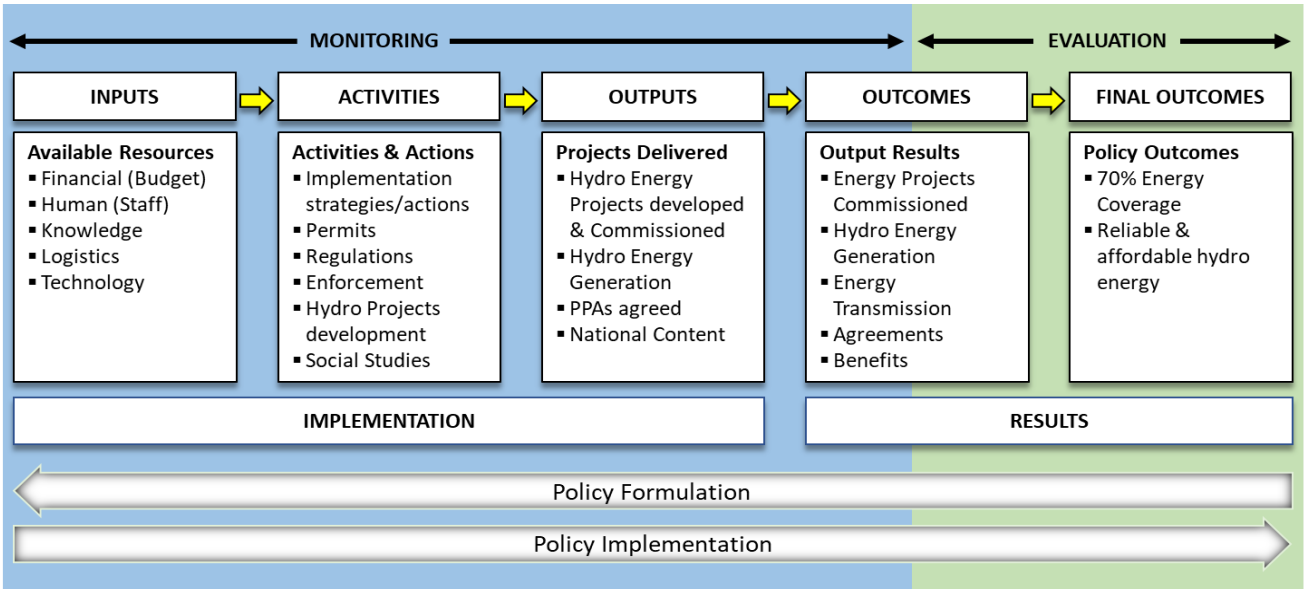
NEA is the custodian of this Policy and will be responsible for periodic and ongoing monitoring and evaluation of the implementation of this Policy in accordance with its M&E Framework. Reports and recommendations will be provided to the Managing Director of NEA, the Minister, and if required, the National Executive Council (NEC).

20.2. FRAMEWORK FOR MONITORING AND EVALUATION

M&E is a process that requires careful consideration and planning. The M&E for this Policy is linked to the goals and expected outcomes, including the implementation and administrative arrangements under this Policy.

Monitoring of the Policy starts from the inputs required to implement the Policy, then the activities to be undertaken to deliver on the outcomes, and ends with the monitoring of the outcomes from the outputs. Evaluation will be undertaken to assess the actual outcomes of the Policy against the long-term outcomes and vision of the Policy.

Figure 18: Policy Results Chain for Monitoring and Evaluation



Source: *National Energy Authority, 2025*

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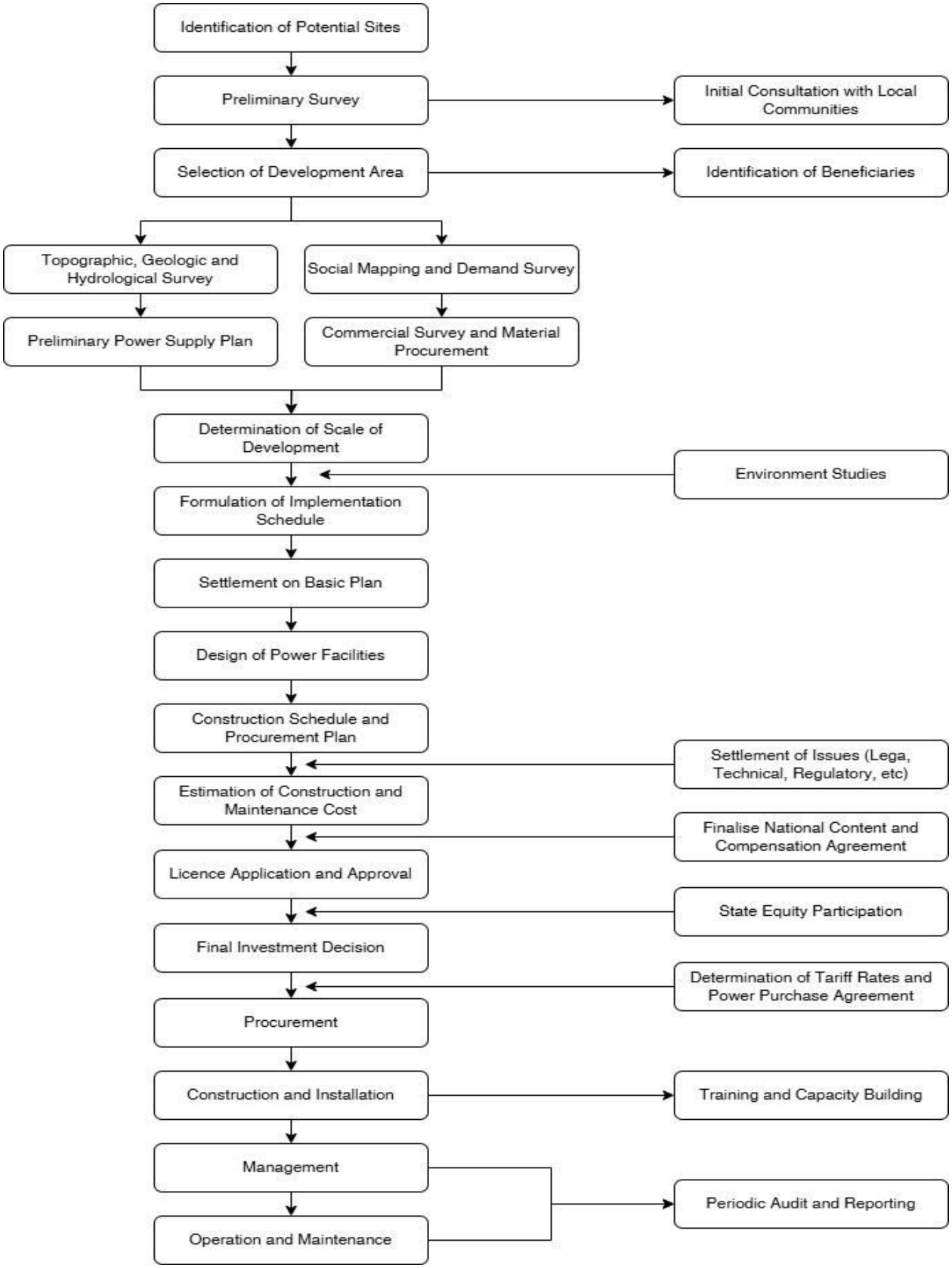
GLOSSARY

Hydropower:	The use of water to generate electricity by converting kinetic energy from flowing water into mechanical energy.
Run-of-River (RoR):	A type of hydroelectric generation plant that uses the natural flow and elevation drop of a river for electricity generation.
Pumped Storage:	An energy storage type where water is pumped to an upper reservoir during low electricity demand and released to generate electricity during high demand.
Hybrid Energy Systems:	Systems that integrate two or more types of energy sources (e.g., hydropower with solar or wind) to enhance efficiency and reliability.
Feed-in Tariff (FiT):	A policy mechanism offering long-term contracts to renewable energy producers to encourage investment.
Multipurpose Hydro Systems:	Hydropower systems designed for uses beyond electricity generation, such as irrigation and flood control.
Grid Integration:	The process of ensuring that power systems, like mini-grids, can be connected to the central grid while maintaining system reliability.
Nationally Determined Contributions (NDC):	Climate action plans developed by countries to meet climate targets under the Paris Agreement.
Holder of a Licence	A person or entity issued a licence under the *National Energy Authority Act* 2021 such as a feasibility study permit, an Ex-Ante Licence, or a Generation Licence.

ANNEXURES

ANNEXURE 1: HYDRO ENERGY PROJECT IMPLEMENTATION FLOW CHART



ANNEXURE 2: APPLICATION OF LICENCES AND NATIONAL CONTENT

Classification	Type of Hydro	Application of National Content	Require Licence
1. Large Scale Hydro System	1.1. Run of River	Yes	Yes
	1.2. Storage Hydro	Yes	Yes
	1.3. Pumped Storage	Yes	Yes
	1.4. In-Stream System	Yes	Yes
2. Medium Scale Hydro System	2.1. Run of River	Yes and No	Yes
	2.2. Storage Hydro	Yes and No	Yes
	2.3. Pumped Storage	Yes and No	Yes
	2.4. In-Stream System	Yes and No	Yes
3. Small Hydro System	3.1. Run of River	Yes and No	Yes
	3.2. Storage Hydro	No	Yes
	3.3. Pumped Storage	No	Yes
	3.4. In-Stream System	No	Yes
4. Mini Hydro System	4.1. Run of River	No	No
	4.2. Storage Hydro	No	No
	4.3. Pumped Storage	No	No
	4.4. In-Stream System	No	No
5. Micro Hydro System	5.1. Run of River	No	No
	5.2. Storage Hydro	No	No
	5.3. Pumped Storage	No	No
	5.4. In-Stream System	No	No
6. Pico Hydro System	6.1. Run of River	No	No
	6.2. Storage Hydro	No	No
	6.3. Pumped Storage	No	No
	6.4. In-Stream System	No	No

ANNEXURE 3: ALTERNATE USES OF STORED WATER

Alternate Use	Description	Key Benefits
Irrigation (For Food Security)	Hydropower reservoirs can serve as an important source of water for irrigation, ensuring crops have a consistent water supply, boosting agricultural yields, and mitigating the effects of droughts.	Improves crop yields, contributes to food security, supports sustainable agriculture, and reduces dependency on rain-fed farming.
Leisure	Stored water from hydropower reservoirs can be used for recreational activities such as boating, swimming, and fishing, enhancing physical health and well-being, and promoting local tourism.	Promotes community engagement, supports local tourism and industries, and enhances the area's aesthetic appeal.
Tourism	Hydropower reservoirs create scenic landscapes and eco-tourism opportunities, generating economic benefits, and employment, and raising awareness on renewable energy.	Promotes eco-tourism, generates jobs, supports businesses, and raises awareness on renewable energy.
Domestic Water Supply	Hydropower reservoirs can supply clean and safe drinking water for communities, improving health outcomes and supporting both urban and rural water supply systems.	Provides reliable water for domestic use, improves health outcomes, and supports water supply systems.
Water, Sanitation, and Hygiene (WaSH) Policy	Hydropower systems contribute to WaSH policies by providing clean water for drinking, sanitation, and hygiene, reducing waterborne diseases, and enhancing public health.	Enhances public health, reduces waterborne diseases, and supports global health goals.
United Nations Sustainable Development Goal (UNSDG) 6	Hydropower systems support UNSDG 6 by ensuring the availability and sustainable management of water for sanitation, addressing water scarcity, and promoting equitable use.	Supports global efforts to achieve SDG 6, promotes sustainable water management, and ensures equitable water use.
Fish Farming (Aquaculture)	Hydropower reservoirs can be used for fish farming, providing a controlled environment for raising fish, contributing to food security, and generating income for local communities.	Supports food security, generates income, and promotes sustainable fish farming practices.

ANNEXURE 4: STAKEHOLDER INVOLVEMENT

As part of the Policy development process, NEA undertook various consultations with Government agencies, development partners and the public through regional public consultations. Invitations were sent out to various institutions and stakeholders, including notices on media platforms for public consultations. Those as listed below, attended the consultations, policy validation or provided feedback in writing.

Government Agencies

1. Climate Change Development Authority (CCDA)
2. Conservation Environment and Protection Authority (CEPA)
3. Department of Agriculture and Livestock (DAL)
4. Department of Commerce and Industry (DCI)
5. Department of Lands and Physical Planning (DLPP)
6. Department of Mineral Policy and Geohazard Management (DMPGM)
7. Department of National Planning and Monitoring (DNPM)
8. Department of Prime Minister and NEC (PM&NEC)
9. Department of Transport
10. Department of Treasury
11. Independent Consumer and Competition Commission (ICCC)
12. Kumul Consolidated Holdings (KCH)
13. Kumul Petroleum Holdings Limited (KPHL)
14. Mineral Resource Authority (MRA)
15. National Weather Service (NWS)
16. Office of the State Solicitor (OSS)
17. Oil Palm Industry Corporation (OPIC)
18. PNG Power Limited (PPL)
19. PNG Tourism Promotion Authority (PNGPTA)

Provincial Governments & Administrations

1. East New Britain Provincial Administration
2. Morobe Provincial Administration
3. Madang Provincial Administration and LLG Representatives
4. Gulf Provincial Administration

Development Partners

1. Asian Development Bank (ADB)
2. World Bank
3. US Aid - PNG Electrification Program (USAID PEP)
4. Japan International Cooperation Agency (JICA)
5. International Renewable Energy Agency – PNG Coordinator (IRENA)
6. Australian Department of Foreign Affairs & Trade Economic and Social Infrastructure Program (ESIP)
7. New Zealand High Commission

Other Stakeholders

1. Media Personel
2. Energy Interest Groups
3. Niugini Electricals
4. Lae Biscuit Company
5. Evangelical Lutheran Church of Papua New Guinea (ELCPNG)
6. Burum Kuat Hydro Dam Representatives
7. East New Britain Energy Limited
8. PAWA PNG Power Island Project
9. PNG University of National Resources and Environment (UNRE)
10. Elirana Electric Technology School
11. Newmont- Lihir

12. National Investment Holdings Limited
13. Valkan Incorporated Land Group (ILG)
14. Pawa Electric
15. East New Britain Development Corporation
16. Lihir Landowner Representatives
17. West New Britain Landowner Representatives
18. Various landowners and individuals who attended the public consultations