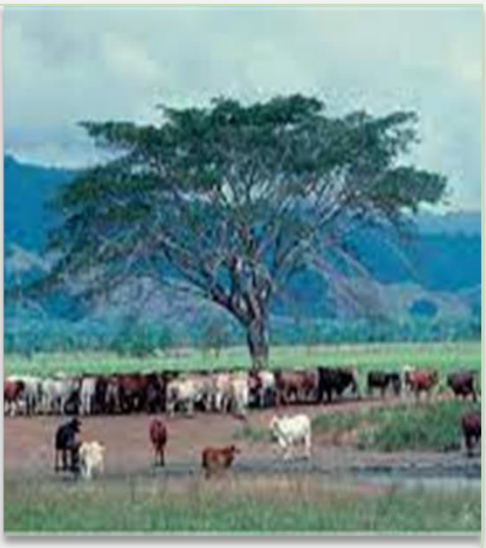
PAPUA NEW GUINEA

# BIOENERGY POLICY

## 2025 - 2030





NATIONAL ENERGY AUTHORITY

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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 Bioenergy Policy as part of the five (5) Subsector Renewable Energy Policies. The other policies are Hydro Energy Policy, Solar Energy Policy, Geothermal Energy Policy, and the Wind Energy Policy.

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

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

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

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

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

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

# STATEMENT BY THE MANAGING DIRECTOR

**Mr. Ronald Meketa**
Managing Director
National Energy Authority

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

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

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

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

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

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

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

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

**RONALD MEKETA**
Managing Director

# ACRONYMS

| | |
|---|---|
| APEC | Asia Pacific Economic Cooperation |
| CCDA | Climate Change Development Authority |
| CEPA | Conservation and Environment Protection Authority |
| CHP | Combined Heat and Power |
| DLPP | Department of Lands and Physical Planning |
| EIP | Electricity Industry Policy |
| EIR | Environment Impact Report |
| EIS | Environment Impact Statement |
| EIS | Electricity Supply Industry |
| EOI | Expression of Interest |
| FIT | Feed- In-Tariff |
| FS | Feasibility Study |
| GCF | Green Climate Fund |
| GHG | Greenhouse Gas Emissions |
| IEC | International Electrochemical Commission |
| IPP | Independent Power Producer |
| ISO | International Organization for Standardization |
| kW | Kilowatt |
| MW | Mega Watts |
| NDC | Nationally Determine Contributions |
| NEA | National Energy Authority |
| NEP | National Energy Policy 2017 – 2027 |
| NISIT | National Institute of Standards and Technology |
| PPA | Power Purchase Agreement |
| PPL | PNG Power Limited |
| RPB | Relevant Public Bodies |
| UNFCCC | United Nations Framework Convention on Climate Change |

# EXECUTIVE SUMMARY

Papua New Guinea's renewable energy sector has the huge potential to provide the foundation of growth in building a modern economy. Among other renewable energy sources, bioenergy is the most promising option for PNG. Bioenergy is a clean and sustainable source of renewable energy for electricity generation, heat, transport fuel, and cooking gas derived from biomass of plants and animals' origin. The bioenergy potential is determined by the abundance of naturally rich flora and fauna and agricultural activities. The biomass resources are also derived from general wastes, sludges, municipal wastes, solid waste, and others that can be converted into bioenergy.

The National Energy Policy 2017-2027 (NEP) sets out the Government's direction to achieve the target set under the PNG's Development Strategic Plan 2010-2030 (DSP) envisioning that by 2030, 70% of households will have electricity access whilst Vision 2050 envisions that 100% of households will have electricity supply from sustainable and renewable energy sources by 2050. To reach the ambitious 2030 target, the National Energy Authority (NEA) has developed this overarching bioenergy policy encompassing biomass, biogas, and biofuels to guide the Government, development partners, investors, and landowners to work collaboratively in developing bioenergy projects in the country to provide accessible, reliable and affordable clean energy.

This Policy aligns with the NEP and other Government development plans and policies in making references to various laws and regulation to establish processes and systems that support bioenergy development. The policy also focused on supporting the Government's commitment under its Enhanced Nationally Determined Contribution to reduce greenhouse gas emissions from PNG's energy sector to achieve net zero by 2050.

The Oil Palm Industry is the leader in the bioenergy subsector having biogas processing facilities that generate more than 10 megawatts of electricity for their own consumption. There were interests expressed by private investors to invest in bioenergy projects but due to a lack of proper policy framework and legal framework to guide investors and proper awareness of indigenous people, the bioenergy subsector is underdeveloped.

Therefore, this policy recognizes the importance of having access to land and establishes a consultative process of securing land for bioenergy project development in accordance with various land legislation. Furthermore, the application of national content applies where appropriate and more so on a larger scale to medium-scale bioenergy projects to equally benefit the people within the vicinity of the project.

PNG's current tariff system is defined under the NEP includes Tariff (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 T1, which is between an Independent Power Producer (IPP) and Off-Taker through a Power Purchase Agreement (PPA) pursuant to Section 57 of the *National Energy Authority Act* 2021. This policy also considers Feed-In-Tariff.

This policy also recognises the importance of attracting investments and therefore provides consideration for the government to provide incentives, participate as project shareholders, and use feed-in tariffs as an option. Furthermore, the policy provides for a Project Development Agreement that a project proponent and State could enter under negotiated terms to support the development of bioenergy projects.

Finally, this policy sets out the strategy for monitoring and evaluation to ensure that it meets the renewable energy targets set under the NEP, PNG's DSP, Medium Term Development Plan IV 2023-2027 (MTDP IV), Enhanced Nationally Determined Contributions (NDC) and other plans and policies.

# CHAPTER 1: INTRODUCTION

## 1.1. INTRODUCTION TO BIOENERGY POLICY

Bioenergy is a clean and sustainable source of renewable energy that has various applications such as for generating electricity, heat, fuel, and cooking gas. According to the International Energy Agency (IEA), bioenergy is the energy generated from the conversion of solid, liquid, and gaseous products derived from biomass resources. Biomass resources comprise of wide range of natural energy crops, forestry residues, agriculture residues, household waste, industrial waste, and other organic materials. Bioenergy plays a vital role in providing energy mix and replacing fossil fuels (*IEA, 2017*).

The yield of bioenergy depends on the base raw material and technology employed. The advancement of technologies has added more value to bioenergy production and supply chain. This Policy classifies technology based on the different processes and uses for generating various forms of bioenergy.

The Bioenergy Policy is an overarching policy encompassing the development and use of biomass, biogas, and biofuels for generating electricity, heat, cooking gas, and fuel. It is formulated in accordance with strategic directions set out under the NEP.

This Policy aims to guide the Government, private investors, development partners, non-government organization (NGOs), and landowners to work collaboratively in developing bioenergy projects in the country. It sets out the objectives of formulating a legislative framework and strategies to facilitate the development of biomass resources to energy sources for different uses.

## 1.2. BIOENERGY IN PAPUA NEW GUINEA

### 1.2.1. Current Status of Bioenergy Use

Papua New Guineans have been using bioenergy for many generations, in the form of biomass such as charcoal, tree, wood, and crop residues. Bioenergy generated from these biomass products are still being used in many rural and urban areas as they are readily available in abundance.

Bioenergy is currently used in PNG for electricity generation. New Britain Palm Oil Limited (NBPOL) and Hargy Oil Palm Limited (HOPL) are using bioenergy in the form of biogas from their oil palm mill waste to generate electricity. NBPOL and HOPL have a generation capacity of 6 MW and 2 MW respectively to support their business operations. NBPOL committed 1 MW of their generating capacity to the Kimbe grid but is not being utilized.

Bioenergy is also used in PNG in the form of biofuel for electricity generation and transportation. The PNG Biodiesel Limited on Karkar Island in Madang Province produces 50,000 liters of biodiesel per month as fuel for electrical generators, sea transport, and land transport from copra oil. A similar project is being developed by Emirau Marine Products Limited in Kavieng, New Ireland Province. The project will produce biodiesel to use as an alternative to conventional fuel for transportation. The Pacific Adventist University (PAU) is producing 9,000 liters of biodiesel per month from industrial cooking oil waste and has been using biodiesel as an alternate source of fuel for their vehicles.

More recently, the Namatanai District in New Ireland Province has been granted full concession (granted generation, distribution, and retail licenses) by the NEA to construct a hybrid biomass-solar power plant to provide affordable and reliable electricity within the district. The biomass plant will contribute 750 kilowatts (kW) whilst solar will contribute 1 MW to the district mini grid.

### 1.2.2. Potential for Future Projects

The potential for development of future bioenergy projects is huge due to abundant resources and favorable climatic conditions. PNG's naturally abundant flora and fauna plus many agriculture activities produce residues such as rice husks, sugarcane bagasse, coconut shells, and others from the forestry sector including woodchips, sawdust, pallets, charcoal, and biochar contributes sufficient biomass feedstock. Energy crops like jatropha, oil palm, and copra can be cultivated for biomass feedstock. The different industries also contribute to the accumulation of biomass resources in terms of general waste, sludges, municipal waste, and solid waste to harness bioenergy.

Potential sites for bioenergy projects have been identified by private investors. Among other projects, PNG Biomass, a subsidiary company of Santos Limited, is developing a biomass project in Markham Valley in Morobe Province. The project will grow wood chips to potentially generate 30 MW of electricity. Another project that is under the pipeline for development is the Cocoland Sugar Development Project in Abau District, Central Province. The project developer proposes to construct a biogas power plant with a production capacity of around 45 MW. It will use biomass from sugar production.

PNG currently has an expanding palm industry that has great potential for , both from the crude palm oil produced and the waste which can be converted as feedstock. New Briatin Palm Oil is currently using waste materials to produce electricity to support its operations.

## 1.3. POLICY RATIONALE

Lack of access to reliable and affordable electricity remains one of the country's most critical barriers to economic growth and social wellbeing. The country's current electrification rate, in terms of grid connectivity, stands around 20%. This means that over 80 percent of PNG's population mainly in rural areas lack reliable access to power. More recently, there have been efforts by Government and Development Partners to increase the accessibility rate through implementation of off-grid energy projects, mainly off-grid solar and bioenergy energy systems. 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:

(a) **Unreliable power:** PNG Power Limited (PPL) struggles to provide reliable electricity due to aging infrastructure and financial constraints.

(b) **High network costs**: The cost of the network is high due to the country's geography, population dispersal, and aging infrastructure.

(c) **Limited competition:** The electricity market is small and has limited capacity for users to pay, which limits the scope for competition.

(d) **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.

(e) **Gaps in regulatory framework:** Recently, the Government established the NEP and enacted the *National Energy Authority Act* 2021. However there remains gaps in the policy and regulatory framework to support the development of renewable energy sources in PNG.

(f) **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, all other towns still operate standalone grids.

(g) **Complex land tenure system**: Approximately 97% of land in PNG is held under customary tenure, owned collectively by clans or kinship groups. Customary land is managed through unwritten customary rules and arrangements. The remaining 3% is alienated land, which is administered by the *Land Act* 1996 and other relevant laws. The complex land tenure system makes access to land for the development of renewable energy projects a challenge.

(h) **Lack of incentives:** There is lack of incentives, especially fiscal incentives to attract private investments in renewable energy projects. Medium-large scale bioenergy 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 bioenergy potential. This calls for policy and legislative reforms that enables a shift in addressing issues in the energy sector to allow for investments in renewable energy sources such as bioenergy projects.

## 1.4. SCOPE OF POLICY

This Policy focuses on creating an enabling framework to promote investment in the bioenergy energy subsector, contributing to the nation's renewable energy mix. This Policy aims to establish the platform that drives investments in harnessing PNG's abundant bioenergy energy potential to achieve national electrification goals, by providing 70% of the households with access to electricity by 2030 and 100% by 2050. 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 also recognizes that achieving electrification targets in PNG requires both on-grid and off-grid solutions. By supporting the development of bioenergy projects, 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 Society Organisations, Landowners, and Project Impact Communities.

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

# CHAPTER 2: POLICY DIRECTION

## 2.1. VISION

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

## 2.2. MISSION

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

## 2.3. OBJECTIVES

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

(b) To establish mechanisms that support public and private investment in bioenergy 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.

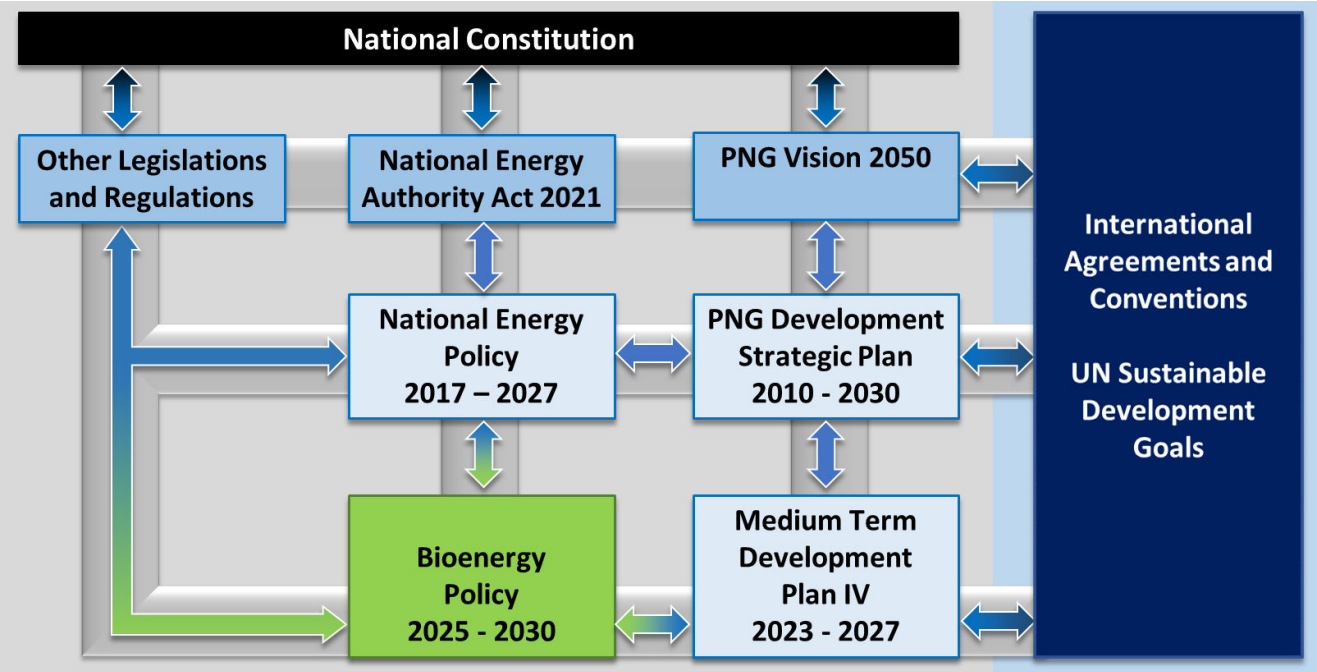
(e) To promote sustainable growth and improve the socio-economic well-being of our people through partnerships.

# CHAPTER 3: LEGAL AND POLICY FRAMEWORK

This Policy is aligned to the various legislations and policies. The principal legislation for the policy is the *National Energy Authority Act* 2021. This Policy is also defined under the National Energy Policy 2017 – 2027.

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

**Figure 1:** Alignment of Bioenergy Policy




*Source: National Energy Authority, 2025*

## 3.1. LEGAL FRAMEWORK

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

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

### (b) *National Energy Authority Act* 2021

The *National Energy Authority Act* 2021 is the principal legislation that establishes and mandates the 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. Bioenergy projects will require land for energy generation as regulated under the *Environment Act* 2000.

**(f) Other Legislation**

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 legislations 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 envisions PNG to use 100% renewable energy for power generation by 2050.

**(b) PNG Development Strategic Plan 2010 – 2030 (DSP)**

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% of households in PNG will have access to a reliable and affordable power supply. It targets that total power generation capacity by 2030 will be 1910 MW, of which hydro would generate 1020 MW, gas 390 other renewables including bioenergy would generate in total capacity of 500 MW.

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

The NEP sets out the platform and direction for the development of the energy sector in PNG. It provides for the development of various subsector policies, including this 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 bioenergy resources 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 GHG emissions within the energy sector and achieve PNG’s NDC targets under United Nations Framework Convention on Climate Change (UNFCCC) commitments.

**(e) Medium-Term Development IV 2023-2027 (MTDP IV)**

The 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. Under MTDP IV, the Government identifies energy and electricity as an important sector of PNG's economy and commit to improving access to a reliable, affordable, and clean energy supply to cater to 70% of households by 2030.

The MTDP IV identifies five (5) Strategic Priority Areas, which includes National Power Generation Investment Program. The MTDP IV further sets out various investment targets, key result areas and strategies for the energy sector.

# CHAPTER 4: BIOENERGY RESOURCE AND CONVERSION PROCESSES

Bioenergy is produced by collecting biomass feedstocks from farms, forests, waste streams, or aquatic environments. The biomass or organic feedstocks are then converted by using conversion technologies such as thermochemical, biochemical, and mechanical/physical.

## 4.1. TYPES OF BIOENERGY FEEDSTOCK

The bioenergy feedstocks are used to harness energy. They are extracted from different sources to generate energy outputs as shown in Table 1.

**Table 1:** Sources of feedstock and its energy output

| Source of biomass feedstocks | Types of Feedstocks | Output |
|---|---|---|
| Wood | Forest residue, wood chips, and sawdust | Electricity and heat |
| Agricultural Residues | Corn stalks, straw, oil palm waste, sugarcane bagasse and rice husks | Heat, electricity, cooking gas and biodiesel |
| Energy crops | Coconut oil (copra), switchgrass, miscanthus, and other dedicated energy crops | Electricity, heat, and biodiesel |
| Animal manure and waste | Livestock farms | Electricity, heat, and cooking gas |
| Organic municipal waste | Food waste, grease waste, yard waste, and other biodegradable waste | Electricity, heat, and bioethanol |
| Aquatic organisms | Algae | Biodiesel |

Biomass feedstocks are broadly classified into wet and dry categories based on their moisture content. This distinction significantly impacts their processing methods, storage, and suitability for specific bioenergy technologies.

**(a) Wet Biomass Feedstock**

Wet Biomass has a high moisture content, typically above 50%. These feedstock are often unsuitable for direct combustion but are ideal for biological processes like anaerobic digestion or fermentation. Wet Biomass include animal waste, food waste, aquatic waste, sewage sludge, industrial organic waste, and crop residues. The challenges of Wet Biomass are that high water content reduces energy density, requires drying for thermochemical processes like combustion or pyrolysis, and is difficult and expensive to store and transport due to bulkiness and moisture.

### (b) Dry Biomass Feedstock

Dry Biomass has a low moisture content, typically below 20%. These feedstock are energy-dense and are well-suited for thermochemical processes such as combustion, gasification, and pyrolysis. Dry Biomass include wood and forestry residues, dry crop residues, dedicated energy crops, agricultural by-products, solid urban waste, and charcoal and biochar. The advantages of Dry Biomass are that they have higher energy density compared to wet biomass, easier to transport and store due to reduced bulk and moisture, and compatible with a wide range of thermochemical processes.

**Table 2**: Comparison of Wet and Dry Biomass.

| Aspect | Wet Biomass | Dry Biomass |
|---|---|---|
| Moisture Content | High (>50%) | Low (<20%) |
| Energy Density | Low | High |
| Storage and Transport | Difficult, bulky, prone to decomposition | Easier, compact, stable |
| Preferred Process | Biological (e.g., anaerobic digestion) | Thermochemical (e.g. combustion, pyrolysis) |
| Examples | Manure, algae, sewage sludge | Wood, straw, dried bagasse |

## 4.2. BIOENERGY CONVERSION PROCESS

The conversion of biomass feedstocks into energy, fuels, or other valuable products involves various processes. These are broadly classified into thermochemical, biochemical, and mechanical/physical methods based on the technology and end products.

### (a) Thermochemical Conversion

Thermochemical processes use heat and/or chemical reactions to convert biomass into energy, fuels, or chemicals. These methods are generally suitable for dry biomass with low moisture content.

#### (i) Combustion

The combustion process involves direct burning of biomass in the presence of oxygen to produce heat, which can be converted into electricity. The feedstocks used for combustion include wood, agricultural residues, and municipal solid waste.

#### (ii) Gasification

The gasification process involves partial oxidation of biomass at high temperatures (700-1500 ℃) to produce syngas—a mixture of hydrogen, carbon monoxide, and methane. The feedstocks used for gasification include wood chips, agricultural residues, and municipal solid waste. The end productions of gasification include syngas, char, and ash. The syngas can be used to fuel turbines or engines for electricity generation or as a feedstock for producing biofuels and chemicals.

#### (iii) Pyrolysis

Pyrolysis involves heating biomass in the absence of oxygen, resulting in three main products: bio-oil, biochar, and syngas. Each of these products has its applications—bio-oil as a liquid fuel, biochar as a soil amendment, and syngas for power generation.

#### (iv) Liquefaction

Liquefaction converts wet biomass into liquid biofuels at moderate temperatures and high pressures. The resulting bio-oil or bio-crude can be refined into fuels like biodiesel, offering a renewable alternative to petroleum-based energy sources.

### (b) Biochemical Conversion

Biochemical methods use microorganisms or enzymes to break down biomass into fuels or chemicals. These processes are suited for wet biomass with high moisture content.

#### (i) Hydrolysis

Hydrolysis breaks down biomass into simple sugars using water, enzymes, or acids. These sugars can then be fermented into biofuels such as ethanol, which are widely used in transportation and as fuel additives to reduce greenhouse gas emissions.

#### (ii) Anaerobic Digestion

Anaerobic digestion is a process where microorganisms break down organic matter in the absence of oxygen. It is often used for biogas production from organic waste.

#### (iii) Fermentation

Fermentation is used to produce bioethanol from biomass by converting sugars into alcohol using microorganisms.

#### (iv) Transesterification

Transesterification is a chemical reaction used to produce biodiesel from oils and fats by reacting triglycerides with alcohol (commonly methanol).

### (c) Mechanical/Physical Conversion

These methods involve physical or mechanical processes to alter biomass for easier handling, storage, or use.

#### (i) Pelletization

This process involves compressing biomass into dense pellets or briquettes. The feedstocks for pelletization include sawdust, wood chips, and agricultural residues. The end products are biomass pellets or briquettes. The end products are used for combustion in stoves or boilers, and export.

#### (ii) Oil Extraction

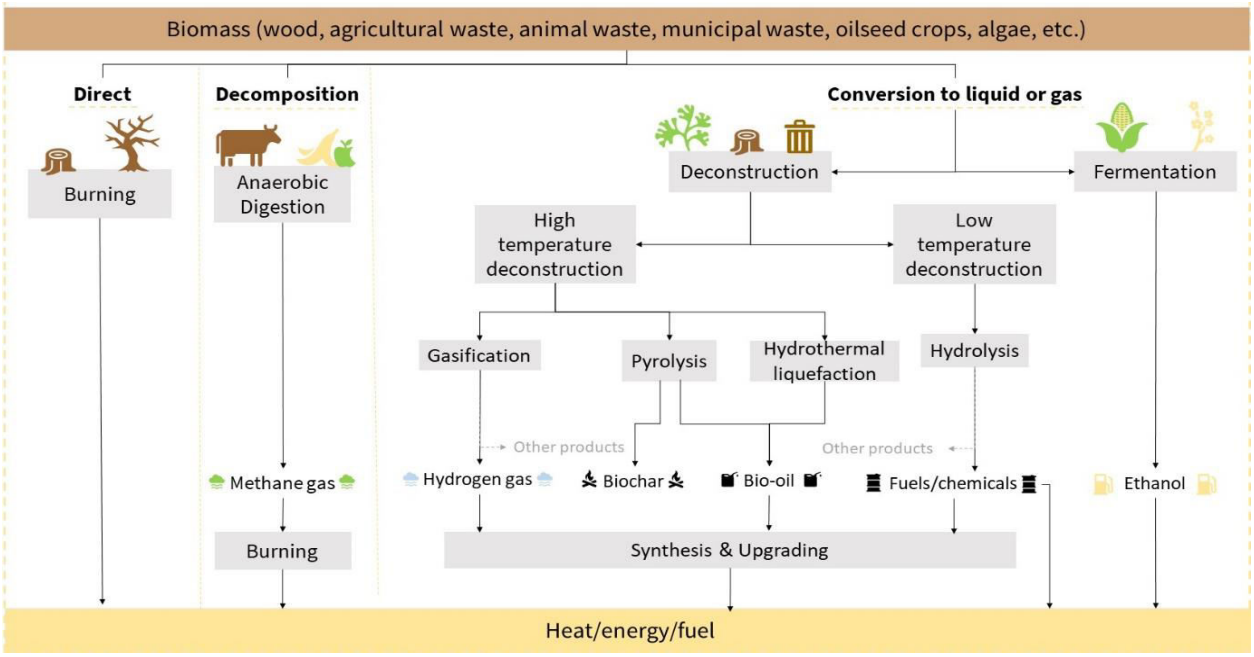
This process involves mechanical pressing or chemical extraction of oils from biomass. The feedstocks for oil extraction are oilseeds (soybean, jatropha, palm), and algae. The end products include vegetable oil and biodiesel feedstock. They are used for biodiesel production and cooking.

#### (iii) Drying

This process involves removing moisture from wet biomass to improve energy density. The feedstocks for drying include wet agricultural residues and sewage sludge. The end product for drying is dried biomass and is used for combustion, pyrolysis, or gasification.

The key processes involved in converting biomass feedstock into useful energy for electricity production are depicted in Figure 2.

**Figure 2:** Energy conversion from biomass feedstock through conversion processes.




*Source:* [https://www.climatehubs.usda.gov/hubs/northwest/topic/biofuel-production](https://www.climatehubs.usda.gov/hubs/northwest/topic/biofuel-production)

Electricity can be produced from heat by directly burning biomass. It can also be produced through decomposition, called anaerobic digestion where microorganisms break down organic matter in the absence of oxygen. The anaerobic digestion process produces biogas which is then used to produce electricity. Those feedstocks that do not undergo direct combustion to produce heat, or anaerobic digestion to produce biogas, are put through a two-step process to convert them into either a liquid or gaseous fuel. This can be further processed into a bioenergy resource. This two-step process involves:

**(a) Deconstruction**

It involves the breaking down of biomass into simpler components for further processing and.

**(b) Synthesis and Upgrading**

It involves rebuilding these processed components into usable bioenergy fuels.

Each of this process converts biomass into usable energy in distinct ways, creating a spectrum of power generation technologies that can meet different energy needs and environmental goals. The conversion processes of biomass into useable fuels are summarized in Table 3.

**Table 3**: Biomass conversion processes.

| Conversion Process | Temperature Range (°C) | Deconstruction | Extraction Process | Output |
|---|---|---|---|---|
| Combustion | High (800 – 1200) | - | Direct Combustion | Heat |
| Gasification | High (600 – 1000) | Low Oxygen (Low) | Thermochemical | Syngas |
| Pyrolysis | High (500 – 800) | - | Thermochemical | Bio-Oil, Syngas |
| Liquefaction | Moderate (200 – 350) | Water or other solvents | Thermochemical | Bio-Oil, Bio-Crude |
| Hydrolysis | Low | Water | Biochemical | Sugars |
| Anaerobic Digestion | Low (30 – 60) | - | Biochemical | Biogas (Methane) |
| Fermentation | Low (25 – 40) | - | Biochemical | Biofuel (ethanol) |
| Transesterification | Low (50 – 70) | - | Biochemical | Biodiesel |

# CHAPTER 5: BIOMASS

Biomass covers different states of organic matter which can be collected and converted into useful bioenergy. Harnessing biomass is one of the earliest and most common ways of accessing energy globally. Biomass feedstock is solid renewable organic matter that is derived from dedicated energy crops, agricultural residue, forest residue, municipal waste, solid organic waste, and others.

Modern biomass technologies, which focus on enhancing energy efficiency and maximizing productivity, are increasingly being recognized as viable alternatives to fossil fuels to reduce GHG emissions, drive energy transition, and meet current and future demand.

Harnessing biomass resources in PNG will enable local communities to have access to a sustainable and renewable energy source. This has the potential to accelerate socio-economic development in rural areas where the bulk of the people live.

## 5.1. TYPES OF BIOMASS POWER PLANT TECHNOLOGIES

Biomass power plant technologies involve the direct combustion or thermochemical conversion of biomass feedstock to generate electricity through the production of steam. The steam flowing through rotates turbine blades which generate electricity of up to 100 MW. In most instances, the conversion of energy depends on the type of feedstock used and the technology employed.

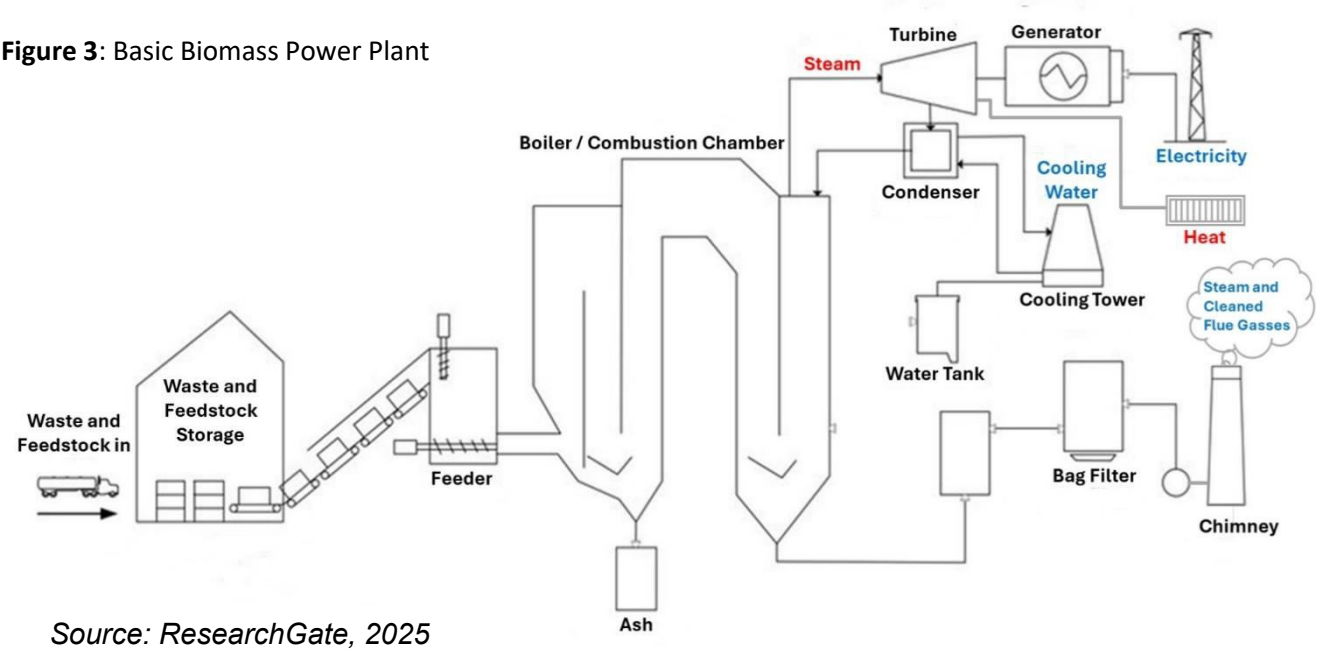
Apart from the direct combustion of dry feedstock, the process of harnessing biomass resources is chemically intensive. Therefore, the choice of power plant systems is determined by factors such as type of feedstock, environmental considerations, and capability to deal with the type of biomass and associated wastes produced through these processes.

There are a number of technologies developed to convert stored energy in biomass resources to various energy by-products and energy carriers. These technologies have added more value to the production, supply, and consumption chain of biomass energy. Although these conversion processes are different, they all occur under very high temperatures.

### 5.1.1. Direct Combustion Power Plants

In direct combustion power plants, the dry biomass feedstock is burnt in the presence of oxygen at high temperatures to produce electricity. The combustion process begins by pre-treating the feedstock, which includes size reduction, separation, and drying before it is fed into the combustor or boiler. Combustion of the feedstock then occurs in the boiler, which converts water into hot steam vapor. This steam vapour travels under high pressure into the steam turbine which rotates a series of turbine blades. The rotation of a steam turbine generates mechanical energy which drives a generator to produce electrical energy or electricity.

**Figure 3**: Basic Biomass Power Plant

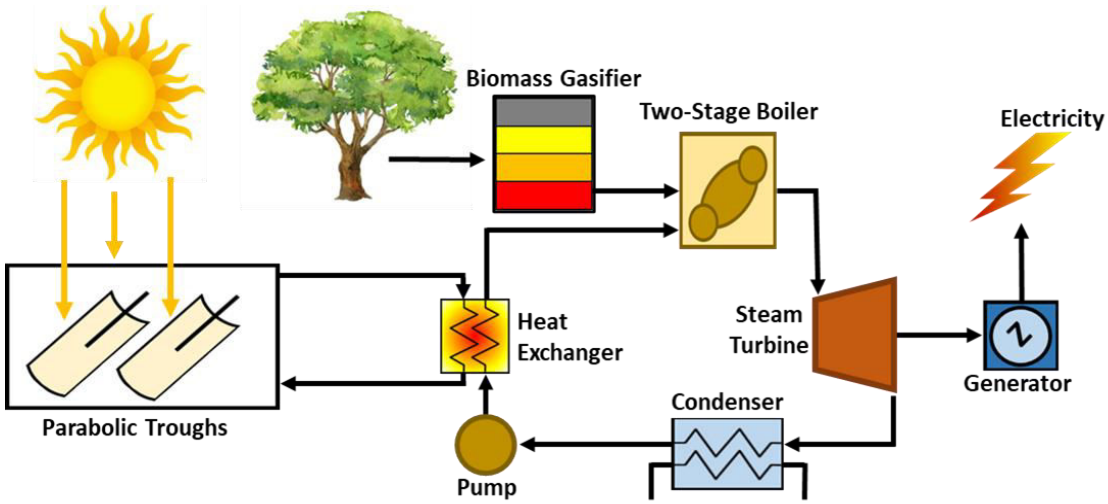



*Source: ResearchGate, 2025*

### 5.1.2. Gasification Power Plants

The gasification process happens in a gasifier or chamber where biomass feedstock is fed into the chamber under very high temperatures in the presence of oxygen. The heat applied to the gasifier breaks down the feedstock and converts it into syngas. Syngas is then purified and travels under pressure into a gas turbine which has a rotor shaft directly coupled to an electric generator. The pressure of the hot gas causes the shaft to rotate and generate mechanical energy that transfers to the generator which then produces electricity.

**Figure 4:** Schematic representation of a gasification power plant.




*Source: National Energy Technology Laboratory, 2025*

### 5.1.3. Pyrolysis Power Plants

Pyrolysis is a thermochemical technology that converts biomass feedstock into energy byproducts, such as cooking gas and biofuels. The pyrolysis process involves treating solid biomass feedstocks, which are then fed into a bioreactor. The biomass is subjected to a constant heat range of 300 – 650°C in an oxygen-deprived (inert) environment, causing the feedstock to decompose into two main products.

**(a) Bio-oil**

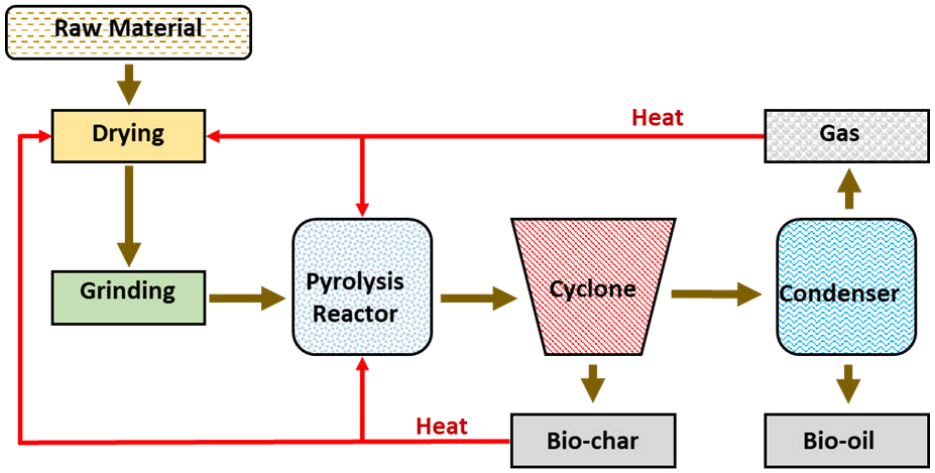
A liquid product that can be upgraded into biofuels for transportation or used as fuel for combustion engine including those in electricity generators.

**(b) Syngas**

It can be directly utilized as a cooking gas or refined and combusted in gas turbines or combined heat and power (CHP) systems for electricity generation.

The separation of these products is achieved through techniques like filtration, distillation, and condensation. The bio-oil can be refined into biofuel, which can then be used to power electrical generators or internal combustion engines, contributing to electricity production. Syngas, after purification, can also be used in gas-fired generators.

**Figure 5:** Diagram of a Pyrolysis Power Plant.




*Source: Crystal 2021*

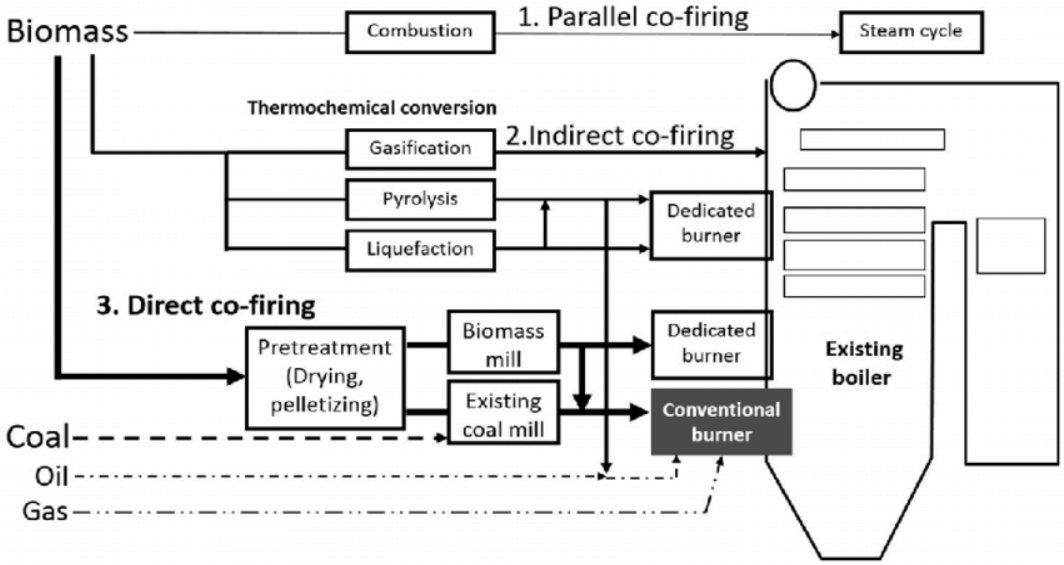
### 5.1.4. Cofiring Power Plants

Biomass Cofiring is the process of simultaneously combusting biomass and fossil fuels in the same power plant to enhance energy efficiency and reduce greenhouse gas emissions. This technology allows existing fossil fuel power plants, particularly coal-fired plants, to incorporate renewable biomass as part of their fuel mix, contributing to lower carbon emissions.

The cofiring mechanism involves blending biomass—such as wood chips, agricultural residues, or energy crops—with traditional fossil fuels (e.g., coal) in a controlled ratio. The blended fuel is then ignited in the combustion chamber, where both fuels burn together. The heat generated from this combustion process is used to produce steam by heating water in a boiler.

The steam is then directed to drive turbines, which in turn power an electrical generator, producing electricity. The cofiring process can be adapted to varying levels of biomass input, from low percentages to nearly 100% biomass, depending on the plant's design and the properties of the biomass used.

**Figure 6:** Schematic showing the three types of co-firing methods.




*Source: ResearchGate, 2025*

The three types of co-firing that occurs in the combustion chambers are::

**(a) Parallel Cofiring**

In this process, a separate boiler is used for biomass, and the steam generated is then mixed with steam from the coal boilers. The combined steam is then directed to a turbine for electricity generation.

**(b) Indirect Cofiring**

In indirect cofiring plants, the biomass is first converted to a liquid or gaseous fuel (through gasification, pyrolysis, or liquefaction), which is then burned with the coal in a boiler.

**(c) Direct Cofiring**

This method uses a single boiler with either common or separate burners to burn the biomass together with the coal/ fossil fuel. The steam generated is used to drive a turbine to produce electricity.

By substituting a portion of fossil fuels with biomass, cofiring not only reduces the plant's carbon footprint but also improves the overall efficiency of electricity generation, as biomass is often more readily combustible than coal. Additionally, cofiring can take advantage of existing power plant infrastructure, minimizing the need for new capital investments while transitioning to a more sustainable energy mix.

### 5.1.5. Cogeneration Power Plants

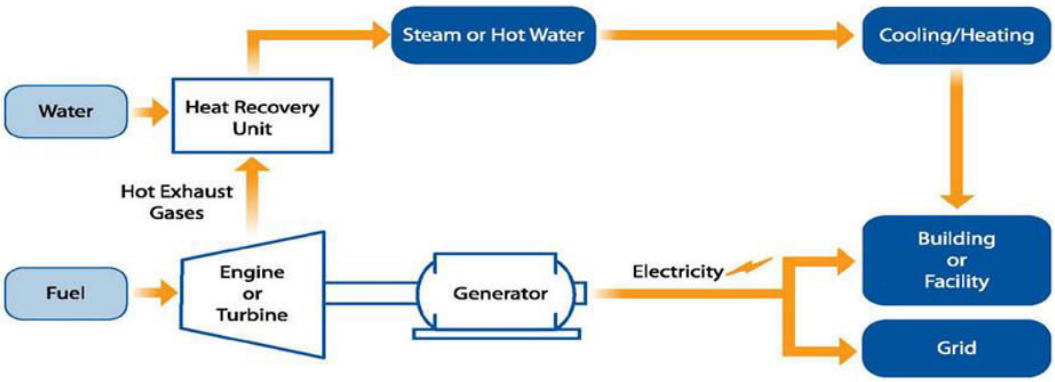
Cogeneration, also known as Combined Heat and Power (CHP), is a biomass-based system that simultaneously generates electricity and heat from a single biomass plant or integrated system. This dual-generation process significantly increases overall energy efficiency and reduces environmental pollution by utilizing the waste heat that is typically lost in conventional electricity generation.

In a CHP system, biomass undergoes both physical and thermochemical processes, with the output of electricity depending on the system design and the properties of the biomass being used (e.g., moisture content, energy density). The process begins by feeding treated biomass into a steam boiler, where it is combusted. The heat generated from burning the biomass produces high-pressure steam, which drives a turbine. The rotation of the turbine blades powers an electrical generator, producing electricity.

What makes CHP systems highly efficient is their ability to recover the waste heat produced during electricity generation. Instead of being lost to the environment, this heat is captured through an integrated recovery system within the same biomass plant. The recovered heat can be used for various applications such as industrial processes, district heating, or domestic heating, further enhancing the system's overall energy efficiency. By utilizing both electricity and heat, CHP systems can achieve efficiencies of 60% to 80%, compared to conventional power plants that typically operate at around 35% efficiency.

The ability to recover waste heat not only improves the total energy output but also contributes to a reduction in greenhouse gas emissions, making cogeneration a more sustainable option for electricity.

**Figure 7:** Schematic diagram of a Cogeneration Power Plant.




*Source: National Energy Technology Laboratory,2025*

## 5.2. CLASSIFICATION OF BIOMASS PROJECTS

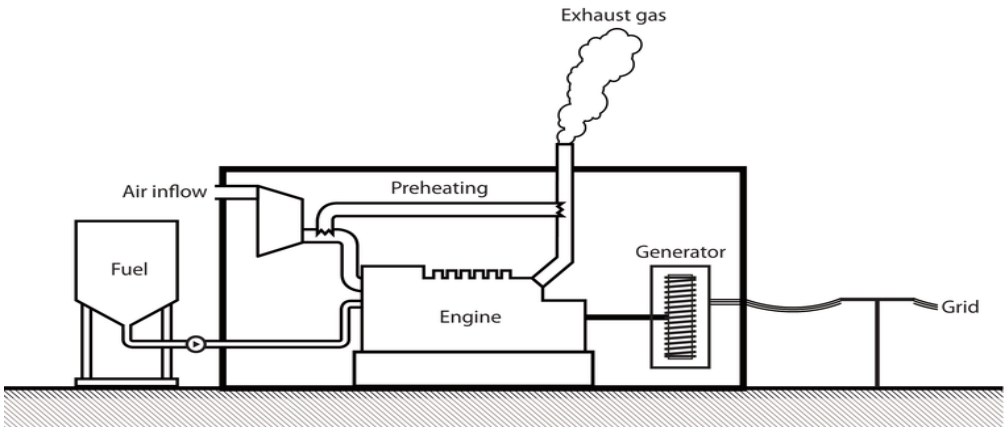
Biomass projects are classified according to the project size and are defined by their electricity generation capacity and end uses. The classification includes three categories: large-scale biomass projects, medium-scale biomass projects, and small-scale biomass projects. **Annexure 1** gives detail into the classification of Biomass Projects.

# CHAPTER 6: BIOFUEL

## 6.1. BIOFUEL POWER PLANT

A biofuel power plant generates electricity by utilizing biofuels such as biodiesel and bioethanol. These plants often retrofit or adapt existing diesel or gas engines to use biofuels, enabling a cleaner alternative to fossil fuels. Figure below shows the diagram of a conventional diesel engine power plant that can be used with biofuel to generate electricity.

**Figure 8:** Diagram of a conventional diesel engine power plant.




*Source: ResearchGate, 2025*

Biofuel refers to liquid or gaseous fuels derived from biomass feedstock, which can be used for transportation, electric generators, and other applications. Biofuel will play a critical role in the decarbonization of the energy sector by meeting energy demand in an environmentally friendly and cost-effective way while reducing dependence on imported fossil fuels.

PNG transportation and off-grid electricity sectors are heavily reliant on fossil fuels to meet the growing energy demand. The volatility of global crude oil price has a direct impact on the country's socio-economic development and energy security.

Despite these challenges, biofuel represent a promising solution for PNG as a substitute for fossil fuels. Biofuel can be used in standard diesel and petrol engines without modification. PNG is rich in locally available, low-cost biomass feedstocks, such as coconut oil and agricultural waste, that can be harnessed for biofuel production. This potentially offers a viable pathway to reduce reliance on imported fossil fuels, enhance energy security, and mitigate the economic impact of fluctuating global oil prices.

In PNG, biofuel is currently produced for small-scale applications by establishments such as:

(a) PNG Biodiesel Limited on Karkar Island and Emirau Marine Products Limited in New Ireland are producing biodiesel from coconut oil (copra).

(b) Pacific Adventist University (PAU) is currently producing biofuel from waste cooking oil and industrial byproducts for internal use.

## 6.2. TYPES OF BIOFUEL PLANTS

The most common and widely used biofuels are biodiesel and bioethanol. Bioethanol is an alcohol made by fermentation process from biomass containing carbohydrates in organic matter. Biodiesel is produced from triglycerides that are found in the biomass feedstock, including fatty acids from animal fats and vegetable oil, through a biochemical process known as transesterification.

Biofuels can be directly used in their pure form in standard diesel and petrol engines or blended with fossil fuels to reduce the carbon footprint. Any blending must be done in accordance with any national or international standards and guidelines.

The two primary biofuels are bioethanol and biodiesel, both of which can be blended with conventional fossil fuels to be used efficiently in most engines without modification.

**Figure 9:** Biofuel produced by the Pacific Adventist University (PAU).

*Source: Pacific Adventist University, 2025*

### 6.2.1. Bioethanol

Bioethanol ($C_2H_5OH$, or ethyl alcohol) is produced by converting the carbohydrate content of biomass feedstock into alcohol through the fermentation process. Common raw materials for bioethanol production include molasses, sugarcane juice, wheat, algae, corn, cassava, and other carbohydrate-rich feedstocks.

The production process begins with the growing, harvesting, and collecting of these raw materials, which are then delivered to a biofuel plant. At the plant, the feedstock undergoes pre-treatment to convert it into a suitable substrate for fermentation. During the fermentation process, this substrate is converted into alcohol with the help of yeast. After fermentation, the mixture is purified through distillation, resulting in high-quality ethanol or bioethanol.

### 6.2.2. Biodiesel

Biodiesel is a renewable liquid fuel made from vegetable oils, waste cooking oil, grease waste, animal fats, and other oil-bearing plants through a process called transesterification. In this process, the triglycerides in the oils or fats are broken down to form methyl esters of fatty acids, which are the main components of biodiesel.

The production begins by extracting the glycerol-based esters of fatty acids from the triglycerides in the raw material. Using a catalyst such as potassium hydroxide or sodium hydroxide, the fatty acids react with methanol, forming biodiesel (methyl esters) and glycerine as a byproduct. The biodiesel is then purified to ensure a high-quality product.

Biodiesel has a conversion efficiency of 88% to 95%, meaning it produces almost as much energy as fossil diesel. Additionally, it offers significant environmental advantages, such as reduced emissions of pollutants, making it a cleaner alternative to traditional diesel.

### 6.2.3. Biofuel Blending

Biofuel blending is one of the most common practices in the transportation sector for reducing dependence on fossil fuels and lowering emissions. This involves mixing biofuels (such as bioethanol or biodiesel) with conventional fossil fuels without the need for engine modifications or compromising engine performance.

Blended fuels provide high-quality fuel while significantly reducing pollutants such as carbon monoxide, particulate matter, and sulfuric compounds. The blending ratios (such as E10, 10% bioethanol with 90% petrol, or B20, 20% biodiesel with 80% diesel) will be determined by NEA in compliance with international standards and best practices. These blending standards will ensure that biofuel production does not face undue constraints and meets the country's energy security and environmental goals.

Once thoroughly tested for safety and reliability, blended fuels will be gradually introduced and made available across the country. This approach will ensure the transition to biofuels is both smooth and beneficial to PNG's energy sector and its citizens.

## 6.3. CLASSIFICATION OF BIOFUEL PROJECTS

Biofuel projects are classified according to the project size and end uses. The classification includes three categories: Large-scale biofuel projects, Medium-scale biofuel projects, and Small -scale biofuel projects. Details of the classification of biofuel projects is provided in **Annexure 2.**

# CHAPTER 7: BIOGAS

Biogas is a renewable energy source produced through the decomposition of organic matter by microorganisms in the absence of oxygen. This process is known as anaerobic digestion. The organic matter used as feedstock includes municipal waste, agricultural waste, industrial food waste, wastewater, energy crops, and wood chips, among others. The chemical composition of biogas contains methane, carbon dioxide, and trace amount of other gases like hydrogen, sulphide and moisture.

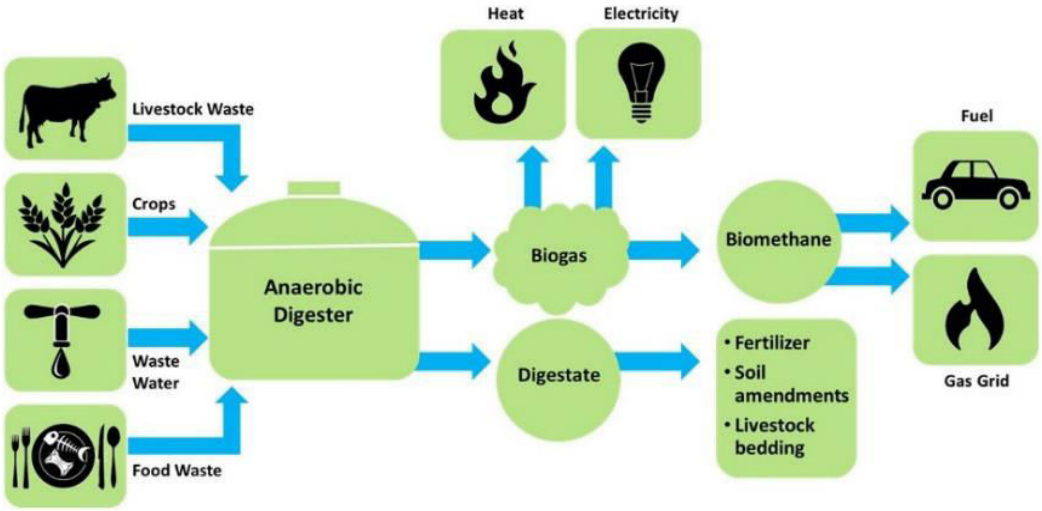
The anerobic digestion process is vital in mitigating GHG emissions by capturing methane content in the feedstock and converting it into usable forms of energy. The efficiency and energy yield of biogas generation depends on several factors. These include the design and capacity of the digester, the type and quality of feedstock, and the operational parameters such as temperature and retention time.

In developed countries, biogas production through anaerobic digestion is a well-established technology, often contributing to their baseload electricity supply. While in developing countries like PNG, there is immense potential and opportunities for biogas, however, lack of infrastructure and appropriate regulations hinder the development of biogas. Despite this, the Palm Oil companies in the country have tapped into biogas electricity using oil palm mill effluent. They have established medium-scale biogas processing plants for electricity generation to support their business operation. The excess power generated can be feed into the main electricity grid system. By fostering biogas, PNG can create a more resilient and diversified energy mix while meeting energy demand in an environmentally sustainable way.

## 7.1. BIOGAS SYSTEM

Biogas systems refer to the technology and infrastructure used to convert organic feedstock into energy, particularly biogas. These systems are suitable for producing electricity at various scales, ranging from small, community-level plants to large, industrial operations. Biogas technology is highly adaptable, and its application can support energy needs in both rural and urban settings.

**Figure 10:** Simple schematic of the Biogas Production Process.




*Source: EESI ,2025*

As shown in Figure 10, anaerobic digestion takes place in an airtight tank called a digester, where the organic waste is mixed with water. Inside the digester, bacteria break down the organic material, converting it into two primary products: biogas and digestate (a nutrient-rich byproduct). Apart from biogas being used to produce electricity, it can be further refined to produce biomethane which can replace natural gas.

## 7.2. TYPES OF BIOGAS POWER PLANT TECHNOLOGIES

There are four commonly recognized types of biogas plants, classified based on the feeding method of the feedstock as stated below.

### 7.2.1. Continuous System Biogas Plant

A continuous system biogas plant is suitable for both small-scale and large-scale commercial biogas projects. In this system, feedstock is constantly fed into the digester, ensuring continuous biogas production with high efficiency. There are two types of continuous systems:

**(a) Single-stage Continuous System**:

In this design, both the acid formation (hydrolysis) and methane formation (methanogenesis) occur in a single digester or chamber. This is more common in smaller biogas plants.

**(b) Two-stage Continuous System**:

In larger or more advanced plants, the process is split between two digesters. The first digester handles acid formation, where organic material is broken down into volatile acids. The partially digested material is then diluted and transferred to the second digester, where methane formation takes place, converting the acids into biogas. This system enhances biogas yield and efficiency by optimizing each stage.

### 7.2.2. Semi-continuous System Biogas Plant

In a semi-continuous biogas plant, feedstock is mixed with water and added to the digester at predetermined intervals. After each addition, the same volume of digested material flows out of the digester from the outlet, maintaining the system's balance. This system is commonly found in:

**(a) Fixed-Dome Plants:**

These plants have a closed, dome-shaped digester with a rigid gas holder. The gas is stored in the dome, and the pressure in the system increases as more biogas is produced.

**(b) Floating Drum plants:**

These consist of an underground digester with a movable gas holder that floats on the surface of the digested slurry. As gas is produced, the drum rises, and as gas is consumed, it falls, keeping the pressure constant.

### 7.2.3. Batch System Biogas Plant

A batch system biogas plant involves feeding the biomass into the digester in batches with a longer interval between feedings. Once a batch is loaded, the system is sealed and allowed to digest over a period, producing biogas gradually.

This type of plant is ideal for small-scale projects or situations where feedstock is available in irregular amounts. It is often used for diverse feedstocks that may not be available on a continuous basis. Although it requires less frequent feeding, the biogas output is not as steady as in continuous systems.

### 7.2.4. Balloon System Biogas Plant

The balloon system biogas plant consists of a flexible, sealed plastic or rubber bag that acts as both the digester and the gas holder. The bag is heated to maintain the optimal temperature for anaerobic digestion.

This system is usually designed for domestic use, particularly in rural areas, as it promotes clean cooking by producing biogas for household consumption. It is relatively simple and inexpensive to install, making it an ideal option for small-scale, low-cost biogas production. However, it is less durable than more rigid systems and is better suited to regions with mild climates.

## 7.3. CLASSIFICATION OF BIOGAS PROJECTS

Biogas projects are classified according to the project size and are defined by their electricity generation capacity and end uses. The classification includes four categories: Large-Scale Biogas Projects, Medium-Scale Biogas Projects, Small-Scale Biogas Projects, and Domestic Biogas Projects.

**Annexure 3** gives detail into the classification of Biogas Projects.

# CHAPTER 8: HYBRID ENERGY SYSTEMS

A Hybrid System for energy generation combines two or more different energy sources and technologies to produce electricity. These systems are designed to harness the strength of each energy source, improving efficiency, reliability, sustainability, while reducing GHG emissions. By integrating renewable sources like bioenergy, solar, wind, or even fossil fuel, hybrid systems can balance energy supply and demand more effectively.

Hybrid energy systems help mitigate the limitations of relying on a single energy source, such as the intermittency of solar or wind, by combining them with more stable sources like bioenergy or fossil fuel. This enables hybrid systems to provide consistent power, reduce reliance on fossil fuels, and enhance the overall resilience of the energy grid. Hybrid systems are increasingly important in PNG where energy demand fluctuates with unreliable power supply. The use of hybrid systems in PNG can also maximise the penetration of renewable energy sources.

The Government through NEA will encourage and promote the use of hybrid systems. Regulations and guidelines will be established to promote the use of hybrid systems.

## 8.1. BIOENERGY WITH SOLAR

The integration of bioenergy with solar energy generation is an emerging technology growing at a remarkable pace. By combining two technologies bioenergy flexibility is preserved where solar power helps during sunny periods whilst bioenergy is used in the nights and non-sunny days to ensure a constant power supply.

## 8.2. BIOENERGY WITH WIND

Hybridizing bioenergy with wind energy systems combines the complementary strengths of bioenergy and wind power to provide a more reliable and consistent energy supply by leveraging both energy sources to ensure reliability when one source is less available.

This combination enhances the efficiency and reliability of renewable energy production, allowing bioenergy to generate electricity when wind conditions are low, ensuring continuous electricity supply.

## 8.3. BIOENERGY WITH THERMAL

A hybrid bioenergy to thermal power plant offers a combination of renewable and non-renewable energy sources, providing a reliable, flexible, and cost-efficient electricity solution. The bioenergy feedstock burns to produce steam which drives turbines to generate electricity, and thermal power plant burns fossil fuel that drives turbine to generate electricity. This complementary system ensures continuous energy production, leading to lower fuel costs and decreased emissions. This can address both economic and environmental goals.

# CHAPTER 9: PROJECT DEVELOPMENT STAGES

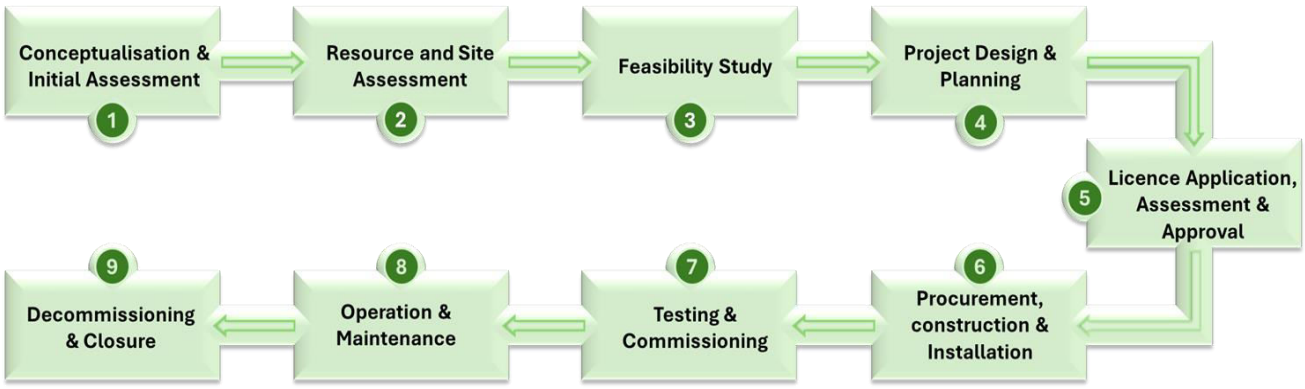
This Policy prescribes possible development stages of a medium-large scale bioenergy project. This different phases or stage is to provide guidance for an effective licensing and regulatory system for medium – large scale bioenergy projects.

A bioenergy project or biomass plantation developed purposely for electricity generation will be required to comply with the processes and requirements established under this policy or related laws and regulations. Medium – large scale commercial agriculture projects such as oil palm and sugar projects, that can generate electricity from the wastes from their primary business or operations, may not be required to undergo the full process or development stages since their primary business would be sugar or palm oil production.

Regulations will be developed to determine the requirements of licensing to utilize bioenergy products for electricity, heat, biofuels, and other related byproducts.

The main bioenergy project development stages are discussed below.

**Figure 11:** Bioenergy Project Development Stages




*Source: National Energy Authority, 2025.*

## 9.1. CONCEPTUALIZATION AND INITIAL ASSESSMENT

The first stage of development is to define a bioenergy project's goals and objectives, and undertake initial feasibility studies or assessment. The activities of the first stage involve identifying the type of bioenergy projects such as power generation, biofuel production, and biogas. It involves assessing the

potential energy demand and market opportunities, identifying possible feedstock sources such as agricultural residues, forestry waste, or organic waste, and conduct high-level analysis of site suitability.

The final outcome of this stage will be to prepare an initial project concept for further evaluation.

## 9.2. RESOURCE AND SITE ASSESSMENT

The next stage is to determine the availability and sustainability of feedstock supply, and identify an appropriate site. This also involves determining logistics for sourcing feedstock.

The activities at this stage involve conducting resource mapping to evaluate biomass availability, evaluating site location for accessibility, proximity to feedstock, and grid connection, assessing environmental and social factors, and performing a pre-feasibility analysis to evaluate site viability. The outcome would be to select and confirm the site's sufficiency and sustainability of feedstock supply.

## 9.3. FEASIBILITY STUDY

The Feasibility study stages involves analysing the technical, economic, and environmental feasibility of the project.

The activities of this stage involve:

(a) Technical feasibility assessment to determine appropriate conversion technology.

(b) Economic feasibility assessment to develop preliminary cost estimates of capital and operating costs and revenue projections.

(c) Environmental impact assessment involves the analysis of potential impacts and mitigation measures.

(d) Grid connection study assesses the grid interconnection possibilities and requirements.

After undertaking all these studies and assessments, a comprehensive feasibility study report is then produced for decision making.

## 9.4. PROJECT DESIGN AND PLANNING

Based on the feasibility study, the nest stage is to develop detailed project specifications, timelines, and strategies.

Possible activities under this stage involve:

(a) Prepare detailed engineering designs such as plant layout, and feedstock processing systems,

(b) Establish supply chain and logistics plan for feedstock collection, storage, and transportation,

(c) Plan for waste and byproduct management,

(d) Define and establish project timelines and milestones,

(e) Engaging stakeholders, including the local communities, governments, and feedstock suppliers.

The final outcome for all these activities will be to compile a complete project design and implementation plan.

## 9.5. LICENCE APPLICATION, ASSESSMENT AND APPROVAL

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

The licensing and regulatory process under the *Environment Act* 2000 must be complied with. The Licensing process is further discussed separately under Chapter 10. The Environment Permit will be a pre-requisite for the approval of a Generation Licence.

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

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

- Settlement of National Content Issues and Compensation agreements.
- Settlement of all Technical and Legal Issues.
- Settlement of commercial matters (this may include tax matters, project equity matters, financing, and compensation).
- Determination of Tariff Rates and Power Purchase Agreements
- Other requirements as maybe required under the law and imposed by NEA.

## 9.6. PROCUREMENT, CONSTRUCTION, AND INSTALLATION

The next phase is the actual procurement of materials and equipment for construction or to establish the project, including the installation of the systems.

The activities for this stage involve:

(a) Procuring technology and equipment, turbines, building infrastructure, including the plant, storage facilities, and grid interconnection points.

(b) Overseeing the installation and integration of equipment, and conducting construction in compliance with permits and safety regulations.

The outcome of these activities is to fully construct the bioenergy facility with installed systems.

## 9.7. TESTING AND COMMISSIONING

After construction and installation of equipment and systems, the next phase is to test the system, and if the facility operates as intended, the the project facilities are commissioned for energy production or generation. .

The activities of this stage involve:

(a) Conducting trial runs of the bioenergy plant under real conditions.

(b) Testing energy production, emission levels, and feedstock processing efficiency.

(c) Verifying that systems meet design specifications and regulatory standards.

(d) Optimizing processes, and addressing technical issues identified during testing.

Commissioning of the Project Facilities for energy production or generation for commercial use.

## 9.8. OPERATION AND MAINTENANCE

After commissioning, the project facilities can now produce or generate energy for commercial purposes or private use.

The activities of this stage involve:

(a) Full-scale energy production of electricity, heat, or biofuels,

(b) Deliver energy to the grid, industrial users, or other customers,

(c) Ensuring compliance with reporting requirements for emissions, safety, and production.

The outcome of these activities is to ensure consistent, reliable energy production and distribution.

## 9.9. DECOMMISSIONING AND CLOSURE

Should an operator or licence holder of the bioenergy project or facility decide to close or shut down it down, the operator or licence holder must comply with the laws or regulations to decommission and close the project or facility. This may include requirements for rehabilitating the environment

NEA will develop the regulations, guidelines and related requirements for decommissioning and closure of bioenergy projects or facilities.

# CHAPTER 10: LICENSING

Establishing a licencing process for the development and use of Bioenergy resources is crucial for the development and growth of the renewable energy sector in PNG. The licensing process will ensure proper record keeping of investment, compliance, and monitoring of bioenergy-related activities in the country. It will also ensure transparency, accountability, and good governance for the development and use of bioenergy resources.

## 10.1. BIOENERGY LICENSING PROCESS

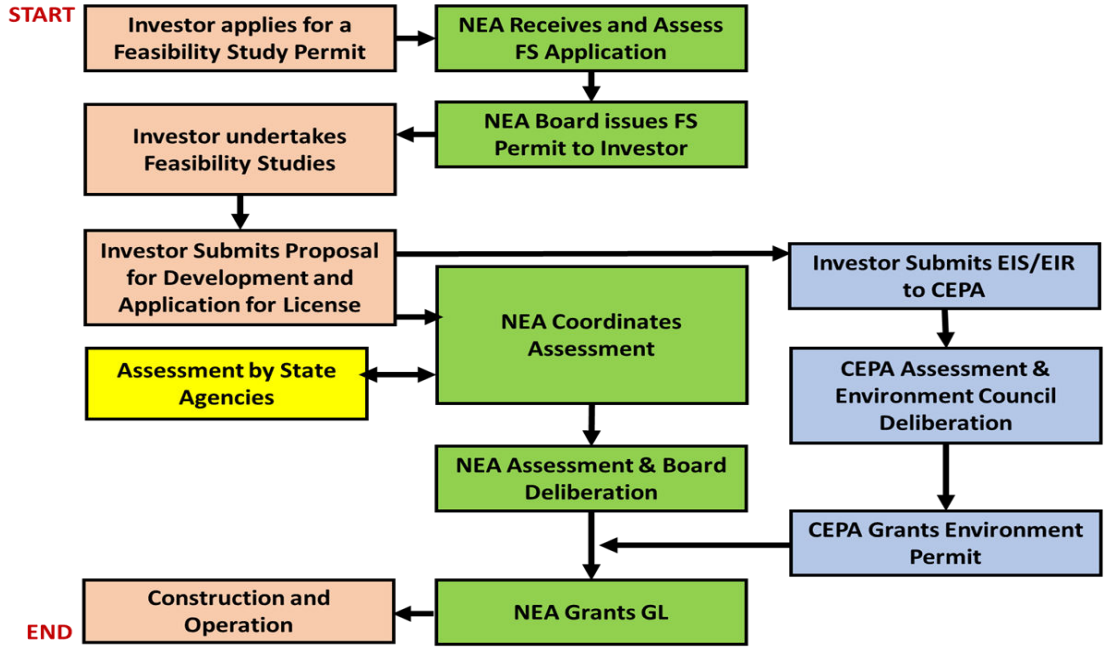
Medium – large scale bioenergy projects must comply with the licensing process and requirements established under the law nd related regulations. Licencing for small-scale bioenergy projects will be regulated under the Off-Grid Small Power System Regulation.

This policy introduces are licensing process for a medium – large scale bioenergy project

The licensing process outlined in the diagram below is provides guidance and establishes the process for development medium-large scale bioenergy projects. The Government through NEA will undertake legislative reforms and clearly define the define the different licences and the licensing process.

The licensing process in Figure 12 is tied to the Project Development Stages discussed in Chapter 9.

**Figure 12:** Licensing process for Bioenergy Projects.




Source: *National Energy Authority,2025*

## 10.2. TYPES OF LICENCES

### 10.2.1. Feasibility Study Permit

An investor or developer of a bioenergy project must apply and be issued a Feasibility Study Permit by NEA to undertake feasibility studies. Which includes any preassessment or site assessment. Initial site assessments will not require a feasibility study permit.

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

The feasibility study permit will apply to any project seeking to generate electricity from 1 MW and upwards in either as an individual system or in combined capacity.

### 10.2.2. Ex-Ante Licence

The Government recognizes the challenges associated with securing finance for bioenergy projects, including obtaining a guarantee from the Government to support the development of bioenergy projects. Investors for renewable energy projects such as bioenergy often require a guarantee or assurance from the State to secure financing for project construction or installation.

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

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

(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 an Ex-Ante Licence to NEA.

### 10.2.3. Environment Permit

Bioenergy projects depend on the environment for feedstock as well as other natural process. Any project developments have environmental impacts which are also regulated under the *Environment Act* 2000.

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

For any medium-large scale bioenergy project, the environment permit will be a pre-requisite for the issuance of a generation licence.

### 10.2.4. Generation Licence

Any bioenergy project with an installed generation capacity of 1MW and upwards, must apply for and be issued a Generation Licence by NEA to operate a bioenergy power plant to generate and supply electricity.

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

### 10.2.5. Other licences

**(a) Biofuel Production Licence**

A person or entity producing biofuel for commercial purposes, or for electricity generation or transportation, will be required to obtain a licence from NEA. The requirements for obtaining the licence will be developed by NEA through regulations.

**(b) Biofuel Production Demonstration Licence**

A person or entity producing biofuel as part of a research, demonstration or testing of biofuels, will be required to obtain a licence from NEA. The requirements for obtaining the licence will be developed by NEA through regulations.

## 10.3. LICENSING FOR OFF-GRID AND SMALL POWER SYSTEMS

Off-Grid Small Power Projects are electricity projects with an installed capacity of less than 1 MW. The full licencing process applied to projects with an installed capacity of more than 1 MW shall not be applied to Off-Grid and Small Power Systems.

An investor or developer of a small bioenergy-power system of less than 1 MW must apply for and be issued an Electricity Permit to generate and supply electricity. The requirements of the Electricity Permit and related conditions will be developed by NEA through regulations.

# CHAPTER 11: PRICING AND ELECTRICTY MARKET

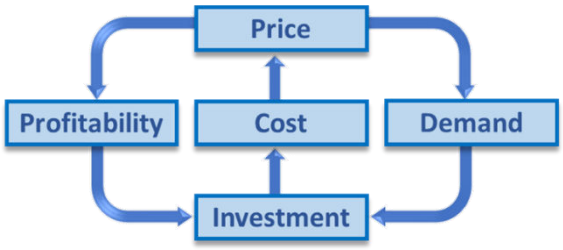
The most fundamental issue in electricity market is the price of electricity. At what price should electricity be sold to maximize economic welfare? The structure of the economy and the energy or electricity market also determines the demand for energy or electricity. Demand and supply affect the price 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 encouraging the development of bioenergy projects.

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

**Figure 13:** Relationship between Price and Sustainability of energy generation

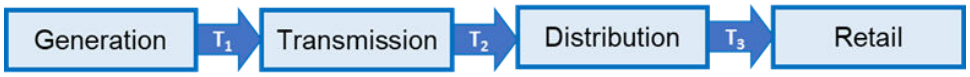



*Source: National Energy Authority,2025*

## 11.1. TARIFF SYSTEM FOR BIOENERGY 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 shown below.

**Figure 14:** Energy Value Chain and Tariff Points




*Source: National Energy Policy 2017-2027*

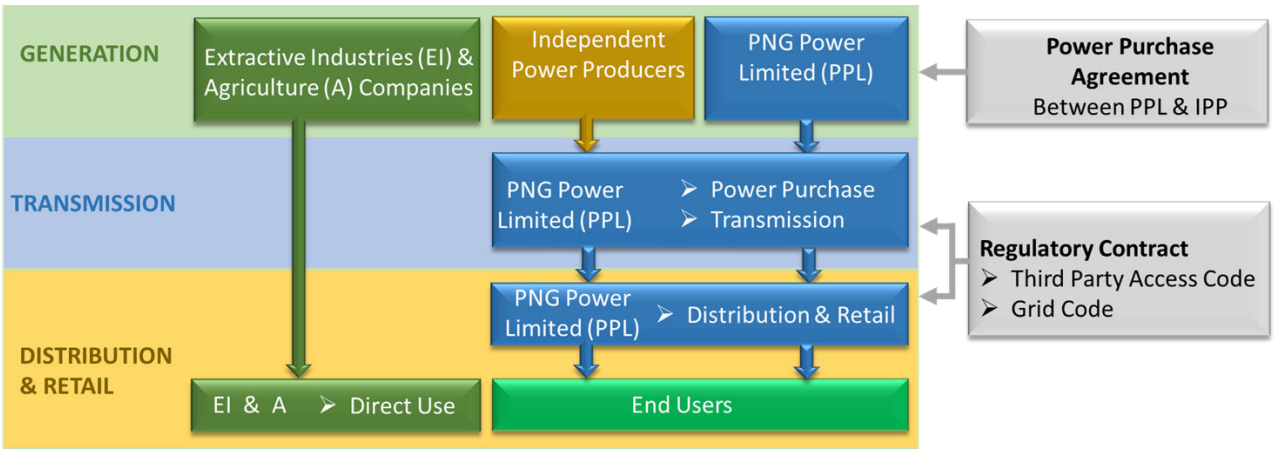
$T_1$, $T_2$, and $T_3$ are the three different points at which the tariffs are charged. $T_1$ is the tariff agreed between the IPP and the Off-Taker. $T_2$ is the potential tariff for a transmission company charged to and bought by the distribution company. $T_3$ is the retail tariff charged by the 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 by 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. Bioenergy 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 bioenergy generation license receives a price based on generation costs and capital costs recovery.

## 11.2. RESTRUCTURING THE ELECTRICITY TARIFF SYSTEM

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

**Figure 15:** PNG's Current Electricity Supply Industry

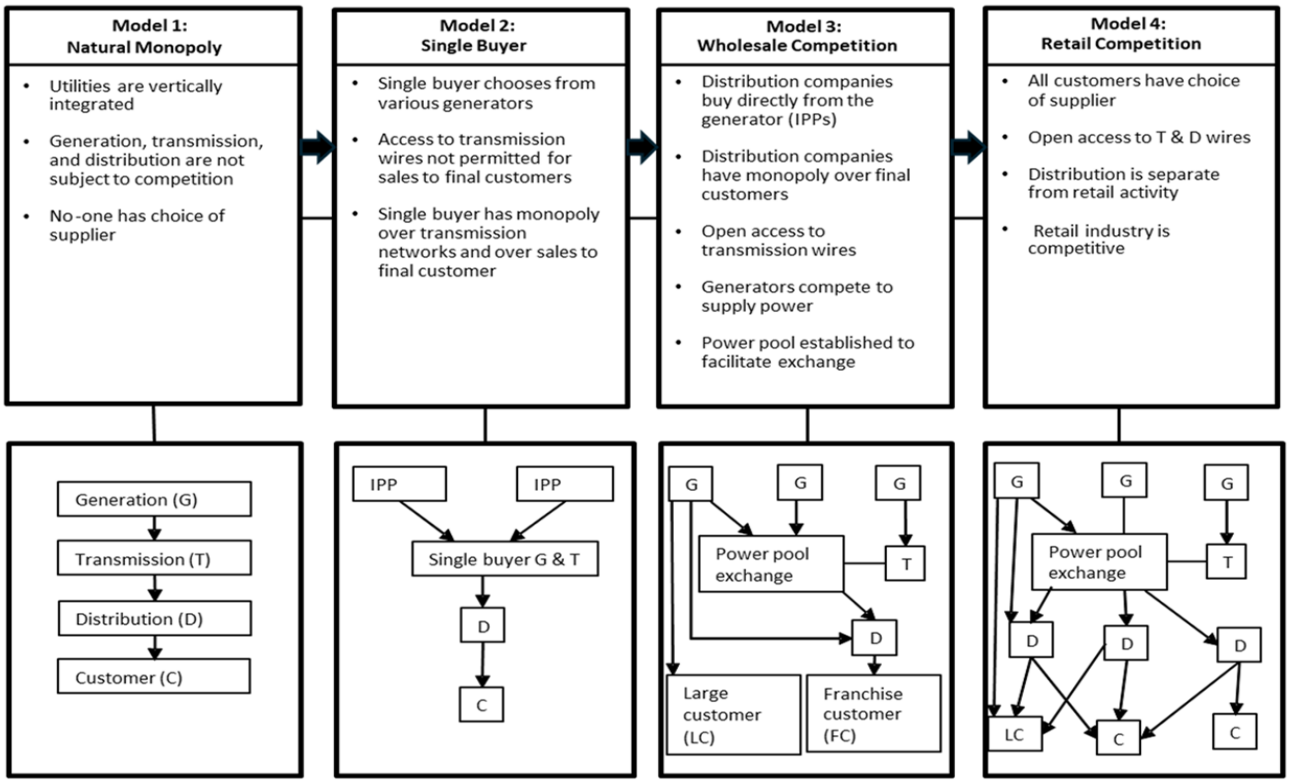



*Source: National Energy Authority, 2025*

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

To restructure the tariff system, it is important to consider the different tariff systems and models that countries' electricity systems transition through. The Electricity Supply Industry (ESI) market structure has developed over time, and transitions from a monopolistic market to a competitive market with the developmental progress of a country. The pricing mechanism is therefore designed based on the market structure. Four models are widely discussed and accepted around the world. These models are distinguished by the type of competition at each stage in the supply chain rather than ownership as shown in Figure 15.

**Figure 16:** 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 figure 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.

The current tariff regime 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.

## 11.3. REFORMING 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, is reliable, and is 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.

### 11.3.1. Short to Medium-Term Electricity Market Reform

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

The government will establish and implement a 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 subject to the On-Grid Tariff Regulation.

### 11.3.2. 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 restructuring of the business model of the state-owned utility company. It is incumbent on the government to ensure that the 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's business model for its operation in the wholesale competition market.

### 11.3.3. Off-Grid Power System

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

## 11.4. FEED-IN TARIFF

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

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

(a) Eligibility for the tariff.
(b) Eligible renewable energy resources for feed-in tariff.
(c) Duration of feed-in tariff power purchase agreement.
(d) Principles and methodology for determining the Feed-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.

## 11.5. 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 bioenergy 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 12: REGULATION AND COMPLIANCE

## 12.1. REGULATION

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

Bioenergy projects involve other sector legislations as well. Therefore, this requires a whole of Government approach to regulating the bioenergy subsector. NEA, being the agency mandated to regulate the energy sector, will play the leading role in coordinating Government efforts in regulating the bioenergy subsector.

**Table 4:** Government agencies with specific roles in the bioenergy subsector**.**

| Government Agency | Role |
|---|---|
| National Energy Authority | Licensing and regulation of bioenergy projects development. Ensure all legal requirements are met. |
| Conservation Environment Protection Authority | Licensing requirements at the development of bioenergy project.<br>Ongoing environment regulation, mainly discharge of waste into water. |
| Department of Lands & Physical Planning | Deal with land and landownership issues, including compensation issues. |
| PNG Immigrations & Citizenship Authority | For visa requirements of employees of bioenergy projects. |
| Department of Labour & Industrial Relations | Enforcement of labour laws and regulations.<br>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 bioenergy 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 bioenergy project activities either for domestic or international transactions. |

## 12.2. HEALTH AND SAFETY

All bioenergy operations in PNG must ensure the health and safety of its employees, the environment, the project infrastructure, and surrounding communities. The developer shall comply with all legislations when establishing health and safety standards.

The license holder of a bioenergy project shall comply with any other legislation that affects the health and safety of its operations and adopt these standards into their risk assessment and management plans, including safety plans during all phases of development and operations. The developer shall

adopt the best industry technology, practice, standards, and codes into its health and safety management regime.

### 12.3. 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.

### 12.4. CONTROL MECHANISM FOR IMPORTED PRODUCTS AND EQUIPMENT

To address the influx of cheap and substandard products and equipment entering the bioenergy 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 electric products and technology adhere to internationally recognized quality standards and certification with, 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 the wharf and at distribution points.

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

## CHAPTER 13: TECHNOLOGY AND STANDARDS

### 13.1. TECHNOLOGY

PNG does not have specific guidelines on renewable energy technology, nor guidelines that are specific to bioenergy. 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 bioenergy technologies. The project developers must be responsible for managing the risk associated with the operations of bioenergy 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, will 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 bioenergy 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.

### 13.2. STANDARDS

Bioenergy technology must meet international requirements, standards and best practises. The Government through NEA will promote standards that are compatible with bioenergy 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 bioenergy project must comply with all standards and requirements established under the *National Energy Authority Act* 2021 or any other legislation and related regulations.

## 13.3. CERTIFICATION

Bioenergy certification is crucial in promoting sustainable and quality bioenergy activities in the country. The government through, NEA will be responsible for certifying commercialization, production, and other activities of bioenergy in the country to ensure that it meets the international standards and certification. Any bioenergy projects and other related activities carried out in the country must be certified by NEA. The guidelines for certification shall be developed under NEA's regulations.

## 13.4. ENERGY EFFICIENCY

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

### 13.4.1. Supply -Side Efficiency Measures

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

(a) **Turbine Efficiency**: Advanced turbine designs that minimize energy losses and optimize energy output.

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

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

(d) **Optimizing Feedstock Moisture Content**: Ensuring proper drying and size reduction of biomass feedstock to reduce moisture content and enhance efficiency.

### 13.4.2. Demand-Side Efficiency Measures

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

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

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

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

### 13.4.3. Regulatory Support for Energy Efficiency

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

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

b) Promoting the use of certified energy-efficient equipment in bioenergy projects through incentives for compliance with recognized international standards. This requires developers and licence holders to conduct energy system and technology audits and implement energy-efficiency improvement measures in their bioenergy projects.

### 13.5. GRID INTERGRATION

Grid integration and stability are essential for ensuring that mini-grid or small power system, particularly in isolated service areas, can seamlessly connect to the central electricity grid without compromising overall system reliability.

Different frameworks for grid integration and stability of the small power system will be inherited under regulations to ensure the requirements for operating decentralized mini-grids in isolated areas, their interconnection with the main grid, and the technical and procedural standards needed to ensure smooth integration while maintaining grid stability.

### 13.6. INTELLECTUAL PROPERTIES 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.

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 14: COMMERCIAL

Certain commercial aspects are crucial to the development and sustainability of renewable energy projects such as bioenergy projects. The main commercial aspects are taxation, incentives, and price (tariff), as discussed in Chapter 11 of this Policy. Other commercial aspects that are also important in PNG include the State's equity participation and monetary benefits, especially royalties that are paid to landowners.

### 14.1. TAXATION

The developer or licence holder for a bioenergy project shall 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 bioenergy sector are compatible, investor-friendly, and do not discriminate against any investors.

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

### 14.2. INCENTIVES

The Government will provide incentives to support the development and commercialisation of bioenergy 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

## 14.3. 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 bioenergy 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.

## 14.4. 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. Similarly, royalty payment in PNG is usually paid to the State who then grants a portion to the landowners in the extractive industry. It is usually 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 oil or gas or other finite, non-renewable resources, bioenergy is a renewable energy resource, which is harnessed from natural biomass or waste from other production processes to generate electricity. The electricity generated is then sold to an off-taker at a price (tariff). Unlike traditional hydrocarbons, such as oil or gas which are extracted from the ground, and are owned by the State, Biomass is owned by the developer. Therefore, the royalty concept in the extractive industry cannot be applied to bioenergy projects.

Government through NEA will review Section 82 of the *National Energy Authority Act* 2021 to ensure that Royalty is not paid for bioenergy projects to the State or any landowners for the natural bioenergy resources that is harnessed to produce energy. Instead, there will be consideration for compensation for land used to establish the infrastructure and farms for medium - large scale bioenergy projects.

## 14.5. 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 bioenergy projects.

## 14.6. SUBSIDY

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

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

# CHAPTER 15: ENVIRONMENT

## 15.1. COMPLIANCE WITH ENVIRONMENT REQUIREMENTS

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

## 15.2. WASTE MANAGEMENT

The developer or holder of a generation licence for a bioenergy 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, inter-alia:

(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 as may be required by CEPA or NEA as prescribed under any law in PNG.

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

## 15.3. REHABILITATION AND CLOSURE

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

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

# CHAPTER 16: CLIMATE CHANGE

## 16.1. COMPLIANCE WITH CLIMATE CHANGE REQUIREMENTS

The Government through NEA in collaboration with Climate Change and Development Authority (CCDA) shall ensure that a developer or holder of a licence for a bioenergy project complies with:

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

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

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

(d) The UNFCCC's Inter-governmental Panel on Climate Change 2006 (IPCC-2006) Guidelines, the Good Practice Guidance (GPG) and subsequent improvements in methodologies, guidelines and tools.

## 16.2. DOMESTIC SHARE OF CARBON CREDIT

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

In recognizing the ownership rights of bioenergy project area landowners, a twenty percent (20%) domestic share of proceeds shall apply to every disclosed credit contained in the inventory of a medium-large scale bioenergy 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.

## 16.3. JUST TRANSITION PATHWAYS

Renewable energy projects such as bioenergy 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 through socio-economic strategies and directions provided under this Policy.

## 16.4. PROMOTING DECARBONIZATION

The development of bioenergy 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 bioenergy projects, integrating hybrid energy systems, and improving energy efficiency in both supply and demand. The Policy encourages carbon accounting, monitoring, and the adoption of low-carbon technologies and clean development practices. To incentivize decarbonization, the Government may consider providing tax breaks, facilitate for climate finance, and consider Feed-in Tariff, where required.

# CHAPTER 17: LAND AND LANDOWNER MOBILISATION

## 17.1. ACCESS TO LAND

Access to land for bioenergy projects shall be facilitated or acquired under the *Land Act* 1996 by the developer or licence holder of a bioenergy 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 bioenergy 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 damage or inconvenience caused to the land, environment, or landowners, shall be subject to compensation under a compensation agreement.

## 17.2. LANDOWNER IDENTIFICATION

During the feasibility stage, before undertaking any project development, the holder of a licence must undertake landowner identification and social mapping studies of the area proposed to be impacted by the bioenergy project. The scope and method for social mapping or landholder identification study will be determined under the *National Energy Authority Act* 2021 or related regulations.

## 17.3. SOCIAL IMPACT ASSESSMENT

The developer or licence holder for a medium – large scale bioenergy project shall conduct social impact studies as part of the feasibility studies. The requirements and process for the social impact assessment and ongoing management and monitoring of potential social impacts of a project will be determined by the NEA in collaboration with relevant Government agencies.

## 17.4. LANDOWNER PARTICIPATION

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

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

## 17.5. LAND BOUNDARY DEMARCATION AND RECORD KEEPING

Proper land boundary demarcation and the timely recording of land information are critical to the successful development of bioenergy 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 proper management of land issue for bioenergy 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 18: NATIONAL CONTENT

National content refers to the activities and benefits, including community assistance, that can be provided to landowners and impacted communities of a specific medium – large scale bioenergy project.

If required national content will be discussed and agreed to in a National Content Forum in accordance with Section 80 of the *National Energy Authority Act* 2021, with the outcome captured in a benefit-sharing agreement or such other arrangements on benefits sharing.

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

## 18.1. APPLICATION OF NATIONAL CONTENT

The National Content provisions under this Policy will only apply to medium-large scale bioenergy projects whose primary business is electricity generation and others including biofuel which may have a bigger impact on the environment and society, such as the displacement of people for farming biomass resources.

The application of National Content for the bioenergy project is determined as provided in the tables below.

**Table 5:** Application of National Content for Bioenergy Projects

| Classification | | | National Content | Explanation |
|---|---|---|---|---|
| Large-Scale Project | Auto-Producer/ In-Built for use of Bi-products | | No | Embedded generation – National content does not apply because electricity is not the primary business. |
| | Farming | Private Investor | Yes | Electricity generation is the primary business. National content shall apply for large-scale bioenergy projects which usually have a large impact on the environment and, if some spin-off activities can be off-loaded to landowners. Compensation to be considered. |
| | | Landowners | No | |
| Medium-Scale Project | In-Built/Auto-Producer | | No | Embedded generation – National Content does not apply because electricity is not the primary business. |
| | Farming | Private Investor | Yes | Electricity generation is the primary business. National content may apply if bioenergy projects have a bigger impact on the environment, and if some spin-off activities can be off-loaded to landowners. Compensation to be considered. |
| | | Landowners | No | |
| Small -Scale project | | | No | |

## 18.2. EMPLOYMENT AND TRAINING

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

## 18.3. BUSINESS DEVELOPMENT

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

The developer or holder of a licence for a bioenergy project where required, shall submit a Business Development Plan as part of its application for a bioenergy project licence if there will be any business opportunities that will be provided to landowners. The developer or licence holder must submit to the Managing Director of NEA, an annual report on the implementation of the Business Development Plan.

## 18.4. COMMUNITY DEVELOPMENT ASSISTANCE

The developer or holder of a licence for a bioenergy project shall provide community development assistance to the affected communities and landowners consistent with Section 86 of the *National Energy Authority Act* 2021.

## 18.5. COMPENSATION

The developer or licence holder for a medium- large scale bioenergy project, where required by law, shall pay compensation in respect of his entry or occupation of land, which is the subject of the licence,

to the landowners for any loss or damage suffered or foreseen to be suffered by them. Compensation under this policy is subject to Section 135 of the *National Energy Authority Act* 2021. The compensation to which landowners are entitled includes compensation for –

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

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

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

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

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

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

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

(h) Social disruption or displacement.

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

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

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

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

## 18.6. RESETTLEMENT

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

NEA will coordinate with relevant Government agencies to review and approve the resettlement action plan. The developer or holder of a generation licence shall implement the approved resettlement action plan and provide reports to NEA on an annual basis. NEA with support from relevant Government agencies will monitor the implementation of the resettlement action plan.

The details and structure of a resettlement action plan shall be determined by NEA.

## 18.7. BENEFITS MANAGEMENT

The National Goals and Directive Principles under the Constitution call for equal sharing of wealth for 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 bioenergy project must bring benefits to the Government, landowners, and impacted communities.

If there are benefits for medium – large scale bioenergy projects, the impacted landowners and communities will be required to have benefit agreements with any developer or licence holder of any bioenergy projects to ensure that the benefits are shared amongst the intended beneficiaries.

Through this Policy, the Government will ensure that appropriate benefits defined by relevant laws and policies flow to landowners and impacted communities of any bioenergy project. Landowners and impacted communities shall have a benefit-sharing agreement with any developer or licence holder of a bioenergy project to ensure that the benefits are shared amongst the intended beneficiaries.

### 18.8. 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.

Majority of the 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.

### 18.9. NATIONAL CONTENT FORUM

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

## CHAPTER 19: SMALL TO MEDIUM ENTERPRISE

Small to Medium Enterprise (SME) is a new and emerging market in the bioenergy subsector. The State, through NEA will encourage and support SME by providing incentives, creating a conducive marketing environment, and training local SME owners to develop and operate their businesses. This support spans all stages of bioenergy projects from biomass stockfeed production, and mobilization to commercialization and delivery to final consumers. Such SME activities are reserved for Papua New Guineans.

NEA is responsible for certifying any bioenergy SMEs in accordance with the International Standard Organization (ISO) and International Best Practices as mentioned under Chapter 13.

Key SME activities to certify under bioenergy include, but are not limited to:

(a) Certification for production and sale of pellets.

(b) Certification for growth and sale of woodchips.

(c) Certification for collection and sale of recyclable solid waste.

(d) Certification for blending of small-scale biofuel.

(e) Certification for small-scale domestic cooking-gas production and sale.

(f) Certification for Production and sale of gas stoves.

(g) Certification for other local bioenergy SME activities.

# CHAPTER 20: 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.

## 20.1. PROJECT DEVELOPMENT CONTRACT

The State through NEA, upon approved by the National Executive Council (NEC) may enter into any agreement consistent with the relevant laws of PNG relating to the development of a medium to large-scale bioenergy project. This agreement may contain provisions relating to:

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

(b) sharing of benefits; and

(c) the acquisition of an equity interest by the State either directly or indirectly in any bioenergy 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.

## 20.2. BENEFIT SHARING AGREEMENT

If there will be any benefits from bioenergy 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 includes the licence holder of a bioenergy project, the National Government, host sub-National Governments, and the landowners. The BSA shall only be for medium to large-scale bioenergy projects.

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

## 20.3. COMPENSATION AGREEMENT

Bioenergy projects and its related activities have the potential to cause disruption to the environment and inconvenience to the livelihoods of the landowners. Hence, any developer or holder of a generation licence for a bioenergy project is required to pay compensation to the landowners and the 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 bioenergy project. The Compensation Agreement will capture compensation discussed under Section 18.5 of this Policy.

### 20.4. POWER PURCHASE AGREEMENT

The Power Purchase Agreement (PPA) is the main contractual agreement between energy buyers and sellers. The holder of a generation licence for a bioenergy 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 bioenergy generation licence who generates electricity for private consumption, instead, a permit will be granted by NEA.

### 20.5. OTHER AGREEMENTS

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

## CHAPTER 21: DISPUTE RESOLUTION

### 21.1. DISPUTE RESOLUTION MECHANISM

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

### 21.2. ARBITRATION

If parties continue to disagree and cannot settle the dispute following the initial dispute resolution process under the Complaints Handling and Dispute Resolution Guideline, the NEA may arbitrate over the dispute following the arbitration process under the Complaints Handling and Dispute Resolution Guideline and in accordance with the *Arbitration Act* 1951. Further disputes may be referred to the PNG Courts.

## CHAPTER 22: INFORMATION AND REPORTING

### 22.1. ACCESS TO INFORMATION

The Government through the NEA under respective legislations shall require any investor or company operating a bioenergy project to provide all required information concerning a bioenergy 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.

### 22.2. REPORTING REQUIREMENTS

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

# CHAPTER 23: POLICY IMPLEMENTATION

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

## 23.1. POLICY ADMINISTRATION

### (a) Policy Implementation

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.

### (b) National Energy Authority

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.

### (c) Other Agencies

The implementation of this Policy will require support and action from various Government agencies under various national laws.

## 23.2. POLICY IMPLEMENTATION

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

**Figure 17:** Policy Implementation Strategies and Linkages


*Source: National Energy Authority, 2025*

### 23.2.1. Legislative Reforms

There is no specific legislation on bioenergy 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 bioenergy projects, including the deployment of new technologies that support reliable and affordable energy.

Legislative Reforms will include, but not limited to:

i. Provide a clear definition of the bioenergy project or system.
ii. Define the licencing process of bioenergy projects.
iii. Industry-specific regulation and mechanisms for enforcing compliance.
iv. Provisions for ensuring the sharing of information and reporting.
v. Establish a tariff system with related regulations.
vi. Clearly define benefits and sustainable management of the benefits.
vii. Create linkage to other legislations for regulatory purposes.
viii. Legislative framework that supports partnerships and collaboration.
ix. Other legislative reforms that will give effect to the implementation of this policy.

### 23.2.2. Partnerships

Establishing partnerships is important for the development and operation of bioenergy projects to address social, environmental, financing, and economic issues and to ensure the effective delivery and operation of bioenergy projects. Partnerships and engagement should be at multiple or different levels and different phases of a bioenergy project development and operation stages. The key stakeholders, among others, for effective partnership are:

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

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

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

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

The Subnational Governments can also invest in bioenergy 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 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 Development Partners in the implementation of this Policy.

**c) Private Investors**

Private investors play a key role in the development of renewable energy projects. such as bioenergy. PNG needs investments in the renewable energy sector such as bioenergy 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's energy sector through the deployment of finance and technology in renewable energy development. This

provides the direction to create an enabling environment that supports and promotes private investments in bioenergy projects.

**d) Landowners & Impacted Communities**

Most of the land in PNG is customarily owned and almost all the land has a landowner, either individually or communal. Landowners are considered an important partner under this Policy for any bioenergy project development. The Government through NEA, and any developer of a bioenergy 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 medium-large scale bioenergy projects to ensure they are also considered for any possible benefits and participate in any bioenergy project development.

**e) Civil Society and Non-Government Organizations (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 bioenergy projects, including sourcing finance to finance 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) Academia and Research Institutions**

Academia and research institutions are important partners in the energy transition as they are responsible for research and to provide the source of knowledge and information 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 technical support to development of renewable energy projects.

**g) Financial Institutions**

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

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

### 23.2.3. Community Engagement

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

### 23.2.4. Increase Private Investment

This Policy is aimed at driving private investments in bioenergy projects. Often Governments in trying to address growing electricity demand undertake bioenergy projects that take time to complete or are

abandoned. This is because medium to large-scale bioenergy projects are capital-intensive and require technical expertise.

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

### 23.2.5. Public-Private Partnership

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

The objectives of PPP in bioenergy development focuses on attracting private investments by creating transparent and stable conditions, leveraging public resources for private sector involvement, and ensuring project sustainability through long-term collaboration. The 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 public 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.

### 23.2.6. Incentives

Medium – large scale bioenergy projects require a long and complex development phase as they are capital-intensive and require a lot of planning and design work. Many private investments in large bioenergy projects in emerging markets have shown that there is a disconnect between the lifespan of bioenergy projects and the debt maturities that are offered by their financiers. While bioenergy plants can be exploited for more than 30 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 bioenergy projects less competitive than many other power sources.

The Government will therefore consider incentives to drive private investments in bioenergy 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 bioenergy projects.
- Subsidies for small and hybrid bioenergy projects.
- Undertake PPP arrangements.

### 23.2.7. 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 struggling to provide a reliable, affordable, and consistent power supply due to high operational cost and aging infrastructure.

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

a. Unbundling of the electricity market to open up the market for generation, transmission, distribution, and retail of electricity.
b. Decentralising unprofitable mini-grids in provincial towns by allowing private investments or public-private partnerships to generate, transmit, and distribute electricity.
c. Provide incentives to support private sector investments in renewable energy generation.
d. Establish regulations and guidelines to ensure a competitive, affordable, and cost-reflective tariff system.
e. Consider a new business model for PPL that will ensure cost recovery and viability going forward in its operations.

### 23.2.8. 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 bioenergy projects, which is driven by human capital development. Any increases in human capital investment always leads to significant improvements in the bioenergy 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 advanced technologies. Therefore, any strategy for human capital development in bioenergy projects must enhance human capacity in technology advancement. There is a burgeoning demand for a workforce that is not only technically proficient but also creative and adaptable to new challenges. This demand extends to the need for specialists in digital technologies, underscoring the importance of educational investments in relevant courses, and degree programs, as well as the micro-credentials that are gaining popularity in recent years as an alternative to traditional higher education. Additionally, the shift requires human capital with expertise in new policy and regulatory frameworks. Furthermore, skills in sustainability and environmental management are becoming crucial as these areas increasingly intersect with the energy sector's transformation.

### 23.2.9. Research and Development (R&D)

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.

### 23.2.10. Framework for Robust Monitoring and Reporting

Monitoring and reporting are important strategies to ensure effective implementation of this Policy. Continuous monitoring will be undertaken by NEA in accordance with the monitoring and evaluation framework discussed under Chapter 25 of this Policy.

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

# CHAPTER 24: RISKS

In the current climate change and energy security environment, bioenergy generation is an important resource option as a clean renewable source of energy. The existence of bioenergy potential presents PNG with the potential to diversify its energy mix. Bioenergy in PNG remains a largely undeveloped energy resource with enormous potential, which is yet to be fully explored and understood. This imposes risks on investment decisions for bioenergy projects.

Furthermore, the process involved in developing a bioenergy project also has certain risks that affect decisions at different stages, often affecting project development and commercialization. There are also regulatory and policy risks that impact project decisions and development.

Under this Policy, the risks are classified into two main categories and further discussed, with proposed strategies for addressing and mitigating the risks. The first category is risks that are related to the implementation of this Policy, which are the bioenergy policy risks. The second category comprises risks that are related to a bioenergy project.

## 24.1. BIOENERGY POLICY RISKS

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

### (a) Overlapping institutional arrangements

Different institutions have different laws and regulations. This can result in overlapping institutional arrangements and jurisdictional conflicts. This has been a norm in Government, not just in PNG but across different jurisdictions.

State agencies in PNG have worked together to permit and regulate resource projects. Bioenergy is no different and with NEA now established, it will coordinate all Government efforts.

### (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 benefits to landowners.

This Policy provides clear guidance and references on land, landowner participation, and national content. This is in line with the National Government's policies to ensure meaningful landowner participation and benefit distribution.

### (c) Lack of resources

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

The key agencies responsible for licensing and regulating the bioenergy sector, are Statutory Bodies established under relevant statutory laws to ensure resourcing is available to effectively deliver on their mandated tasks.

NEA will coordinate the implementation of this Policy and will generate revenue to fully implement the Policy.

### (d) Lack of capacity for policy implementation and effective regulation

Bioenergy in PNG remains largely underdeveloped and is yet to be fully explored and understood. There are few bioenergy projects in the country. This scenario also raises the challenge of adequate capacity in terms of knowledge, skills, information, and experience in implementing the policy and ensuring effective regulation.

NEA is mandated to regulate and have the capacity to implement the policy.

## 24.2. BIOENERGY PROJECT RISKS

Project risks are the potential risks that may be associated with the development and operations of a bioenergy project.

**Table 6:** Identification of Potential Bioenergy 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** | | | | |
| 5.1. Geographic Location | Feasibility & Construction | | | |
| 5.2. Food Security Risks | Life of Project | | | |
| 5.3. Political Risks | Life of Project | | | |

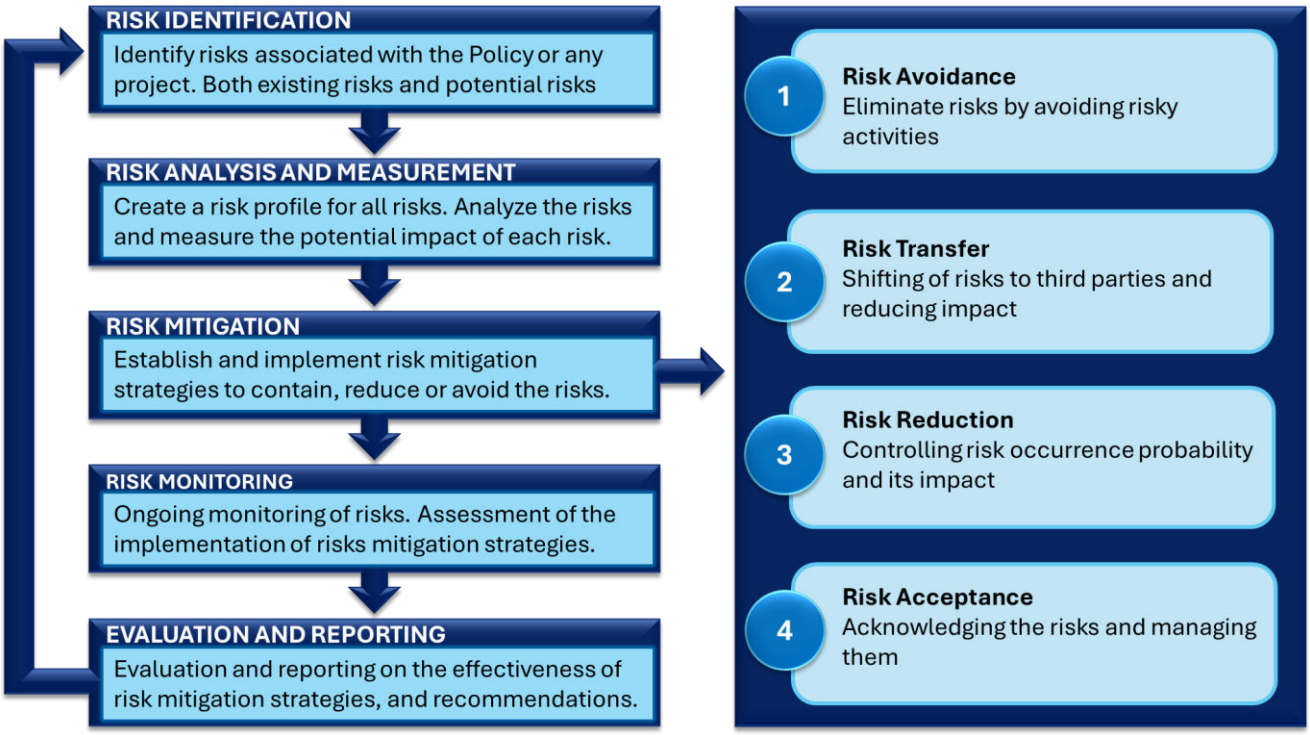
## 24.3. RISK MANAGEMENT AND MITIGATION

There are risks associated with developments in the energy sector, including the electricity industry. Section 24.1 and 24.2 of this Policy highlighted potential risks associated with the implementation of this Policy and development of bioenergy 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 bioenergy 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 bioenergy projects.

**Figure 18:** Risk Management and Mitigation Framework




*Source: National Energy Authority, 2025*

# CHAPTER 25: MONITORING & EVALUATION

## 25.1. MONITORING, EVALUATION AND REPORTING

The monitoring and evaluation (M&E) process is an essential tool for assessing the value 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, measure progress toward achieving the goals of this Policy, and create 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.

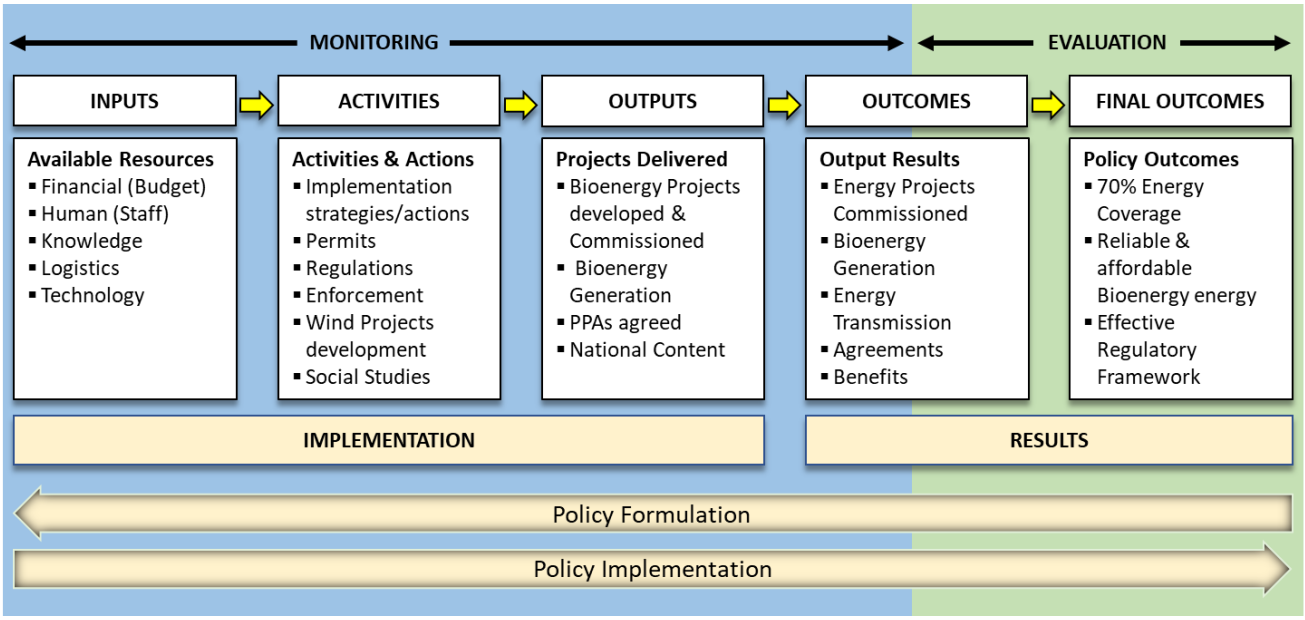
NEA is the custodian of this Policy and will be responsible for periodic and ongoing monitoring and evaluation of the implementation of this Policy in accordance with its Monitoring and Evaluation Framework. Reports and recommendations will be provided to the Managing Director for NEA and the Minister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

## 25.2. FRAMEWORK FOR MONITORING AND EVALUATION

M&E is a process, and undertaking it 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.

The key strategy and approach for M&E of this Policy will be based on the policy results chain under the theory of change. Monitoring the policy starts with the inputs required to implement the policy, then the activities to be undertaken to deliver on the outcomes, and finally 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 19**: Policy Results Chain for Monitoring and Evaluation




*Source: National Energy Authority, 2025.*

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# GLOSSARY

| | |
|---|---|
| Accessibility | Electricity service capable of reaching many people including the people living in the rural areas. |
| Affordability | Degree to which a representative household is able to pay for an essential utility service charge, given its socioeconomic statute. |
| Auto-producer | Generates electricity primary for their own consumption. |
| Authority | Means National Energy Authority. |
| Biochar | Is a charcoal-like substance that's made by burning biomass in a controlled process known as pyrolysis. |
| Biomass feedstock | Raw material uses for bioenergy. |
| Conceptual Decommissioning and Closure Plan | Is a strategic document that outlines the approach, methods, and steps required to safely decommission and close a facility or site after it has reached the end of its operational life. |
| Decarbonization | Refers to the process of eliminating the carbon dioxide ($CO_2$) emissions that result from human activities, especially in energy production, transportation, industry, and other sectors. |
| Electricity Dispatch Code | Is a set of rules or protocols used by grid operators to manage the generation and distribution of electricity within an electrical grid. The code provides guidelines for how power plants and generators should operate and how electricity is dispatched (sent out to the grid) to meet demand while ensuring grid stability, reliability, and efficiency. |
| Employment and Training Plan | Is a strategic framework that outlines how a project, business, or organization will address workforce needs, create job opportunities, and provide skills training to ensure the workforce is prepared to meet the demands of the work. |
| Fermentation | Is the process that convert carbohydrate into bioethanol. |
| Hybrid Power | Are combinations between different technologies to produce power or electricity. |
| Independent Power Producer | It is a private entity involved in the generation of electricity for sale to the market, typically through long-term contracts with utilities, Off-taker or other energy buyers. |
| Landholder | Title holder of a particular land. |
| National Content Forum | Organised forum that focuses on promoting the participation of local landowners and impacted communities in the development and management of natural resource projects. |
| Off Taker | An off taker is essentially the buyer of electricity or other energy products under a contract, usually a Power Purchase Agreement (PPA), with the producer or developer of the energy. |

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| Primary producer | Electricity generations is their primary business. |
| Preventative Maintenance | Is the regular maintenance and repair of a solar power project or . Further, it refers to the proactive steps taken to ensure that a solar power system operates at optimal performance over its lifespan. |
| Secondary producer | Generates electricity to complement their main business activity. |
| Small Power System | A small power system typically refers to an electrical power generation and distribution system that serves a limited area, usually for a specific community, facility, or industrial site. |
| Social Impact Assessment | It is a process used to evaluate and understand the social consequences of proposed projects, or developments, particularly those that may have significant impacts on individuals or communities. |
| Transesterification | Is a reaction of ester with alcohol in the presence of strong base to form biodiesel. |

## Annexure 1: Application of License for Biomass Projects

| Classification | | | Types of Biomass Project | Generation Capacity | Feasibility License | Ex-Ante Licence | Generation Licence | Explanations |
|---|---|---|---|---|---|---|---|---|
| Large-Scale Biomass Projects | Captive/Auto-producer | | Gasification, Combusting Cogeneration Cofiring and Hybrid | >10 MW | Yes | Yes | Yes | Large-scale Auto-producers will require a feasibility license and generation license. Large-scale biomass projects from farming will require a Feasibility License and a Generation License. An Ex-Ante may or may not apply. |
| | Farming | Private Investor | Gasification, Combusting Cogeneration, Cofiring, and Hybrid | >10 MW | Yes | Yes | Yes | |
| | | Landowners | Gasification, Combusting Cogeneration, Cofiring, and Hybrid | >10 MW | Yes | Yes | Yes | |
| Medium-Scale Biomass Projects | Captive/Auto-producer | | Gasification, Combusting Cogeneration, Cofiring, and Hybrid | 1 – 10MW | Yes | | Yes | Medium-scale Auto-producers will require a feasibility license and generation license. Medium-scale biomass projects from farming will require a Feasibility, License and a Generation License. An Ex-Ante may or may not apply. |
| | Farming | Private Investor | Gasification, Combusting Cogeneration, Cofiring, and Hybrid | 1 – 10MW | Yes | | Yes | |
| | | Landowner | Gasification, Combusting Cogeneration, Cofiring, and Hybrid | 1 – 10MW | Yes | | Yes | |
| Small-Scale Biomass Projects | | | Gasification, Combusting Cogeneration, Cofiring Hybrid, and Pyrolysis | <1MW | Yes | | | Small biomass projects will be regulated under the Off-Grid Small Power System Regulations. |

## Annexure 2: Application of License for Biofuel Projects

| Classification | | | Types of Biomass Project | Generation Capacity | Feasibility Studies Permit | Installation Permit | Ex-Ante Licence | Production/Generation Licence | Production/ Demonstration licence | Explanations |
|---|---|---|---|---|---|---|---|---|---|---|
| Large-Scale biofuel Project | Industrial Waste | Private investor /In-built | Biodiesel and Bioethanol | N. A | Yes | Yes | Yes | Yes | Yes | Large-scale biofuel projects shall be issued feasibility licenses and generation licenses. NEA will introduce a Production License for biofuel production. |
| | Farming | Private Investor | Biodiesel and Bioethanol | N. A | Yes | Yes | -Yes | Yes | Yes | A feasibility license and generation license is required for large-scale biofuel projects for farming biomass. NEA will introduce a Production License for biofuel. |
| | | Landowners | Biodiesel and Bioethanol | N. A | Yes | Yes | Yes | Yes | Yes | |
| Medium-Scale Biofuel Project | Industrial Waste | | Biodiesel and Bioethanol | N. A | Yes | Yes | | Yes | Yes | Medium-scale biofuel projects shall be issued feasibility licenses and generation licenses. NEA will introduce a Production License for biofuel. |
| | Farming | Private Investor | Biodiesel and Bioethanol | N. A | Yes | Yes | | Yes | Yes | A feasibility license and generation license are required for medium-scale biofuel project farming biomass. NEA will introduce a Production License for biofuel production. |
| | | Landowner | Biodiesel and Bioethanol | N. A | Yes | Yes | | Yes | Yes | |
| Small-Scale Biofuel Project | Farming | | Biodiesel and Bioethanol | N. A | Yes | Yes | | Yes | Yes | Small biofuel projects for electricity generation will be regulated under the Off-Grid Small Power System Regulations.<br>NEA will develop regulations for small-scale biofuel projects. |

## Annexure 3: Application of Licence for Biogas Projects

| Classification | | | Types of Biogas Project | Generation Capacity | Feasibility Studies License | Installation Permit | Ex-Ante Licence | Generation Licence | Explanations |
|---|---|---|---|---|---|---|---|---|---|
| Large-Scale Biogas Project | Auto-Producers /In-Built | | Anaerobic digestion | >10 MW | Yes | | Yes | Yes | Auto-producers will require a feasibility license and a generation license. Large-scale biogas projects from farming will require a Feasibility License and a Generation License. An Ex-Ante may or may not apply. |
| | Farming | Private Investor | Anaerobic digestion | >10 MW | Yes | | Yes | Yes | |
| | | Landowners | Anaerobic digestion | >10 MW | Yes | | Yes | Yes | |
| Medium-Scale Biogas Projects | Auto-Producer/ In-Built | | Anaerobic digestion | 1 – 10MW | Yes | | | Yes | Auto-producers will require a feasibility license and a generation license. Medium-scale biogas projects from farming will require a Feasibility License and a Generation License. An Ex-Ante may or may not apply. |
| | Farming | Private Investor | Anaerobic digestion | 1 – 10MW | Yes | | | Yes | |
| | | Landowner | Anaerobic digestion | 1 – 10MW | | | | Yes | |
| Small-Scale Biogas Projects | | | Anaerobic digestion | <1MW | Yes | Yes | | | Small biogas projects will be regulated under the Off-Grid Small Power System Regulations. |
| Domestic Gas Project | | | Anaerobic digestion | N. A | Yes | Yes | | | NEA will develop regulations for domestic gas projects. |

## Annexure 4: Supporting Agencies of the Bioenergy Policy

| Organization | 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<br>2. *Employment Act* 1978<br>3. *Employment of Non-Citizens Act* 2007<br>4. *Employment of Non-Citizens Regulation* 2008<br>5. *Employment Regulation* 1980<br>6. *Occupational Safety, Health, and Welfare Act* 1991<br>7. *Workers' Compensation Act* 1978<br>8. *Workers' Compensation Regulation* 1983 |
| Department of Lands and Physical Planning | The DLPP administers all alienated land (State and Freehold) in PNG and facilitates customary land (land under the ownership of the original inhabitants of PNG) issues at the discretion of the customary landowners, for social and economic development.<br>The department also has a strong customer focus in providing a whole range of services like Surveying, Physical Planning, Valuation, Incorporated Land Group registrations, Land Title registration, and Mapping requirements for all land within PNG. | 1. *Compensation (Prohibition of Foreign Legal Proceedings) Act* 1995<br>2. *Survey Act* 1969.<br>3. *Land (Ownership of Freeholds) Act* 1976<br>4. *Land (Ownership of Freeholds) Regulation* 1977<br>5. *Land (Tenure Conversion) Act* 1963<br>6. *Land (Tenure Conversion) Regulations* 1964<br>7. *Land Act* 1996<br>8. *Land Disputes Settlement Act* 1975<br>9. *Land Disputes Settlement Regulation* 1975<br>10. *Land Groups Incorporation Act* 1974<br>11. *Land Groups Incorporation Regulation* 1974<br>12. *Land Registration Act* 1981<br>13. *Land Registration Regulation* 1999<br>14. *Land Regulation* 1999<br>15. *Land Titles Commission Act* 1962 |
| Department of Provincial and Local Level Governments | The Department provides the vital 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 | The Treasury is the government's principal **economic and financial department and maintains oversight** over the entire economy. The | 1. *Fiscal Responsibility (amended) Act* 2005<br>2. *Resource Contracts Fiscal Stabilisation Act* 2000<br>3. *Public Finance (Management) Act* 2005 |

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|---|---|---|
| | Treasury sets fiscal policies, including tax, and deals with taxes and incentives for resource projects. | |
| Conservation and Environment Protection Authority (CEPA) | CEPA ensures that natural and physical resources are managed to sustain environmental quality human well-being and improved living standards. This Agency also ensures that all relevant policies, legislations, and regulations administered by CEPA are implemented effectively in accordance with environmental laws and regulations. CEPA issues environmental permits and regulates water usage. | 1. *Conservation and Environment Authority Act* 2014<br>2. *Environment Act* 2000 |
| 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<br>2. *Prices Regulation Act* 1949<br>3. *Prices Regulation* 1949 |
| Internal Revenue Commission | Responsible for all Tax matters, apart from customs duties. | 1. *Income Tax Act* 1952<br>2. *Goods and Services Tax Act* 2003 |
| Investment Promotion Authority | IPA's primary mandate is 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<br>2. *Companies Regulation* 1998<br>3. Companies Rules<br>4. *Investment Promotion Act* 1992<br>5. *Investment Promotion Regulation* 1992 |
| National Institute of Standards and Technology | NISIT is responsible for overseeing all standardization, quality assurance, and conformity assessment activities in PNG. All new technology will have to be approved for use in the 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 the insidious effects of border crimes, the 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<br>2. *Customs Act* 1951<br>3. *Customs Regulation* 1951 |
| PNG Power Limited (PPL) | PPL is a fully integrated State-Owned Enterprise responsible for the 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<br>2. *Electricity Commission Regulation* 1966<br>3. *Electricity Supply (Government Power Stations) Act* 1970<br>4. *Electricity Supply (Government Power Stations) Regulation* 1970<br>5. *Electricity Industry Act* (Chapter 78) |

## ANNEXURE 5: STAKEHOLDER INVOLVEMENT

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