GEOTHERMAL ENERGY POLICY

2025 - 2030

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Main Photograph:
Aerial View of the Lihir Geothermal Powerplant
Credit: Newmont External Relations

Below Left
Hot Spring in West New Britain
Source: MRA Country Update

Below Centre
Lihir Geothermal Power Plant
Source: MTL NZ Limited, https://www.mtlnz.co.nz/project/lihir-geothermal-power-station/

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Hot Spring in West New Britain
Source: MRA Country Update

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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 Geothermal Energy Policy as part of the five (5) Subsector Renewable Energy Policies. The other policies are Hydro Energy Policy, Solar 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 to pave the way for 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, hydro, 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

BSA	Benefits Sharing Agreement
CCDA	Climate Change Development Authority
CDP	Conceptual Decommissioning Plan
CEPA	Conservation and Environment Protection Authority
DES	Decentralized Electricity Supply
DLPP	Department of Lands and Physical Planning
DMPGM	Department of Mineral Policy and Geohazards Management
DNPM	Department of National Planning & Monitoring
DOT	Department of Treasury
EIP	Electricity Industry Policy
EOI	Expression of Interest
ESI	Electricity Supply Industry
FIT	Feed-In Tariff
GHG	Green House Gas
ICCC	Independent Consumer and Competition Commission
IEC	International Electrotechnical Commission
ILG	Incorporated Land Group
IPCC	Inter-governmental Panel on Climate Change
IPP	Independent Power Producer
ISO	International Organization for Standardization
ITMO	Internationally Tradable Emissions Mitigation Outcome
KCH	Kumul Consolidated Holdings
MTDP	Medium-Term Development Plan
MAC	Mining Advisory Council
MRA	Mineral Resources Authority
MW	Mega Watt
NDC	Nationally Determined Contributions
NEA	National Energy Authority
NEC	National Executive Council
NEP	National Energy Policy 2017 – 2027
NEROP	National Electrification Rollout Plan
NGDP	National Goals and Directive Principles
NISIT	National Institute of Standards and Industrial Technology
PPA	Power Purchase Agreement
PPL	PNG Power Limited
PPP	Public-Private Partnership
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SDG	Sustainable Development Goal
SDP	Strategic Development Plan
UNFCCC	United Nations Framework Convention on Climate Change

EXECUTIVE SUMMARY

Geothermal energy is a clean and reliable source of heat and electricity. It is thermal energy stored in the Earth's crust from the formation of the planet and radioactive decay. The energy is used directly as heat or is converted to electricity. Geothermal energy can be found at various depths and temperatures. The most widely developed resources are those found in hydrothermal systems, which consist of hot water circulating in deep-seated permeable rocks (IRENA and IGA, 2023).

PNG is characterized by quaternary volcanic islands with potentially low to high-temperature geothermal resources that are yet to be fully investigated systematically for development and utilization. PNG's unique geology and substantial mineral resources result from its position on the Pacific 'Ring of Fire' providing a comparative advantage to develop its vast geothermal resources. The current and only geothermal project in PNG is a 50MW geothermal power plant on Lihir Island, which is owned and operated by Newmont Corporation (formerly Newcrest Mining Limited) within its Special Mining Lease.

The National Energy Policy 2017-2027 (NEP) sets out Government's directions to develop the untapped potential of PNG's renewable energy resources. Therefore, it is necessary to establish a Geothermal Energy Policy that sets out the process of developing geothermal resources and to cater for increasing energy demand. The Policy aims to guide the Government, development partners, investors, and customary landowners to work together in developing geothermal resources sustainably. This Policy sets out the processes for developing a geothermal project from exploration, utilization, and the generation of electricity. This supports the Government's aim to meet its commitment to electricity accessibility under the NEP and its commitments under the Enhanced Nationally Determined Contribution (NDC) to reducing PNG's greenhouse gas (GHG) emissions.

The Policy aims to achieve PNG's Development Strategic Plan 2010-2030 (DSP) targets of 70 per cent of PNG households to have access to electricity by 2030 and 100 per cent electricity supply from renewable energy sources by 2050. The Policy encompasses the National Goals and Directive Principles of the Constitution, the provisions of the *National Energy Authority Act* 2021 and other relevant legislations.

The development of geothermal resources requires a combination of processes and systems that include exploration, extraction and electricity generation. The Policy defines geothermal energy and sets out the licensing process for the exploration, and utilization of geothermal resources for electricity generation. The Policy directs the repealing of the geothermal definition under the *Mining Act* 1992 and the redefining of the term 'geothermal development resources' under the *National Energy Authority Act* 2021. The Policy also recognizes the need to develop guidelines to support appropriate applicable technology that conforms to industry and international standards.

PNG's current tariff system defined in the NEP includes Tariff 1 (T1) for Generation to Transmission, T2 for Transmission to Distribution, and T3 for Distribution to Retail. The focus of the Tariff system under this Policy is T_1, which is between the Independent Power Producer (IPP) and the Off-Taker through a Power Purchase Agreement (PPA) as stipulated under Section 57 of the *National Energy Authority Act* 2021. The Policy also considers the use of Feed-In-Tarriff (FIT) for geothermal projects as a renewable energy resource.

The Policy also recognises the importance of attracting investment and therefore, provides the government with the option to provide incentives, participate as project shareholder and the use of feed in tariff. Furthermore, the Policy provides for a Project Development Contract to be entered into under the negotiated terms between a project proponent and the State to support the development of a geothermal energy project.

Furthermore, the Policy recognizes the need to have access to land and recognizes the importance of consultative process in securing land for geothermal projects in accordance with various land legislations. It is also important to state in the Policy the aspiration of the government on national content. Therefore, the Policy provides for the distribution of resulting benefits to PNG citizens and the government to be captured under various agreements.

Finally, the Policy sets out the strategy for the monitoring and evaluation of this Policy to ensure it meets the targets set out under the NEP, PNG's medium-term and long-term development plans, and its Enhanced NDC.

CHAPTER 1: INTRODUCTION

1.1. INTRODUCTION TO GEOTHERMAL ENERGY POLICY

Geothermal energy is a clean and reliable source of energy which can be harnessed for heat and electricity. It is thermal energy stored in the Earth's crust from the formation of the planet and radioactive decay. This energy is extracted mainly by drilling into the ground and then transported to the surface using fluids. At the surface, the energy is extracted and converted to electricity or used directly as heat. Geothermal energy can be found at various depths and temperatures. The most widely developed resources are those found in hydrothermal systems, which consist of hot water circulating in deep-seated permeable rocks (IRENA and IGA, 2023).

Geothermal energy in Papua New Guinea (PNG) is currently classified as a mineral under the *Mining Act* 1992 and *Mineral Policy Handbook*, and is defined as a "valuable, non-living substance excluding petroleum." It is not considered a hydrocarbon under the *Oil and Gas Act* 1998 and the *Unconventional Hydrocarbons Act* 2015, so hydrocarbon-related regulations do not apply to geothermal projects. The *Environment Act* 2000 includes underground water sources in its definition of water but does not specifically address geothermal energy.

The *National Energy Authority Act* 2021 and the National Energy Policy 2017-2027 (NEP) mandates the National Energy Authority (NEA) to develop energy sector policies and plans, regulate the energy sector, and coordinate and implement renewable energy projects such as geothermal. Geothermal energy, however, lacks a specific definition. Thus, this Policy defines geothermal energy as "*a water resource with latent heat that can be extracted for useful purposes".*

PNG has abundant untapped potential of geothermal resources for renewable energy development. However, developing this renewable energy resource is a challenge because of the country's geographical terrain, land tenure system, a largely rural population, and the lack of clear policy direction and regulatory framework. There is need for legislative reforms and increased capital investment from the government as well as private investment to transform this latent and underdeveloped energy resource.

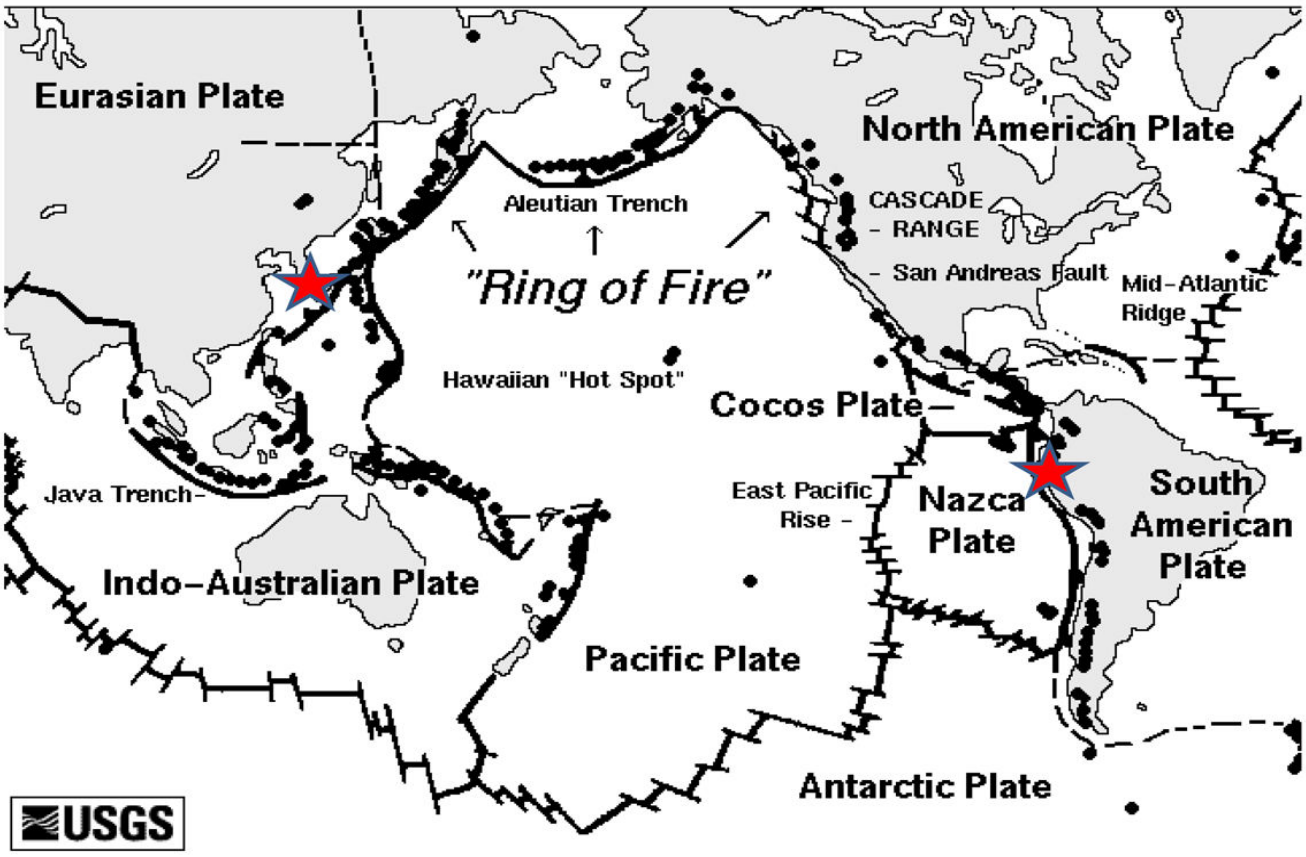
PNG has only one geothermal energy project on Lihir Island. The project, which has a capacity of 50MW, is owned and operated by the Newmont Corporation at Lihir gold mine for its mining operations. Hydro is currently the primary source of the country's electricity supply, providing about half of the 797 MW total electricity generation capacity, while around one-third is from diesel generators which are dominant in off-grid applications. Gas, geothermal and biogas generation represent most of the balance with the bulk of this energy used in the mining sector.

This Policy focuses on creating an enabling environment to promote investment in geothermal resources as a source for sustainable energy to diversify PNG's energy mix. The Policy aligns with the NEP and other Government policies and development plans.

1.2 PAPUA NEW GUINEA'S GEOLOGICAL SETTING

PNG is characterized by quaternary volcanic islands with potentially low to high-temperature geothermal resources that are yet to be fully investigated systematically for development and utilization. PNG's unique geology and substantial geothermal resources is due to its position on the Pacific 'Ring of Fire', the interactive tectonic boundary between the cratonic Indo-Australian Plate to the south and the oceanic Pacific Plate to the north. This tectonic boundary occurs as a complex arrangement of active subduction zones and associated island arcs extending as a crustal-scale suture, east and south through the Solomon Islands, Vanuatu and Fiji to New Zealand, and west into Indonesia and on to the Philippines and Japan (*Williamson & Hancock, 2005).*

Figure 1: PNG and the Pacific Ring of Fire

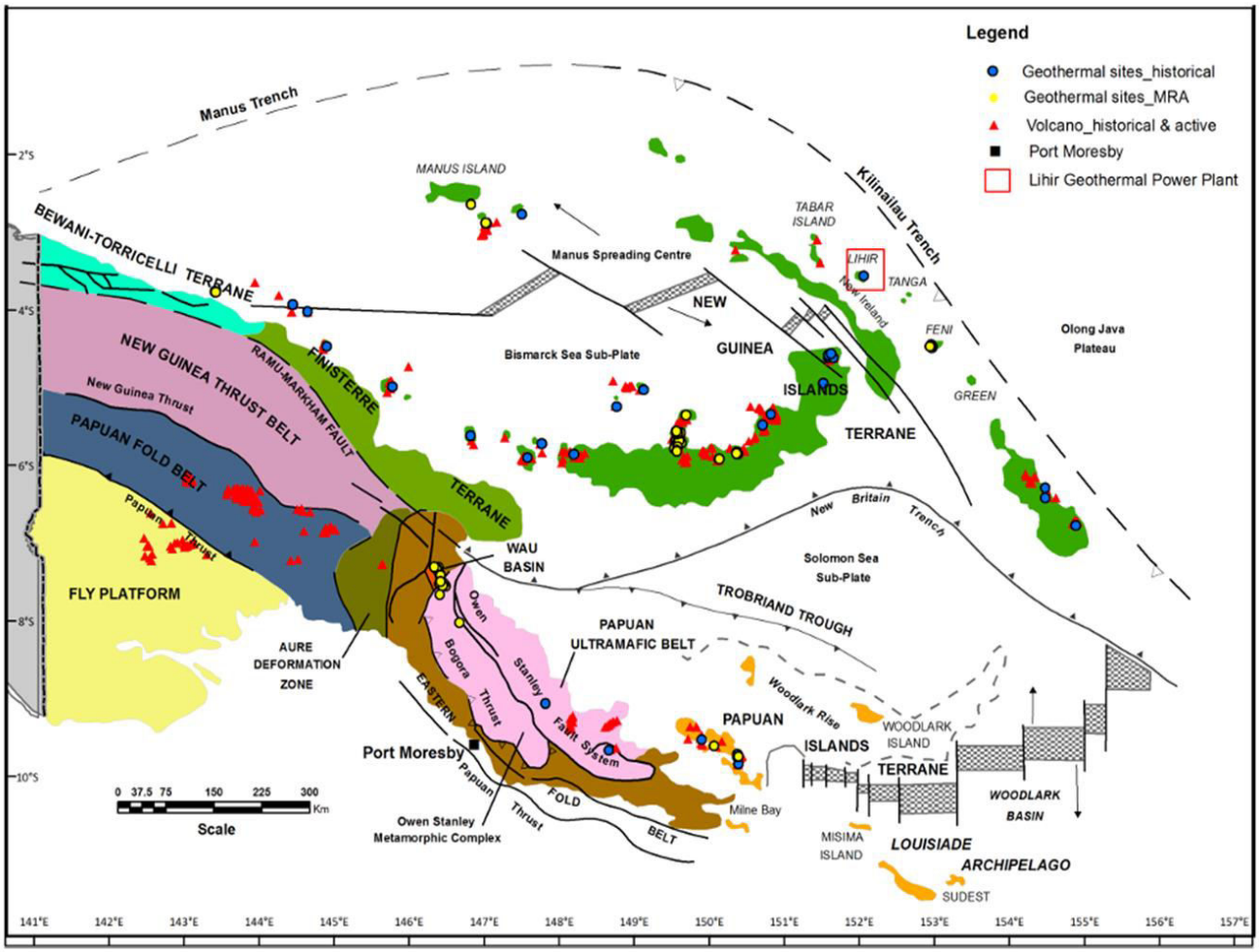


Source: *University of California, Berkeley Campus, Seismology Lab Blogsite, 2023*

1.3 GEOTHERMAL POTENTIAL IN PAPUA NEW GUINEA

PNG's location along the Pacific Ring of Fire positions the country in a prime location for geothermal energy development. This is due to the active tectonic plate movements and volcanic activity. The geological framework of PNG comprises a series of geological terranes that are commonly separated by geological elements or structures as shown in Figure 2. Detailed descriptions of the geological terranes can be found in references to the *Geology and Mineral Potential of PNG* booklet by *Williamson and Hancock (2005)*. The northern zone extending from Madang to New Britain, New Ireland, and Bougainville, and the southern zone, which extends from Mt Lamington in the Northern Province to Milne Bay are identified as areas having the potential for geothermal energy exploitation and development (Geothermal Resource Policy, 2012).

Figure 2: Geological Terranes, Tectonic Settings, and Geothermal Sites in PNG.



Source: Williamson and Hancock, 2005

Geothermal resources in PNG have not been fully explored and categorized as there are minimal references to existing research pointing to its vast potential. Geothermal energy can potentially be a major renewable energy resource for PNG's economic development. The current installed capacity of geothermal in PNG is only a 50 MW geothermal power plant on Lihir Island, which is owned and operated by Newmont Corporation within its Special Mining Lease. The project was developed to support the mine's electricity demand.

Apart from Lihir, development and utilization of geothermal energy for electricity generation have not progressed due to a lack of political will to support the development of policies, legal frameworks, and incentives to facilitate the exploration and development of geothermal projects. Some work has been undertaken over the years through exploration and mapping to understand the existing and potential geothermal sites as shown in *Figure 2* (above). According to *Lahan,et. al* (2005), 55 known geothermal sites have been identified and recorded in the past. Of these, seven regions that have been mapped and sampled are Talasea, Hoskins, Wau Bulolo, Kairiru, Manus, Fergusson, and Feni Islands. Hot spring sampling and geochemistry analyses were undertaken for each region and prospective sites have been identified. However, these potential sites and others yet to be identified in the future, will not be developed for electricity generation without policy and legislative framework.

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 per cent. This means that over 80 per cent of PNG's population, mainly in rural areas, lack reliable access to power. Fifty years after independence, PNG is still plagued by chronic energy shortages and high electricity costs. Other critical issues affecting access to reliable and affordable electricity are:

- **Unreliable power:** PPL struggles to provide reliable electricity due to aging infrastructure and financial constraints.
- **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 remain gaps in the policy and regulatory framework to support the development of renewable energy resources 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 per cent 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 per cent is alienated land, which is administered under 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 a lack of incentives, especially fiscal incentives to attract private investments in renewable energy projects in PNG. Geothermal 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 geothermal 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 geothermal.

1.5 SCOPE OF POLICY

This Policy focuses on creating an enabling framework to promote investment in the geothermal energy subsector, contributing to the nation's renewable energy mix. This Policy aims to harness PNG's abundant geothermal energy potential to achieve national electrification goals, by providing 70 per cent of the households with access to electricity by 2030 and 100 per cent by 2050, primarily from renewable energy sources. It 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 geothermal energy, this 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 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 administrations, civil societies, landowners, and project impact communities.

This Policy provides strategic direction for policy and legislative reforms to address technical, regulatory, and socio-economic gaps within the geothermal energy subsector. This Policy is consistent with the existing laws of PNG and aligns to various legal and policy frameworks, both at the national and sectoral level. However, 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 Geothermal Energy subsector that contributes to achieving 70 per cent of electricity coverage by 2030.

2.2 MISSION

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

2.3 OBJECTIVES

The objectives of the Geothermal Energy Policy are:

(a) The establishment of an effective regulatory framework that promotes sustainable development of Geothermal energy projects.

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

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

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

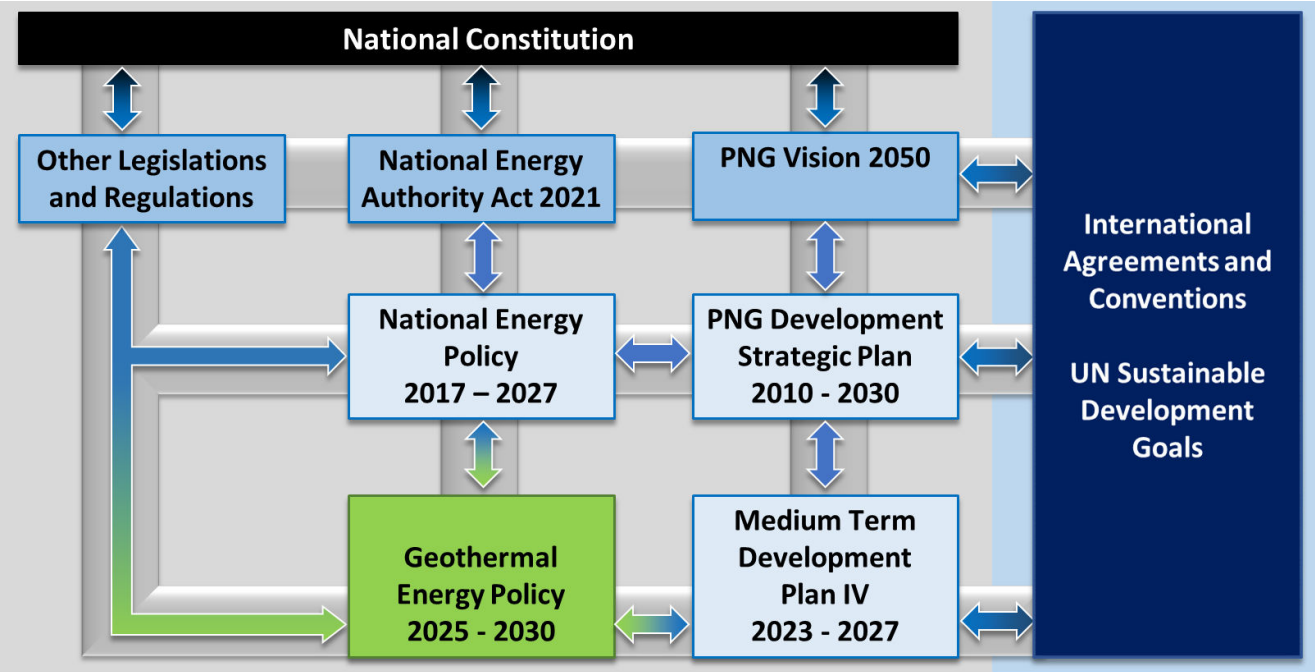
(e) To promote sustainable growth and improve the socio-economic wellbeing of our people through partnerships.

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 Geothermal 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 their country. The NGDPs also provide for the country's natural resources and environment to be conserved and used for the collective benefit of Papua New Guineans 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. Geothermal energy projects will require land and sea areas 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 renewable energy sources to supply 100 per cent of PNG's electricity supply by 2050. This Policy aligns with the Pillars and the energy goals under Vision 2050.

(b) PNG Development Strategic Plan 2010 – 2030

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

It sets out the target that by 2030, 70 per cent of households in PNG will have access to a reliable and affordable electricity. It targets that the total electricity generation capacity by 2030 will be 1910 MW, of which hydro would generate 1020 MW, gas 390 MW and other renewables, including geothermal, would generate in total a capacity of 500 MW.

(c) National Energy Policy 2017 – 2027 (NEP)

The National Energy Policy 2017 – 2027 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 Geothermal 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 the development of geothermal 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 IV 2023-2027 (MTDP IV)

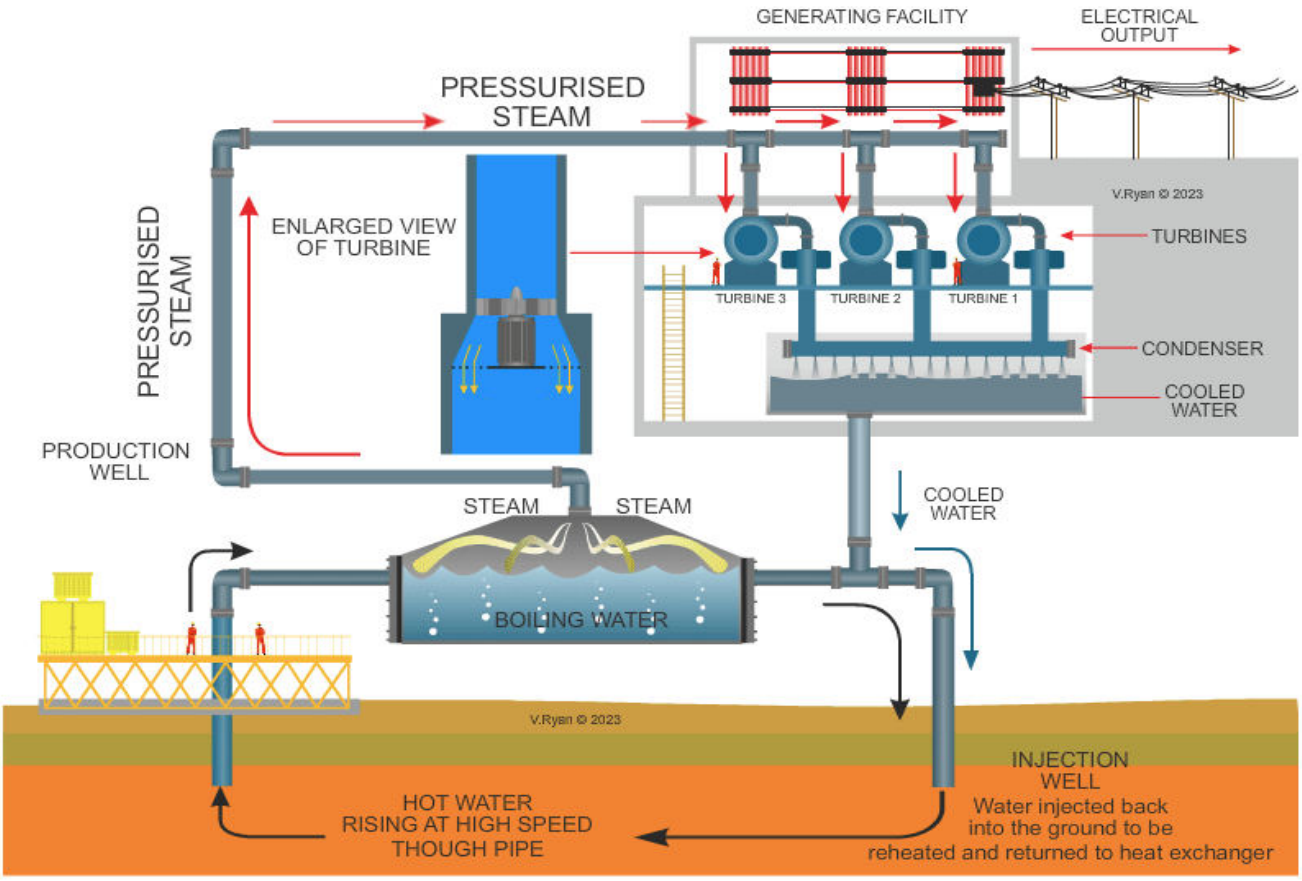
The Medium-Term Development Plan IV 2023-2027 (MTDP IV) is themed on achieving "National Prosperity Through Growing the Economy". The theme captures the Government's intent to invest in strategic priority areas to trigger greater national transformation and economic independence. The MTDP IV identifies 12 Strategic Priority Areas (SPA) for investment by the Government and development partners. SPA 2 of the MTDP IV is Connect PNG Infrastructure. It identifies 8 Deliberate Intervention Programs (DIP). DIP 2.5 is on Connect PNG – Electrification Rollout and identifies the following Investment Programs that include: (i) National Power Generation Investment Program; (ii) National Power Transmission Investment Program; (iii) National Power Distribution Investment Program; (iv) Rural Electrification Investment Program; and (v) Off-Grid Renewable Energy Development Program. The MTDP IV targets that by 2027, 40 per cent of PNG households will have access to electricity from these Investment Programs.

CHAPTER 4: GEOTHERMAL SYSTEMS

A geothermal power plant harnesses heat from the Earth's interior to generate electricity. Production wells extract steam or hot water from underground reservoirs, which is used to drive turbines connected to a generator. Depending on the type, temperature and pressure of a geothermal resource, the system may directly use steam (dry steam plants), flash high-pressure water into steam (flash steam plants), or transfer heat to a secondary working fluid with a low boiling point (binary cycle plants). Condensers cool and recycle steam or fluids, and injection wells reinject cooled water back into the reservoir, ensuring sustainability.

Geothermal power plants offer renewable, sustainable, and environmentally friendly energy. They operate continuously, providing reliable baseload power with minimal greenhouse gas emissions. The choice of plant type depends on the temperature and pressure of the geothermal resource, making geothermal energy a versatile and vital contributor to the global transition toward cleaner energy systems.

Figure 4: General depiction of a Geothermal Energy System



Source: (Flash Steam Power Plant, n.d)

4.1. GEOTHERMAL RESOURCES

Geothermal energy is heat stored in the Earth's crust found at various depths and temperatures. The geothermal energy is extracted from beneath the earth in the form of fluids such as hot water or steam. This energy is then converted to electricity or used as heat. The most widely developed resources are those found in hydrothermal systems, which consist of hot water circulating in deep-seated permeable rocks (IRENA and IGA, 2023).

The method of using geothermal energy relies on the resource temperature, which is divided into three categories: high (greater than 150℃), medium (90℃-150℃), and low (less than 90℃). Electricity production is more favourable from geothermal resources of medium to high temperatures. Medium-temperature geothermal resources are used for various applications, such as heating and cooling, industrial processes and agri-food applications (IRENA and IGA, 2023).

According to *Hou, et.al* (2021), there are about five types of geothermal energy sources. These resources and their characteristics are summarised in the table below.

Table 1: Geothermal resources and their characteristics.

Geothermal Resource	Description	Global Geothermal Mix	Temperature Range (°C)	Electricity Generation Potential	Primary Application(s)
Steam	Steam at high temperature and maximum pressure, stored in the pores of underground rocks	0.5 %	150 – 200+	High	Electricity production and other industrial processes.
Hot Water	Stored underground hot water or water vapor mixture.	10 %	50 – 300	High	Electricity production, heating or other industrial processes.
Hot Dry Rock	High temperature solid rock with extremely low permeability and completely free of water and steam.	29.5 %	200+	High	Electricity through Enhanced Geothermal Systems (EGS).
Magma	Molten rock that is buried in shallow parts of volcanic regions.	40 %	700 – 1200	None	No practical uses.
Ground Pressure	Thermal energy stored in high-pressure fluid minerals such as oil, natural gas, and brine at 2–3 km below the Earth's crust.	20 %	90 – 200	High	No current practical uses but is an emerging technology.

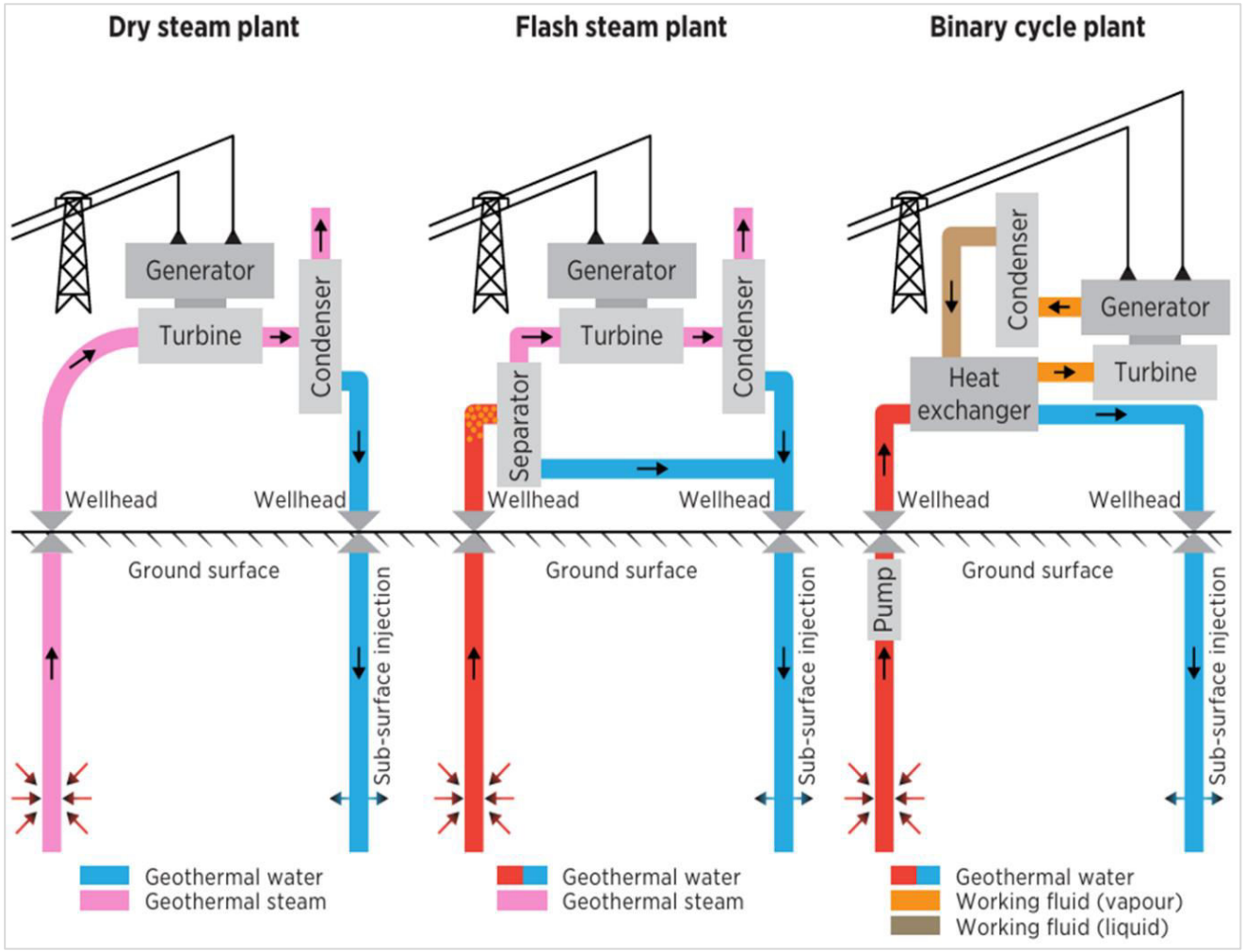
4.2 TYPES OF GEOTHERMAL POWER PLANT TECHNOLOGIES

This Policy recognizes that novel technologies that harness geothermal energy from deep-seated resources beyond those mentioned above (under Chapter 4.1) are being developed through research and demonstration projects and tests of commercial feasibility (IRENA and IGA, 2023). These technologies include Enhanced or Engineered Geothermal Systems (EGS), Advanced Geothermal Systems (AGS), and Supercritical Geothermal Systems (SGS).

The choice of power plant systems is determined by factors, such as the type of depth of geothermal resource, environmental considerations, and capability to deal with the type of geothermal resource to be extracted.

Three primary geothermal power plant technologies are commonly used to convert geothermal energy into electricity. These are dry steam, flash steam, and binary cycle plants (IRENA and IGA, 2023). All geothermal power plants use steam to turn large turbines, which run electrical generators. Figure 5 below presents these three (3) main geothermal energy technologies used for generating electricity.

Figure 5: Geothermal Powerplant Technologies



Source: IRENA and IGA (2023)

4.2.1. Dry Steam Plants

Dry steam power plants use steam directly from a geothermal reservoir to turn turbines which then generates electricity. Dry steam technology is applicable when dry steam is extracted directly from the geothermal reservoir. With this technology, saturated or superheated geothermal steam at high pressure is obtained directly from the geothermal well and directed to a steam turbine coupled with a generator to produce electricity. Dry steam power plants access steam reservoirs ranging in temperatures between 150 – 370 °C.

The steam exhaust from the turbine is discharged into a condenser at low pressure or partial vacuum to optimize the efficiency of electricity generation. In small modular units, backpressure plants that discharge the exhaust steam directly into the atmosphere, provide a technologically simpler and cheaper solution for early electricity generation.

4.2.2. Flash Steam Plants

Flash steam power plants take high-pressure hot water from deep inside the earth and converts it to steam that drives generator turbines. This technology utilizes two-phase geothermal fluids under high pressure and high temperature to generate electricity by first vaporizing the two-phase geothermal fluid at lower pressure through a process known as “flashing”. The steam component of the geothermal fluid generated during this process is separated from the liquid component. The steam is then expanded through a turbine that is coupled to a generator to produce electricity (single flash). Flash steam power plants

typically use geothermal fluid which, under normal pressure, are too hot to stay liquid and have a temperature range between 180 – 300 °C.

Like the dry steam process, the steam exhaust from the turbine is discharged into a condenser at low pressure or released directly into the atmosphere in backpressure plant solutions. The separated liquid component of the geothermal fluid may be flashed further to generate more steam for additional electricity generation (double/triple flash) and eventually returned to the reservoir source through reinjection wells.

4.2.3. Binary-Cycle Power Plants

Most geothermal areas contain moderate-temperature water (below 205 °C). Energy is extracted from these fluids in binary-cycle power plants. In a Binary-cycle power plant, hot geothermal fluid and a secondary (binary) fluid, with a much lower boiling point than water, pass through a heat exchanger. The heat from the geothermal fluid causes the secondary fluid to flash to vapor, which then drives the generator turbines.

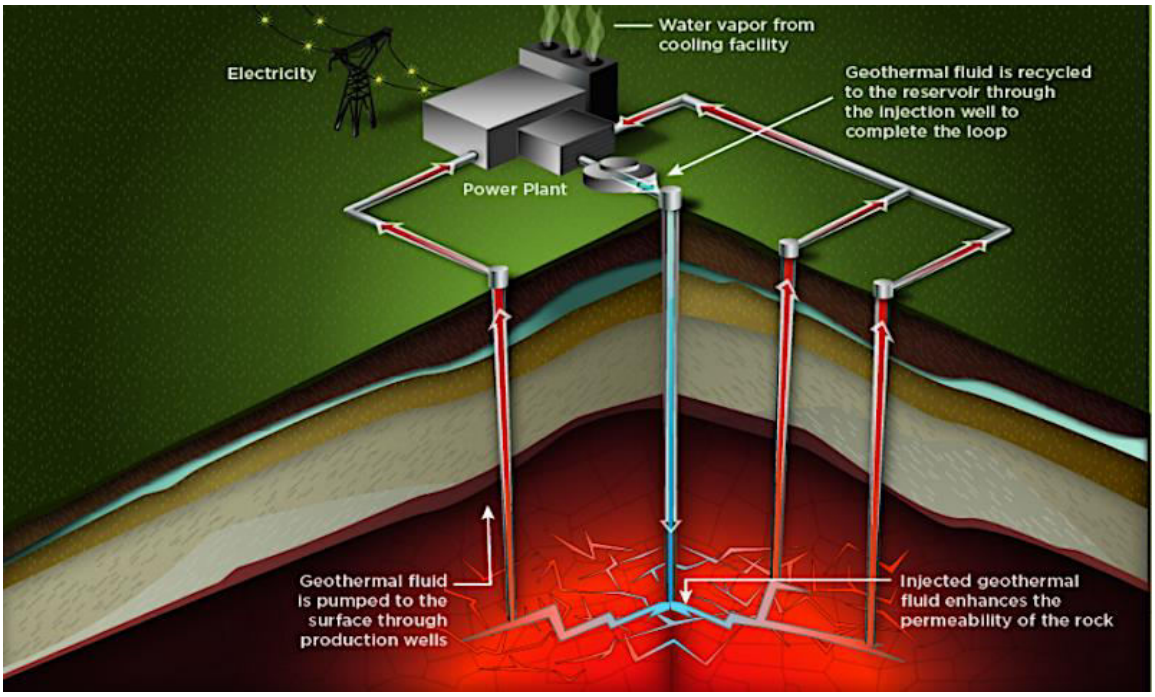
The Binary-cycle plant is a closed-loop system; therefore, nothing is emitted into the atmosphere. Moderate-temperature water is by far the more common geothermal resource. Binary-Cycle power plants utilize lower-temperature geothermal fluids, which can have a temperature range between 85 – 180 °C.

4.2.4. Enhanced Geothermal Systems

The three (3) previous geothermal systems harness naturally occurring hydrothermal reservoirs; those that possess heat, geofluid and rock permeability. From Figure 4, hydrothermal resources make up about 10.5% of geothermal resource distribution. In many areas, the underground rock is hot, however, does not have sufficient rock permeability- spaces where natural geothermal fluid can pass through freely. To solve this issue, human intervention is applied to create a man-made reservoir to extract and utilize heat energy. This is the basis for an Enhanced Geothermal System (EGS).

For EGSs, permeability is created in underground rock by carefully injecting high-pressure fluid under controlled conditions to create and expand existing fractures in the reservoir rock, to allow the fluid to flow freely through them. As the injected fluid passes through, it absorbs the heat energy and is then pumped out and utilized. Continuous injection keeps these fractures open and provides a constant source of water to be heated up and extracted for electricity production.

Figure 6: Enhanced Geothermal Systems (EGS)

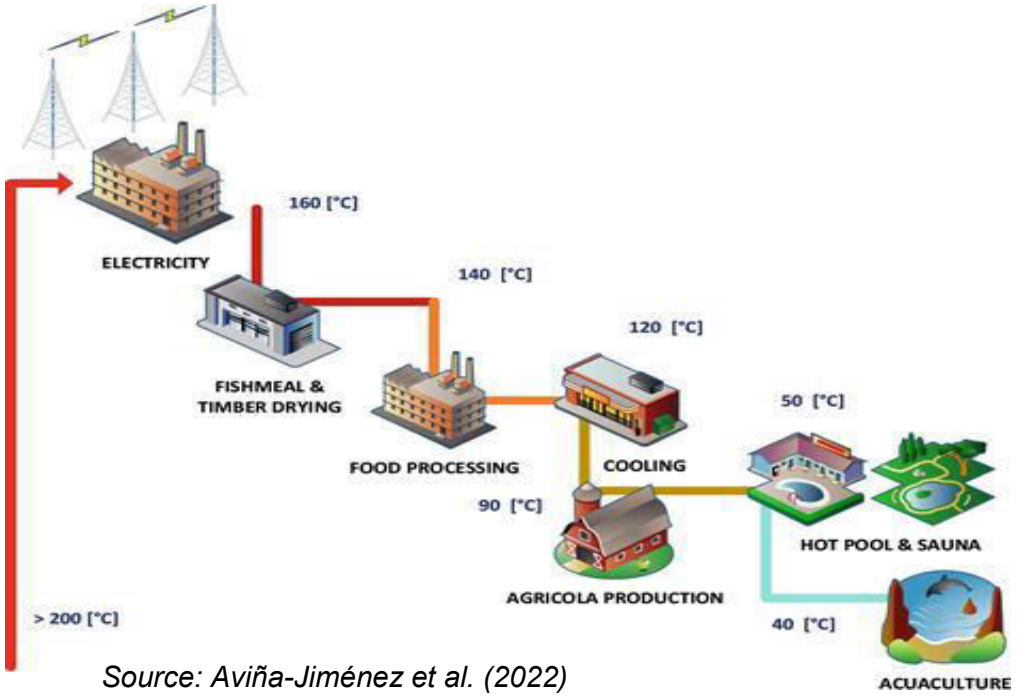


Source: ThinkGeoenergy (2021)

4.3 CASCADING USES OF GEOTHERMAL ENERGY

Cascading uses of geothermal energy refer to the application of the extracted geothermal energy after it serves its primary function of producing electricity. The heat energy after leaving the turbine blades, usually has a high enough temperature for it to be utilized for other purposes. The Government will consider promoting other uses of geothermal energy in the future, where possible, to support sustainable and inclusive growth. The Government through NEA will establish the required regulations, standards and guidelines for cascading uses.

Figure 7: Cascading uses of Geothermal energy.



Source: Aviña-Jiménez et al. (2022)

Types of Cascading Uses of Geothermal Energy

a) Agricultural Drying

Geothermal heat can be used for drying crops such as cocoa, coffee and copra (dried coconut). Utilizing geothermal heat can reduce the reliance of the drying process on natural weather conditions, making it faster, efficient and reliable. Hot water or steam can be piped from a geothermal power plant where it is used in air heaters, drying chambers or other similar technology to dry crops. This could potentially improve the quality of the shelf-life, lowers energy costs and reduces environmental impact.

b) Aquaculture

Geothermal heat can also be used to regulate water temperatures in fish farms. This optimizes water conditions, making them suitable for breeding and fish growth, especially in cooler regions. Warm geothermal water is pumped to and circulated within fishponds or tanks, thus regulating the water temperature. This improves fish farming efficiency, increases production, contributes to food security and creates employment in rural communities.

c) Industrial Process Heating

Heat from a geothermal power plant can also be used for industrial heating processes, especially for agro-industries near geothermal power plants. Geothermal heat can be piped directly into these industrial plants to replace conventional fuels used for heating which reduces costs in the long run.

d) Geothermal Cooling/Refrigeration

Absorption cooling can utilize heat from a geothermal power plant to power absorption chillers, which provides cooling in tropical climates. This reduces the need for electricity-driven air conditioning.

e) Desalination

Geothermal energy used to power desalination plants can be built along coastal areas where the geothermal plant is located. Geothermal energy is used to heat seawater, which when condensed becomes fresh water. This provides a sustainable method of producing freshwater in areas where water is scarce.

f) Balneology and Tourism

Naturally occurring hot springs can be developed as tourist attractions or wellness centres. These utilize naturally heated water for spas and other recreational activities. With its volcanic landscape, PNG can attract local and international tourists to geothermal spas, boosting eco-tourism and support local communities.

g) Enhanced Oil Recovery

Geothermic hot water or steam can be pumped into existing oil fields/reservoirs. This reduces the viscosity of heavy crude oil, making it easier to extract. PNG's oil industry could reduce its reliance on fossil fuel-generated steam, improving efficiency and sustainability in oil extraction.

4.4 GEOTHERMAL FLUIDS (GEOFLUIDS)

In PNG, water (steam and hot water) is the primary geothermal fluid (geofluid) for geothermal energy, especially in high-temperature volcanic areas. Potential geofluids that could be extracted for use in geothermal power plants depend on the country's geothermal resources, which are linked to its volcanic activity and tectonic settings. Brine and mixed hydrothermal fluids are also feasible, particularly in binary cycle plants. There is also potential for exploring supercritical carbon dioxide (CO_2) in deep geothermal systems, and hydrocarbon fluids can be used in binary systems to enhance energy generation from lower-temperature resources. Based on the available geothermal resources, the following geofluids are likely to be extracted and utilized for power generation.

4.4.1. Water (Steam or Hot Water)

The most common geofluid in PNG's geothermal systems is water in the form of steam or hot water. High-temperature geothermal resources in volcanic areas can produce superheated steam or hot water, which is directly used to generate electricity in dry steam or flash steam power plants. PNG has several volcanic regions, such as Lihir Island, New Britain region, and parts of the Northern region which are prime locations for high-temperature geothermal resources.

4.4.2. Brine (Saline Water)

Saline water or brine is another possible geothermal fluid in PNG, especially in areas with high mineral content in geothermal reservoirs. Brine is typically used in binary cycle power plants, where the heat from brine is transferred to a secondary working fluid with a lower boiling point (such as isobutane or isopentane). The brine itself is reinjected into the reservoir after heat extraction. Brine is often found in geothermal reservoirs near volcanic zones, such as the Lihir Gold Mine, which taps into geothermal resources.

4.4.3. Supercritical Carbon Dioxide *(Emerging technology)*

Supercritical carbon dioxide (CO_2) may be a potential geofluid in PNG's geothermal systems, particularly in deeper geothermal reservoirs. While not common, supercritical CO_2 could be used in specialized geothermal systems where the geothermal fluid is primarily CO_2, allowing for higher heat transfer efficiency and potentially reducing emissions. PNG's deep geothermal systems could offer opportunities to explore CO_2-rich reservoirs, although more research is needed to confirm its feasibility.

4.4.4. Mixed Hydrothermal Fluids (Water with Dissolved Gases)

Geothermal reservoirs in PNG may contain water mixed with other gases like CO_2 and hydrogen sulfide (H_2S). These mixed fluids can be used in hybrid geothermal systems or through flash steam processes, where gases are separated and vented, and the remaining water/steam is used for power generation.

4.4.5. Organic Working Fluids (for Binary Plants)

While hydrocarbons like isobutane and isopentane are not native geofluids, they can be introduced as working fluids in binary cycle geothermal plants to extract heat from lower-temperature geothermal resources. Binary plants operating with hydrocarbons as secondary fluids can extract heat from low-to-moderate temperature geothermal reservoirs, which are common in areas with moderate volcanic or tectonic activity. PNG's diverse geothermal resources, including lower-temperature sites, could benefit from binary cycle technology using hydrocarbons.

Table 2: Geofluids and their respective flash/boiling points at standard atmospheric pressure.

Geofluid	Constituents	Plant	Flash/ Boiling Point
Water	Water (main), dissolved minerals, dissolved gases, some salts	Dry steam, flash steam	180 – 370 °C
Brine	Water (main), dissolved salts (high concentration), dissolved minerals, silica, dissolved gases	Flash steam, Binary Cycle	150 – 350 °C
Supercritical CO_2	CO_2, water, trace gases	Emerging technology	
Mixed Hydrothermal Fluids	Water, dissolved gases, dissolved minerals, trace salts	Flash, Dry Steam	150 – 300 °C
Organic Working Fluids	Isobutane, isopentane	Binary Cycle	50 – 150 °C

4.5 HYBRID SYSTEMS

Hybrid geothermal system combines geothermal energy with complementary renewable sources such as solar, wind, and biomass, as well as low-emission technologies, or conventional sources to optimize energy production and grid stability. The integration of geothermal with other energy sources will be through innovation in hybrid technologies, enhancing operational efficiency and expanding the use of geothermal resources in diverse energy systems.

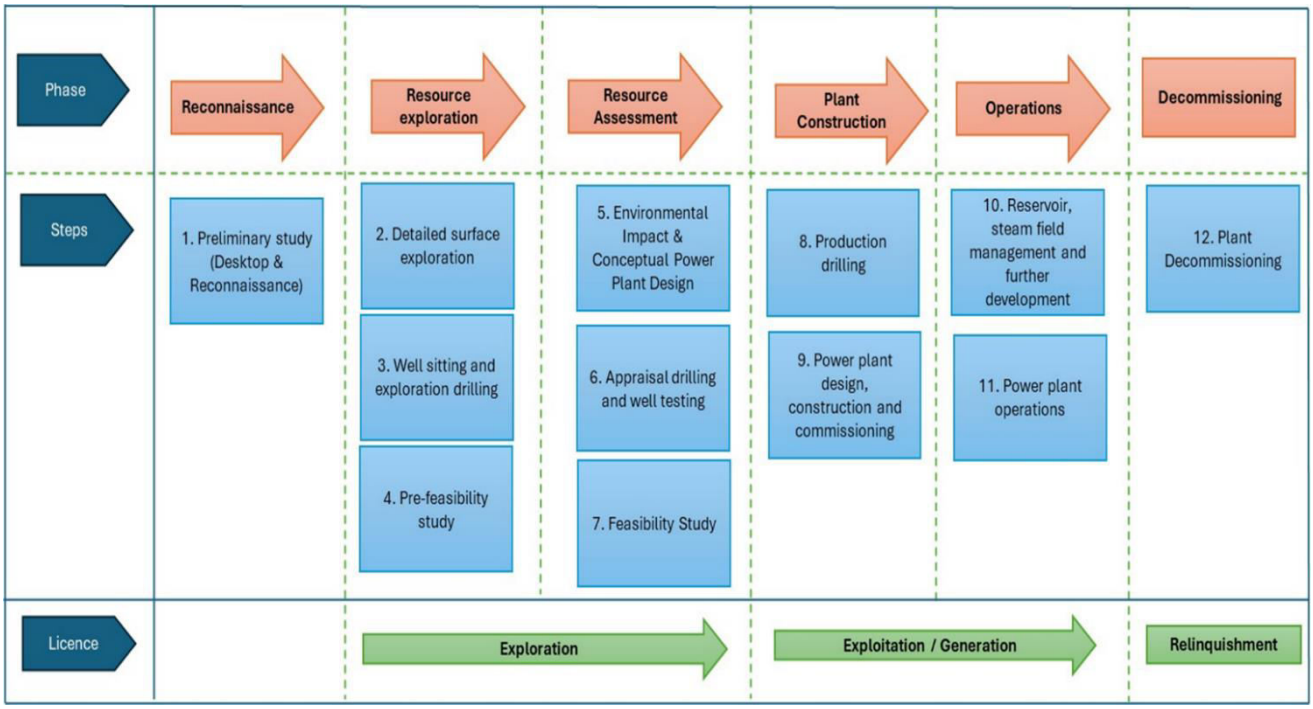
Geothermal hybrid systems will be for both large-scale on-grid power generation and decentralized off-grid applications, especially in remote and underserved areas, to enhance energy access and reliability.

Geothermal hybrid projects must contribute to the reduction of greenhouse gas emissions, supporting national and international climate goals, while promoting sustainable development through the efficient use of available energy resources.

CHAPTER 5: PROJECT DEVELOPMENT PHASE

Geothermal energy project development phases involve reconnaissance (preliminary study), resource exploration, resource assessment, plant construction, project operations and project decommissioning. Figure 8 below shows the phases and applicable licences for developing a geothermal energy project. The full licensing application process is provided in the flowchart in *Annexure 1*.

Figure 8: Geothermal Projects Development Phase and Licencing



Source: National Energy Authority (2025)

5.1. PRELIMINARY STUDY - DESKTOP AND RECONNAISSANCE

The desktop and reconnaissance exercise involves the collection and analysis of all available data regarding a geothermal field, the environment, and the resource information to define the scope for exploration activities.

After the preliminary study, an Inception Report is produced with the recommendation to undertake detailed surface exploration. If the developer proceeds to the next step, then it must apply for a Geothermal Exploration Licence.

5.2. RESOURCE EXPLORATION

There are three steps to be undertaken in the Resource Exploration Phase. These steps are explained below:

(a) Detailed surface exploration

This step entails the following:

i. Geological mapping of important geological features to get acquainted with the geological structure of the geothermal system.

ii. Geo-chemical analysis of fluids from surface manifestations or shallow wells if available to get indications on the reservoir temperatures.

iii. Geophysical explorations, like resistivity measurements, gravity and seismic profiling where needed, to get better understanding of the subsurface features of the geothermal resource.

(b) Well siting and exploration drilling

This step involves drilling of shallow exploration wells (usually 50-300 m) to measure temperature gradients in order to locate the up-flow zone of hot fluids in the geothermal reservoir.

(c) Pre-feasibility Study Report

A pre-feasibility study report lays out a conceptual model based on surface data and drilling. It includes the following:

i. Evaluation of the field capacity
ii. Basic process design
iii. Treatment of geothermal fluid
iv. Preliminary cost estimate
v. Environmental and social evaluation
vi. Recommendations for next steps
    - Environmental and Social Impact Assessment (ESIA)
    - Financing
    - Appraisal drilling and well testing

5.3. RESOURCE ASSESSMENT

Based on the recommendations of the pre-feasibility study report, the next phase is to undertake resource assessment activities. These activities include:

(a) Environmental Impact and Conceptual Power Plant Design

This involves:

i Environmental and Social Impact Assessment for the Power Plant
ii Production and reinjection wells design
iii Update evaluation of field capacity
iv Update on basic process design
v Update on fluid treatment
vi Recommended field operation

(b) Appraisal Drilling and Well Testing

This step involves:

i Confirmation of additional wells based on the pre-feasibility report
ii Design of confirmation wells and test procedure for each well
iii Drilling, testing and evaluation of test results

(c) Feasibility Study

This step involves confirmation and finalization of activities undertaken in the resource assessment phase through a feasibility study report. The feasibility report includes:

i Updated field capacity
ii Process design
iii All main equipment specified
iv Investment and Operational Cost
v Environmental impact assessment for the project
vi Recommendations for the next steps

The feasibility study is to be submitted to NEA with the application for a generation licence.

5.4. LICENCE APPLICATION, ASSESSMENT AND APPROVAL

Once the Feasibility Study Report is finalised, it will be submitted to NEA, together with an licence application (for a Generation Licence) as a proposal for the development of a geothermal energy project.

NEA will undertake its assessment of the application and proposal for development. If need be and where required, other State agencies will also provide support to NEA in assessing areas of concern under respective legislations they administer.

Once the assessments are completed, this will then be submitted to the NEA Board for consideration and approval subject to the *National Energy Authority Act* 2021.

The licensing and regulatory process under the *Environment Act* 2000 must be complied with. The Environment Permit will be a pre-requisite for the approval of a Generation Licence.

During the application and assessment of the application, if need be, various other commercial and socioeconomic requirements may be required to be submitted. 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 as maybe required under the law and imposed by NEA

The Licensing process is further discussed separately under Chapter 6.

5.5. DETAILED PLANT DESIGN 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. The detailed design and construction begin with the following activities:

a) Production/injection wells and drilling platform design
b) Drilling of production/injection wells
c) Infrastructure facilities design and civil works
d) Detailed design of power plant and steam gathering system
e) Detailed design of power transmission lines and point of access determined
f) Service providers contracted for detailed design, engineering, procurement, construction, and project management
g) Construction of the power plant and facilities
h) Training of operators and commissioning

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

5.6. OPERATIONS AND MAINTENANCE

After commissioning, the power plant starts operation to supply electricity to utility companies and clients. The developer will ensure normal maintenance and responsible reservoir management and utilization of the steam field for a sustainable electricity supply.

5.7. DECOMMISSIONING

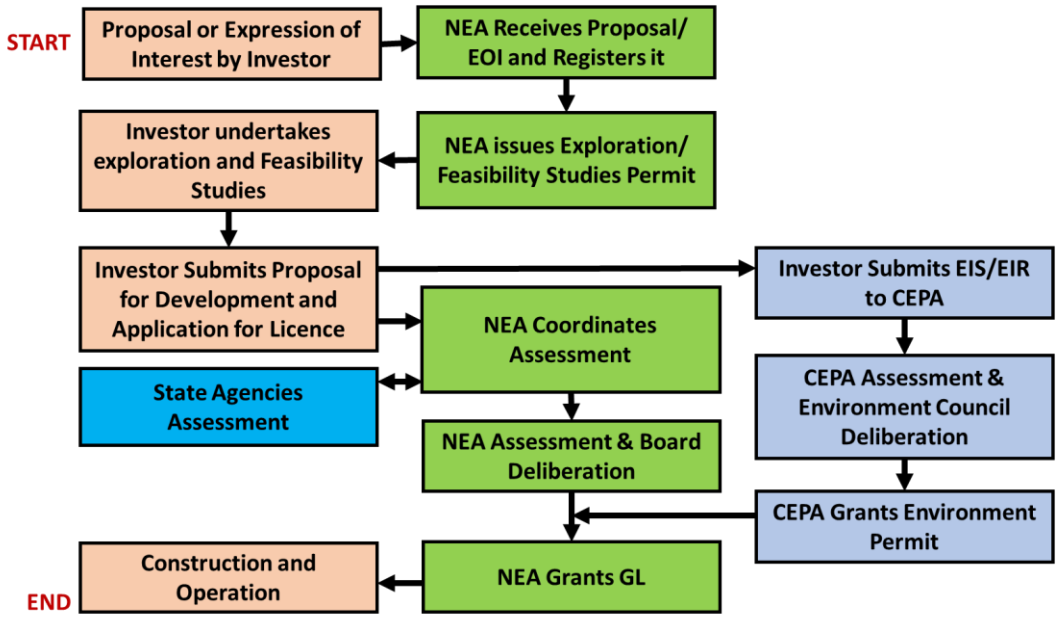
The decommissioning of geothermal wells and power plants will be in accordance with provisions of relevant law(s) applicable to geothermal energy development and regulations developed by the NEA.

CHAPTER 6: LICENSING

6.1. GEOTHERMAL ENERGY PROJECT LICENSING PROCESS

The licensing process for exploration and development is crucial for the development of PNG's geothermal resources. The licence guarantees a developer's right to undertake exploration activities and subsequent development of a geothermal project. It also supports NEA to ensure proper record keeping of investment, regulate and ensure compliance and monitoring of geothermal energy related activities in the country.

Figure 9: NEA Internal licensing process for Geothermal Projects.



Source: National Energy Authority (2025)

As specified in the Development Phases in Chapter 5, the development of geothermal resources for electricity generation will require the licences as presented in the proceeding section.

6.2. TYPES OF LICENSES

6.2.1. Geothermal Exploration Licence

An investor or developer of a geothermal energy project will need to undertake exploration and feasibility studies to identify and define the potential geothermal resource. This includes processes and activities discussed under Chapter 5, particularly sections 5.1, 5.2 and 5.3. The report from these studies forms the feasibility study report which will be submitted as part of the proposal for development of the geothermal project together with the application for a Generation Licence.

To undertake the exploration and feasibility study, the investor or developer must apply to NEA and be issued a Geothermal Exploration Licence.

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

6.2.2. Ex-Ante Licence

This Policy recognises the challenges associated with securing finance for geothermal projects and the lead time needed for design and procurement. Investors for renewable energy projects such as geothermal energy, often require a guarantee or assurance from the State to secure financing and other project logistics.

The Government may provide an Ex-Ante Licence to an investor for the development of a utility- scale geothermal energy project. The Ex-Ante License will only be provided after the completion of a feasibility study and submission of a proposal for development.

For the Government through NEA to provide an Ex-Ante Licence, the Investor must satisfy the following conditions:

(a) Fully completed project feasibility studies submitted to NEA.

(b) Submission of a proposal for Development to NEA.

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

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

6.2.3. Environment Permit

Geothermal energy is basically the use of deep-seated high-temperature water resources as steam 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.

Therefore, an investor or developer of a geothermal project must also comply with the requirements of the *Environment Act* 2000 and be issued an Environment Permit before the construction and operation phase of the geothermal project. The Conservation and Environment Protection Authority (CEPA) will also regulate geothermal energy projects as required under the *Environment Act* 2000.

6.2.4. Generation License

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

The geothermal power plant can only be operated to generated 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.

CHAPTER 7: PRICING AND ELECTRICITY MARKET

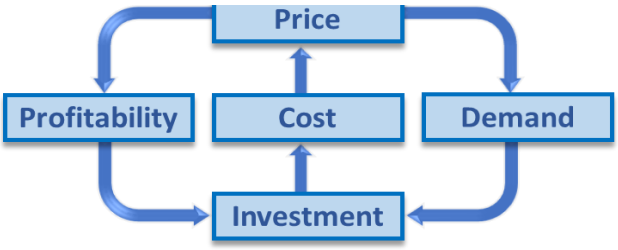
The most fundamental issue in electricity market is the price of electricity. At what price should electricity be sold to maximize economic welfare? The structure of the economy and the energy or electricity market also determines the demand for energy or electricity. Demand and supply affect the price 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. Setting electricity tariffs should take into consideration the factors that affect investment decisions as well as the objective of the government to set an affordable tariff rate.

The determination of a pricing mechanism is critical to encourage investment and development of utility-scale geothermal projects.

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

Figure 10: Relationship between Price and Sustainability of Energy Generation.

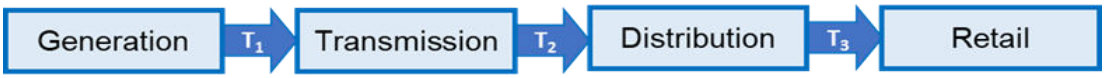


Source: National Energy Authority (2025)

7.1. TARIFF SYSTEM FOR GEOTHERMAL ENERGY GENERATION

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

Figure 11: 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 for a transmission company charged to and 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 to ensure that any tariffs agreed under a PPA are in line with Section 56 of the *National Energy Authority Act* 2021.

Geothermal is a renewable source of energy with high capital costs, including the cost of operation. Therefore, a Feed-In Tariff (FIT) may be considered under T_1 to ensure the holder of the geothermal energy generation license receives a price based on generation costs and capital costs recovery.

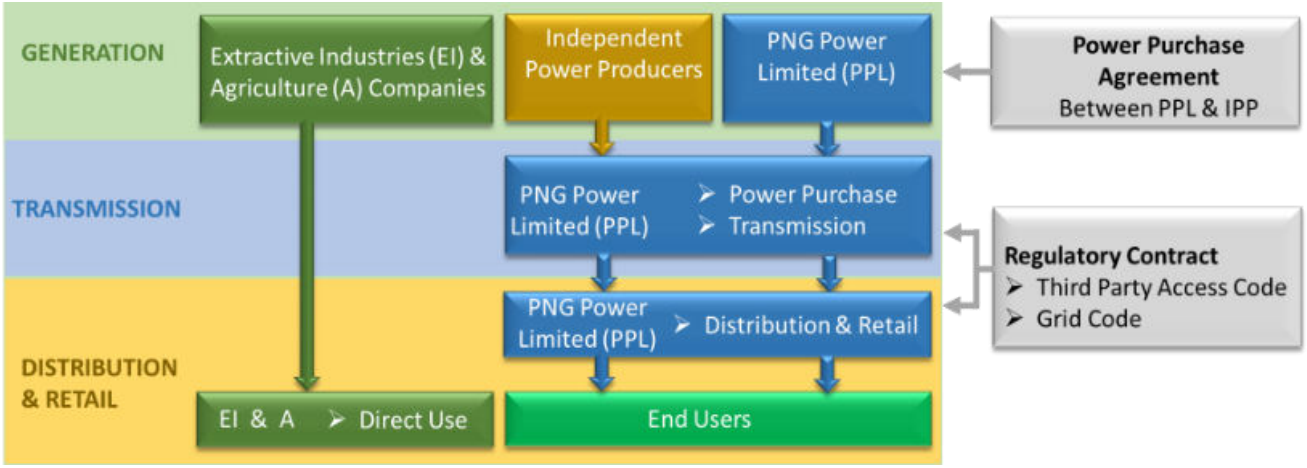
NEA will provide oversight and establish regulations for PPAs to ensure that any tariffs agreed under a PPA are in line with Section 56 of the *National Energy Authority Act* 2021.

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), 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 Figure 12 below.

Figure 12: PNG's Current Electricity Supply Industry.

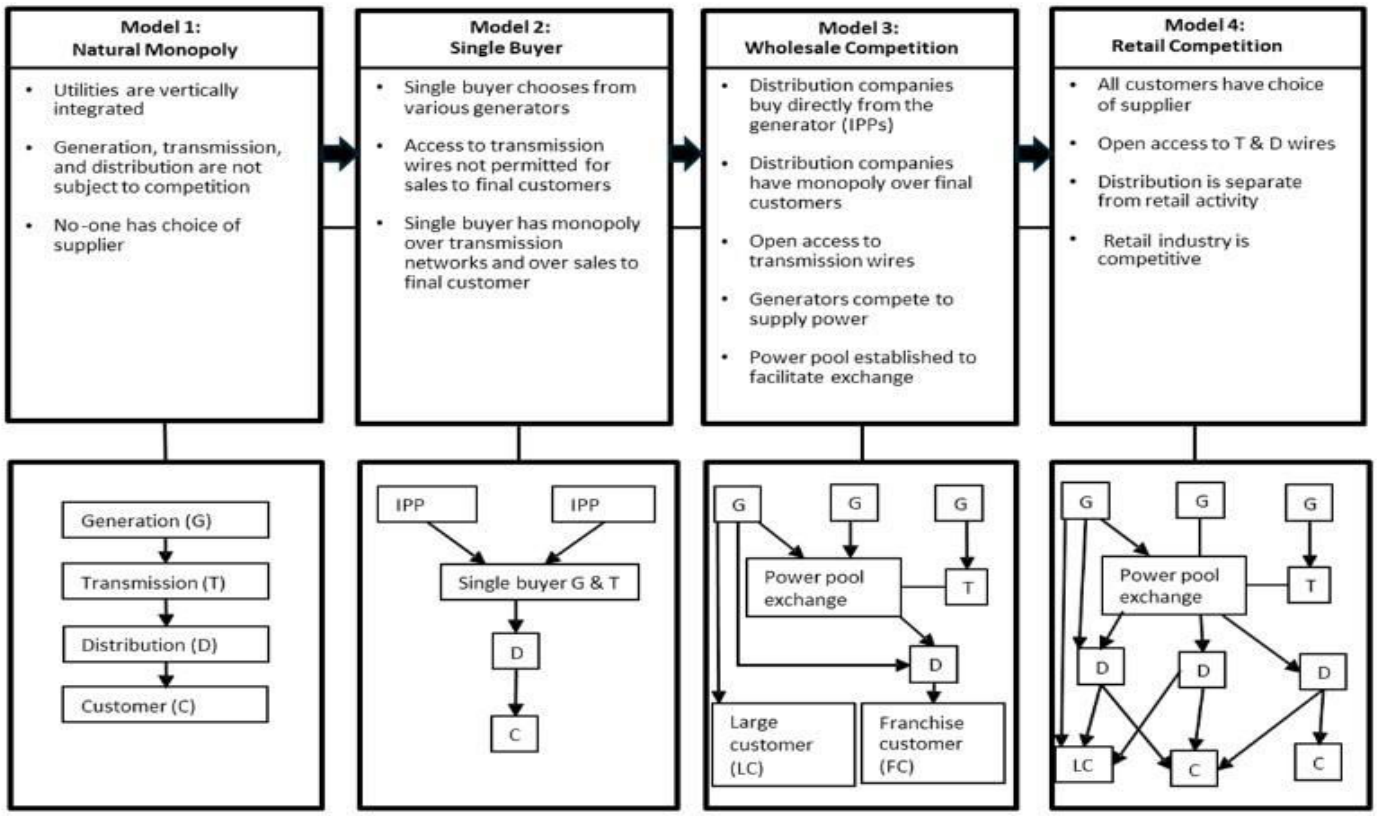


Source: National Energy Authority (2025)

The National Government, through NEA, is taking steps to restructure the electricity industry. This includes the need to restructure the tariff system in accordance with Sections 56 and 57 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 transition 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 13 below.

Figure 13: Different Models for Integrating IPPs.



Source: Gardiner and Montpelier (2000)

The current PNG's 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.

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 has an accessible supply of electricity, that is 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 short – 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 the 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.

One of the key factors for an effective wholesale competition model is the restructure of the business model of the state-owned utility company. It is incumbent on the government to ensure that PPL business model is positionally restructured to effectively operate in the wholesale competition market. PPL and Kumul Consolidated Holdings (KCH) will work in collaboration with NEA to effectively restructure PPL 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 the small power systems. The tariff regime of the small power system 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.

The Authority 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-in 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) of the *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 geothermal power plant is compensated.

NEA will establish regulations and related guidelines to ensure compliance to any pricing and 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. REGULATIONS

Currently there are no specific laws on geothermal energy projects and investments. However, as it relates to energy and the use of geothermal resources, the main legislations to be used to regulate the any geothermal energy projects will be the *National Energy Authority Act* 2021, the *Environment Act* 2000, and other related laws and regulations. The licensing of geothermal energy projects will also be done through these legislations.

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

Geothermal energy projects involve other sector legislations as well, hence requiring a holistic Government approach in regulating the geothermal energy subsector. NEA, being the agency

mandated to regulate the energy sector, will play the leading role in coordinating Government efforts in regulating the geothermal energy subsector.

Table 3: Government agencies with specific roles in the geothermal energy subsector**.**

Government Agency	Role
National Energy Authority	Licensing and regulation of geothermal 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.
Mineral Resource Authority	Provide NEA with geological data and information on geothermal resources and support NEA build in-house capacity to undertake geothermal geological survey and analysis in the future.
Department of Lands & Physical Planning	Deals with land and landownership issues, including compensation issues.
PNG Immigrations & Citizenship Authority	For visa requirements of employees of geothermal 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 geothermal 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 geothermal project activities either for domestic or international transactions.

8.2. HEALTH AND SAFETY

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

The developer or operator of a geothermal energy project 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, and safety plans during all phases of development and operations. The developer or licence holder 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 and the use of cheap and substandard products and equipment entering the 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 and certification, 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 geothermal 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 shall work with the National Institute of Standards and Industrial Technology (NISIT) to establish specific standards and guidelines for geothermal technology. The project developers must be responsible for managing the risk associated with the operations of geothermal technologies deployed on their projects. NEA with relevant state agencies will ensure compliance with any regulations and international standards for technology.

To advance the modernization and efficiency of the electricity industry, the Government, through the NEA, shall promote the digitization of the electricity sector by encouraging the development and deployment of digitally integrated technologies such as smart grids, real-time data monitoring, and advanced control systems to optimize the integration of geothermal energy and other renewable sources. Digital solutions shall be leveraged to improve grid management, enhance energy efficiency, support demand response, and ensure a resilient and adaptive electricity infrastructure for both on-grid and off-grid applications.

9.2. STANDARDS

Geothermal technology must meet international requirements, standards and best practises. The Government through NEA will promote standards that are compatible with geothermal 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 geothermal 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 geothermal energy systems is critical to achieve sustainable energy development goals of PNG. Energy efficiency in geothermal energy projects involves better systems management.

9.3.1. Grid Integration and Stability

Geothermal powerplant operators must ensure seamless integration of decentralized geothermal power plants and mini grids to enhance energy access and reliability across on-grid, off-grid, and remote regions. Geothermal power plants, whether grid-connected or decentralized, contribute to the stability and reliability of the national power grid.

Plant operators must adhere to coordinated maintenance schedules, develop contingency plans for unplanned outages, and integrate with real-time grid monitoring systems, should it be available. Furthermore, load management programs and hybrid system integration will be encouraged to mitigate disruptions and ensure a consistent, reliable electricity supply across the national grid.

Standalone and decentralized geothermal systems will be prioritized in areas where extending the national grid is not feasible, with the objective of providing cost-effective and sustainable energy solutions to underserved communities.

To support this, a robust regulatory framework will be established, outlining technical standards, connection protocols, and incentives for integration into the national grid when infrastructure extends.

9.3.2. Energy Storage Integration

Geothermal powerplant operators, where required, must ensure the integration of energy storage technologies with geothermal power plants to enhance operational flexibility and support grid balancing. Energy storage systems will be incentivized to mitigate short-term power fluctuations, stabilize supply during peak demand periods, and ensure consistent power delivery, especially for off-grid and hybrid systems.

9.3.3. Monitoring and Control Systems

All geothermal power plants must implement advanced monitoring and control systems to optimize operational performance, improve energy efficiency, and support real-time data collection for predictive maintenance and grid management. These systems shall be integrated with national and regional grid management platforms to enable efficient control and coordination.

9.3.4. Geofluid Management & Stability

Geothermal energy projects, where applicable, will be required to ensure best practices for sustainable geofluid management, including the reinjection of fluids to maintain reservoir pressure and prevent resource depletion. Continuous monitoring of geofluid

quality and volume will be required to ensure long-term resource sustainability, minimize environmental impacts, and optimize plant performance.

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

Certain commercial aspects are crucial to the development and sustainability of renewable energy projects such as geothermal. The main commercial aspects are taxation, incentives, and pricing (tariff). Other commercial aspects that are also important in PNG include the State's equity participation and monetary benefits.

10.1. TAXATION

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

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

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

10.2. INCENTIVES

The Government may provide incentives to support the development and commercialisation of geothermal 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 such incentives to be provided under this Policy or for renewable energy projects such as geothermal.

10.3. STATE EQUITY PARTICIPATION

The State has the right but not the obligation to acquire, directly or through a nominee, all or any part of a participating interest not exceeding 20% in each geothermal energy project as stipulated under Section 83 of the *National Energy Authority Act* 2021. The State may enter into an agreement not inconsistent 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 geothermal 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 Government 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, geothermal energy is a renewable energy resource, which is heat stored in the earth's crust that is harnessed by extracting heat through hot water and steam to generate electricity. The electricity generated is then sold to an off-taker at a price (tariff). It is difficult to measure hot steam, unlike minerals, and apply the similar concept for royalty payment. Furthermore, no one owns the heat contained in the Earth's crust, therefore, the royalty concept in the extractive industry cannot be applied to geothermal energy projects.

Contrary to Section 82 of the *National Energy Authority Act* 2021, Royalty will not be paid for geothermal energy projects to the State or any landowners for the natural steam that is harnessed to produce energy. Instead, there will be consideration for compensation for land used to establish the infrastructure for geothermal energy projects.

CHAPTER 11: ENVIRONMENT

11.1. COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

The developer or holder of a licence undertaking feasibility studies, development or operating a geothermal project must comply with all requirements for environmental management under the *Environment Act* 2000.

Areas to also consider in the environmental management of a geothermal project will include, but not limited to:

(a) Surface disturbances;

(b) Physical effects of fluid withdrawal;

(c) Noise pollution;

(d) Thermal effects;

(e) Chemical pollution;

(f) Biological effects; and

(g) Protection of natural features and protected areas.

11.2. WASTE MANAGEMENT

The developer or holder of a generation licence for a geothermal 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 shall include, but not limited to:

(a) storage and disposal of waste;

(b) strategies for waste avoidance, reduction, or mitigation;

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

(d) disaster management and response strategies; and

(e) such other information and issues as may be required by CEPA or NEA as prescribed under any law in PNG.

The developer or holder of a licence for a geothermal project shall periodically update the waste management plan as and when required by CEPA and NEA. Treatment of waste, including wastewater, shall be done in accordance with the *Environment Act* 2000 and any other related standards and regulations.

11.3. REHABILITATION AND CLOSURE

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

Should the licence holder of a generation licence for a geothermal energy project or operator decide to shut down a geothermal energy project or any parts of the geothermal energy project, they must 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 geothermal 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, and 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 geothermal. By investing in geothermal projects, an investor or holder of a generation licence earns 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 geothermal project area landowners, a twenty percent (20%) domestic share of proceeds shall apply to every disclosed credit contained in the inventory of any geothermal 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 geothermal 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 socio-economic development. The Government through NEA will support and promote Just Transition in the implementation of this Policy.

12.4. PROMOTING DECARBONIZATION

The development of geothermal 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 geothermal projects, integrating hybrid energy systems, and improving energy efficiency in both supply and demand.

The Government will encourage 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 Tariffs, where applicable.

CHAPTER 13: LAND AND LANDOWNER MOBILIZATION

13.1. ACCESS TO LAND

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

For customary land, it must be ensured that 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. If required, the holder of a geothermal 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.

13.2. LANDOWNER IDENTIFICATION

During the feasibility stage and 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 geothermal 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 for a geothermal project shall 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, both positive and negative, will be determined by the 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 geothermal 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 geothermal 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 for proper management of land issues for geothermal energy projects.

For Customary Land involving more than one landowner, there must be clear demarcation of land boundaries, which involves 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 a geothermal energy project. The main components of national content are further discussed below. 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 (BSA) or such other arrangements on benefits sharing.

When developing geothermal energy projects, a developer or investor must consider the cascading uses of geothermal energy, as discussed under Chapter 4.3, and provide opportunities for landowners and Papua New Guineans.

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

14.1. EMPLOYMENT AND TRAINING

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

14.2. BUSINESS DEVELOPMENT

The developer or licence holder for a geothermal 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. This only applies if there are such opportunities available to be for landowners to undertake. 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 geothermal project, where required, must submit a Business Development Plan if there will be any business opportunities that will be provided to landowners. They must submit to the Managing Director of NEA an annual report on the implementation of the Business Development Plan.

14.3. COMMUNITY DEVELOPMENT ASSISTANCE

The developer or licence holder for a geothermal 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.

14.4. COMPENSATION

The developer or licence holder for a geothermal project shall pay compensation, in respect of his entry or occupation of land the subject of the license, 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 landholders 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.

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

Should the developer or licence holder and landholders not agree to the rates for compensation, the Minister may determine 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 geothermal project shall be kept in the Register established under Section 79 of the *National Energy Authority Act* 2021.

14.5. RESETTLEMENT

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

14.6. 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 geothermal project must bring benefits to the Government, landowners, and impacted communities.

The Government, through NEA, will ensure that appropriate benefits defined by relevant laws and policies flow to landowners and impacted communities for any geothermal project. If there are benefits, landowners and impacted communities shall have a benefit-sharing agreement with any developer or licence holder of a geothermal project to ensure that the benefits are shared amongst the intended beneficiaries and managed in the long-term.

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.

14.7. WOMEN IN ENERGY

The role of women in renewable energy development and operation must be given importance through a gender inclusive approach. 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.

The majority of land in PNG is customarily owned. Most societies are patrilineal while a few are matrilineal or a mix of the two. Any processes for landowner engagement and participation under this Policy must give consideration and equal opportunities for women's participation and decision-making.

14.8. NATIONAL CONTENT FORUM

The Minister for Energy may call a National Content Forum for all stakeholders before the commencement of construction of a geothermal project as stipulated under Section 80 of the *National Energy Authority Act* 2021.

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. COMMERCIAL AGREEMENTS

15.1.1. Project Development Contracts

The State through NEA, upon approval from the National Executive Council (NEC), may enter into any agreement consistent with the relevant laws of PNG relating to the development of a geothermal project. The agreements may contain provisions relating to:

(a) the circumstances or the manner in which the Government may support the development of a geothermal project; and

(b) sharing of benefits; and

(c) the acquisition of an equity interest by the State either directly or indirectly in a geothermal project; and

(d) 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

(e) 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.

15.1.2. 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 geothermal project and the Off-Taker shall enter into a PPA on the details of power purchase and other arrangements.

NEA shall 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 of the *National Energy Authority Act* 2021.

A PPA will not be required for the licence holder of a geothermal energy generation licence who generates electricity for private consumption (auto producer), instead, a permit will be granted by NEA.

15.2. COMMUNITY AGREEMENTS

15.2.1. Benefit Sharing Agreement

If there will be any benefits from geothermal projects to landowners or subnational 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 include the licence holder of a geothermal project, the National Government, host sub-National Governments, and the landowners.

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

15.2.2. Compensation Agreement

Geothermal 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 geothermal 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 geothermal project. The compensation agreement will capture compensation discussed under Chapter 14.4 of this Policy.

15.3. OTHER AGREEMENTS

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

CHAPTER 16: DISPUTE RESOLUTION

16.1. DISPUTE RESOLUTION MECHANISM

Disputes refer to all disagreements that arise between various project stakeholders concerning a geothermal project that cannot be sorted out amicably within a reasonable time. Should such disputes arise, NEA shall initiate the 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 REQUIREMENTS

17.1. ACCESS TO INFORMATION

The Government through the NEA shall require any investor or company operating a geothermal project to provide all required information concerning a geothermal 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 developers of geothermal projects shall be required to provide reports to NEA or any of the Government agencies as required by this Policy. Reporting requirements will be enforced under the various legislations, especially Section 51 and Section 122 of the *National Energy Authority Act* 2021. Government agencies may also enforce reporting requirements under their respective legislations.

CHAPTER 18: POLICY IMPLEMENTATION

This chapter is presented in two parts. The first part discusses the actual administration of this Policy. The second part identifies the actual strategies for implementing the Policy in delivering geothermal 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. The 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 whose functions are outlined in this Policy under Table 3 and through various legislations. Some of these Government agencies and their functions are listed under Annexure 2.

18.2. POLICY IMPLEMENTATION STRATEGIES

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

Figure 14: Policy Implementation Strategy Linkage.

Source: National Energy Authority (2025)

18.2.1. Legislative Reforms

There is no specific legislation on geothermal 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 geothermal 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 geothermal energy project or system.
- Define the licensing process of geothermal 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 geothermal projects. Partnerships and engagement should be multi-level and at different stages of a geothermal project development and operation. The 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 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 Subnational Governments (PGs and LLGs) will play an important role in the implementation of this Policy to support the development of geothermal 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.

The Subnational Governments can also investment in geothermal 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 Subnational 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. PNG needs investments in the renewable energy sector such as geothermal 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 the energy sector in PNG, 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 geothermal energy projects.

d) Landowners & Impacted Communities

Most of the land in PNG is customarily owned and almost all land has a landowner, either individually or communal. Landowners are considered as a key partners under this Policy for any geothermal energy project development. The Government through NEA, and any developer of a geothermal project, will work closely with landowners to ensure they participate and benefit from any project development.

Consideration will also be given to impacted communities of utility - scale geothermal 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 geothermal energy projects, including sourcing finance for energy projects. Civil Society and NGO's can also empower communities through capacity building, decision making, and ensuring a Just Transition.

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

f) Academic and Research Institutions

The 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 academic and research institutions to support the implementation of this Policy and provide technical support for the development of renewable energy projects.

g) Financial Institutions

Financial 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 that for geothermal developments.

The Government through NEA aims to create linkages with financial institutions to support the development of geothermal energy projects.

18.2.3. Community Engagement

In PNG, land is owned by communities, this includes ownership and user rights to rivers and waterways. These land rights are usually affected through the development of geothermal power projects. Therefore, there must be community engagement strategies

and partnerships with local communities to address issues and ensure the delivery of geothermal power 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 geothermal energy projects. Often governments in trying to address growing electricity demand undertake geothermal power projects that take time to complete which can lead to abandonment. This is because medium to large-scale geothermal projects is capital-intensive and require technical expertise.

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

18.2.5. Public-Private Partnerships (PPP)

To achieve the successful development and implementation of geothermal energy projects, the Government recognizes the importance of fostering collaboration between the public and private sectors. The establishment of clear 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 geothermal energy development focuses on attracting private investment 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

Utility-scale geothermal power projects require a long and complex development phase as they are capital-intensive and requires a lot of planning and design work. Many private investments in large-scale geothermal projects in emerging markets have shown that there is a disconnect between the lifespan of geothermal power projects and the debt maturities that are offered by their financiers. While 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 geothermal power less competitive than many other power sources.

The Government will consider incentives to drive private investment in geothermal 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 geothermal power projects.
- Subsidies for small and hybrid geothermal 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 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 both from 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 geothermal projects, which is driven by human capital development. Any increases in human capital investment always leads to significant improvements in the geothermal project capabilities and improvements in the 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 technologies. Therefore, any strategy for human capital development in geothermal projects must enhance human capacity development 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, degree programs, as well as the micro-credentials that are gaining popularity in the recent years as an alternative to the 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. 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.

18.2.10. Framework for Robust Monitoring and Reporting

Monitoring and reporting are important strategies to ensure the effective implementation of this Policy. Continuous monitoring will be undertaken by NEA per the monitoring and evaluation framework discussed under Chapter 20 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.

CHAPTER 19: RISKS

Geothermal energy is an important option as a clean renewable source of energy under the current climate change and energy security environment. The existence of geothermal potential presents PNG with the potential to diversify its energy mix. Geothermal 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 geothermal projects.

Furthermore, the process involved in developing a geothermal energy project also 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 risks that are related to a geothermal energy project.

19.1. GEOTHERMAL ENERGY POLICY 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. Geothermal is no different, and with NEA now established, it can coordinate all Government efforts and collaborate with relevant Government agencies to license and regulate geothermal 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 geothermal 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

The only geothermal project in the country on Lihir Island was developed by the mining company for its own operations. No geothermal projects have been developed in PNG for electricity generation on commercial terms for electricity supply to the grid. Therefore, the challenge is for adequate capacity in terms of knowledge, skills and experience in implementing the Policy and ensure effective regulation.

NEA is mandated to regulate and to implement the Policy, as well as to improve capacity by any means to implement the Policy and regulations on geothermal project development.

19.2. GEOTHERMAL ENERGY PROJECT RISKS

Project risks are the potential risks that may be associated with the development and operations of a geothermal energy project. These risks are identified in the table below.

Table 4: Identification of Potential Geothermal Energy Project Risks

Risk	Duration or Period of Risk	Risk Rating		
		High	Medium	Low
1. Financial Risks				
1.1. Financing /Debt Service	Life of Project			
1.2. Resource 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**				
b.				
5.1. Geographic Location	Feasibility & Construction			
5.2. Political Risks	Life of Project			

19.3. RISK MANAGEMENT AND MITIGATION FRAMEWORK

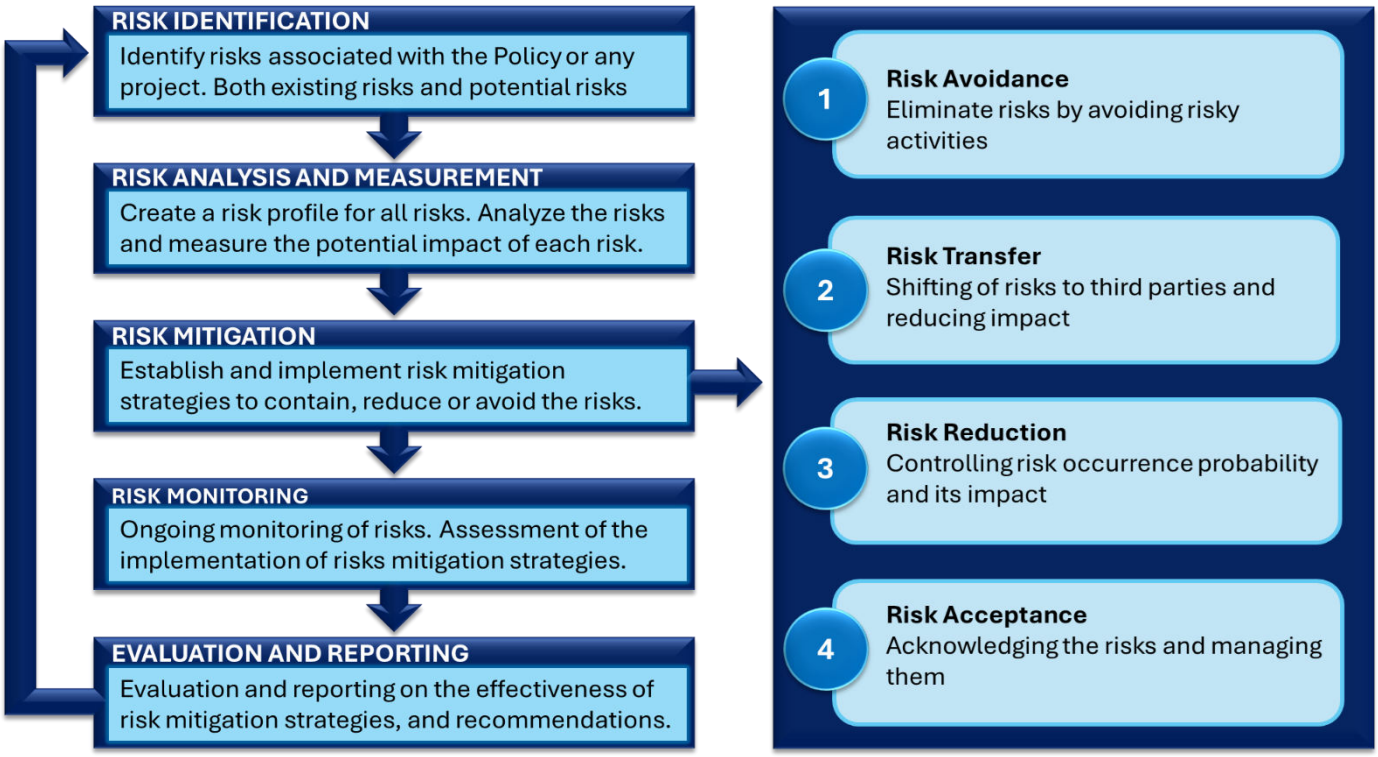
There are risks associated with developments in the energy sector, including the electricity industry. Section 19.1 and 19.2 of this Policy highlighted potential risks associated with the implementation of this Policy and development of geothermal energy projects respectively.

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 geothermal 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 geothermal energy projects.

Figure 15: 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 a 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.

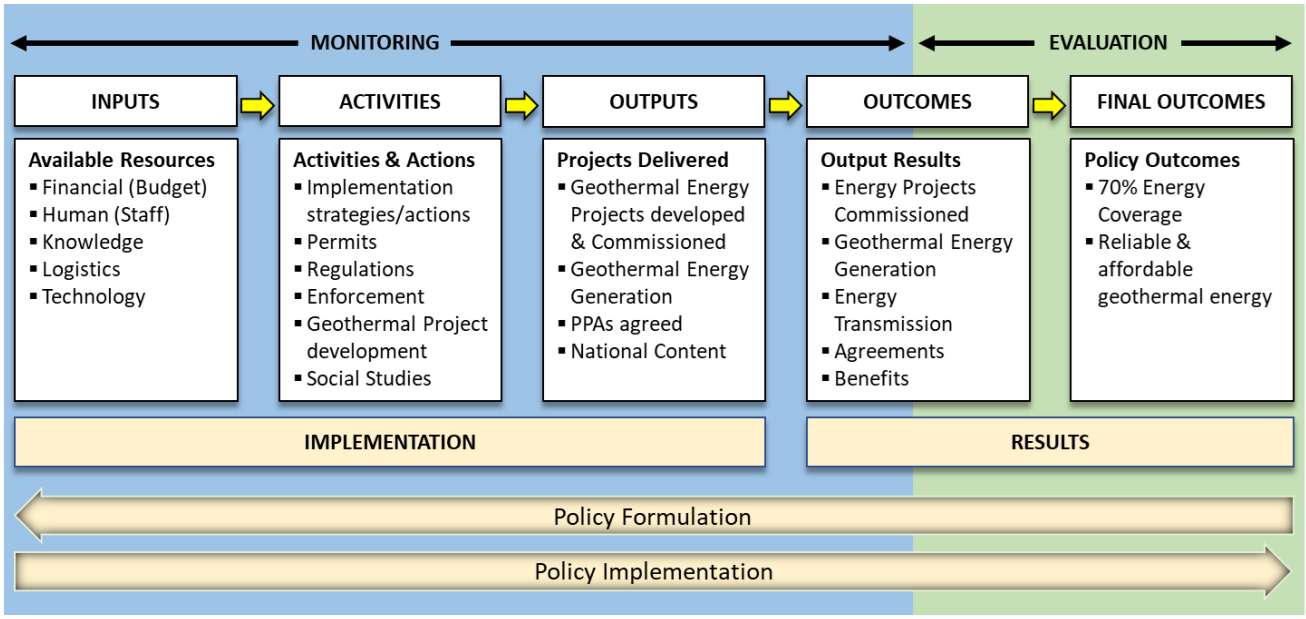
NEA is the custodian of this Policy and will be responsible for periodic and ongoing monitoring and evaluation of the implementation of this Policy in accordance with its M&E Framework. Reports and recommendations will be provided to the Managing Director of NEA, the Minister, and if required, the National 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 16: Policy Results Chain for Monitoring and Evaluation



GLOSSARY

Word	Definition
Advanced Geothermal System (AGS)	AGS refers to innovative geothermal technologies designed to harness heat from deep-seated resources that lack naturally occurring fluid or permeability. These systems use human intervention to enhance permeability and enable heat extraction.
Backpressure Plant	A backpressure plant discharges steam exhaust directly into the atmosphere instead of using a condenser, providing a simpler and cost-effective solution for early-stage electricity generation in developing geothermal fields.
Benefit Sharing Agreement (BSA)	An agreement outlining the distribution and administration of benefits among stakeholders, including the government, license holders, sub-national governments, and landholders, ensuring that geothermal project benefits are equitably shared.
Binary-Cycle Plant	A geothermal power plant technology that uses moderate-temperature geothermal fluids to heat a secondary fluid with a lower boiling point. This process generates vapor to drive turbines in a closed-loop system, ensuring no emissions to the atmosphere.
Blackstart	Refers to the ability of a geothermal power plant to restore operations independently without relying on the external power grid, contributing to grid resilience and reliability.
Brine	A geothermal fluid rich in dissolved salts, minerals, and gases, typically extracted from geothermal reservoirs. It is used in flash steam and binary cycle power plants.
Carbon Credit	Tradable permits or certificates earned by reducing greenhouse gas emissions, incentivizing private investment in renewable projects like geothermal energy.
Climate Change and Development Authority (CCDA)	The authority responsible for ensuring compliance with climate change-related legislation, such as the Climate Change Management Act, and international treaties under the UN Framework Convention on Climate Change.
Compensation Agreement	A legal arrangement requiring developers to compensate landowners for any disruptions or damages caused by geothermal project activities, ensuring fair treatment.
Conceptual Decommissioning and Closure Plan (CDCP)	A preliminary plan required at the licensing stage for managing the socio-economic and environmental impacts of closing and rehabilitating a geothermal project.
Conference of Parties (COP)	An international gathering under the UNFCCC where climate agreements and decisions, such as the Paris Agreement, are negotiated and adopted.
Conservation and Environment Protection Authority (CEPA)	The agency tasked with enforcing environmental regulations, including monitoring compliance with waste management and rehabilitation plans for geothermal projects.
Developer	An entity holding licenses for geothermal exploration or exploitation, responsible for project planning, execution, and compliance with regulations.
Dry Steam Plant	A geothermal power plant that directly uses steam from the reservoir to drive turbines and generate electricity. This technology is suited for high-temperature steam reservoirs.
Electricity Supply Industry (ESI)	The network of organizations involved in electricity generation, transmission, and distribution.
Electrification Rate	The percentage of the population with access to electricity, used as an indicator of energy development.
Emission Reduction Plan (ERP)	A developer-submitted document detailing baseline emissions and short- and long-term decarbonization goals for a geothermal project.
Enhanced Geothermal System (EGS)	Geothermal systems where permeability in underground rock is artificially created or enhanced using high-pressure fluid injections. This enables heat

	extraction from otherwise impermeable rocks, offering a solution for areas without naturally occurring hydrothermal systems.
Environment Permit	A regulatory authorization issued under PNG's environmental laws, enabling developers to undertake geothermal exploration and exploitation activities in compliance with environmental management and protection standards.
Equity	Ownership stake or shareholding in geothermal energy projects, either by the state, private entities, or other stakeholders, to ensure fair participation and benefit distribution.
Ex-Ante License	A preliminary or temporary licence issued to an applicant after submitting his application for a generation licence which provides guarantee to progress other requirements or steps for a project development until a generation licence is issued.
Exploitation	The phase in geothermal project development where resources are extracted for energy production, following exploration and resource confirmation.
Exploitation & Generation License	A combined regulatory approval for resource extraction (exploitation) and electricity generation in geothermal projects.
Exploration	Activities involving the identification and assessment of geothermal resources, including geological surveys and drilling, to determine feasibility.
Exploration License	A permit granted to conduct geothermal exploration activities, defining the scope and responsibilities of the licensee.
Feed-In-Tariff	A pricing mechanism that guarantees a fixed rate for electricity generated from renewable energy sources, including geothermal energy. It incentivizes investment by ensuring cost recovery for developers based on generation and capital costs.
Field Capacity	The maximum sustainable energy output from a geothermal resource as determined by technical and environmental assessments.
Flash Steam Plant	A geothermal power plant that uses high-pressure hot water from underground, which is "flashed" into steam by reducing pressure. The steam drives turbines to generate electricity, while the remaining liquid can undergo additional flashing to maximize energy extraction.
Flashing	The process where high-pressure geothermal fluid is vaporized into steam by reducing its pressure. This is a critical step in flash steam power plants to separate steam from the liquid component for power generation.
Generation	Refers to the maximum energy output or generation potential that can be sustainably extracted from a geothermal resource, as assessed during resource evaluation phases.
Generation Capacity	The total amount of electrical power a geothermal energy system can produce, measured under ideal conditions.
Geothermal Energy	A water resource with latent heat energy that can be extracted for useful purposes.
Geothermal Field	A geographic area characterized by geothermal activity, including reservoirs of hot water, steam, and associated geological formations suitable for energy extraction.
Geothermal Fluid (Geofluid)	The naturally occurring hot water or steam from geothermal reservoirs used to transfer heat from underground to the surface for energy production. It may contain minerals, salts, or dissolved gases.
Geothermal Resource	Includes all heat stored in the Earth’s crust, accessed via geothermal fluids or dry rock, and categorized by temperature levels (low, medium, or high).
Government	Unless otherwise stated, it shall mean the Government of the Independent State of Papua New Guinea.
Hydrothermal Systems	A subset of geothermal systems where heat is naturally transferred via water circulating through deep, permeable rocks. These systems are commonly developed for energy production due to their natural fluid presence.
Impacted Community	Communities whose social, economic, or environmental conditions are directly affected by geothermal project activities. These communities are prioritized in benefit-sharing and community engagement programs.

Inception Report	A preliminary report produced after initial reconnaissance and desktop studies of a geothermal project. It outlines the scope for exploration and sets recommendations for detailed surveys.
Independent Consumer & Competition Commission (ICCC)	The primary economic regulator and consumer watchdog in PNG. ICCC oversees the pricing and market practices for electricity, ensuring fair trade and compliance with the *ICCC Act* 2002.
Independent Power Producer (IPP)	Private entities authorized to generate electricity for sale to the grid or other customers under a Power Purchase Agreement (PPA). They play a key role in diversifying power generation sources.
Injection Well	A well used to reintroduce spent geothermal fluids back into the reservoir after heat extraction, ensuring reservoir sustainability and pressure maintenance.
Installed Capacity	The maximum electrical output a geothermal power plant is designed to produce, reflecting the sum of all installed generation equipment.
Internal Revenue Commission (IRC)	The agency responsible for overseeing tax administration, including taxation policies applicable to geothermal projects in Papua New Guinea.
International Electrochemical Commission (IEC)	An international standards organization that develops safety and performance benchmarks for electrical and electronic technologies, including geothermal energy systems.
International Organization for Standardization (ISO)	An international body that establishes global standards to ensure quality, safety, and efficiency in various industries, including geothermal energy.
Internationally Transferred Mitigation Outcomes (ITMOs)	Mechanisms under Article 6 of the Paris Agreement allowing countries to trade carbon credits or emissions reductions, supporting global climate mitigation goals.
Investor	An entity that provides financial or technical resources to develop and implement geothermal energy projects. Investors play a critical role in financing exploration, infrastructure, and operations.
Land Access Agreement	An agreement between a geothermal project developer and landowners permitting access to land for exploration, exploitation, and project development. This agreement ensures compliance with customary and legal land requirements.
Landholder	An individual or entity holding ownership, lease, or usage rights to land that may be affected by geothermal energy projects. Compensation for impacts is stipulated within agreements.
Landowner	The person or group with recognized ownership of land, especially customary landowners in Papua New Guinea, who must be consulted and consent to geothermal development projects.
License Holder	An entity granted exploration, exploitation, or generation rights for geothermal projects, subject to compliance with environmental, social, and regulatory standards.
Mixed Hydrothermal Fluids	Geothermal fluids containing a combination of water, dissolved gases, minerals, and trace salts, typically utilized in hybrid or flash steam systems.
National Content Forum	A stakeholder meeting, convened under Section 80 of the National Energy Authority Act, to discuss local participation, benefits sharing, and project impacts
National Electrification Trust Fund	A mechanism established to pool resources for the expansion of electricity access across PNG, including investments in renewable energy projects like geothermal.

National Energy Authority (NEA)	The central agency mandated by PNG's National Energy Authority Act 2021 to regulate, license, and oversee geothermal energy projects, ensuring compliance with environmental, safety, and operational standards.
Nationally Determined Contributions (NDC)	Commitments made by Papua New Guinea under the Paris Agreement to reduce greenhouse gas emissions and support renewable energy transitions, including geothermal energy.
Off-Grid	Refers to geothermal energy systems that operate independently of the main power grid, often used in remote or rural areas for localized electricity supply.
Off-Taker	The buyer of electricity generated from geothermal projects, typically through long-term agreements like Power Purchase Agreements (PPAs).
Organic Working fluids	Hydrocarbons like isobutane and isopentane used in binary-cycle geothermal plants to enhance energy transfer from low-temperature reservoirs.
Pacific Ring of Fire	A region encircling the Pacific Ocean known for tectonic activity, including volcanoes and geothermal resources. Papua New Guinea's position within this zone gives it significant geothermal potential.
Permeability	The ability of rock formations to allow fluids to pass through. High permeability is essential for the efficient extraction of geothermal fluids.
Permeable Rock	Geological formations that allow fluids to flow through due to the presence of interconnected pores or fractures. Permeability is a critical factor in harnessing geothermal resources.
Power Purchase Agreement (PPA)	A contract between a geothermal energy producer and an off-taker detailing terms for electricity sale, pricing, and conditions.
Production Well	A drilled well that extracts geothermal fluids (steam or water) from underground reservoirs to supply energy for electricity generation.
Project Development Contract	A legal agreement between the state and a developer outlining roles, responsibilities, and terms for geothermal project execution, including benefit sharing and dispute resolution.
Project Development Contract	A legally binding agreement between the state and a developer outlining roles, responsibilities, and conditions for developing a geothermal project. It covers operational, financial, and regulatory aspects.
Quaternary	The most recent geological period, encompassing significant volcanic and tectonic activity. Quaternary volcanic features in PNG contribute to its geothermal resource potential.
Radioactive Decay	The natural process by which unstable atomic nuclei release energy, contributing to the Earth's geothermal heat production.
Regulatory Contract	A formalized agreement that specifies compliance requirements with PNG's energy regulations and policies for geothermal project operation.
Relevant Public Bodies (RPB)	An entity representing The State in a PPP arrangement. A RPB can either be The Independent State of PNG, a State-Owned Entity (SOE) or a Provincial or Local Level Government.
Royalty	Payments made by developers to landowners for the use of geothermal resources within their land, calculated as a percentage of the project's revenue.
Supercritical CO_2 (Carbon Dioxide)	A potential working fluid for deep geothermal systems, offering higher heat transfer efficiency and reduced environmental impact compared to conventional methods.
Supercritical Geothermal System	A geothermal energy system that utilizes supercritical fluids, which are in a state between liquid and gas, typically found in very high-temperature and high-pressure environments. These systems offer higher efficiency and energy output compared to conventional geothermal systems.
Tariff	The pricing structure applied to electricity generated from geothermal sources, which includes agreements for generation, transmission, distribution, and retail. Tariffs aim to ensure cost recovery and fair returns for developers while maintaining affordability for consumers.
Tariff System	The framework defining pricing structures for electricity generated from geothermal resources, including agreements between Independent Power Producers (IPPs) and off-takers.

Tax Break	Financial incentives provided by the government to geothermal project developers, such as reduced tax rates, tax holidays, or exemptions on imports of geothermal equipment, to encourage investment in renewable energy projects.
Terrane	A region or fragment of the Earth's crust with a distinct geological history, contributing to geothermal activity. PNG's terranes are integral to its geothermal potential.
Theory of Change	A conceptual framework outlining how geothermal energy projects achieve desired outcomes by mapping pathways of change and identifying necessary preconditions.
United Nations Framework Convention on Climate Change (UNFCCC)	An international treaty under which countries, including PNG, commit to reducing greenhouse gas emissions and addressing climate change through policies like the Paris Agreement and related decisions.
Waste Management Plan	A document submitted by geothermal project developers detailing the strategies for managing waste generated during exploration and operation, including storage, treatment, disposal, and environmental protection measures.

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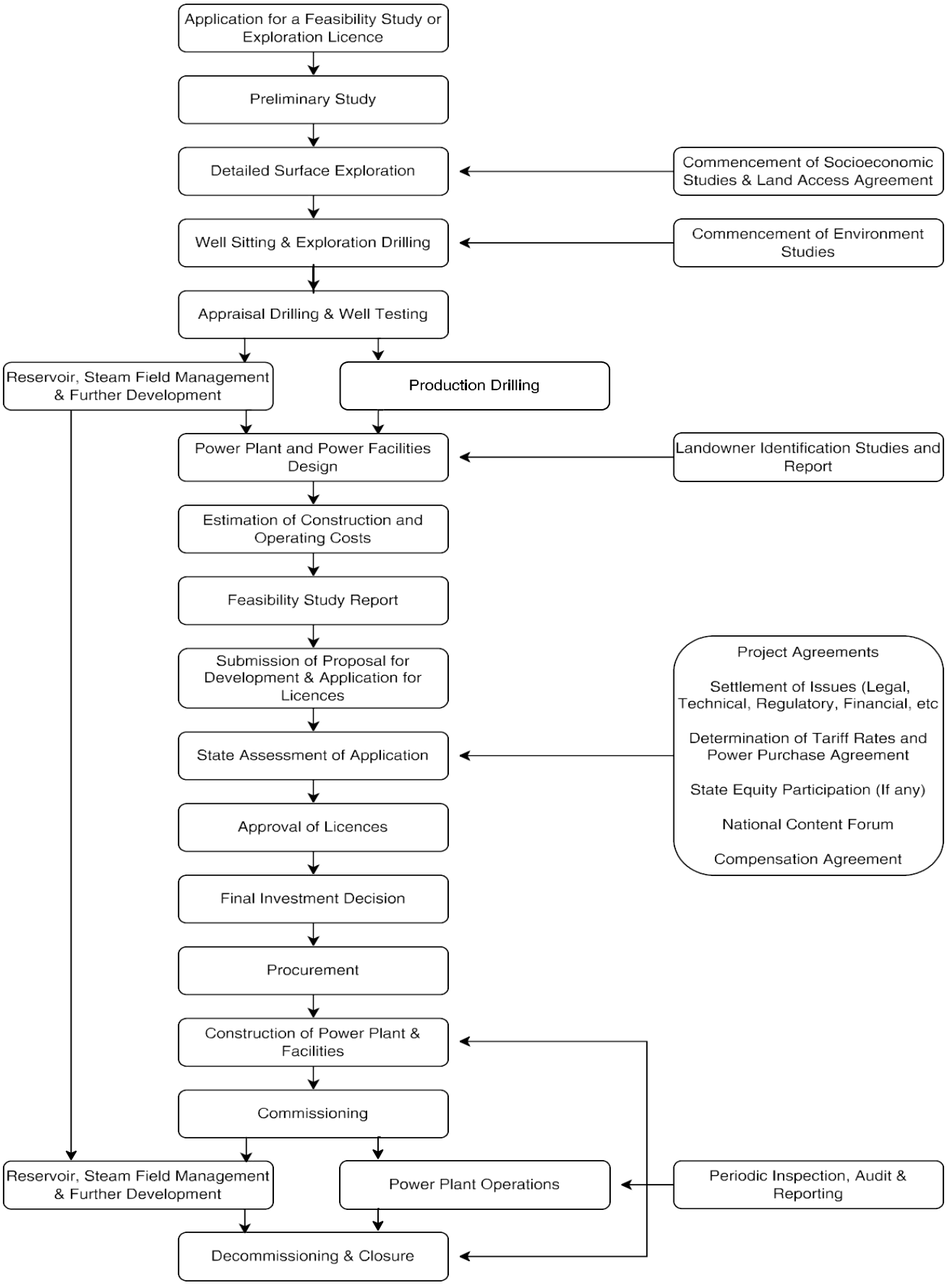
ANNEXURES

ANNEXURE 1: GEOTHERMAL ENERGY PROJECT IMPLEMENTATION FLOW CHART



ANNEXURE 2: SUPPORTING AGENCIES OF THE GEOTHERMAL ENERGY POLICY

Organisation	Roles / Responsibilities	Legislations & Policies
Climate Change Development Authority (CCDA)	CCDA is the Government agency mandated to coordinate and implement the country's climate change policies and programs. Its role is also to ensure PNG adapts to the impacts of climate change and to reduce its greenhouse gas emissions.	1. *Climate Change Management Act* 2015
Department of Labour and Industrial Relations (DLIR)	DLIR is responsible for promoting labour employment opportunities at a national level to furnish employees with information on their rights through the office of labor administration. DLIR also ensures harmonious industrial relations by setting and enforcing terms and conditions of employment, to promote employment opportunities.	1. *Apprenticeship and Trade Testing Act* 1986 2. *Employment Act* 1978 3. *Employment of Non-Citizens Act* 2007 4. *Employment of Non-Citizens Regulation* 2008 5. *Employment Regulation* 1980 6. *Occupational Safety, Health and Welfare Act* 1991 7. *Workers' Compensation Act* 1978 8. *Workers' Compensation Regulation* 1983
Department of Lands and Physical Planning	DLPP administers all alienated land (State and Freehold) in PNG, and facilitates customary land issues at the discretion of the customary landowners, for social and economic development. The department also has a strong customer focus in providing whole range of services like Surveying, Physical Planning, Valuation, Incorporated Land Group registrations, Land Title registration and Mapping requirement for all land within PNG.	1. *Compensation (Prohibition of Foreign Legal Proceedings) Act* 1995 2. *Survey Act* 1969. 3. *Land (Ownership of Freeholds) Act* 1976 4. *Land (Ownership of Freeholds) Regulation* 1977 5. *Land (Tenure Conversion) Act* 1963 6. *Land (Tenure Conversion) Regulations* 1964 7. *Land Act* 1996 8. *Land Disputes Settlement Act* 1975 9. *Land Disputes Settlement Regulation* 1975 10. *Land Groups Incorporation Act* 1974 11. *Land Groups Incorporation Regulation* 1974 12. *Land Registration Act* 1981 13. *Land Registration Regulation* 1999 14. *Land Regulation* 1999 15. *Land Titles Commission Act* 1962
Department of Provincial and Local Level Governments (DPLLGA)	DPLLGA provides the link for coordination and partnership between all stakeholders to mobilize and provide the necessary support to strengthen the provincial and local level government and their administrations.	*1. Organic Law on Provincial and Local Level Governments*
Department of Treasury	Treasury is the government's principal **economic and financial department and maintains oversight** over the entire economy. Treasury sets fiscal policies, including tax and deals with taxes and incentives for resource project.	1. *Fiscal Responsibility (amended) Act* 2005 2. *Resource Contracts Fiscal Stabilisation Act* 2000 3. *Public Finance (Management) Act* 2005
Conservation and Environment Protection Authority (CEPA)	CEPA ensures that natural and physical resources are managed to sustain environmental quality and human well-being and improved living standards. This Agency also ensure that all relevant policies, legislations,	1. *Conservation and Environment Authority Act* 2014 2. *Environment Act* 2000

	and regulation administered by CEPA are implemented effectively in accordance with environment laws and regulations. CEPA issues environment permits and regulates water usage.	
Independent Consumer & Competition Commission (ICCC)	ICCC is PNG's principal economic regulator and consumer watchdog. Its primary role is to administer and implement the ICCC Act and other related legislation, including regulation of electricity prices at the retail point. ICCC regulates PNG Power under a regulatory contract.	1. *Independent Consumer & Competition Commission Act* 2002 2. *Prices Regulation Act* 1949 3. *Prices Regulation* 1949
Internal Revenue Commission	Responsible for all Tax matters, apart from customs duties.	1. *Income Tax Act* 1952 2. *Goods and Services Tax Act* 2003
Investment Promotion Authority	IPA's primary mandate to promote and facilitate investments in PNG and to regulate the business industry in the country. Any business operating in PNG must register with IPA under the *Companies Act* 1997.	1. *Companies Act* 1997 2. *Companies Regulation* 1998 3. Companies Rules 4. *Investment Promotion Act* 1992 5. *Investment Promotion Regulation* 1992
Mineral Resources Authority	MRA is a government institution established to regulate and sustainably manage the mining industry in PNG. MRA is responsible for licensing mineral exploration and extraction and has undertaken significant geological survey and investigation of geothermal resources in PNG. Hence, MRA has catalogued geological data and information on geothermal resources and has built capacity overtime to do so. Hence, MRA will support and provide NEA with geological data and information on geothermal resources and assist NEA build in-house capacity to undertake geothermal geological survey and investigation in the future.	1. *Mineral Resources Authority Act* 2005 2. *Mining Act* 1992 3. *Mining Regulations* 1992 4. *Mining Safety Act* 1977
National Institute of Standards and Technology	NISIT is responsible for overseeing to all standardization, quality assurance and conformity assessment activities in PNG. All new any new technology will have to be approved for use in country by NISIT, including any new standards.	1. *National Institute of Standards and Industrial Technology (Amendment) Act* 1993
PNG Customs	PNG Customs is responsible for protecting PNG's borders and the economy from insidious effects of border crimes, production and distribution of objectionable materials and the consequential risks and threats. PNG Customs is responsible for the clearance of all project equipment and materials.	1. Custo*ms Tariff Act* 1990 2. *Customs Act* 1951 3. *Customs Regulation* 1951

PNG Power Limited (PPL)	PPL is a fully integrated State-Owned Enterprise responsible for generation, transmission, distribution and retailing of electricity throughout PNG. PPL operates three (3) major electricity grids and fourteen (14) other standalone provincial systems. PPL assets comprise generation assets, 4,100 km of transmission and distribution lines nationwide encompassing industrial, commercial, government and domestic sectors.	1. *Electricity Commission (Privatization) Act* 2002 2. *Electricity Commission Regulation* 1966 3. *Electricity Supply (Government Power Stations) Act* 1970 4. *Electricity Supply (Government Power Stations) Regulation* 1970 5. *Electricity Industry Act* (Chapter 78)

ANNEXURE 3: STAKEHOLDER PARTICIPATION

As part of this Policy development process, NEA undertook various consultations with Government agencies, development partners and the public through regional 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 Limited (KCH)
13. Kumul Petroleum Holdings Limited (KPL)
14. Mineral Resource Authority (MRA)
15. National Weather Service (NWS)
16. Office of 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 Administrations
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, individuals and Public who attended the public consultations
19. Various individuals and Public